Fusion Energy Foundation

The Industrialization of AFRICA

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Preface

There are various answers to the question of the political and economic future of Africa. The *Council on Foreign Relations* has described one of these in their study "Africa in the 1980s" as an "eventful scenario". The conclusion here is that

> "As quarrelling breaks out everywhere, economies stagnate and authoritarian regimes multiply, since they are best suited to defending scarce and slowly expanding resources from external attack, putting the lid on internal demand and maintaining a constant state of military readiness. Paradoxically, the general postwar exhaustion and unproductiveness that have produced this situation prevent the limited hostilities from becoming widespread conflict; there is simply not enough tinder to make bushfires a forest fire. As the 1980s draw to an end , the external world decides that Africa is not worth the conquest, and a tacit hands off agreement is reached, leaving the continent a ghetto to fight its own battles."

This dim prognosis might appear quite realistic, given the world's economic and political conditions at the end of the 1970s, and given the economic and political situation of numerous African nations.

In June 1979, the *Fusion Energy Foundation* held a conference in Paris, titled "The Industrialization of Africa", where the discussion focussed on the foundations upon which a fundamental change can be begun in order to guarantee the African population not only a future of mere survival, but a future of real progress in economic and political development. At the end of the three-day conference, an African student took the floor and said:

> "The way things have been discussed here is an innovation. You have shown many theories which are usually defended,to be totally wrong. You are animated by the humanist spirit. You have a certain concept of man ... You made an ideological choice and you have taken an ideology against that prevailing up to now. That is not an easy task! The aim of science for you is to prepare actions in Africa. To do that, you have to make Africans understand what you are proposing. You have to make them understand the need for the New World Economic Order, and that the New World Economic Order is for the benefit of all mankind. That is not easy — I wish you good luck. I hope you succeed. I hope with all my heart that your project will be understood and accepted by Africans."

The purpose of this present book is to make the ideas and conceptions which were presented and discussed at the conference accessible to a broader leadership and , thereby, to make it an active element in the present conflict over the New World Economic Order. We have not made it the task of this book to provide detailed items of information on the theme of the industrialization of Africa. Where that does occur, the purpose of the detail is to be of an *exemplary character*. The purpose of the book, rather, is to demonstrate, in concrete form, a perspective

for the development of the entirety of Africa as an alternative to Mathusian policies, and to illustrate the challenges for diverse aspects of economic policy, such as energy policies, the decision for "hard" and "soft" technologies, the question of appropriate credit policies, and especially the issue of the development of African labor power. Although the book has emerged on the basis of discussions with, and among, experts in industrial and developing nations, it is to be understood less as a final result of this discussions than as a conceptually rigorous basis for discussion. It is in this latter respect that the book claims to be exact and original, and not with respect to the details offered as examples or with respect to the quantitative arguments per se.

The division of the book into individual sections is based on the following train of thought: Chapter I presents the present, concrete political and economic beginning point for the industrialization of the African continent. In this connection, the chapter deals with the fundamental problems which are the causes of the catastrophic situation in most parts of Africa today, on the one hand, and demonstrates the conceptual foundation and economic governing conditions on the basis of which the only actual development of Africa can be made possible.

The development of African labor power plays *the* crucial role in this. For this reason, the spiritual and material prerequisites for the development of African labor power (Chapter II) are taken as the foundation for the "Blueprint for the Industrialization of Africa".

The third chapter, then, summarizes once again the various determining conditions on the basis of which a rapid industrialization of Africa would be possible. The *nuplex-concept* is discussed as the paradigm for the "hard technology" approach, as the seed-crystal for industrialization. It is decisive that this concept is not viewed as a purely technocratic solution to the problem of low productivity of under-developed regions, but rather as the best strategy for the development of the labor force. The concluding discussion of some exemplary economic sectors indicates the dimensions, in terms of the African and the world economy, which a serious development policy for Africa will entail.

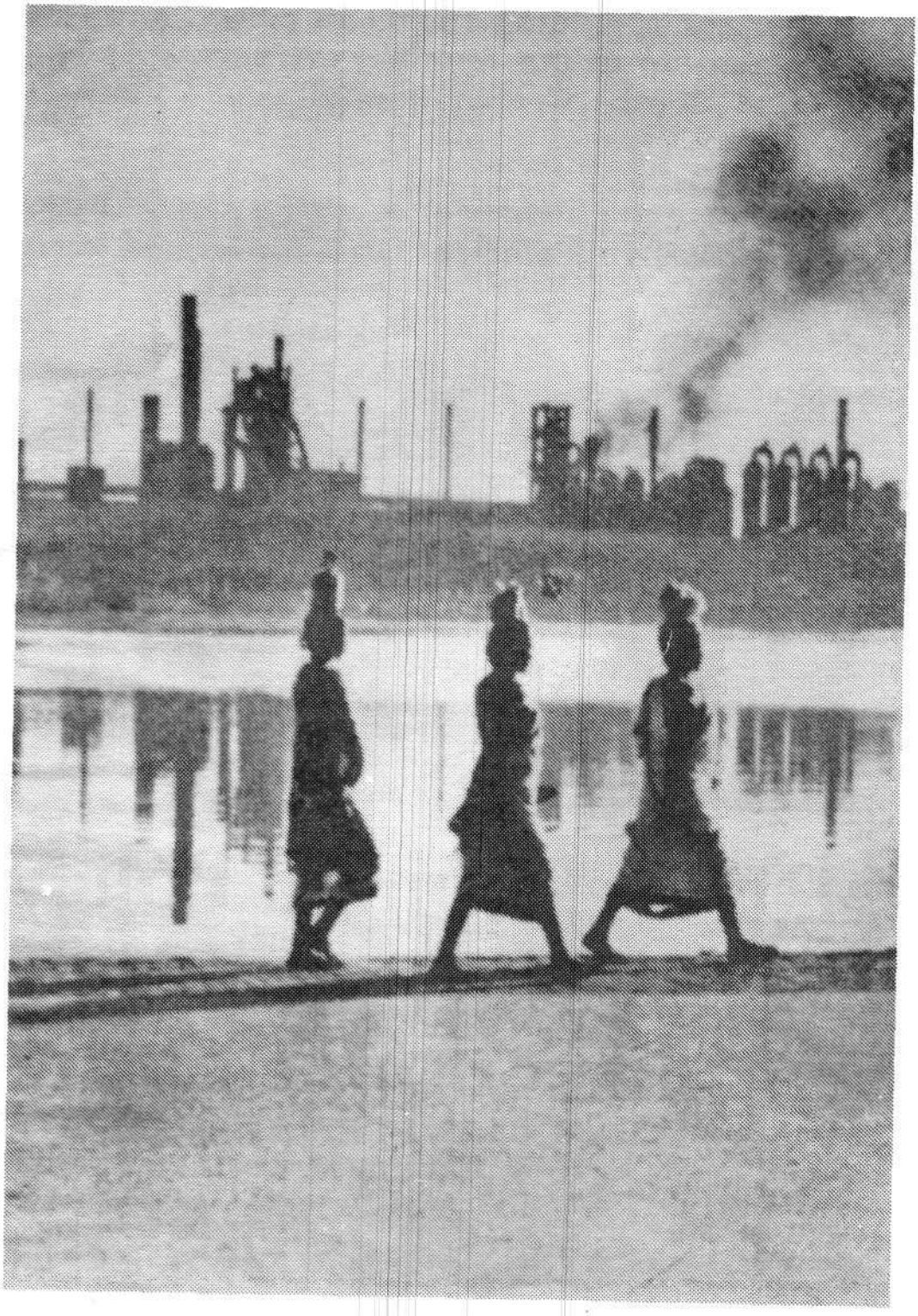
The derived demands on the world monetary and credit system are discussed in the concluding Chapter IV. This leads the reader back once again to the problems posed in the first chapter — the need for the New World Economic Order as the basic precondition for the industrialization of Africa.

The sequence of chapters reflects, by and large, the succession of the presentations and course of discussion at the conference in Paris. Chapter I, II, and IV contain speeches held at the conference in revised form. Chapter III represents the actual FEF background study on the theme of the conference which was only presented in an abbreviated form at the conference.

The authors received additional impulses for the "Blueprint" at a second conference in Rome in October 1979, as well as from innumerable discussions. The authors wish to thank all the participants once again for their aid and contributions. They hope that the book will become the beginning for far more discussions in the industrial nations and in Africa, discussions which help to launch the industrialization of Africa in the context of the New World Economic Order in the 1980s.

Wiesbaden, December 1979 The publisher

I. Development Policy in a New World Economic Order



"Africa will write its own history, and in North and South that history will be seen to be one of glory and righteousness."

(Patrice Lumumba, 1961)

Opening Adress to the FEF Conference on the Industrialization of Africa

Hans Bandmann

At this conference we intend to discuss the industrialization of the African continent: a perspective of increasing economic prosperity and political stability in Africa. Yet, if one looks at the present situation of the continent, the question arises, "Is this a realistic option? Is Africa not a continent in crisis, whose future will be characterized by economic instability, famine, political unrest and continuous tribal or even regional wars?"

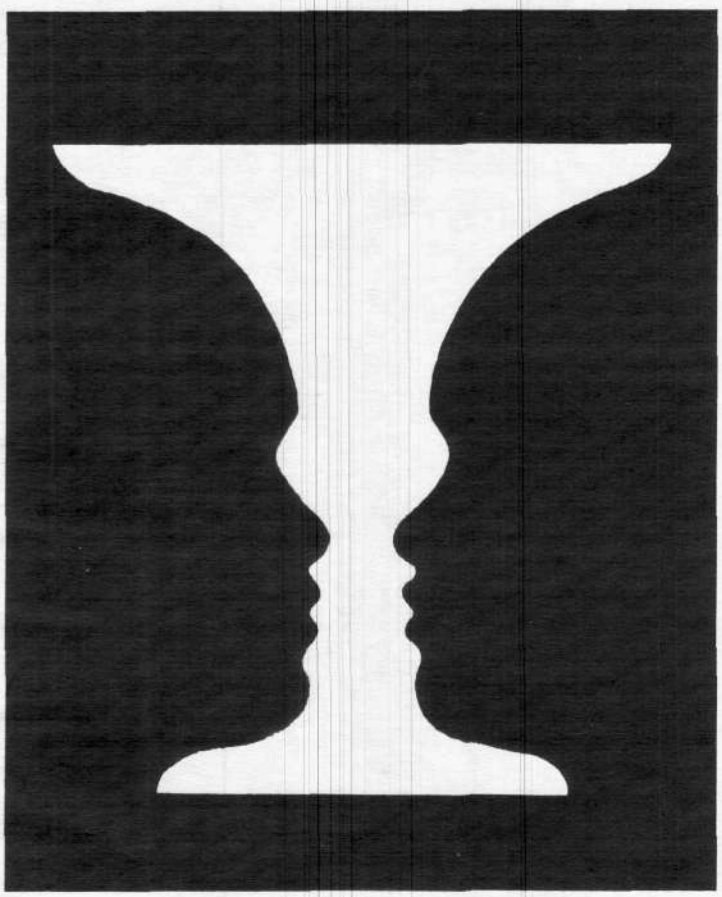
If we talk about the African continent, we can do that from essentially two different conceptual standpoints.

The one is based on the "Neo-Malthusian model", the so-called "Free Trade" or "Free Market Economy" idea of the liberal school of Adam Smith and his successors or that which was called, in the economic debate of the 19th century, the "British System".

The contrary conceptual approach to economics was termed by the German economist Friedrich List the "Industrial System", and known also as the "American System", because at that time this concept was the practical basis for the industrialization of the United States.

Contrary to the idea of economic liberalism, it emphasizes a dirigistic, deliberate development of a country's productive powers.

Depending on which of these two different conceptual approaches one takes, one comes to different conclusions as to the present state and the future prospects of Africa. Because of the importance of this point, let me underline it by showing you a simple, but ambiguous picture (see figure below).



It is only one picture which you are looking at, yet at one moment you can see a vase, at another moment the heads of two persons looking at one another. The primary cause for your alternating perception lies in your mental effort of synthesizing the various features of the picture in front of you into a definite gestalt. Once you have comprehended that your perception is a function of your mental activity, it is possible for you to shift, by a small mental effort, your point of view to the one or the other perception.

Bringing this experience to bear on the discussion here at the conference in the course of today and the two following days we can define the actual subject of this three-day conference: that should be our collective mental effort of conceptualizing the economic and political problems of Africa in such a way that we come to a conceptual starting point for considering the development of Africa, leading to a perspective of increasing prosperity and political stability.

To give the conference discussion a general orientation and clarity, let me elaborate the basic features of the two different approaches to economic policy a little further.

The conceptual starting point on which the "Neo-Malthusian model" is based can be characterized roughly as follows:

1) The human mind is finite. It has unsurpassable "internal limits" *(1)*. It cannot change nature in the sense of introducing new laws into nature through the development of new scientific concepts that can lead, by their technical realization, to appropriate industrial applications.
2) Nature is governed by a finite set of fixed, unchanging laws. Its "natural state" is a stationary equilibrium.

The logical conclusion from this is that any development, any growth and progress, sooner or later, will reach the "internal limits" of the human mind as well as the "external limits" of nature set by the finiteness of resources and the the equilibrium state of the ecology, and therefore has to come to an end.

Thus the primary starting point for any economic policy based on such conceptions is to keep economic development within the framework of these assumed, but fictitious limits.

The intellectual starting point on which the "Industrial System" is based, can be characterized roughly as follows:

1) It is the creative potential of mankind which makes the human mind infinite and allows man to surpass, in principle, every "internal and external limit" for his development. Through task-oriented scientific thinking, the human mind can create new scientific concepts, which, through research and development work, lead to new technologies, which not only apply existing laws of nature but also introduce new laws.
2) Nature is determined by a lawful process of self-development, in which man, through his increasing understanding of the physical laws, plays a more and more critical role. This process of self-development can be described best by the Riemannian concept of nested manifolds, where each manifold corresponds to a metastable state of equilibrium. The fundamental lawfulness does not lie however in stationary equilibria, but in qualitative and quantitative self-development.

The necessary conclusion is that scientific and technical progress and industrial growth create the basis on which to surpass every limit; for limits can be defined only relative to a certain level of scientific, technical and industrial development. The primary starting point for any economic policy is therefore the systematic promotion of scientific and technical progress and industrial growth.

I have elaborated these two fundamentally different and contradictory concepts in this general form, because this antithesis will be, in a certain way, the underlying *leitmotiv* of our dicussions during the next three days, whether we talk about a new approach to the education of the workforce, a cultural renaissance or the technical aspects of a strategy for industrialization and urbanization. The broad spectrum of ideas, perceptions, policies and programs concerning the economic and political future of the industrial and the developing nations — and thus the future of Africa — is essentially determined by the antithetical poles defined by the "Neo-Malthusian model" and the "Industrial System".

What do these two different policy approaches concretely mean now for the economic and political perspective for Africa? To illustrate that, I want first to elaborate the "Neo-Malthusian" approach, referring to a currently operational policy concept, and then counterpose to that the approach defined by the "Industrial System", which is our own approach to the economic perspective for Africa.

The study, *"Africa in the 1980s"*, of the New York Council on Foreign Relations (CFR)*(2)*, offers the best example at present of an approach based on the "Neo-Malthusian model". There are several reasons why it is most appropriate to refer in the context of our conference to this study as an example:

1) On the basis of its "1980s Project" studies, of which the study on Africa is only one part, the CFR intends to shape the global evolution of the post-Bretton-Woods-System era, just as it shaped the post World War II order on the basis of a major study at the beginning of the 1940s. Particularly the economic order established by the former Bretton Woods System

reflects the influence of CFR policy-making. Today's CFR project locates the potential evolution of Africa as a subsumed feature of the monetary, economic, military and geopolitical implications of global issues; these global issues distill down essentially to the struggle between the liberal concept of Neo-Malthusianism and the concept of a global economic policy based on the "Industrial System", which the CFR refers to as Neo-Mercantilism *(3)*. In a superficial, ideologically distorted form these issues are commonly discussed as the North-South and the East-West conflict. Because we intend to locate the perspective for the industrialization of Africa in the context of a Grand Design for a New World Economic Order, which — obviously only from the formal side — defines a similar frame of reference, the CFR study offers itself as a paradigm of a counterdesign. That the CFR's "Project 1980s" is not a mere academic undertaking is proven by the fact that besides Cyrus Vance, many other members of the Carter administration have been involved in the study. The restrictive monetary policy implemented by U.S. Treasury Secretary Volcker, which threatens to collapse economies of the developing sector especially, has to be considered as an integral part of this strategic design.

2) The CFR has extremely close links to private institutions such as the *Ford Foundation* and the *Rockefeller Foundation*, public institutions such as the *International Monetary Fund* and the *World Bank*, as well as to related initiatives such as the *Club of Rome* and the *North-South Commission*. These links constitute the CFR as an important and critical element in an international network. Discounting minor differences, those policy options outlined in the "1980s Project" can be regarded as generally representative for this international network. This is true especially in respect to its practical policy toward Africa. Thus the CFR study represents a document for the better understanding of present events in Africa, which are either the results of the implementation of that policy, or part of the fight against it. This fight against the implementation of CFR policy is led by what we term the Grand Design forces, whose aim is the establishment of a New World Economic Order on the basis of the "Industrial System". These forces have constituted themselves out of industrial factions in Japan, Italy, Germany and France (particularly the two latter countries) and at least at the moment, they have a strong influence on government policy in those countries. In addition, the Mexican as well as the Soviet government, as well as political factions in India, and in the Arab and other developing countries are oriented to the same Grand Design.
3) In the first session this morning you had the pleasure to listen to Mr. LaRouche, a Democratic Party U.S. Presidential candidate, who has presented himself as the alternative to the two other Presidential candidates promoted by the CFR. With his economic writings such as *"The Theory behind the European Monetary Fund" (4)*, he is at the moment the most explicit spokesman for a Grand Design of global industrialization, who has had a strong conceptual impact on those international forces that follow the policy of the "Industrial System". This treatise as well as other economic writings, constitutes the general conceptual basis for the FEF's program of industrializing Africa. The CFR's policy, as formulated in their study on Africa, can therefore be considered as the most explicit counterstrategy to the policy concepts presented here at this conference.

Now, let's look at the CFR study, which has the significant subtitle, *"A Continent in Crisis"*. What does it say? What is its analysis of the African crisis? What are the remedies it proposes?

The study says explicitly, "that Africa as a whole will continue to undergo a Malthusian crisis" *(5)*. As a reason for that, Prof. Zartman, one of its authors, remarks that "population growth is likely to put increasingly heavy strains on already inadequate resources ... this pressure will be compounded as national groups compete for the allocation and equitable distribution of scarce resources ... Any other elements, such as ethnic rivalries or class conflicts, are merely second-level manifestations of the basic issue." *(6)*

Zartman predicts that on the basis of serious chronic shortages of food, crises of potentially monumental proportions may hit many states. As a remedy, he suggests a shift in emphasis of

economic policy away from "top heavy" industrialization to rural development.

His co-authors, Landon and Mytelka, formulate an alternative economic strategy for Africa, which today is already the operational policy for those institutions for which I already described the CFR policy option as being representative.

Instead of stressing the necessity for the systematic development of productive powers, i.e. the capability to produce an increasing amount of wealth, the authors put primary emphasis on redistributional measures.

Instead of calling for a rapid industrialization of the continent, a historically proven precondition for increases in productivity within agriculture, they propose rural development programs with labor intensive and energy saving "appropriate" technologies.

Instead of urging close cooperation with industrial corporations of the industrialized countries, their strategic concept for the African countries is to "delink" them from the international economic system and to persuade them to adopt self-reliant strategies of development.

That means not only that the CFR's perception and conceptualization of the problems of Africa, in terms of the discrepancy of demographic growth and food production, is explicitly determined by Malthusian prejudices, but also that the policy measures derived from that analysis are nothing but the application of the principal elements of economic policy which Malthus formulated more than 170 years ago in his *"Essay on the Principle of Population..."* and in his *"Principles of Political Economy"*.

In fact it is precisely the implementation of Malthusian economic policy measures, based on a Malthusian perception and conceptualization of Africa's economic problems, which makes the Malthusian forecast of economic crisis a self-fulfilling prophecy.

It is exactly the prevention of rapid and massive industrialization of Africa as a whole which will lead to the kind of situation in the course of the 1980s which Prof. Zartman describes in the study as his "Eventful Scenario". He concludes his description of that scenario with the following words: "As quarrelling breaks out everywhere, economies stagnate and authoritarian regimes multiply, since they are best suited to defending scarce and slowly expanding resources from external attack, putting the lid on internal demand and maintaining a constant state of military readiness. Paradoxically, the general postwar exhaustion and unproductiveness that have produced this situation prevent the limited hostilities from becoming widespread conflict;there is simply not enough tinder to make bushfires a forest fire. As the 1980s draw to an end, the external world decides that Africa is not worth the conquest, and a tacit hands off agreement is reached, leaving the continent a ghetto to fight its own battles." *(6)*

An important French politician remarked at the beginning of the 1930s: "There are no crises in Africa, they only serve as an excuse for those who don't want to leave the old track". Knowing the background and the intention of the "1980s Project", I think at least the latter part of the remark is still valid today.

I want to emphasize here, that a perspective such as that described in the above mentioned CFR scenario might be caused not only by those who deliberately consider such a development to be in favor of their global interests, but also by those generally well-meaning policy- and decision-makers, who fail to look at the present problems of the African continent from a conceptually correct point of view, making false compromises and adapting to wrong policy concepts, that carry the seed of failure already within them.

To sharpen the systematic understanding of a conceptually correct policy approach, the actual subject of our conference will be the formulation of a political and economic perspective for Africa, based on a view of the continent from the standpoint of the "Industrial System". If we seriously want to discuss the development of the continent, there is no real alternative to that approach. Or do you believe that Japan, Italy, France, Germany, the U.S. and the Soviet Union could have reached the productive capacities they have today on the basis of the above outlined "rural development" strategy? Throughout history, only the approach which was

determined from the point of view of the "Industrial System" has led to the development of today's industrialized nations in the West and in the East.

What does this mean in terms of economic policy measures for Africa? I don't want to anticipate in a few words what we shall discuss extensively during the next three days. I want to limit myself to only a few principal remarks here.

To take up the challenge represented by a doubling of Africa's population in the course of the next two decades, means to recognize that the industrialization of Africa is indispensable. There is no real rural development without industrialization, for it is principally the availability of cheap industrial inputs that increases productivity in agriculture. The most efficient means for bringing this transformation about is by the *nuplex concept* as will be elaborated in the following sessions.

The Fabian concept of redistributing the present economic wealth of a small minority in Africa represents no alternative at all to the systematic development of the productive powers of labor in the context of capital- and energy-intensive modes of production. Compared to today's over 400 million people in Africa, the cumulative quantity of wealth possessed by a rich minority in Africa (or even in the industrialized sector) is tiny; compared to the 800 million people in the year 2000 it is as good as nothing.

The implications of a strategy for the systematic and concentrated development of labor power, in terms of educational, cultural and material preconditions will be demonstrated in the following sessions.

Without a fundamental change in currency, credit and trade policy on the part of the industrialized nations, there is no chance at all for the development of Africa, nor is there a chance for an economic recovery in the industrialized nations. The European Monetary System (EMS) can be considered as a first step towards this necessary fundamental change. To counter the danger of a new world recession caused by present U.S. monetary policy, the official reintroduction at the earliest possible time of a gold-based monetary system is necessary. On that basis the EMS arrangement has to be extended to the OPEC countries and others, thereby establishing the liquidity potential for a multibillion dollar development fund, making long-term, low-interest credits available for industrialization projects in the developing sector. Those measures will lead towards a New World Economic Order.

The necessary boundary conditions created by a New World Economic Order in terms of an improvement of currency, credit and trade conditions will be elaborated during the last day of the conference. Contrary to, for instance, the CFR monetary schemes for the stabilization of the world monetary system, such a New World Economic Order has to determine currency- and credit-policy measures as instruments that will further primarily the development of productive powers, i.e. increasing the capacity to create wealth. Our blueprint for the industrialization of Africa indicates in what dimensions the economic development of Africa has to take place, so that the productive powers of Africa will have reached, by the turn of the century, a level at which continent-wide projects can be implemented. Projects such as the creation of an artificial Lake Congo - Lake Chad - Second Nile watersystem, will then be carried out by the African states, in cooperation with the industrialized countries, as an integral part of the further political and economic integration of the African continent.

Such a large development plan was proposed by the head of Japan's Mitsubishi Research Institute last year in his proposal for a "Global Infrastructure Fund" *(7)*, and had in fact been worked out several decades ago. It is not only interesting from a technical point of view, but in addition it reflects to a certain extent a permanent fight for the real development of Africa, whose most explicit expression can be found in Hanotaux's keynote address to the Geographical Congress of Oran, in May 1902. The former French Foreign Minister said there:

> "Africa has been discovered. It must now be civilized... Where water is lacking, it will be captured, retained, harnessed andutilized; the problem of the desert will be taken on, and one day, through appropriate cultivation, it will know a kind of richness and fertility... The exploitation of phosphates, tin and iron minerals is orienting the until-now exclusively

agricultural Algeria and Tunisia toward industrial development. There is no lack of coal... Oil is appearing. In any event, the harnessing of waterfalls will soon furnish African industry with incalculable and inexhaustable energy resources..."

"But the great benefit which civilization must bring to Africa is firstly peace... which must count on a precious auxiliary: labor... not toilsome, damned and detested labor, but joyous, proud and satisfying labor."

Hanotaux was a leading politician who fought for a Grand Design in which France, Germany, Russia and Japan already at that time planned the industrialization of those parts of the world we term today the developing sector. The emerging constellation of the Grand Design forces was destroyed by the British Empire, following which a succession of political and economic crises escalated to a global situation, in which politicians considered the war, which today we call the First World War, to be inevitable.

After World War I, under worse circumstances, a similar combination of forces tried to implement an equivalent policy. Its failure led lawfully to a chain of events culminating in World War II.

Yet also after World War II a combination of forces constituted mainly out of France, Italy and West Germany followed a similar strategy. De Gaulle, Mattei and Adenauer are the well-known names representing a continental European political faction, which tried to implement a policy of North-South (especially in respect to Africa) and East-West cooperation based on the "Industrial System". At the beginning of the 1960s, this policy was paralyzed. Mattei was assassinated, Adenauer pushed out of office and De Gaulle only narrowly escaped several assassination attempts. Since then the world monetary system has undergone a period of accelerated crisis. Parallel, and closely interrelated with this, has been the growing global economic crisis and political instability.

Nevertheless, that historical series of events does not doom Africa to be a continental ghetto, nor does it condemn the industrialized world to destruction by a nuclear World War III. Today, there are forces in existence that can successfully implement the Grand Design of global industrialization provided that they determinedly and boldly implement, in a coordinated form, the right policy concepts.

To discuss and elaborate these concepts in respect to the industrialization of Africa, to sharpen the judgement and perception of those forces concerning the right and the wrong concepts of development, is the purpose of this conference.

Notes

(1) Compare for instance the formulation of the *Declaration of Cocoyoc* of the United Nations Environment Program and the *United Nations Conference on Trade and Development*, the *Club of Rome* concepts reflected in the RIO (Reshaping the International Order) report, the statements of the *North-South Commission*, etc.

(2) "Africa in the 1980s", (1980s Project — Council on Foreign Relations), by C. Legum, I.W. Zartman and others, 1979, McGraw-Hill Book Co.

(3) "Alternatives to Monetary Disorder", of the same study series, by F. Hirsch, M. Doyle and E.L. Morse.

(4) "The Theory behind the European Monetary Fund", by Lyndon H. LaRouche, Jr., Campaigner Publ.,1978.

(5) I.W. Zartman, "Africa in the 1980s", p.82.

(6) ibid, p. 118.

"Anyone who is born into an already «occupied» world, and does not have the necessary means for his own existence available either from his family or through work, simply has no right to subsistence. In fact he is just superfluous on the world. There is no place laid for him at the great table of nature. Nature orders him away — and she brooks no delay in the execution of her order."

(Rev. Thomas Robert Malthus *(1)*, 1798)

Towards a European Grand Design for Africa

Philip Golub

There is a general atmosphere of crisis surrounding the preparations for the Tokyo summit which begins its deliberations tomorrow. The summit comes at a particularly crucial moment in the evolution of the international economic and monetary situation and the decisions or lack thereof decided at Tokyo will influence the course of events for years to come. It is one of the aims of the conference we are holding here in Paris today to define the areas of economic and technological solutions capable of resolving the crisis which are overshadowing Tokyo: (1) the international monetary crisis and its economic consequences, (2) the so-called energy crisis, and (3) the military conflicts which are shaking numerous regions of the developing sector and are increasingly endangering world peace and stability.

Given the causal links which connect these three points it would be foolish to hesitate to introduce political considerations in analysing them.

We are presently confronted with a transitional phase in the evolution of the international monetary and economic situation. The exponential increases in the indebtedness of the

developing sector nations since 1973 has forced general recognition that a failure to find rapid institutional solutions to Third World debt and correlated problems implies that the world would move inevitably towards a massive international monetary crisis, an illiquidity crisis followed by a general writing off of hundreds of billions of valueless paper assets, the classical road straight into the mouth of a world depression.

In creating the *European Monetary System* (EMS) and the *European Monetary Fund* (EMF) in 1978 French President Valery Giscard d'Estaing and West German Chancellor Helmut Schmidt not only acknowledged the irremediable failure of the postwar International Monetary System and its institutions, but at the same time created the institutional forms for a global change in the monetary system. Those who have observed this evolution over time will know the importance of the open break with Keynesian theory which Schmidt announced in 1976. Keynes and the equilibrium theoreticians of the International Monetary Fund had been proven wrong in practice - the iron test of the failure of the theory.

We are thus confronted by the paradoxical situation that two fundamentally antagonistic economic and monetary systems are simultaneously functioning in the Western World. The old monetary system and its institutions still largely rule over the behaviour of the international markets, yet the embryo of the new system is growing. Nonetheless, the political effect of the EMS has already been massive and has changed the rules of the game in the international financial markets. Most significantly, the EMS and the EMF are based on a pool of reserves of member countries, 20% of the mix in gold reserves. This first step towards the remonetization of gold, increasingly certain as the market price of gold rises, is the most striking break from IMF practices. Although it presently still functions as a mere monetary stabilization system, the EMS is designed in phases to become a credit-issuance institution with an enormous capital base.

In sum, politically speaking, the EMS is the institutional core of a New International Economic Order and is the most advanced and conceptually bold effort which has been undertaken in that direction to date.

As Europe has recognized, the key to solving the international monetary crisis which has been raging since the late sixties and which exploded in public in 1971 with the demonetization of gold, lies in the developing sector. To the extent that the economies of the developing sector are subordinated to oppressive credit conditionalities, the productive expansion of the advanced sector nations is in the short run limited and in the long run impossible. The industrialization of the developing sector is a sine qua non for the creation of new export markets and thus for the gearing up of the productive forces in the advanced sector. It was with this in mind that the EMF was conceived. All other proposed institutional forms have failed.

The multilateral and regional institutional forums set up by the United Nations, the special dialogue committees of the EEC, the United Nations General Assembly above all, have proven their incapability to lead to a New World Economic Order. Even such a positive institution as the LOME negotiations, which bring together Europe, Africa, and the Caribbean countries, has proven itself at best inefficient. No existing institutions until now have **proven capable of organizing development on a world scale**. Yet that is precisely the task ahead of use. The European Monetary System without doubt can become the kernel of the required effort, just as the follow up of the EMS effort in the **trialogue** proposed by Valery Giscard d'Estaing can become the vehicle for integrating the developing sector nations into the EMS.

This has not yet been achieved, but it must. This is not a matter for academic debate: failure to cement the EMS into what it must become implies the death of the greater parts of the developing sector.

It is thus not accidental that major political conflicts have emerged in the past two years between Anglo-Saxon theoreticians and those of the continental Europe. Deep down the conflict over development policy is a conflict between a **dirigistic theory of development** which France and some of its European partners adhere to, and, on the other side, a theory of permanent underdevelopment which lies at the foundation of liberal British economic theory.

Figure 1 THE AFRICAN DEBT BURDEN: EXAMPLES

Country	Year	Balance of trade	Total debt	Debt service due	Ratio of debt service to foreign exchange (%)
		(in millions of dollars)			
Zaire	1972	112.2	541.1	61.1	8.0
	1973	258.4	860.5	93.0	9.0
	1974	469.4	1,292.2	189.1	13.6
	1975	80.8	1,650.9	153.6	17.8
	1976	320.6	2,170.0	119.8	13.8
	1977	476.9		378.4	37.1
	1978			453.9*	50.0**
	1979			448.3*	
	1980	NA	NA	459.3*	
	1981			385.2*	
	1982			357.2*	
	1983			309.7*	
Zambia	1970	NA	547.8	54.4	NA
	1971		534.6	71.8	
	1972	81.4	559.6	85.3	11.3
	1973	401.9	568.9	346.5	30.0
	1974	421.6	679.6	77.7	5.5
	1975	-327.9	957.2	76.5	10.2
	1976	228.0	1,184.3	86.5	19.8
	1977	77.4	1,270.0	185.4	
	1978			211.0*	
	1979			210.5*	
	1980	NA	NA	176.8*	NA
	1981			128.9*	
	1982			112.9*	
	1983			109.1*	

* World Bank projections

** estimate, *Euromoney* (Feb. 1979)

Sources: *International Financial Statistics*, March 1979; IMF *World Debt Tables* (World Bank); *Euromoney*, Feb. 1979

The paradox we are presently experiencing - two systems in contention - cannot persist indefinitely. The laws which govern the economic behavior of both are antithetical and only one will prevail.

I want to illustrate this using Africa as a crucial example of some of the problems of development. The whole of Africa, ranging from the conflicts in Northern Africa to those which periodically shake Zaire and its bordering countries, to the increasing violence of conflicts in South Africa, is undergoing powerful social and military crises. Although outside interventions account for many of the actual detonations, it is the lability of the nations of Africa which makes them susceptible to such intervention. One can say without any permissible doubt - Schmidt and Giscard have understood this among other things - that the chronic underdevelopment of

most African nations is the root cause of any so-called regional political conflicts (with the exception of such situations as Rhodesia, although here also it is colonial policy which has led to the ongoing war).

This chronic underdevelopment in turn is not merely some residue of colonial looting, but is the result of the **continuation of the looting policy of the colonial period**, in the form of the physiocratic raw materials policy pursued by the International Monetary Fund, the World Bank, etc. It is the openly stated policy of the IMF, the World Bank, of the modern Malthusians, to minimize and halt the industrial development of developing sector nations and to maximize ruralization and feudal economic policy.

Let us use some cases in point. Zaire is a crucial case study of the problem, and is relevant to many other African nations. Similar examples can be cited in Asia and the Mideast.

At the end of 1973, following an abrupt collapse of copper prices on the London Metals Market (a collapse which had nothing to do with supply and demand but had a lot to do with geopolitical reasoning) the copper-dependent Zairean economy enters into a period of disorganization and massive indebtedness which forces the country into massive borrowing from the International Monetary Fund and some private loan consortia. Without major changes in the copper markets intervening in the next two years, by 1975 Zaire is forced to agree to IMF "stabilization" conditionalities, which do efficiently "stabilize" the balance of payments of the country and the flow of debt repayment, but which thereby very efficiently destabilize the social situation in Zaire. Violent austerity is imposed,the currency is aligned to SDR's, import restrictions are imposed. The second IMF plan for Zaire, worked out in 1976, forces a further 42% devaluation of the Zaire currency and launches a forced ruralization program. It does not take much to understand what this implies for a nation the size of Europe, whose population of 25 million is scattered in rural villages. As a result, the growth of debt from 1976 to 1979 is exponential, while production decreases steadily. To cap it off, in 1978 the director of the IMF committee for Zaire, M. Blumenthal, demands that 30% of all export earnings be automatically deposited for payment of debt-service. The national currency is again devalued by 50% Production collapses further. Zaire now functions on **negative growth rates**. The IMF meanwhile officially controls the central bank and the finance ministry.

So what does this mean for the population?

a) massive unemployment
b) a resurgence of malaria and other epidemic diseases in the population, in direct correlation with the collapse of living standards
c) famine
d) massive increases in infant mortality.

It is inevitable under these conditions that tribal conflict and internecine warfare break out. Under conditions of industrialization, the atomization of social groupings into tribes, clans, etc., disappears more or less rapidly. The reverse obviously holds for the reverse case. Under such circumstances very little was needed to trigger near civil war via destabilization operations in Shaba in 1977 and 1978. (In both cases it has been documented that Anglo-Belgian mining and financial interests — the London Rhodesia Corp. — were involved.)

In sum, the IMF conditionalities have destroyed Zaire.

Zaire is in no way an isolated case; quite the contrary. The same holds true for Peru, Turkey, Gabon, Sudan, Egypt, Bangladesh, and dozens of other African nations, like Zambia.

Let's look at Zambia for a minute. The effects of a long war of attrition and IMF conditionalities at the same time have left Zambia's economy in ruins. The IMF conditionalities, however, would by themselves have led to this result. Since the first IMF programs in 1975, occasioned by illiquidity due to copper market collapses, one devaluation after another has occurred, austerity budgets have cut state subsidies on all primary consumption products including corn and fertilizers, and subsidies to industry have collapsed, leading to a collapse in manufacturing.

In 1978 the crisis became so vast that Zambia had to accept a new international loan of 800

Figure 2
AFRICAN FOOD PRODUCTION: A DOWNWARD SPIRAL

Index of Per Capita Food Production
for Selected African Countries
1966-1975

	Average 1961-65	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Tanzania	100 ($24)	111	99	100	99	102	102	103	98	86	95
Angola	100 ($26)	101	103	103	105	103	94	87	94	87	67
Zambia	100 ($8)	122	187	81	85	92	110	157	113	135	125
Zaire	100 ($24)	109	111	114	120	122	111	108	111	115	111
Rhodesia	100 ($31)	97	92	85	90	79	93	103	77	102	92
S. Africa	100 ($68)	96	121	100	101	101	113	115	93	114	104
Nigeria	100 ($47)	94	88	83	102	96	94	96	89	92	93
Guinea	100 ($17)	93	101	108	109	106	108	107	107	104	104
Mali	100 ($18)	92	95	82	96	87	80	66	60	67	65
Niger	100 ($27)	100	107	98	99	96	88	73	52	71	64
Ethiopia	100 ($34)	100	101	103	102	100	99	91	87	87	77
Sudan	100 ($24)	90	106	87	100	106	109	100	92	103	104
Kenya	100 ($23)	99	105	100	95	95	90	97	95	95	96
AFRICA*	100	96	97	97	101	98	98	97	91	95	94

*excluding Egypt, South Africa

Source: USDA, Indices of Agricultural Production in Africa and the Near East, 1956-1975.

The figures are for production of food, including estimates for the subsistence sector and without regard for imports or exports. The dollar amounts are farmers'prices in constant dollars of the 1961 - 1965 period for the worth of per capita annual food production.

million dollars, tied to a direct political conditionality: reopen the borders to Rhodesia.

One may try to object that these situations apply only to those countries dependent on the export of a single raw material. Yet most African nations depend either on monocultures like coffee and tea or on raw material mining. Every single nation of Africa is subject to the same colonialist economic organization. Furthermore, in cases of countries with a strong manufacturing base like Turkey and Peru, the methods of the IMF and World Bank are identical.

Globally in Africa we have reached a critical point. Many nations' gross production is lower today than at independence. Financing conditionalities have drastically worsened the global conditions of production and life in Africa. A dozen African states are facing negative GNP growth rates. A dozen others have a zero rate of growth of GNP, which is in fact negative when looked at from a manufacturing standpoint.

The IMF and World Bank use and apply criteria and premises which inevitably lead to Malthusian crises. The most basic real parameters of economic progress - contrary to the obscenity of balance of payments theorists - are as follows:

1) The social characteristics of the population, the social composition of the population, that is to say the division of population into manufacturing labor, agricultural labor, services sector etc. Economic progress is indicated by the **rate of transformation** in the rates: by a decrease of agricultural population, an increase in manufacturing labor, as a continuous process.
2) The characteristics of agricultural production, the concentration of labor-per hectar-per yield. An increase in yield per worker per hectar is the indicator here.
3) Capital formation. Investments directed into manufacturing and modernization of

agriculture. Maintenance of an increasing rate of investment over years, with an increasing proportion going into manufacturing activities, is the only possible means of ensuring the social and productive transformations alluded to above.

Thus, when the IMF and the World Bank suggest so-called appropriate technologies, and amazingly, ruralization, they are inevitably condemning nations to backwardness and sometimes even to extinction.

Looking at the world as a whole it thus becomes clear that the so-called recession affecting the economies of the advanced sector is intimately related to the increasing contraction - to speak politely - of the economies of the developing sector. This regression in the developing sector countries is thus at the root of the acceleration of a world economic crisis. One can schematically establish the causal link as follows:

Decrease of productive activity in the advanced sector (decreases of investment into new technologies, etc.,) - closure of import markets for developing sector goods - increasing, exponential indebtedness of developing sector nations - closure of import markets for advanced sector goods - advanced sector loss of export markets - recession - so on and so forth.

A complete circle ties the aggravation of the crisis on one sector to the other. Aggravated over time, this means a massive world contraction. The contrary emphasis in credit policy, leading to capital formation in the "developing sector" would immediately create the conditions for a reverse chain, i.e., the creation of export markets for the advanced sector. The **absence of development** is **the** problem.

A global solution now demands urgent and radical measures. The continuation of IMF policy implies the danger of irreversible damage to the developing sector. If, as planned presently by the Bank for International Settlements and other international institutions, further significant cuts in credits to the development sector occur, the situation might well become irreversible before 1981.

On the other hand, if the political will is mustered in Europe to engender a rapid accumulation of industrial capital in advanced and developing sectors via the EMS, a world economic boom is on the horizon. A change in U.S. economic and financial policy will be forced by such a dirigistic European effort.

We need a global dirigistic policy. Development must be planned on a global and regional scale. Yet for this to occur, the European Monetary System and its follow-up in the EMF must come to dominate the world. We are calling for political courage from Europe's political, financial, and economic leaders to bring about a New World Economic Order.

Notes

(1) *Thomas Robert Malthus*, son of a rich English merchant, tutor and director of the College of the British *East India Company*, principal instrument for the construction of the British Empire.

"The Heads of State or Government (of the Nonaligned Nations) called upon the developed countries to exercise political will and courage and take steps to seek a solution to the problem of recession in their economies through restructuring the international economy, based on the generation and growth of aggregate demand and productive capacity in the developing countries. Any other approach based on short-term considerations would in the long run operate to the long-term political and economic detriment of the developed countries themselves."

(Economic declaration of the 6th Conference of Nonaligned Nations, Sept.1979 in Havana)

The Myth about Equilibrium Economics

Lyndon H. LaRouche

For more than half a century, it has been well known that the application of twentieth-century science and technology can transform the semi-arid, starving region of the Sahel into the breadbasket of the African continent. President Franklin Delano Roosevelt outlined the main features of such a post-war effort to Prime Minister Winston Churchill during their war-time meeting at Casablanca.

Each decade, governments, financial institutions, engineering firms, and others complete studies of new projects. To date, for Africa alone, we have a substantial accumulation of projects of investment which are not only technoligically feasible beyond doubt, but which would produce a substantial contribution to the national surplus of the nations and the regions in which they are intended to be placed.

Indeed, at this moment we have more sound projects to launch than the combined forces of the industrialized and developing nations have the present economic means to launch simultaneously.

Our practical task for development is that of selecting a combination from among those proven projects. We must allocate limited capital resources for development to a combination of selected projects which, taken together, will have the optimal effect in raising per-capita output in the developing nations.

Up to that point, the policy-making and administrative problem is well-defined and is easily understood among the relevant professionals. Limiting our attention to those governments, parties, financial institutions which are opposed to a neo-Malthusian, Club of Rome, genocidal policy, the problem occurs the instant those groups' sound packages are turned over to the economic specialists. With some few exceptions, the economic specialists respond with elaborate explanations showing why the high-technology development of continents such as Africa is more or less impossible.

In point of fact, the arguments of such economic specialists are worse than mistaken. The variety of economic theory they are employing is worse than incompetent. Unfortunately, graduates of Cambridge University, the London School of Economics, or likeminded training institutions infest the administrative infrastructure of governments, parties, banks, firms, and trade-union organizations even in the best of nations. Governments and others set forth to undertake an eminently sound program for the economic development of the so-called "developing nations." The bureaucratic mice from Cambridge and London School of Economics gnaw at the roots of such programs. As a result of this gnawing at the roots, sound programs wither, and the abused and neglected developing nations slip closer to the abyss of biological catastrophes of famine, epidemic, combined with the effects of the social chaos fostered through such enmiseration.

I refer our attention on this point to the wartime policy-proposals of President Franklin D. Roosevelt. At the Atlantic and Casablanca meetings with Prime Minister Churchill, Roosevelt informed an understandably enraged Churchill that the United States was not going to fight a second world war for the purpose of once again saving the British Empire. Roosevelt added that under his policy for the post-war world, the United States would crush all efforts by the British and others to subject the international economy to "British eighteenth-century methods."

Unfortunately, Roosevelt died on the brink of peace in Europe. To put the matter in the kindest possible terms, President Harry S. Truman was no Franklin Roosevelt.

Excepting such cases as President Eisenhower's "Atoms for Peace" policy and the policies associated with Charles de Gaulle, the post-war Bretton woods monetary system has been a cancerous revival of what Roosevelt rightly denounced as "British eighteenth-century methods." This Bretton Woods system has meant leaving former colonial nations to carry independently their accumulated debts — independent of significant assistance from the industrialized nations. This is the phenomenon which developing nations often describe as "neo-colonialism." On balance, since the death of President Roosevelt, the United States government has worked to perpetuate the old British Empire in thin disguises, and has done so by embracing what Roosevelt denounced as "British eighteenth-century methods."

The Cambridge school of economics, including such fellow-travelers as the Mont Pelerin Society and the liberals and radicals of the London School of Economics, is the formalization of precisely those "British eighteenth century methods." Without rejecting those methods, without junking those miserable varieties of political-economy, the New World Economic Order could not be brought into being.

For such reasons, it is a wishful delusion to speak of the development of regions such as Africa without committing ourselves to the replacement and eradication of those kinds of economic doctrine associated with Cambridge and the London School of Economics.

Since I began to gain public notice for my work on this matter, about five years ago, some important progress toward a New World Economic Order has been made.

During the Spring of 1974, my associates and I proposed the immediate reorganization of the European Community's monetary structure into the form of what we termed then a "Golden

Snake." We demanded the pricing of monetary gold at its price of production, not some fictitious gold valuation of the sort earlier used under Bretton Woods. We proposed that a gold-based EC currency-bloc would be made economically feasible through economic-cooperation agreements with the Comecon nations.

Happily, that 1974 demand of ours has been satisfied on the initiation of President Giscard d'Estaing and Chancellor Helmut Schmidt. The establishment of the European Monetary System, combined with new accords among Moscow, Paris, and Bonn, has established the indispensable cornerstone for the new, needed world monetary system.

During April 1975, I announced a further proposal at a press conference in Bonn. This proposal was later publicized in a series of reports under the title of *The International Development Bank*. The requirements of that further proposal are satisfied by the second aspect of the initiatives of President Giscard and Chancellor Schmidt, the European Monetary Fund.

If the members of the EMS place common reserves in a gold-based pool, that pool is readily converted into a new credit-banking facility. Churning liquidities held by central banks and other major institutions can be exchanged for purchase of low-interest, gold denominated, long-term bonds. The liquidity so concentrated in the new banking facility can aggregate to a level of hundreds of billions of dollars. This provides the basis for issuing low-interest, long-term credits for export of high-technology capital goods from the industrialized to developing nations.

I do not know to what extent my own proposals and those of my collaborators directly or indirectly influenced the shaping of the EMS and EMF institutions. Pope Paul VI's 1967 *Progressio Populorum*, the initiatives of President Charles deGaulle, of the late Jacques Rueff, were already proposals in the same direction. The economic principles involved do not differ from the economic principles of Jean-Baptiste Colbert, Gottfried Wilhelm Leibniz, Alexander Hamilton, Henry C. Carey, and Friedrich List. The point is that there was a convergence between my own proposals and the designs accomplished by the various contributors to and architects of the EMS and EMF. To the lasting credit of President Giscard and some other leaders, we have made and are making some important progress away from the swamp of "British eighteenth-century methods."

If we assume that the European Monetary Fund will be put into operation quickly now, this step is excellent. It is an indispensable step if we are to avoid an otherwise certain world depression and almost certain thermonuclear war.

However, this step by itself is not yet adequate. One more ingredient must be added. We must rid our government and financial institutions of the pernicious influence of "British eighteenth-century methods." Without that additional measure, both the EMS and EMF must tend to fail — and the condition of Africa, among other developing regions, will then become hopeless.

This last problem I have attacked in a publication entitled *The Theory of the European Monetary Fund*, published last Autumn. As part of the same effort, I directed a group of my close collaborators to create a computer model matching the specifications of the same published document. Such a computer-model has been constructed. It has been tested using a database of U.S. statistics from the 1968-1973 period, and the model tested has been proven to have approximately 100 per cent reliability. The crucial test has been accomplished through using 1968-1973 data-based versions of the model to predict post-1973 developments. The computer model so developed has been named a "Riemannian Economic Model."

This conference on the development of Africa is a most appropriate occasion for reporting some of the leading, indispensable functions the "Riemannian Economic Model" will have in ensuring competent projections and measurements of economic performance. This model enables us to replace the "British eighteenth-century methods" embedded in the computer-models and other economic-accounting procedures heretofore generally in use.

To that purpose, I shall now summarize for you the following key points.

First, I shall locate myself as an economist directly in the tradition of what the great Marquis

de Lafayette and others defined as the "American System." The best-known economists of the "American System" are George Washington's Treasury Secretary, Alexander Hamilton, President Abraham Lincoln's economic advisor, Henry C. Carey, and the close collaborator of Lafayette, Germany's Friedrich List.

Second, I shall identify the gross incompetence of the system of National Income Accounting in official use in the United States today. By means of this illustration I shall leave no doubt in your minds of the rightness of the theory of Hamilton, Carey and List, or of the gross incompetence of the sort of economics advocated by both British liberals and the Mont Pelerin Society today.

Third, I shall turn your attention to the flaw of omission in the economic theories of Hamilton, Carey and List. I shall emphasize that what I have accomplished, relative to my leading predecessor-thinkers of the "American System", is to have employed the kind of relativistic physics associated with Bernhard Riemann and Georg Cantor to solve the problem of generating predictive economic models consistent with the fundamental principles of the "American System".

In this connection, I shall show why no competent administration of development of the developing nations is possible without replacement of British methods of political economy by the American System.

The presentation will bring into focus the point emphasized in the title of this presentation. In the conclusion, I shall turn your attention again to the special characteristics of the "Riemannian Economic Model", to show why any mathematical model or accounting system reducible to simultaneous linear equations is axiomatically incompetent to represent a developing economy. As a corollary point, I shall have shown you that the effort to administer an economy or world monetary system according to doctrines derived from Petty, Smith, Ricardo, Mill, Keynes, Schacht, von Mises, or von Hayek, must direct economies into relative stagnation and ultimate collapse.

I shall emphasize, in passing, that Karl Marx was wrong in his misguided effort to adduce the principles of industrial-capitalist development from the British model. Marx was correct, however, in showing that depressions, misery and ultimate collapse are intrinsic to societies which model their economies according to the doctrines of Smith and Ricardo. Today, if we choose the "American System", we shall not only survive, but open up a half-century of unprecedented world-wide growth and prosperity. If we tolerate the British model, we are doomed either to early nuclear war, worldwide biological catastrophe, or both.

1. Hamilton: The origins of Political Economy

To understand the "American System" economics of Hamilton, Carey and List adequately, we ought to trace the development of modern national economies from a comparison between Dante Alighieri's *De Monarchia* and the *Concordantia Catolica* of Cardinal Nicholas of Cusa. From the middle of that Dark Age following the defeat of the Hohenstaufen, to Europe's emergence into the Golden Renaissance, the leading Augustinians and city-builders of Europe had progressed to the notion of a world-order based on national republics. Cusa's ecumenical proposals, beginning with his *Concordantia Catolica*, have an importance that is presently vastly underestimated in the emergence of the modern nation-state, and of national economies.

The first modern political-economist was the great Byzantine Platonist and collaborator of Cosimo de Medici, Plethon. Reading Plethon's proposals for national economy today, we are properly filled with profound contempt for David Ricardo's *Principles* as well as the British productions of William Petty and Adam Smith. Relative to the great Plethon from the early fifteenth century, Ricardo, four centuries later, did not comprehend even the ABC's of national economy.

The first successful establishment of a modern nation-state and national economy was accomplished during the last half of the fifteenth century by France's magnificent Louis XI.

Louis XI's achievements in France, intersecting Augustinian city builder currents within Tudor England, contributed to the establishment of the second modern nation-state, England, during the early sixteenth century.

From that point onwards, into the American Revolution, there was a philosophical and practical alliance between what became the Commonwealth Party in England and the Navarre-centered *politiques*, the Commonwealth Party of France. Jean-Baptiste Colbert is the interim culmination of this process in the France of the post-1653 period.

The overthrow of the Commonwealth Party in Britain in 1660 was a terrible blow to the republican cause. However, the English Commonwealth Party provided for the future by its seventeenth-century colonization of what was later to become the United States. Over the period 1766 through 1789, the figure of Benjamin Franklin was the focal point for alliance of the transatlantic Commonwealth Party with the networks of the heirs of Colbert and Leibniz throughout the continent of Europe.

Looking at the problems of the eighteenth-century from Benjamin Franklin's Paris we observe the following. Eighteenth-century France was the most advanced and most rapidly developing industrial nation of that period — in contrast to relatively stagnating Britain. Nonetheless, parasitical forces among aristocratic serf-holders and Amsterdam-Geneva-linked rentier-finance prevented France from realizing its industrially-based potential to become a true republic. As Lafayette's policy toward Louis XVI illustrates, the political defect of France was seen to be not the monarchy as such, but the grip of anti-industrialist oligarchical forces of countryside and rentier-finance on the monarchical government. The wrecking of French credit by the evil father of the evil Madame de Staël exemplifies the problem.

In the dedication of Franklin's transatlantic conspirators, the American Revolution was not simply an American internal affair nor a geopolitical matter of continental efforts at weakening the British monarchy's evil power. The new American Republic was intended to become the more or less perfected realization of the kind of republican order the heirs of Dante, Cusa, Colbert and Leibniz intended to bring into being throughout Europe most immediately.

Therefore, when we speak of the "American System" of political economy, we are not suggesting that the European networks centered around Lafayette proposed to imitate some recent concoction autochthonously sprung up in North America. Although it was the majority of American people who, principally, had made the revolution and established the young republic, the republic was based on political and economic principles of European design.

Whether or not they have been informed of such details, when nations of the developing sector today demand a New World Economic Order, they are demanding in fact the same policies the American revolutionaries demanded in adopting the U.S. Constitution. They are demanding the benefit of those policies which Lafayette and his allies knew and promoted under the name of the "American System".

It is an absurdity, a wild distortion of the bare facts of U.S. history, to regard the American Revolution merely as an internal conflict between British colonies and the British throne. That Revolution was in fact a world-wide struggle between two opposing political and economic systems, between that we identify as the "American System" and what the misguided Karl Marx admires as the "British model".

A handful of brief illustrations are important here.

The successful assimilation of modern technology by Japan was rooted in the acceptance of Dutch humanist influences long before the Meiji Restoration, a group of gifted persons in Japan dissected a corpse, satisfying themselves that European science was relatively sound, and Chinese culture backward and absurd on this and related points. In a like manner, the forces which launched a nineteenth-century economic miracle in Japan under the Meiji Restoration drew on two sources. By way of historic connections of Neoplatonic Europe, connections to German republicans, Japan adopted the political-economy of Friedrich List. With aid of a Meiji leader who apprenticed himself in the Lincoln administration, Japan took directly from the economics of Alexander Hamilton and Henry C. Carey.

List and Carey were not parallel developments. List was a part of an international conspiratorial network headed by Lafayette, and spent ten years in the United States, under the sponsorship of Lafayette, where List worked closely with Henry C. Carey and his father Mathew C. Carey. List presented his work to Europeans under the name "The American System". Hamilton, Carey, List and the great French political-economists of the early nineteenth century represented in fact a community of collaborating scholars.

Although British subversion of leading institutions of the United States was a major problem throughout the nineteenth century, the essentials of the American System were deeply embedded in the republic. The forced industrialization of the nation under President Lincoln made the success of the American System irreversible — at least until the ominous reverses of the 1960s and 1970s. Similarly, the Meiji Restoration embedded the "American System" in the economy of Japan. The achievements of List and his collaborators have been organically embedded in Germany's Rhineland and Ruhr. It is the heritage of France's Hanotaux and Russia's Count Sergei Witte, a heritage based in the "American System", which still to this days serves as the institutional basis of reference for the Gaullist policy toward the European continent.

Today, it is rightly the model of the young United States' republic, the model of Japan's economic miracles, and the model of German technology — of the Ruhr and nineteenth-century Göttingen, which corresponds with the need to create a New World Economic Order.

Hamilton's Economics As Such

The kernel of the economics of the "American System" was first elaborated by George Washington's Treasury Secretary, Alexander Hamilton. During the period 1789-1791 Hamilton drafted a collection of policy-outlines on banking, credit and economic policies. Those reports by Hamilton bring together most of the essential, distinguishing features of the "American System". The most profound and important among Hamilton's writings is his 1791 *Report on the Subject of Manufactures*. In this Report, Hamilton systematically shows to be absurd those notions of political-economy embodied in Adam Smith's *Wealth of Nations*. Hamilton refuted in advance the absurdities of David Ricardo's *Principles*, as well as John Stuart Mill, Marshall, John Maynard Keynes, Hjalmar Schacht, and also the liberal and Mont Pelerin Society outgrowths of the British school.

In opposition to the physiocrats, including Smith, Hamilton discredited totally the British doctrine of rent, and also discredited in advance Ricardo's foolish notion of "average necessary labor-time" as the determinant of economic value.

Hamilton's factual basis for this proof was restated later by Mathew Carey, by Henry C. Carey, by Friedrich List, and by key French thinkers of the early nineteenth century. Although later thinkers have had the advantage of a broader range of facts than Hamilton commanded, Hamilton's own devastating refutation of the British doctrine of rent is so thorough, and presented in such comprehensible form that any person who has not mastered this and come to essential agreement with it is professionally unqualified to speak on political-economy.

The source of wealth is not the "bounty of nature". Each mode of productive technology defines a different spectrum of natural resources than earlier and later modes of technology. Petroleum, at a premium today, will be a petrochemical source of diminishing importance as fusion-energy processes emerge into general usage during the next century. Old resources are relatively finite, and must be replaced by new kinds of resources through development of more advanced technologies.

Only a British rentier or a feudal landlord or usurer could repeat the nonsense, arguing that land has a natural fertility for agricultural use. It is productive, ingenious farmers, whose improvements in land make that land fertile and improve its fertility.

In the U.S. state of California there is a piece of former desert, called today the "Imperial Valley", which is among the richest agricultural land in the world. What physiocratic imbecile

could argue that the value, the fecundity of this land is a product of the "bounty of nature"?

Continuing the line of thought outlined by Hamilton, during the next two decades of fission-energy development, fission-energy plants will add between seven and ten thousand gigawatts of capacity to the world's fixed-plant energy supplies. During this phase, we shall transform the arid Sahel into the rich breadbasket of Africa, using the principles which turned California's desert into the basis for the "Imperial Valley". During the last decade of this century, fusion-energy will become commercially-applicable on a broad scale. As continued perfection of fusion-energy advances, we shall have the energy at sufficiently low social cost to transform the Sahara and Gobi desert into gardens for human habitation.

One can believe in the unchanged fecundity of land only in a society which refuses to meet its obligation to create the fecundity of the soil.

The second, connected point proven by Hamilton is more sophisticated, more fundamental, more important. Let us look at this point in terms of its refutation of the absurd belief that the "average necessary labor-time" of production determines economic value.

Let us suppose we turn back the clock of history to our ancesters hominids of the late Pleistocene age. Could we maintain a world population of even a hundred million persons through the forms of food-gathering and primitive production employed by old-stone-age ancestors? What is the value today of the average labor-time of persons at such level of culture? It is less than zero. Stone-age man could not maintain a world population of a hundred million persons even with an eighteen-hour labor-intensive day. It is not the time of labor that determines value, nor the price paid for a day's labor. It is the *quality* of labor that determines value, the level of technology represented by the successive advancements in culture of man from the Pleistocene to the present.

What then, is the source of economic value? What is there reflected in the potentialities of a modern labor-force which enables us to maintain a world population of about four billions today, and will enable us to maintain an improved standard of existence for about six billions persons twenty years ahead? It is nothing but a secular process of progress in developing the productive powers of labor.

This is the essential point of axiomatic difference between the American System and our adversary, the British system. That point of essential difference is Hamilton's principle, that the *sole ultimate source of all wealth is the development of the productive powers of labor.*

As a corollary principle, Hamilton proves that the development of the productive powers of labor requires the mediation of increased savings embodied as capital. It is through "artificial labor", the use of machines to employ energy above and beyond that of the human musculature, that continued development of productive powers of labor is to be secured.

In general, Hamilton's approach was consistent with that of Jean-Baptiste Colbert. The development of an industrial republic requires that the state organize the credit required for commerce and investment, and that the state act to create a protective environment around those ventures which contribute more advanced productive technologies to the national labor force as a whole.

The British doctrine of "free trade", or the modern name for the same thing, "the free-market economy", is an historical absurdity and an economic fraud. Historically, industrial capitalist development occurred through the directing role of the state. This was the case for the France of Louis XI, for Tudor England, for France from 1653 through 1814, and for the young American republic. It was the case for Meiji Japan, and the case in the effects of List's customs-union for Germany. Never in the course of modern economic history in any part of the world, has private capitalist investment by itself succeeded in developing a healthy capitalist economy.

What private capitalist venture does accomplish is to enable different technological and entrepreneurial ingenuities to compete in such a way that those enterprises embodying the best combinations of technology and management will tend to predominate, and new, more progressive firms will nip threateningly at the heels of those firms whose managements tend to

become lazy in respect of technology, and parasitical in respect of their use of profit-incomes. This system of competition functions only on condition that the state creates a system of credit and taxation through which progressive ventures are aided to prosper at the relative expense of the more backward and parasitical capitals.

On this point, one may usefully refer to the observation of Mathew Carey.

During the period of 1815-1818, the United States committed the folly of adopting the British doctrine of "free trade" as U.S. governmental policy. The result of this ill-fated embrace of "free-market economy" principles was a disastrous depression. As a result of that experience, the United States abandoned "free trade" policies, and returned to the policies of Hamilton. The 1818-1828 period of "dirigism" was one of prosperity.

Commenting on this in 1818, Mathew Carey compared the case of Portugal. Carey showed how Portugal's submission to the British doctrine of "free trade" had ruined that nation's credit and economy. We might add, comparing the economies of Portugal and the U.S. over the past two centuries, that it was Portugal's persistence in "free trade" practices which brought that once-proud nation down to its present relative semi-backward condition. Carey showed exactly how "free trade" was destroying the U.S. economy during the 1815-1818 period.

A related experience afflicted the United States under Presidents Andrew Jackson and Martin Van Buren. At the time of Jackson's election — one must add, elected with aid of a massive vote fraud — in 1828, the United States had the best credit of any nation of the world, and was a technological leader, more advanced than Britain at that time. Under Jackson's "free trade" policies, the credit of the United States was ruined, and the nation plunged into the disastrous panic and depression of the period beginning 1837. The United States did not recover significantly from Jackson's and Van Buren's "free trade" follies until Lincoln's industrialization drive.

A most-relevant illustration is given by the case of the 1930s depression.

In 1940, the United States began a war-production mobilization. At first, the mobilization was stalled by the effects of accumulated obsolescence and decay in productive capital, and by the labor force's loss of much of the skill-level that labor-force had possessed in 1928-1929. Nonetheless, by 1942, a war-production boom was underway; the United States went through super-employment of its labor-force and cranked out a production of goods which staggered the imagination of the world.

Why, then, did the United States permit itself to undergo ten years of hideous economic depression? Granted, ammunition is not generally eatable, and artillery and military aircraft are not very useful as chemical plants or machine-tools. However, if, instead of war-goods, the United States of 1929, 1934, or 1936 had used war-production mobilization methods for producing masses of capital goods, the depression would have ended. Moreover, since capital goods are recoverable values through production — where military goods are not — any long-term debt incurred for such capital-goods production would have represented a non-inflationary, negotiable asset.

As long as an industrial-capitalist system employs such dirigist methods, no depressions are possible. The reason the United States remained in a depression throughout the 1930s is that both President Hoover and President Roosevelt refused until 1940 to break with the British policies of "free trade".

The Hamiltonian New World Economic Order

The illustration I have just given I have emphasized because of its direct bearing on the New World Economic Order. The methods Roosevelt used for 1940-1945 war-mobilization in the United States are a model of reference for the methods by which I proposed to make the New World Economic Order a reality.

Contrary to official U.S. government statistics, the U.S. economy as a whole is currently operating at a net loss. The statistical reports of economic growth and profitability are largely fictitious, they are based on including within Value Added items of revenue which involve non-

productive or even outrightly wasteful purchases. The agricultural and industrial sectors of the U.S. economy, in particular, are in a cannibalistic phase, where a shrinking capacity is mantained by "triaging" part of output-capacity as a whole.

Although the U.S. could secure export-contracts for capital-goods increasing the level of exports by about $100 billions annually, the U.S. economy has shrunk since 1966-1967 to the point that prompt delivery on such increased volumes of exports is presently doubtful. I emphasize the figure of $100 billions because that is the approximate level of increased annual exports of capital-goods the U.S. must contribute to launching the New World Economic Order during the course of the immediate four years ahead.

Therefore, the problem of bringing the U.S. economy to the point it can deliver an additional $100 billions of capital-goods exports annually is a problem very much like the war-mobilization problem Roosevelt confronted in 1940.

On condition that the European Monetary Fund is implemented in the way I have indicated earlier, and on condition that the United States and Japan are brought into support of the EMF, that will establish a new world monetary system, replacing the bankrupt and cancerous relics of the Bretton Woods System — the IMF, World Bank, and London financial market. This new system, being based on a true gold-reserve basis, can generate hundreds of billions of dollars-equivalent annually, provided that the credit issued is for sound projects, and that the credit is issued primarily for world-commerce either in capital goods or in commodities circulated in payment against capital-goods purchases. In other words, it is a world-wide, peaceful equivalent of a war-economy.

On that basis, anticipating nuclear-energy plants to be a large component of total increased capital-goods exports, we are projecting levels of added world commerce in capital goods in the order of between two and three hundred billions dollars-equivalents annually, as soon as production-levels can be cranked-up to meet such requirements.

East-West economic cooperation will be an essential part of this. For various reasons, the Comecon nations are not suited to become a significant part of the world division of labor in consumer products. Therefore, unless the Soviet Union, for example, were to meet its purchase obligations with a combination of gold bullion and primary commodities, there would appear to be important difficulties in the way of adequate expansion of East-West economic cooperation. However, the Comecon economies, especially the Soviet economy, have excellent potentials for producing high-quality capital goods for Third World use. Thus, the Comecon can increase its purchase of imported capital goods for its own internal development against the proceeds from supplying other capital goods exports for development of Third-World nations.

Admittedly, this effort depends upon the subordination of old Third-World debt to the long-term credits of high-technology development. With a new, gold-based monetary system replacing the cancerous IMF, the suitable reorganization of old debt-structures can be accomplished without causing dislocations in the internal banking systems of industrialized nations.

This effort is also to be understood by comparing the United States and the British Empire over the term of the nineteenth century. It was the British Empire which had the larger territory, the greater mass of natural resources, and the larger population. Yet, compare the rate of per-capita growth of wealth of the two entities.

To study the matter, it is adequate to compare the effects of the Hamiltonian development of Meiji Restoration Japan with the misery of India during the latter part of that century. Although India today has a low average annual output and income per-capita, it also represents the nation with the third-largest complement of scientists and engineers in the world. This present contrast reflects the earlier contrast between India's advanced culture and its misery during the nineteenth century. By looking at nineteenth-century India in this way, and applying the comparable cases of Japan's development and U.S. assimilation of illiterate immigrants during the last decades of that century, it is easily shown that India could have achieved the per-capita

prosperity of today's Japan, but for India's participation in the British Empire's "free trade" system.

The use of "free trade" to impose economic backwardness and misery upon nations is argued in Adam Smith's *Wealth of Nations*. Although most of Smith's *Wealth of Nations* is devoted to lying representations of the work and policies of Jean-Baptiste Colbert, Smith is accurate insofar as he shows the necessary connection between "free trade" and the conditions Britain imposed on the victims of its colonial rule.

If those victimized regions of the world had lived under the hegemony of the "American System," rather than the British system, the hideous condition of much of the Third World would not exist to be remedied today.

2. U.S. National-Income Accounting

Apart from the spread of the toxic doctrines of Smith, Marshal, Keynes, and Mises in U.S. universities and corporate board-rooms, the chief subjective cause for the present decay of the U.S. dollar and economy is the use and acceptance of the National Income Accounting system employed by the Department of Commerce, Federal Reserve System, and by most influential institutions of the private sector. The absurdity of the National Income Accounting system is most easily demonstrated beyond any margin for objections.

If the United States were merely to legalize the present level of domestic traffic in illegal narcotics and related, illegal mind-altering substances, the reported Gross National Product of the United States would be increased by more than $100 billions annually. A similar kind of result would be accomplished by legalizing illegal gambling, and by absorbing large portions of the unemployed as employees of an expanded number of gambling establishments. If one were not satisfied with this amount of increase in the National Product, the legalization of burglary and armed robbery would enlarge the GNP.

It can be recalled that John Maynard Keynes once argued than an economy could be stimulated by hiring unemployed persons to dig and refill holes in the ground. If all the labor-force in the United States were discharged from productive employment, and employed by the government in digging and refilling holes in the ground, the payment of an adequate hourly wage for this employment would suffice to increase the GNP over the levels existing when production was still functioning.

This imbecility of the National Income Accounting system is the chief reason that the past twelve years decline of the U.S. economy has been a period which GNP figures report to be one of more-or-less successful continuation of economic growth.

Although Habsburg Vienna's so-called economists were influential in the design of that GNP system, the axiomatic principles were consistently British. The mere fact that any person could take Keynes seriously, after Keynes' observation on the digging and refilling of holes, is adequate evidence that in matters of political-economy, at least, such an admirer of Keynes must be either a moron or a certifiable lunatic.

It is relevant that despite Karl Marx' self-deception on this point, the Reverend Thomas Malthus was a collaborator of David Ricardo. The fact that Marx is self-contradictory in his own definition of "productive" in his *Capital* is not inconsistent with Marx' unjustified praise for the relative "scientific" merits of Smith and Ricardo. In Volume I of *Capital*, Marx gives a wrong definition for "productive;" in a location in *Theories of Surplus Value*, Marx's distinction between *productive* and *non-productive* is close to being correct. It is important to stress such observations concerning Marx when dealing with the Third World, since the London School of Economics representation of Marxian economics has been promoted among Third-World intellectuals, including Third-World leaders who otherwise have a sensible view of economic development.

In the case of Thomas Malthus, Malthus's refusal to distinguish between productive and non-productive forms of consumption is only more luridly obvious than in the writings of Smith, Ricardo, Marshall, Mill and the professedly Malthusian Keynes. Malthus is only more

shameless than many other British political-economists on this point.

In the British system, especially the "utilitarianism" of Mill and Mill's successors, the consumption of a commodity or service is an end in itself. The fact that someone is induced to purchase or otherwise consume a paid commodity-production or service is wrongly adopted as the "elementary fact" of the economic process. So, Malthus proposed that the purpose of the production of profit was to sustain an army of non-productive, oligarchical parasites — such as himself.

The proper distinction between productive and non-productive consumption is readily made. The case of capital consumption is most easily accepted on this point. If a firm does not employ its plant, machinery, materials and related capital in production of new outputs, the capital purchased goes to waste. The same is true of labor. If households are nourished, clothed, educated, housed, and so forth, but the labor-force represented by those households is not productively employed in production of goods, that portion of consumption has no direct economic value to the economy as an economy.

Consumption is not the final phase of the production-chain. Consumption, to the extent that it represents economic value, is the connecting link between what has been produced and new production. Growth signifies that the result of consumption of old production is more production than was previously produced.

On condition that we correct and reinterpret Marx's economic categories from the standpoint of the American System, a rigorous definition of "productive" is obtained through two steps of successive approximation. We give the first approximation at this point, and then develop the final approximation under the next sub-heading.

To analyze an economy, we must take the population of that national-economy as a whole. That is to say, we must not fall into the foolish practice of assessing an economy as a mere aggregation, one-by-one, of its component parts. The first step of analysis is to apportion the households of the total population into two sectors. One part is households of productive labor, meaning households of persons who are modally operatives in industry, construction, agriculture and such tangible infrastructure as transportation. The other portion of households is "non-productive."

From the productive sector of the population we define a total productive labor-force. The total output of this productive labor-force is analyzed in categories roughly corresponding to Marx's. These are C for cost of reproduction of used-up material preconditions of production, V for the cost of all the households representing productive labor, and S for the portion of tangible-product output remaining after deducting C and V.

The fact that the second group of households fall under "non-productive" does not mean axiomatically that they are not usefully engaged. It signifies merely that their relationship to the productive process *does not involve any direct physical changes in nature*. This category of "non-productive" includes socially-indispensable services such as education, administration, science and engineering, medical and hygienic services, and so forth. It includes Keynesian economists and other parasites, of course.

The portion of the total product consumed by the non-productive households and by activities related to non-productive functions is designated by the symbol D.

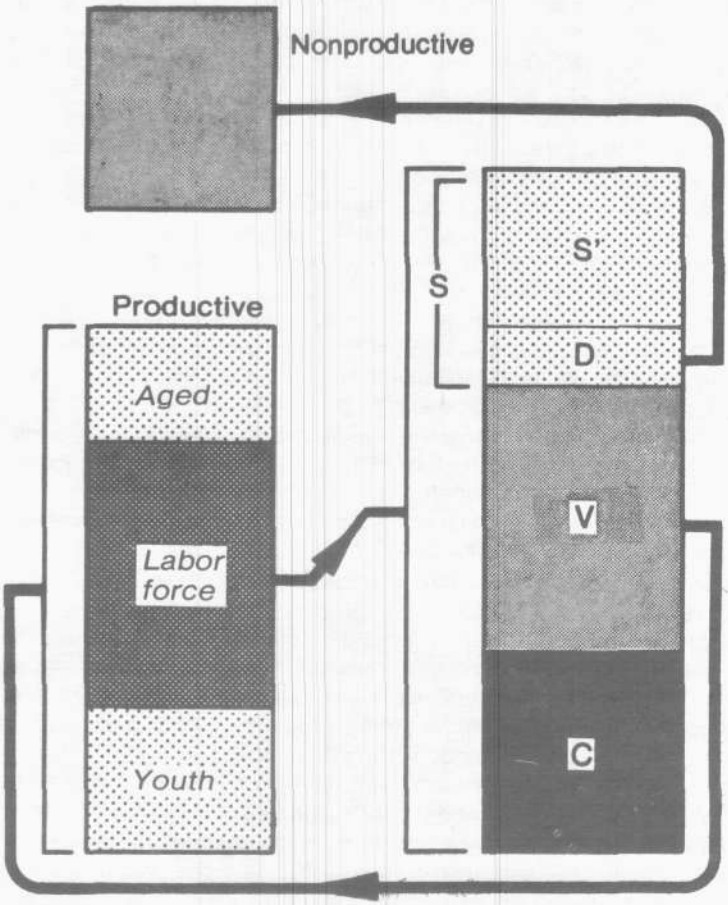
D is paid for from the surplus product (S). This gives us the net of (S—D) as net surplus product, which we identify otherwise by the symbol S'.

It is the ratio of net surplus product to social cost of product, the social *rate of profit* S'/(C+V), which occupies the central place in a proper study of an economy. It is that production and consumption which either at least maintains or, preferably increases the value of this, while also increasing the scale of production, which we define as the productive relationship.

The social rate of profit, S'/(C+V), does implicitly define the relationship between necessary forms of services and the economy's productive base. That is, the total value of such services must not rise faster than permits a rising value of the social rate of profit S'/(C+V).

As my collaborators, Parpart, Bardwell, Goldman et al. have demonstrated, rearranging available U.S. official statistics to fit the social rate of profit S'/(C+V) prescription produces a suitable portrayal of changes in the post-war U.S. economy, a portrayal which correlates directly with the way in which the inflationary decay of that economy has in fact occurred.

That is to be called wealth which is tangible wealth, and which, in its adopted mode gf consumption, leads to production of new such wealth at an increased rate.



v: **variable capital**, the portion of the total product (output) produced through a given production-consumption cycle representing the cost of reproducing the productive labor force at the same cultural-material level.

c: **constant capital**, the portion of total product representing the cost of replacement of plant, equipment, and raw materials at current level and quality of production.

s: **surplus product**, the portion of total product exceeding the quantity c+v.

d: **nonproductive consumption**, the portion of total product representing the cost of reproducing non-productive labor in the private and public sectors at current level.

3. Correcting the Flaw of Omission in Hamilton et al.

The continuing formal flaw in the quantitative economic practice of the American System's theory has been that it could not go further than the implications of the first-approximation of "productive" just identified.

The American System correctly prescribes that ratios of the form of the social rate of profit S'/(C+V) define the productive relations of an economy. Second, the American System has correctly insisted that it is the continued advancement of productive technologies, toward higher rates of per-capita output, which is the real, deeper criterion of a healthy economy.

Therefore, the required quantitative model of an economy is one in which such technological progress is represented as the driving force of the economy. Using mathematical terms, technological progress is the *invariant* of the economic process; it is not a dependent variable of a system of linear equations, nor is it an exogenous factor to be introduced or omitted by choice.

If we examine this special kind of invariant we must associate with technological progress against the backdrop of modern relativistic physics, the physics specialists should quickly recognize that this is a special kind of invariance, and corresponds to a very specific kind of physical space. There is only one current within physics which deals with such special kinds of physical space. That is the kind of physical space identified by Bernhard Riemann in his 1854 habilitation dissertation.

It is for related reasons that the computer model reported has been named a "Riemannian Economic Model."

Although all of Riemann's principal contributions to physics were in fact derived from the conception presented in the 1854 paper on hypothesis, so far to date the general appreciation of Riemannian physics among specialists has not taken that connection systematically into account. The kind of invariance which Riemann's 1854 paper implies is not an ordinary sort of invariance, but what I have, appropriately, defined as a "transinvariance."

I confess, that from the standpoint of Maxwell-oriented physics, the notion of "trans-invariance" embedded in Riemann's 1854 dissertation is shocking almost to the point of incomprehensibility. Indeed, Maxwell, Rayleigh, Bertrand Russell and other spokesmen for the Cambridge school of mathematics have sometimes been even violent in expressing their fury against Riemann's habilitation dissertation, or otherwise against crucial aspects of the physics Riemann derived directly from that same methodology.

I, too, wrestled with the problem of the dissertation, until a study of George Cantor's development of the notion of transfinites enabled me to comprehend Riemann's conception. That insight came back over a quarter-century ago, in 1952, and it was between six and eight years later before I was able to elaborate this breakthrough into a form fully appropriate for economics. Although these conceptions were embedded in the instruction in economics I gave beginning 1966, it was not until certain among my associates applied this economics heuristically to crucial problems of so-called anomalies in recent years' plasma research that they, too, were as fully convinced as I of the fact that the 1854 dissertation represented a fundamental breakthrough in the understanding of the lawful ordering of our universe. It was because those among my associates otherwise specialists in plasma physics were able to see such a connection, that it became possible to develop a suitable computer model for the kind of economic analysis with which I have been associated during the past two-and-a-half decades.

Therefore, taking such matters into account, one must not be tempted to blame Hamilton, Carey, List and so forth for failing to solve the problem of predictive economic models.

Although the lack of such Riemannian approaches was a defect in the quantitative methodology of the American-System economists, this defect does not place those economists at a disadvantage relative to the reductionist economists of the British school. Rather, without an adequate, Riemannian approach to economic models, the economist of the American-System school is obliged to approximate the economy detectively by using methods which may resemble those of the best variants of the British school.

To restate the same point: the best kinds of economic models employed up to this time, especially those used for computer simulations, employ systems of linear equations. The input-output models associated with the work of Wassily Leontieff are examples of this. Any model fitting such specificiations is of the form otherwise termed an "*equilibrium model.*"

.The moment we assume that an economic process can be simulated by a computerized "equilibrium model," we have, wittingly or not, introduced a monstrous sort of axiomatic assumption to the analysis. Overlooking the deliberate falsifications included in the computer model of the Club of Rome's Meadows and Forrester, Meadows and Forrester would have produced analogous results even had they not included fraud in their construction. *An "equilibrium model" of an economy is axiomatically a neo-Malthusian model.*

If the proponent of one of these sort of models were to object to our observation, arguing that practical forms of mathematical applications demand such assumptions, our reply must be that such varieties of mathematics are axiomatically incompetent to represent an actual economy. Or, to be more exact, any policies derived from such a model must have the worst possible effects on the overall course of economic development.

In real economies, it is true that the relative finiteness of the primary resources associated with any unimproved technology means either that such an economy must tend to exhaust such resources, or, at best, to secure these only at a rising marginal cost. If that Malthusian assumption had been characteristic for the human species' existence, the human species would amount to a population of about one millions world-wide today, and we should, like our remote ancestors, have failed to progress to the technology of the paleolithic scraper. Unless the human species had been characterized by progress in technology, the human species today would live in a condition comparable to that of an intelligent variety of baboon.

It is true that some branches of the human population have, over the past thousands of years, either failed to progress technologically, or, like the fifteenth-century American Indians had degenerated to their found condition from a civilized into a mean, savage condition. However, the increase of the human population over the past three millenia, since Ionian Greece rose out of the preceding Aegean dark age, has been accomplished chiefly by those branches of the human family which have progressed technologically, or as a result of the influence of more-advanced cultures on less-advanced.

By adducing those impulses of technological progress associated with the rise of successful forms of human culture, we are able to construct an approximate time-series, representing successive technological advances in humanity's mode of production and social life. Examining this series, we note that the most obvious parameter of technological progress is an increase in the per-capita density of the number of usable calories of throughput. Advances in agriculture place control of most useful plant-life at society's disposal per-capita. Animal husbandry places more animal — and plant — energy at man's per-capita disposal. Improved tools have similar effects. Development of sources of so-called "artificial energy" increases in relative importance as we come historically into civilized forms of existence.

This secular tendency for increase in the per-capita energy-density of human production means an increase in the "reducing power" of societies. Limited old resources are exploited at a lowered social cost; new kinds of resources are introduced.

When sections of mankind have, at any point, resorted to "energy conservation," societies would have collapsed, biological catastrophes of famine, epidemic and desertification would have plunged such a society back toward savagery. It is to be emphasized that various now-dead societies did choose the Malthusian, "energy-conservation" policy, and did slide into savagery or even oblivion.

At first, what we have considered on this immediate point concerning energy might be misinterpreted to imply that new, external sources of energy are brought into societies, that this is the way in which societies progress. It is a rule that setting fire to factories may help ensured entrepreneurs out of financial embarrassment; this method does not increase the productivity of the enflamed factory.

There is something more profound than mere calories of energy involved in effecting the successful branches of human cultural development. *The source of the new energy is the creative-mental potentialities of the human mind.* In those courses of development of

technologies which we comprehend coherently as progress in scientific knowledge, man increases his knowledgeable, willful mastery of the lawful organization of our universe.

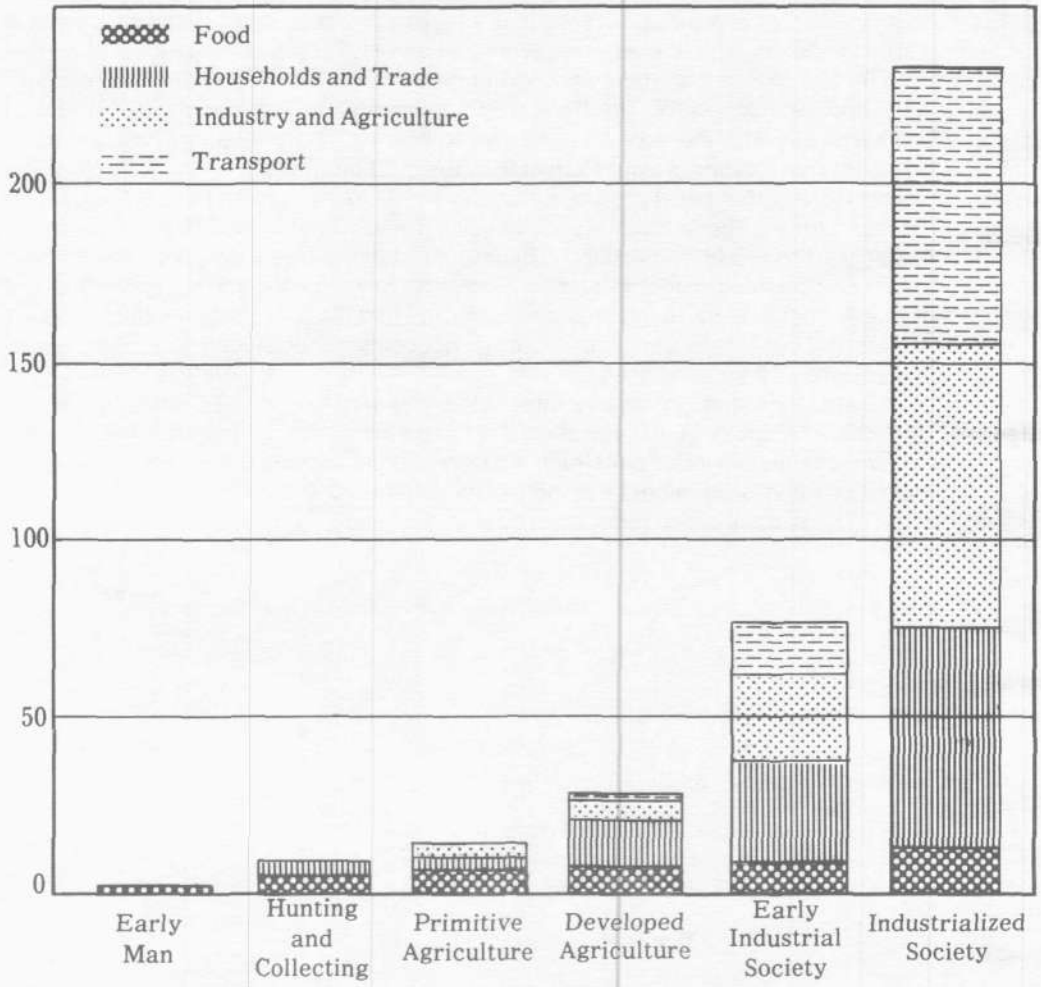
This advancement in knowledgeable practice is not limited to increasing man's power to loot nature. As the case of agriculture illustrates most dramatically, man is empowered to increase the richness of man-altered nature way beyond what might be termed its natural state.

From this standpoint, we ought to be able to identify quickly the problems reflected in British schools of political-economy.

The abstract man represented in the equations of the computer-models of Leontieff and so forth is not a human being. Leontieff's man is a mere beast, with fixed ranges of behavior, like a laboring ox or a talking parrot. The computer models so constructed degrade human economy to an analogue of an ecological equilibrium-model involving grass, rabbits and foxes.

Man is not a beast. He is not grass, a rabbit, or a fox, nor is he permissibly degraded to work in fields or factories like an ox, nor in administrative and academic positions as a mere parrot. The Cambridge-style equilibrium-model degrades man to ox-likeness, proving that in a society in which people think like existentialist oxen, that society will soon collapse in an ecological crisis — and will soon pass into the academic mercies of future paleontologists.

DAILY PER CAPITA CONSUMPTION OF ENERGY (in 1,000 kcal)



Let us turn back now to Hamilton's principle. The only source of wealth of nations is the development of the productive powers of labor. The Cambridge model merely proves Hamilton to be correct, if in an entirely negative way. Mankind can not survive for long, if ever he permits his economy to be managed according to the prescriptions of the Cambridge school of political-economy. That which is properly termed wealth is only that which violates the axiomatic principles of the Cambridge school.

The notion of wealth is not properly limited to the idea of that consumption which facilitates replacement of what is consumed by a society. The notion of wealth is properly restricted to those aspects of consumption which mediate effective technological progress — which effect increases in the value of the social rate of profit $S'/(C+V)$.

It is not the *object* of wealth in itself that constitutes true wealth. Objects represent wealth only to the extent that their consumption *mediates* the advancement of the technological potentials of both man and his means of production.

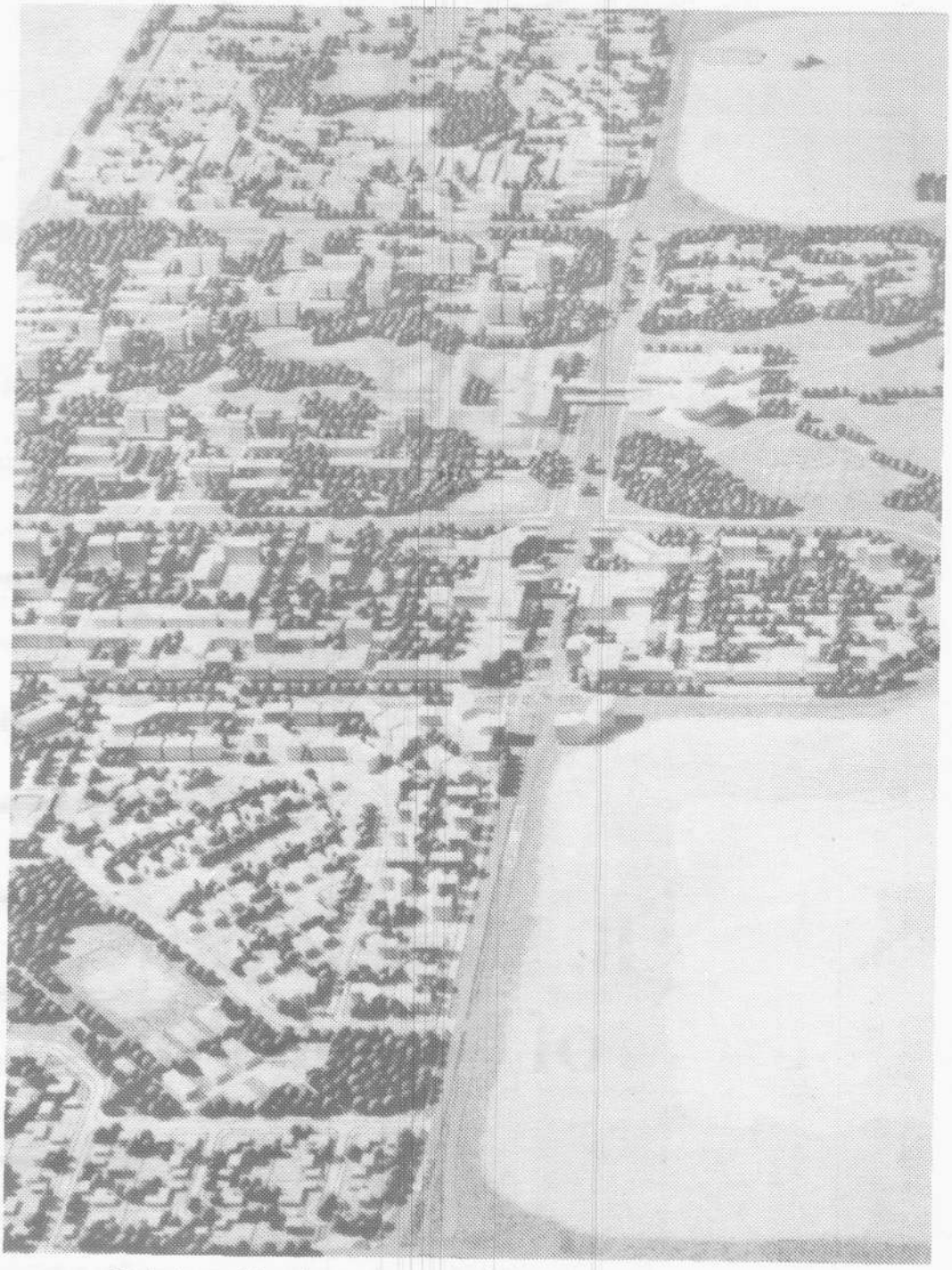
In other words, the *quantum* we must measure if we are to analyze an economy competently is not a scalar magnitude. It is not numbers of objects, prices, hours of labor, or anything of that sort. *The crucial parameter is the quantum of technological progress mediated through the* production and consumption of useful objects. Although the notion of wealth is properly associated with such objects, that association exists only because those objects have some ephemeral but necessary connection to the mediation of a quantum of technological progress.

The Cambridge school proves perversely that we are correct. If man does not progress technologically, societies must die as horribly as the neo-Malthusian implications of British economic theory and British-inspired computer models imply. One may choose to measure anything one chooses in a society. The thing worth measuring in an economy is that unit of action which correlates with the economy's power to survive. The only unit of action which satisfies that latter specification is a quantum of technological progress.

I do not elaborate here the formal-physics issues involved. I refer specialists' attention to the other publications on the Riemannian Model which have been made available for you here today. It is sufficient to report that making a quantum of technological progress the primary determinant of an economic model is identical conceptually with the notion of the kind of relativistic space identified by Riemann's cited 1854 dissertation. No "equilibrium model" could conceivably approximate any actual form of economy but the economy of a society deliberately engaged in destroying itself.

Since my collaborators and I have now presented you with the kind of computer-model needed, I am entitled to propose that you should discard entirely the accounting systems, the economics texts, and the algebraic constructions heretofore generally used by governments, financial institutions and universities. You no longer require such dangerous rubbish. I now place into your hands a body of economic science which works.

II. Development of Labor Power



Part-view of the planned, new capital city of Nigeria located in the interior of the country

"The fundamental law manifested in the activity of the trading cities during the Italien Renaissance was that progress, human development, was necessary for human existence. This was the basis of Humanism. Its immediate aim was to create a higher quality human being ..."

(S.Pepper, Art and Neo-Platonism in the Renaissance, 1977)

Reviving the Tradition of City-building in Africa

Kotto Essomé

According to the usual stereotypes, declared to be "scientific", Africa would never have known the "fascination" of city life had it not been for colonialization.

Condemned to dispersal, to a proto-historic eternity of "tribes" and "savages" scattered by the wind, Africa would (according to these myths) have the exclusive privilege of lacking any historical inspiration after which to fashion its cities. If Aimé Césaire was right in saying that "the shortest path to the future is that which passes through the profound study of past history", then this path forward would be forever denied to an Africa deprived of all retrospection; her emergence from rural life would be at the complete mercy of the lords of international finance.

It is this alibi of pre-colonial rural virginity which has been used to permit the wildest "remodelling" schemes for Africa, about which an astonished Pierre Vennetier remarked: "Some imagine (Africa) as perpetually doomed to an exclusively pastoral life."

Against such clichés, whose ideological coloring makes further analysis superfluous, there

is an urgent necessity to reestablish the truth about the pre-colonial period. The truth is revealed by archaeological excavations, by the reports of eminent historians such as El Bekri in the 11th century, Ibn Khaldun and Ibn Battuta in the 14th century, and Màhmud Kati in the 16th century; all attest to the existence, prior to 1885, of cities at least as large as those of Asia and Europe in the corresponding periods.

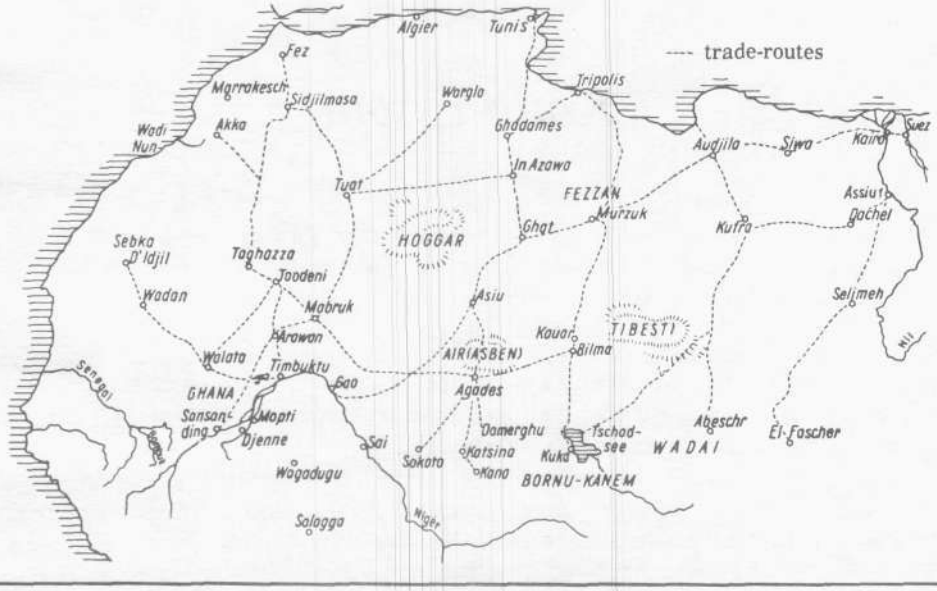
This reality of pre-colonial Africa, so rich in lessons for the future, lays bare two scandals which must be denounced and fought. First, today's Africa presents a disorganized panorama of a "de-continentalized" continent, while yesterday its cities were distributed in a continental system. Second, the present prevalence of anti-urbanism cannot continue to deliberately ignore the high level of urbanism which Africa had attained before its socio-economic structures were ravaged by the slave trade. In sum: stop the process of dispersal, and transcend anti-urbanism!

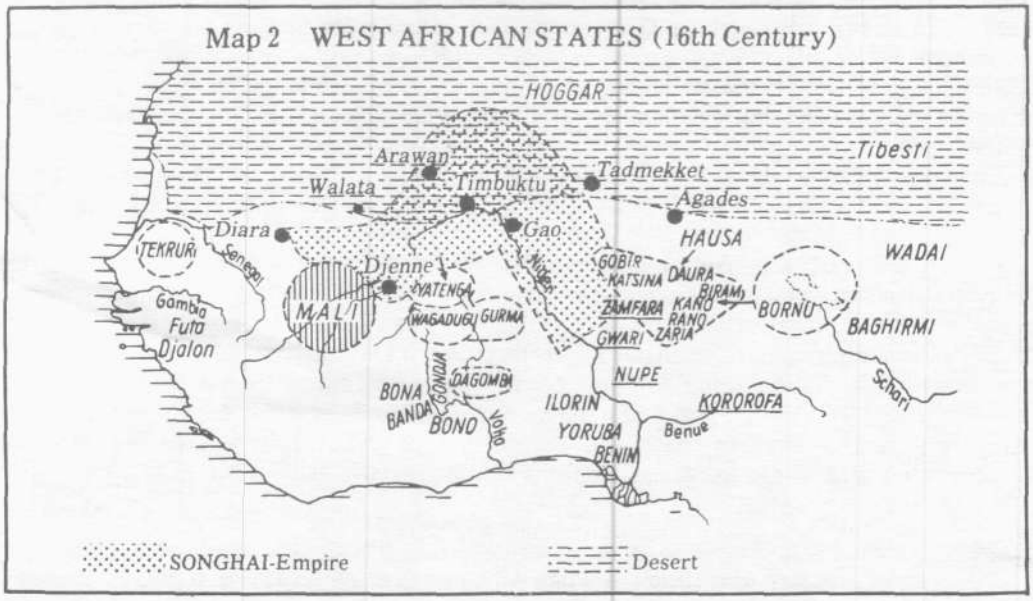
How could Africa defy that law, always confirmed, according to which every natural region not covered by desert develops the socio-economic conditions for the concentration of the population?

Even the Sahara, whose reputedly untraversable expanse nourished the myth of a pre-colonial Africa detached from the rest of the universe, was once the scene of the entire spectrum of human activities. This was so already when the kings of Ghana created caravan routes described by H. Lhote, and up to the time of Sonni Ali the Great, founder of the Songhay Empire, who had canals dug for boats of thirty tons, on the Niger, and built routes connecting this river with the Mediterranean, and through the reign of Kankou Moussa, the most celebrated Emperor of Mali, who intensified commerce by adding Chad routes to the Ghanaian ones, routes leading to Libya and Egypt and connecting the Tekrour to the Tafilatet. The Sahara has known vast population movements along these routes which, in the West, linked Ghana with Morocco, and connected the source of the Niger (Gao) to Tripoli, and passed in the East from Kanem to Fezzan and from Darfour to Lower Egypt.

Indeed, Africa's historical development is quite the opposite of the present period, where

Map 1 TRANS-SAHARIAN TRADE-ROUTES





the continental Soudan is being emptied to the benefit of its urbanized coasts — as shown by the massive exodus of the inhabitants of the middle and lower Senegal valley toward Dakar, Saint-Louis, Conakry,and Abidjan, as well as that of the Mossi of today's Upper Volta toward the coastal cities of Ghana and the Ivory Coast (especially to Abidjan). The entire Sahel-Soudan region was formerly covered with a constellation of cities open toward the Mediterranean, whose commerce defined an integrated infrastructure. Examples? As the excavations led by Raymond Mauny show, Koumbi Saleh, the capital of Ghana, swarmed with shops and markets. Aoudaghost, a city founded by the Sanhadja in the 9th century , controlled, according to El Bekri, the trade between Western Soudan and the Maghreb. The numerous cities which flourished under the Mansa of Mali, and later under the Askia of Songhay, caused population concentrations unequalled today in continental West Africa. According to Mahmud Kati, Timbuktu, Djenné and Walata each reached sizes of 100,000 inhabitants — a fact resulting from their mediating role in very large trade flows. Consider Ki Zerbo's account of the merchandise in the stores of Djenné:

> "(One could find) cereals in large sacks, blocks of "karite butter" carefully wrapped in leaves, peppers, olives, dried fish, jars of honey, indigo bread, baskets of cola nuts, bars of excellent iron produced in the furnaces of Karagema, packs of ivory-tipped ostrich feathers, sticks of virgin gold, tanned leather hides, lead from the d'Hombori mountains, marble bracelets, antimony for eye make-up, varieties of cotton and woollen clothing, Segou loin-cloths, sheets decorated with geometric sketches, dates from Touat, thousands of thick, white bars of salt..."

It so happens that at the end of the 15th century Africa was gradually inserted into the world market, largely through the slave trade. The arrival of the Portuguese, who were armed with the post-medieval knowledge and inventions of the Renaissance, sparked a progressive shift away from the existing continental commercial axis towards a coastal Atlantic one.

This demographic and urban de-continentalization accelerated following the partitioning of Africa in 1885.

It is apparent that the essential cause for this de-continentalization has been the construction of communication lines bypassing the shallow waterways and rapids which made large-scale transportation of continental resources towards the sea difficult.

It is evident that the concentration of small and larger cities along Africa's waterways was oriented towards their natural maritime outlet, which naturally became the privileged outlet of an immense hinterland.

However in contrast to the other great maritime ports of the world, those of Africa were not made to coincide with the continent's waterways! Their unique raison d'etre, as is easily proven in the cases of the interlinked ports of Massaouih and Lorenzo-Marques, and of Mocamedes and St. Louis, was to serve as railway terminals. Even those rare ports used for fluvial transport as is seen in the case of Matadi on the Zaire, Libreville on the Gabon and Douala on the Wouri.

In short these ports have no harbour functions. Yet they were deemed sufficiently appropriate to serve as railway terminals for continental commerce that enormous investments were made in their construction. Abidjan, Casablanca, Pointe Noire, etc., are good examples of this. This is hardly surprising when one knows that the scarcely hidden objective of the lords of the world market has been to open up the continent to the exploitation of its colossal raw material wealth. Minimal infrastructural outlay was made in these regions only to the extent absolutely indispensable to reach and service the zones of exploitation. Thus several disconnected railway lines were built rather than a continental network.

Colonialism's Effect

The external pressure to restructure urban Africa towards the coastline triggered and amplified the depopulation of the continent. This was forced by the conjunction of three economic causes.

First, the substitution of traditional means of payment in continental commerce by money instituted by colonial administrations and its enterprises. Commercial cultivation chosen by the colonial administration became mandatory if the rural population desired means of exchange, leading to the cultivation of tobacco, tea, cotton, cocoa, coffee, bananas, etc. The low revenue earned from monocultures whose values are subject to fluctuations on the international market (which is outside African control) forced emigrations from the villages towards the mining areas. This flow has continued towards the cities where higher wages are a great source of attraction.

Second, conjunctural catastrophes. It is quite common for the alternation of dry and wet seasons to cause a rainfall shortage grave enough to threaten harvests and wipe out livestock. Such was the case only recently in the Sahel and in Ethiopia. The peasant is forced to travel to the closest coastal town. The sudden growth in population of Nouakchott from 40,000 people in 1973 to more than a 100,000 in 1974 was solely due to the absorption of tens of thousands of such victims. This also applies to Abidjan which now contains some 500,000 Mossi, forced off their land after a number of continuous dry seasons.

Lastly, the local demands and needs are not met by production which is solely directed towards exports. This again forces migration towards the larger cities and towns which thus become the receptacles of these refugees from hunger, causing food supply problems in the urban areas. This is in contrast to the pre-colonial period when food supply problems were solved in inner continental migrations, made easier by the lack of defined frontiers. Since 1885, no possible alternative has existed for populations hit by hunger but emigration to the cities, leading to urban over-population which is directly proportional to the abandoning of continental lands. This is clearly shown in the study by Abdoulaye Diop on the displacement of the Toucouleur towards Dakar, as well as by the invasion of Mungo and Douala by the Bamileke whose population density originally had been of 100 to 200 inhabitants per square kilometer.

A series of socio-political causes are added to the weight of an externally-regulated economy. Above and beyond the cited reasons for continental depopulation, forced labor in plantations, in the construction of railways, in monocultures destined for export, required an authoritarian concentration of the peasantry, shifts in habitation and the break up of traditions

from which the peasants would flee, when possible, to escape from the constraints imposed by the "commander-torturers". In the past two decades the underground "liberation struggles" and civil wars in Africa have accelerated continental depopulation. Douala was filled by populations fleeing the insecurity of the Bassa and Bamikele countries just as the Yoruba cities absorbed villagers fleeing the colonizer during the slave-trade wars.

What are the consequences of the decentration of Africa by and towards extra-African centers? The extension of this type of political economy of human transfer from the continent towards the coast follows with further human transfer from the coast to the major countries of the world market, leading to a proliferation of "immigrant workers". One need not look further to find an adequate explanation for the rapid growth of the Sahara which is devouring the Sahel-Soudan border area. Desertification is no longer contained by organized life! Lastly a mortal blow is struck against continental African intellect. As the historian Hubert Deschamps correctly deplores, "the regions of the interior, such as the Nigerian-Soudan, hitherto a center of economic and cultural life, are declining as compared to the coasts".

This de-continentalization was accompanied by the imposition of landscapes external to Africa.

Foreign interests were apparently not satisfied with the ravages of their demographic and economic de-continentalization, and have imposed since 1885 a so-called "urbanization" which completely ignores the natural and social environments of Africa.

The science of urbanization prescribes that all cities be conceived and realized in relation to available space, architechtonic and urbantechtonic volumes and area specificities, ranging from noise and light to considerations of atmospheric pollution as well as social and cultural dialectics. This correct type of planned city building - bringing into relation space and needs - is made impossible by the parasitic economic structures imposed on the African economy from abroad. Economies are oriented towards fulfilling foreign needs at the expense of local socio-economic and cultural needs.

The eminent specialist of urban geography Pierre George has made the point quite clearly that "when a break occurs between society and economy there can be no urbanism . . .: this is the case in Third World cities which for the most part are bloated by increasing numbers of a sub-society which has no economic base. Their access then to a miserable urban habitation is made possible only by a transfer of resources aimed at minimizing the cancer of this non-integrated population."

It is thus hardly astonishing that the present urban areas of Africa reveal nothing about the deep, millenial structures of African society. On the contrary they reflect the rupture of 1885 and the exploitation of Africa under the dictates of a market economy. The division in all African cities between "white quarters" and "black quarters" is still noticeable today. The former regroup a mixed population of European descent, and, since the 1960s, a part of the local "comprador" bourgeoisie dealing with administrative, industrial and commercial affairs. These areas are fully equipped with modern facilities. The "black quarters", exclusively African, have - and will never have - these urban benefits. These areas are at best large villages lacking any urban equipment. It is necessary to add to this that these co-called cities have been built with a total disregard for the natural environment they are placed in. The "best realizations" of this type, using reinforced concrete and corrugated iron imported from Europe, are unsuited to tropical climates; indeed vertical cities built by the multinational prevail in spite of immense virgin spaces.

Precolonial Urbanization

The clever mystification of African history has served this process by disregarding the achievements of African urbanization, achievements which could have been used to avoid the present prevailing anti-urbanism.

This pre-colonial urbanization is of great present interest, and reveals, contrary to all ex-

pectation, four distinct types of urban environments: Soudanian, Guinean, Equatorial-Austral, and Oriental, isomorphic to the four natural sub-Sharan areas of Africa. Their differences reflect also the cultural and historic histories of these regions.

The Soudan area is characterized by an architecture using local materials (in contrast to the present importation of materials) such as the puddled clay and Banco bricks. This is seen in the important urban centers of Koumbi Saleh, Niani, Timbuktu, Gao, Djenne, Walata, Sevou Idjil, Azougui, Aoudaghost, Chinguetti Dyara, Taodeni, Tadmekka, Konkya, Bourassa, Agades, Bilma, Kano, Zaria, Sokoto, Gasfa, El Fasher, El Obeid, Dongola, Meroc, Berber, Atbara, Soba, Sennar, and Singa.

Contrary to what is generally said, this city building in Soudan occurred prior to the spread of Islam. The capital of Ghana, Khoumbi Saleh, a grandiose and ancient city founded in the 3rd century AD and which reached the heights of its development in the 10th and 11th centuries, is most illustrative of the genius of that African civilization which knew how to structure its cities within Africa's environments. Raymond Mauny who led the archaeological excavation of Khoumbi Saleh has the following to say:

> "The city of Khoumbi Saleh was entirely built of stone, a grey schist, found in the area. This material was used for all types of construction, the walls, the paving stones, decorations, the cemetaries ... The center of the city was focused around a large square, into which led numerous streets ... The paving, the floor-tiles, the wall-frescoes decorated with inscriptions, the beautiful niches in the walls and pillars, the stone stairways, speak eloquently of the civilization which flourished here ..."

What is more, the social structure of the city of Khoumbi Saleh from the quarters of the Lord to that of the traders as well as that of the administration personel was integrated, in sharp contrast to the distortion imposed on Africa by the colonial division into "white" and "black" quarters.

It is due to the same urban specificities that the Soudan had many such cities, some of which, according to Mahmud Kati, the historian and counselor to the Askia Mohammed Toure, contained upwards of 100,000 inhabitants at the end of the 16th century. Gao, Djenne, Timbuktu, and Walata are cases in point. Leon the African reports that "there are numerous doctors, judges, and priests appointed by the king in Timbuktu. He (the king) greatly honoured men of letters". Such famous professors as Ali Takaria, Ahmed Ibn Abder Rahim and the illustrious Ahmed Baba (astronomer, legislator, theologian, and author of some fifty books) taught either simultaneously or one after the other in the universities of Soudan, their native land, or those of the Magreb.

The Guinean area contains a constellation of cities: Ife, Oyo, Ibadan, Benin, Kumasi, Abeokuta, Abomey, Quinda, Onitsha, Ijebu, Aro-Chuku, and Ca Labar among others. These cities were centers of the perfection of the use of bronze and developed urban techniques for forest and forest-plain (savanna) areas, techniques which were the most adanced in the 16th century under Eware the Great.

One of the first voyagers to the coasts of Africa, the Sieur de la Croix, marvelled at the "galleries supported by wooden pillars encased in copper" which he found in Benin, the roofs, the porch roofs, the balustrades covered with palm and banana leaves, the domesticated leopards caught in the Guinean forest and chained in the palace of the King. It is with reference to this forest context that the Yoruba architect Onwuka Dike describes those exterior and interior walls "covered by straw roofs or leaves, and which were used as living rooms, the interior court so worked that it served to canalize rain water, and the extensions of the roof which served as a veranda in open air".

It is to be noted that the social hierarchy was faithfully reproduced in the varied architecture, given that the "breadth of the courts and the height of the houses depended on social status", according to Onwuka Dike.

As far as the Equatorial-Austral area is concerned, its unity hinges on the Bantu element. The

Map 3 CITIES IN PRE-COLONIAL AFRICA

area integrates two geographic sub-sectors. The first, Equatorial area, was characterized by an architecture based on vegetal materials found in the forest. Enclosures were built out of pallisades of wooden stakes linked with lianas, with papyrus or palm-tree fibers, which were used to weave matting for the walls, and the dividing walls made of slackened clay and covered with various straws. Here, again, the inner organization of the cities, particularly in Mbanza Kongo, corresponds to the social structure: the relatives and functionaries closest to the King would live closest to his palace.

The second area, Austral Africa, characteristically used for its cities the savannah stones, and bears the mark of Zimbabwe, which in Bantu language means "large stone house". Absolutely monumental ruins have been found from the 4th century AD which defy the imagination. An oval enclosure of over two and a half kilometers is walled in by a dry-stone (non-cemented) wall, seven meters thick and ten meters high. Smaller walled enclosures are to

be found in turn within the first, leading to two conic towers: the elliptical temple. Further south one can find the Acropolis hill on which gigantic fortifications are built, integrating the landscape so that the site as a whole appears titanic. Blocks of stone weighing over one ton were used, and were arranged in varied patterns. Of course under the weight of influence of racism, some people have argued lengthily that the origin of these African constructions is not African but, variously, Phoenician, Persian, Arabic, the miners of King Solomon or even the legionaries of Mark Anthony who supposedly sought refuge on this site following the battle ofActium! We had to wait for the discovery of dolicocephalic skulls in the burial grounds and the confirmation brought by carbon 14 analyses to admit the Bantu, African origin of the Monomotapa constructions, monuments which are no less great that those of the pyramids of Egypt.The same signature can be found in Inyanga, in Dholodo, and in Khami. Again in this case the structures shed light on the social structure of those ancient cities, given the hierarchical construction of the houses, from the Acropolis, reserved for the emperor, on down. The other cities of Austral Africa complete this picture: Mapungubwe, Rimuka, Tete Sumbo, Dambare, and Lealui. In Equatorial Africa one can find also Mindul, Musumbo, Kazembe, Cassange, Bilunda, Bihe, Galange, and Caconda.

Lastly the Oriental area, which has a more composite urbanism, caused by the great multiplicity of human cross-connections and the mingling of the social strata. Pierre Vennetier has described it using the example of Ethiopia: "the urban nature of the agglomeration is attested to by the subfoundations that were unearthed: numerous stairways whose walls bear witness of an elaborate architecture, many-floored constructions, tall obelisks (the tallest of which rose to above 33 meters, and on which one can see the carved image of a multi-level-facade building". This description of Axoum is valid for Matara, Roha, Lalibela, Tana, Condar Ankober, Warra, Illou, Abzollo and Adis Alem.

With this the veil has been lifted from Africa's city building genius. The history of Africa provides a useful contrast to the present so-called urbanization of the continent.

It forces one to repudiate the latter in the name of the social and natural horizons which it is desecrating.

It is only a display of utterly foolish disregard of geographic globality which allows the extravagance of the "white"districts, where colonial governments only settled on the hills, heights, and plateaus, for the better control of the populations, to prevent insurgency. There, the "business" district only consists of a few central avenues made up of a score of massive concrete, 2- to 3-level buildings; the proximity of harbors and railways, allows the setting up of polluting factories in the very middle of the cities; the residential area, with its geometrically-cut streets, its radiocentric design, is a sharp contrast to the indigenous overpopulation, given the very low population density of the former.

It is an insult to rational urbanism to afford the extravagance of those "black districts" whose existence is generated by the "white" districts: the latter's very existence generates a labor market which draws the rural population and provokes, and speeds up, the decontinentalization of Africa. Since the incompatibility between the foreign interests and the necessary urbanization of the local masses imposes "laissez-faire" as a rule, the tumultuous inflow of uprooted villagers generates only heterogenous landscapes.

The mark of improvization, nonetheless, is far from representing merely a defect. It rather exposes the destiny of the center which, being located outside the continent, must suffer an overwhelming inflow of uprooted peripheral social masses. For Africa in fact, the intensification of such a dialectic holds the promise of recovering its real history in Timbuktu, in Zimbabwe, in cities which would be capable of re-projecting Africa upon itself.

"British colonialist domination imposed an artificial backwardness on many nations and their people. It caused both an abnormal stagnation of cultural development and even cultural retrogressions."

(LaRouche, A Theory of Development for African Labor, 1979)

"Tribalism is even more criminal than imperialism."

(Ahmed Sekou Touré, Guinea's head of State, 1979)

Tribalism: an Obstacle to Progress

Muriel Mirak

"Each African people has its own history. This history goes backwards from the Sasa to the Zamani, from a moment of intense experience back to a period beyond which nothing happens. In traditional African thought, there is no concept of history moving 'forward', towards a future climax or towards the end of the world. Since the future is conceived of only in terms of a couple of months, the future can open neither a golden age nor a state of radically different affairs... The notion of messianic hope or of the final destruction of the world has no place in the traditional concept of history. Therefore, African peoples do not believe in 'progress', in the idea that the development of activities and human achievements move from a lower to a higher degree..."

These are not the words of Margaret Mead or Ruth Benedict, nor do they come from a Levi Strauss protege lecturer at Oxford University. They are the words of Reverend John S. Mbiti, professor of Theology and Comparative Religion at Makerere University in Uganda, and they

can help us identify the problem that tribalism poses for development. The problem is not tribalism itself, seen as some "African way of life"; we know there is nothing specificially African in tribalism, but rather that it has been imposed on Africa by the colonial powers that subjugated the continent. The problem is that many Africans, including certain academic layers like Prof. Mbiti, have accepted and internalized this colonialist notion that tribalism, in one way or another, gives them their identity as Africans. It is this self-conception — which has nothing to do with real African history — that constitutes the main obstacle that a successful development policy must overcome.

To understand how a tribalist self-conception tends to block development, we must take into consideration the kind of personal identity necessary to industrial development and from that standpoint identify the problem specific to tribalism; then, the means for a solution can be elaborated. A coherent development policy for Africa must take as its focal point the development of a modern African labor force. That is the task of wide-ranging educational programs that must be implemented. But the aim of such education cannot be only the development of certain specific professions and qualifications. Clearly Africa cannot develop without engineers, scientists, doctors, teachers and skilled workers in industry and agriculture; but cadre formation is not in itself sufficient.

The reason for this lies in the fact that the quality of a labor force is not defined solely by its skill level. A skilled construction worker is not an innovating force for social development by virtue of his knowing the trade, but by virtue of the fact that through the progressive advances he makes in the specific domain of construction, he sees himself as an individual whose skill level can and must be constantly increasing. It is not the specific skill that he learns which is important, but rather the fact that he is capable of mastering even higher levels of knowledge. In other words, the quality of a productive worker is characterized by the fact that he recognizes that development, self-perfecting his own powers for development, is the fundamental quality of humanity. Once an individual experiences this type of self-development in his own education and formation, then he knows what it means to be truly human. Furthermore, to the extent that he sees how his labor and activity tend to effect a progressive, general change in the society around him, he comes to grasp the more profound truth about development: that is, that such continuous self-perfection of productive individuals raises the whole society to higher material and cultural levels of existence. His own intellectual progress is the means through which general social progress is made possible.

An individual who has seized this reality of his role in mediating social progress is truly universal; and his faith in society's and his own powers to guarantee that progress is what we properly term "culture." At this point, Prof. Mbiti, whom I cited earlier, along with others like him, would object, saying, "that's not African culture, Africans have no such faith in progres."

Here is the crux of the problem: it is not the "Africans" but the tribalist culture imposed on an underdeveloped Africa which leaves no room for the idea of progress. It actually prevents the individual from developing a sense of himself coherent with progress. Tribalism identifies the individual in an anti-human, bestial manner. Instead of being judged on the basis of his contribution to universal human knowledge, the individual in a tribal society is defined first and foremost as an Akamba or a Dorobo or the member of some other tribe. He believes that his tribal religion, his language and his geographical location are particulars juxtaposed to the interests of all other tribes. It is the tribal identity which motivates and limits his loyalties and personal choices; his identity is fixed along the lines of tribes and clans. He is to die as he was born, carrying up until his death the fixed, immovable "imprint" of what he was. It is this identity, fiercely defended, that has allowed colonial forces to set up one tribe against another and to create totally artificial tribal warfare.

Although the most extremely barbaric forms expressed, for example, in the *rites de passage*, do not exist throughout Africa, the basic reality of tribalist culture is indeed anti-human. Even in the *rites* which are supposed to celebrate the process of maturation in the individual, tribalism insists on the physical, biological nature of man, and in doing so, reduces the highest ex-

pression of universal development — man — to the level of a degraded beast.

Here it is important to raise two points to clarify the underlying reality of this tribal culture. First, contrary to the lies fabricated by the cultural relativist experts, tribalist practice does not represent in any way a "primitive phase" of human development, beginning from some concocted Rousseavian "natural man". In addition to arachaeological and historical records proving the existence of urban, industrial societies prior to the 16th century, there is sufficient internal proof within tribal belief structures to demonstrate this. If one tries to find an epistemology common to the internal functioning of a ritualistic, magical worldview, on the one hand, modern scientific knowledge on the other, one falls into despair: there is none. There is no way one could lead to the other. There is no common epistemology in Europe, Africa or anywhere else capable of showing how magic can lead to science. Human scientific knowledge has developed from a standpoint that is radically opposed to the magical view. It is founded on the proven notion that the human mind can seize universal processes of self-development, precisely because the human mind is creative and self-developing. The magical worldview and the ritualistic practices embodying it denies that universality by posing the existence of causality as a mysterious *unknowable* mechanism lying outside the physical universe. The idea of *cause* itself, in events like birth, growth and death etc., has no lawfulness in tribalism; the causes of human events are considered to lie outside man, like something he can only propitiate through totemic rites or other religious practices. Therefore, there can be no historical or conceptual connection between tribalist ideology and scientific thought.

But — and this is the second point to be emphasized — if tribalism is not a necessary step in cultural evolution, this offers further proof that tribalism is the result of economic regression. In fact, the only reality capable of "explaining" tribalist practice is that of backwardness and stagnation. Magical rites for birth and maturation can be motivated only by a brutally precarious economic and social existence where medical care, nutrition and education are seriously lacking. In the absence of the material conditions necessary for life, the family and the society are literally thrown to the mercy of some unknowable force, since the socio-economic means for ordering existence have been destroyed.

The proof of this can be found outside Africa itself, proof that shows what we are dealing with is not only an African problem. A glance at southern Italy suffices to show the same process of regression. What was once the most advanced region of the world, part of Magna Grecia and later under the Hohenstaufen in the 13th century was considered the "wonder of the world", was thrown into economic decadence after the defeat of the Hohenstaufen humanists. Once the decadence took root, the humanist culture that had flourished was decimated. Dionysian rites and cults reappeared under the form of modern "tarantism"; witchcraft and magic took root and survived to this very day. Cultish practices and idol-worship supplanted Christianity and the population plunged deeper and deeper into barbarism. A large part of southern Italy today is dominated by tribal culture, with rituals and cults that closely resemble those of the most backward regions of Africa today.

We have seen, then, that tribalism is not in any way a "first necessary stage of evolution"; nor is it a characteristically "African" phenomenon. It is nothing but the result of economic devastation. Nonetheless, tribalism exists and any development policy must pose the question: "How can we move from this situation to another? How can a population subjected to tribal culture become a modern industrial labor force?"

An industrialization process based on nuplexes will give the African population confidence in the power of progress. As cities are built, and the living standard is increased, even the most "resistant" layers of the population will tend to shift their loyalties towards the new society. But this is not enough. Africa needs a new culture, a new art, a new literature. It needs an education policy that forms not only engineers, scientists, doctors and professors, but also great artists and poets.

No renewal of socalled "tribal art" or "negritude" can evoke such a renaissance. Whoever proposes any such revival for Africa or, like the World Health Organization, favors tribal medical

practices, is an enemy to African development. Africa must create a humanist culture like the one that *Dante Alighieri* created in Italy 600 years ago. Dante faced problems very similar to those of modern Africa. Italy was divided into thousands of tiny local entities or "tribes;" each one believed firmly in the existence of its own special interests and prejudices, each spoke its own dialect; none of these entities was able to communicate important, universal ideas to any others.

Dante understood that his country would fall into ruin if it were not able to shake off its chauvinist, tribal mentality. Therefore he took on himself the task of creating a national identity for Italy. This is the reason why he wrote the *Divine Comedy*, a poem written in the new Italian language that he had created. But the language is not the only important aspect of the poem in seeding the later Renaissance. Dante used this poem to lead the population to grasp the depth of degeneration in which it had fallen. He described a voyage into *Hell*, where he showed how human beings degraded themselves to the level of mere beasts and, through poetic images explicating the process, he achieved a magnificent polemic against the mentality that accepted such degradation. It was above all his poem that educated the population, that pulled the population out of the bestiality of Hell, raised it to the level of rational thought and thence, ushered it into the *Paradise* of creative intellectual activity.

To throw off the yoke of tribalism, Africa needs new Dantes, poets, artists and musicians capable of using typically African references, characters and situations, to shape works of art that can polemicize ironically against tribal culture. The translation and diffusion of great European and African works will awaken the new creative energies required for the task. And thanks to this new African art, the population will be able to celebrate its triumphant emergence out of the Hell of tribalism and cultural relativism, to enter into the realm of science.

"The nature of all other beings is limited and constrained by us. Thou, constrained by no limit, in accordance with thine own free will, in whose hand we have placed thee, shalt ordain for thyself the limits of thy nature."

(Pico della Mirandola, Oration on the Dignity of Man, 1482)

The Lessons of the Arab Renaissance

Helga Zepp-LaRouche

The US Energy Minister Schlesinger declared in front of a conference of energy advisors about two weeks ago that the present energy crisis cannot be solved by producing more energy but only through a *Malthusian economic scheme*. The British press, particularly those publications controlled by the British conservative Tory Party, emphasizes the need to return to the British colonial methods of the eighteenth and nineteenth centuries. These two statements of commitment to the same policy belong together; it should be obvious that when we speak of the need to abolish cultural relativism and tribalism, that task cannot be postponed.

Cultural relativism has been spread by them and other closely-connected agencies, which include the London Institute for Race Relations; it is not an ideology as such, but just a way to mantain suppressed people under their suppression. *Cultural relativism is a racist concept.* The development of the human species is universal. It is universal as the ability of every human being to act and think creatively, totally independently of the colour of his skin, of race, of sex or of religion. The majority of the people in Africa today are living in misery, and far below the

level of bare existence not because they are unable to learn the use of modern technology or because they don't want modern technology, as many people say today, but because they are the victims of a policy which has been imposed on them by colonialism, which reduced them to an inferior cultural level.

I want to talk about the *Islamic Renaissance* because I think this is the most immediate example for Third World development, in a sense. The idea of a Nuplex city can best be seen in the example of the creation of the Baghdad caliphate under Abbasid, during the 8th century. At the time of the *Abbasid caliphate* a material and cultural level was reached that can be compared only to that of Europe at the end of the 18th century. We should really ask ourselves whether Europe would have managed to get out of the "Dark Ages" without the influence of Islamic science.

Today ten million people live in Iraq, and it is only as a result of the industrialization policy of the present government that the population potential of that country is increasing once again; but during the caliphate of Abbasid, 30 to 35 million people lived in the region where Iraq lies today. Agriculture had been revolutionized through extremely sophisticated irrigation systems, allowing the nutrition of such a large population. The Abbasid circles fought against the oligarchy which had until then imposed a rural system and had had control of trade. That oligarchy's policy can be compared to the present policy of the International Monetary Fund, the World Bank, or the British colonial system, which we have to fight. The Abbasid caliphate, which overthrew that previous system, based its conception on man's creative capacities. In less than two generations a Golden Age was created: a tremendously developed school system was created, libraries were built, research initiated in all fields; the population wanted to learn and increase its creative capacities. That's why the Islamic Renaissance produced such geniuses as Al Kindi, Al Farrabi (who was the founder of the well tempered system which Bach developed), Ibn Sina (Avicenna), and numerous scientists. This just gives you an idea of how many African geniuses, how many brilliant minds can be created in Africa!

The first political act of Abassid when he took power was that he ordered a city to be built. and said, "let us build a city as a city of peace, and let us build a city as a universal contribution to mankind as a whole". His second concern was to gather all the most advanced knowledge of that time, particularly scientific and technological knowledge, and to create the most skilled work force possible, which was then brought together to build the city of Baghdad.

This conception was totally opposite to that for example, of the Egyptian Pharaohs, whose concept of building was that of using slaves to build pyramids — which is the same conception as that of the Brandt Commission, the World Bank and the IMF today. The conception of Abbasid was instead that of planning, already in advance, all the needed scientific and technological input. This made it possible to complete, in less than fifteen years from the start of building, the construction of Baghdad, the most modern city of that time. More than 1 million people lived there, and given the time, the eighth century, that was a tremendous accomplishment.

Abbasid ordered his people to read the translations of the works of Plato, among others. The idea of progress was the governing principle in Baghdad. The school was then established which made Avicenna possible, Avicenna whose main contribution was not primarily specific developments in medicine, geography and optics, but rather the development of a scientific method which is based on the formulation of hypothesis out of reason. Avicenna's notion of the *necessary being* includes the notion of a universe which develops itself in a negentropic way into an ever higher order. This conception of coherence between the physical universe and the human, creative mind, which was later outlined by Cardinal Nicholas of Cusa as the coherence between the microcosmos and the macrocosmos, defines the universal responsibility of the individual for the development of the human race as a whole. If we intend to take on the challenge of the development of Africa, this can only be accomplished on that basis.

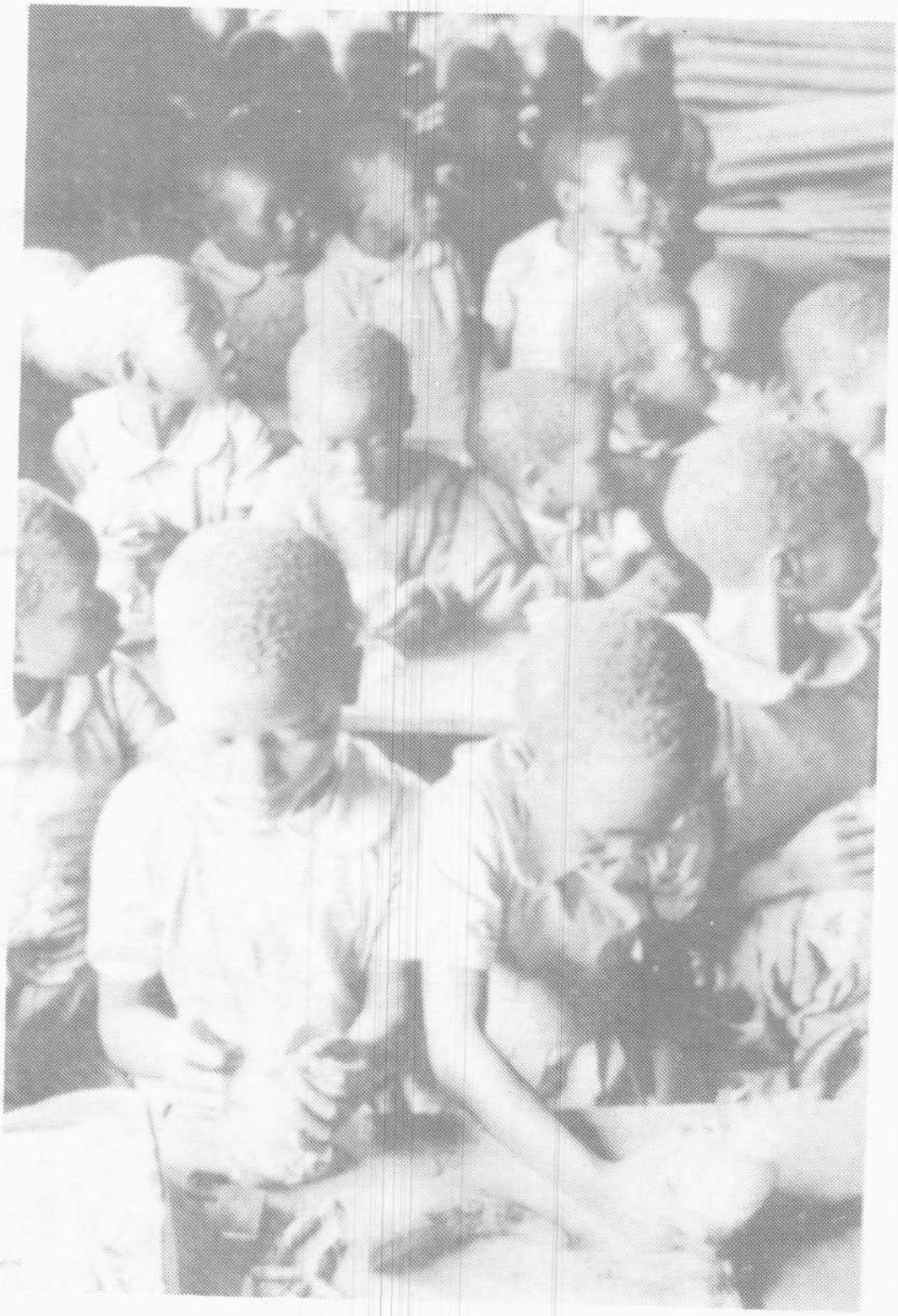
To understand the dangers which have to be faced in the task of industrializing Africa we can

also draw lessons from the Islamic Renaissance, concerning the causes which led to the decay of this Golden Age. The movement against the Abbasid was led at that time by the Islamic fundamentalists Al Ashari and Al Ghazali, who denied man's capability to understand the universe and know its laws, and who, like Khomeini today, replaced the Islamic conception of progress with irrationality, predestination; they destroyed Baghdad and burnt all the books which had been produced during the Abbasids' Caliphate.

Unfortunately it is not only the humanists who are conscious of thousands of years of history; the oligarchs are also conscious. Why does that Institute of Race Relations exist do you think? They tried to learn the lessons of history better, in order to better suppress the people. The International Monetary Fund, World Bank, Brandt Commission, Hans Seidel Stiftung, the Muslim Brotherhood and all those organizations are trying to spread evil in Africa. Islamic fundamentalism has been used to create a new Dark Age, exploiting the fact that the Islamic religion is relatively widely spread. The IMF spreads mysticism and cults in order to destroy the idea of progress in the African people.

What is needed for Africa instead is, on the one side, the extension of cheap credit in the range of hundreds of millions of dollars, for the construction of Nuplexes. But there is something else which is extremely important. You must immediately concentrate on the development of an *African elite*, an elite which from top down can distribute the highest level of knowledge to all sections of the African society, use the highest levels reached in today's knowledge, and create a humanist education system.

The African elite must use the example of the Baghdad city-building. Most of us, no matter whether we are European, African, Asian or American, will be dead when the development program for Africa is fully realized. So the question is how to give to the population the moral strength to identify themselves in the future development of humanity; that is why it is necessary to study the Ionian city building, why it is necessary to study the Baghdad Renaissance. It is because we have to gain the strength out of this to plan the future at least one hundred years ahead. Our acts today are only a mediation of this universal process. This is what I mean when I say that we have to develop an African elite which is characterized by the power of reason. This is the lesson of the Islamic and European Renaissance, this is the lesson of history in general. As long as people do not even have the material conditions necessary for survival, they cannot develop such power of reason. Today for the first time in history we have the technology which allows us to realize the hopes of the humanists of the 18th century to build an Age of Reason. The New World Economic Order is not only a new world economic order, we want to build a new world! Humanity has the chance to become, as humanity, fully adult. This possibility will not be offered to us again, and therefore, let us act now!



"Labor is the source of wealth of all kinds, it follows that the more numerous the industrious and useful class the more a country should gain in riches and comfort. To that end governments must apply themselves above all to internal improvements and seek continually to increase the number of useful individuals."

(Robert Fulton, 1798)

The Demographic Effects of African Development

Emmanuel Tremblay

Viewed as a whole, Africa is a continent of about 30 million square kilometers, with a population of 374 million in 1973, about 425 million in 1978, and an average population density of approximately 14.5 inhabitants per square kilometer. This population, however, is increasing rapidly: the African growth rate of 2.8 % averaged over the period 1970—1973, was in that period only surpassed by Latin America (2.9%) and Middle Asia (2.9%). However, since then, the growth rate of Middle Asia has noticeably decreased, so that Africa together with Latin America are the two continents whose overall population growth is the most rapid. Thus Africa presents itself as a continent at the same time thinly populated and with a rapidly growing population.

Apart from the nuances of individual differences between the African nations, the demographic problem of Africa is therefore that of a thinly populated region with a rapid demographic progression; in other words, with a very large demographically determined investment required to raise overall living standards.

The big question is: *Can the financing potential of a relatively small adult population provide the investments necessary to employ the youth?* In other words, is the capacity of the adult population to finance investment in economic development sufficient both to provide employment for a very numerous younger population, and to ensure the economic development which alone can raise the standard of living.

On other occasions we have analyzed the occurrence of a Malthusian phenomenon, in its three phases: from birth to the age of 20 years, from 20 to 65, and after. Today we must analyse the reverse phenomenon: the development of a population in rapid growth, with all the consequences which such development implies on the economic and demographic planes.

Two additional remarks are called for:

1) The Malthusian phenomenon is beginning to appear in Egypt and Tunisia, for example, where fertility is beginning to decrease.
2) On the other hand, there are situations in which the birth rate increases even while fertility is constant, or even falling. The essential reason is the following: in Africa, as elsewhere, there is a more or less marked decrease in mortality rates for the ages between birth and maturity, so that the population group which has reached maturity is much larger today than it was 30 years ago. As large new generations arrive at the age of procreation, the birth rate correspondingly rises.

For the purpose of clarity, we will assume a sudden increase in the birth rate of x % (for example 20 %) at time T, the birth rate remaining thereafter constant. From time T, the demographic phenomena evolve in three phases: from 0 to 20 years later, from 20 to 65 years later, and in the following period. These phases are appropriate to the study of any phenomenon depending on changes in birth rates.

In the *first phase*, from T to $T+20$, a generation much larger than preceeding generations arrives at the time of procreation.

(a) Nothing changes except the number of children, *which increases progressively*, attaining an increase of x % (e.g. 20 % in the example chosen). At the end of this phase ($T+20$), the number of adults, the number of aged and the proportion of aged to the adult population, does not change, all things being equal. The population continues to increase rapidly, of course. The population as a whole becomes "younger" — the average age decreases — by the addition of younger elements to the population.

(b) Economically, this has the following effects:

— the productive capacity of the adult population remains unchanged, other things being equal (in particular we are neglecting the effects of technological progress).
— the costs of maintaining the aged population do not change, other things being equal. In fact, there is a tendency for the aged population to increase, due to improvements in medicine and hygiene.
— as the youth group increases, there is an increase in the costs of maintaining this group, as well as an expansion of the markets for consumer goods and a resulting increase in consumption-oriented production. Finally, there is an increase in employment (assuming that the adult population is able to generate the necessary additional jobs) and a decrease in unemployment. Thus the productive part of the population remains fixed while the consumption demand increases (this is only true for the first phase of a population cycle based on a "pure" initial state, not for the case of superimposed cycles, i.e. when the second phase of one cycle coincides with the first phase of the following cycle).

This phenomenon is important, since in a country such as Algeria, a rapid birth increase of 200,000 inhabitants over the space of one year, levelling off thereafter, leads 20 years later to an additional 4,000,000 inhabitants — about half of the present population of Belgium! In fact, there was more than a doubling of the Algerian population between 1960 (9 million) and 1978 (18.5) — a yearly increase of more than 500,000, which however did not come from the youth alone.

The unfavorable phenomena are thus the increase in the costs of maintaining the youth, and

the tendency for decreases in the availability of investments, as economic means are sucked up by the demands of the demographic shifts (e.g. investment into the replacement of the adult population). These negative effects are masked and compensated by the expansion of consumption and employment markets, the increase in production, decrease in unemployment, and the reinjection into the economy of the monetary mass corresponding to expanded consumption and production. This expansion is an essential source for investments into economic development.

The main question is to what extent the satisfaction of needs related to the "demographic investment" detract from productive investments and from current living standards. In fact, the sums corresponding to the increase in production and consumption are fortunately reinjected into the economy and can to a certain extent finance necessary productive investments. In this period everything depends on the increased labor of the adult population.

The *second phase* runs from $T+20$ to $T+65$. During this phase, the *augmented* younger generations enter into the productively active population; their number is increased by x %, and does not increase further in the example chosen with a supposed fixed absolute birth rate. The number of adults increases constantly, and at the end of this period, it will have increased by x %. The number of aged either remains constant, other things being equal, or increases as a result of improvements in medicine and hygiene over the 45 years involved. The proportion of aged to the adult population will thus *decrease*, by an amount no greater than x %.

Economic effects are:

— the young population is large but stable.
— the adult population increases more and more, attaining a level x % larger by the end of this period.
— productive capacity increases in the same proportion, other things being equal (e.g. apart from technological progress).
— the aged population is constant or increases.
— costs connected with the aged population (medical-social costs and pensions) decrease considerably, but by at most x % (if the progress of medicine and health care increases the aged population by x, i.e. by the same percentage as the adult population, then this proportion will remain *constant*).
— the potential for investment (which is what is left from the total produce when the expenses of maintaining current living standards, social-medical costs and pensions have been deducted) *increases, assuming that the adult population is employed.*
— the economic expansion which was due to increases in consumption in the first phase (the adult productive population remaining unchanged) is now caused primarily by the increase in productivity of labor, including the influx of productive investment.
— technological and scientific progress, requiring such investments, can exceed projections.
— pensions can be paid without inflationary tendencies (reduced proportion of money paid out without work in exchange), owing to the reduction in the proportion of aged population to adult population. It should be noted, however, that this decrease has been observed to be less than forseen, and could even disappear in the limiting case.
— the financing by redistribution of pension requirements is largely assured by the large increase in pension-saving adults (x %).
— available financial means increase, assuming as always that the adult population is fully employed.

Therefore, this period sees an expansion of the economy and of rates of investment, linked to technological progress and general economic development, once more under the condition that the increased adult population is fully employed.

Thus, everything depends on the capacity to expand employment — that is, productive investment — which the adult population in the first phase is capable of generating. If it can furnish the youth with productive jobs, as they enter into active life precisely at the beginning

of this second period, everything goes well. As we shall see, that is the very center of the problem.

The *third phase* begins at *T*+65: Now, the increased generations attain old age, and for the first time, the number of aged persons, which had been stable or somewhat increased by improvements in health standards, expands while the young and adult populations remain stable.

The ratio of aged population to adult population begins to *increase* and the costs of maintaining the aged population, born by the adult group, *increase*. The economic expansion accomplished in the first two periods allows these additional costs to be met.

The economic-demographic mass of the countries concerned will have increased by *x*%. There will be an initial decrease in average age, followed again by an increase, as the increased young generations reach middle age.

That was a schematic resumé of what happens in countries where a demographic expansion occurs as a rapid increase of birth rates, followed by a levelling off at the increased rates. These phenomena are not unfavorable, and these countries, instead of being doomed to death and stagnation like certain Western countries, will live and progress — and not least in economic terms. This should not surprise us. Do not forget that the country which has seen the most rapid demographic expansion in the world — the United States of America, whose population was multiplied by a factor of 40 during a single century (5.3 million in 1800 to 215 million in 1978) — has in the same period become the richest country in the world.

However, there are difficulties, linked essentially to the capacity of the adult population to generate the productive employment necessary for the younger generation. To understand the problem better, it is interesting to look at two concrete examples: Algeria and Egypt. One could easily choose others.

Algeria is presently experiencing a demographic explosion. Its population, which was 9 million in 1960, 12 million in 1966, reached *18.5 million* in 1977, and will probably become *35 million* by the year 2000. In 1977, those inhabitants less than 18 years old represented 53 % of the population — in round figures, about 10 million people. Those above 65 years old accounted for only 5—6 %, that is, around one million people.

In other words, the adult population of 18.5 — (10 + 1) million — that is, 7.5 million adults, including some 3,750,000 men — must not only work for the entire population, ensure its own employment, but must also generate the jobs necessary for the youth, which are maturing at the rate of 500,000 per year; with an employment rate of 50 % for the female adults, that means approximately 250,000 new jobs per year. This must be generated by an active male adult population of 3,750,000.

That is the task which France must accomplish over 8 years, in order to emerge from its crisis. But in the case of France, there are 21,000,000 working adults, instead of 3,750,000 who will have the responsibility for 10,000,000 young people. That means that 6 times more effort must be expended in Algeria to create productive employment as compared with France, for every active adult. And we know that France today is failing to solve its unemployment problem. In the decade 1960—1970, *without an economic crisis*, only 100,000 jobs were created.

This problem can evidently only be solved by massive financial support from the outside.

The situation in **Egypt** is similar to that in Algeria. There, 9.5 million, out of a total of 38.2 million inhabitants in 1978, must ensure the creation of 100,000 jobs every year. But Egypt is not the most extreme example, because its rate of population growth is only 2.2 % as compared with an African average of 2.8 % over the period 1970—73, which today has fallen to about 2.7 %.

The Central Point

The key question is thus the capacity of the active adult population of Africa, which is now generating an increase in births, to provide in 20 years from now the employment required by

the new generations which then will enter active life. This active adult population must effect the investments necessary to increase its productivity, maintain its international competitiveness and raise its standard of living; for these countries often exist at a standard below minimum levels.

Obviously, this population will have to work very hard. Investment is the key parameter:

1) in the creation of *new jobs* for the initial adult population, i.e. that which must support the increased demographic investments.
2) in the increase in overall productivity.

Countries like Libya may have the necessary funds in the form of petroleum resources and capital, but most of the African countries do not have the means to solve their problems. Here is where the West, especially, can intervene. And it is here also that the demographic-economic catastrophe of the West takes on a decisive importance, threatening to hinder Africa from solving its problems.

The demographic-economic crisis of the Western countries has two phases:

(1) In the first there is an augmentation in financial means. Here, the West can provide financing, also for Africa. But this phase is transitory, without a future, and gives way to a period of financial collapse. Then the West must conserve its finances to cover its own demographic and economic investments, to correct its demographic crisis and prevent the emergence of an irreversible second phase. Only what means remain *after* solving its own problems are available for investment elsewhere.

(2) The second phase of the crisis would be characterized by *financial collapse*, a collapse which would be definitive and would prevent any future role in African investments. Thus we must do everything to prevent such an eventuality, however inevitable it may seem at present.

It appears thus that the solution of the African problem involves the solution of the demographic-economic crisis in the West today.

That is the key to the problem. Far from sacrificing itself to the Third World, as René Dumont says, it is the crisis of Europe which prevents it from contributing to the solution of the problems of the Third World and Africa particularly. It is not an empty Europe that can provide solutions, transformed into a vast hospice supported by a pitifully small adult population, its resources essentially absorbed by the maintenance of a very large aged population, with little or nothing left over for Africa. On the contrary, only a Europe with powerful financial and human means can contribute significantly to the development of Africa (the USA, even in the best of circumstances, cannot do everything).

The countries of Africa must *spring over* intermediate levels of productivity.

Their needs being so enormous, they must deploy the most powerful and productive technologies, whether in the production of energy, in industry, or in agriculture. We must underline, at this point, the particular importance of the concept of "nuplexes" — that is, the organization of economic development around centers of nuclear energy production. This is again a question of *financing*, and we refer to what we have said above. Secondly, it is a question of *training and education*.

These technologies presuppose a high level of intellectual development. Here is one of the big problems if not the greatest (because the financial problem is vast). For, one cannot transform people with only a primary school education into highly trained engineers by a mere wave of a magic wand. Here, as in the case of financing, the Western countries play a key role, in transfering the mastery of highly advanced and highly productive technologies.

In Summary

Contrary to the theory which proposes that a demographic collapse of the West, by compensating a demographic expansion in the Third World and Africa in particular, would play a

positive role in the solution of Third World and African problems — the thesis of René Dumont, totally without scientific foundation — we arrive at the following three conclusions:

(1) The demographic expansion of Africa will remain considerable, in spite of certain local decreases (e.g. Egypt and Tunisia).
(2) There is a major problem of creation of productive jobs for the young population entering into active life.
(3) Only the Western countries can provide the human and financial means necessary to create those jobs.

And we arrive at the conclusion that the demographic collapse of the Western countries, apart from a limited period of financial surplus, leads to a collapse of those financial and human potentials which could solve the problems of the Third World. Hence, the problem of Africa necessitates the solution of the demographic-economic crisis of the West.

The utilization by the African population and for the African population of the most advanced and most productive technologies not only requires large economic means, but also huge human resources. It is therefore the West which must provide these resources, while the Africans develop the necessary competence to operate these advanced technologies themselves.

That is, schematically, the demographic problem of Africa and its constraints. We have placed emphasis on the assistance which this continent necessarily must receive, assistance which can principally only come from the West, on the condition that the latter solves its own demographic-economic crisis.

The Prevention of Epidemics in Africa

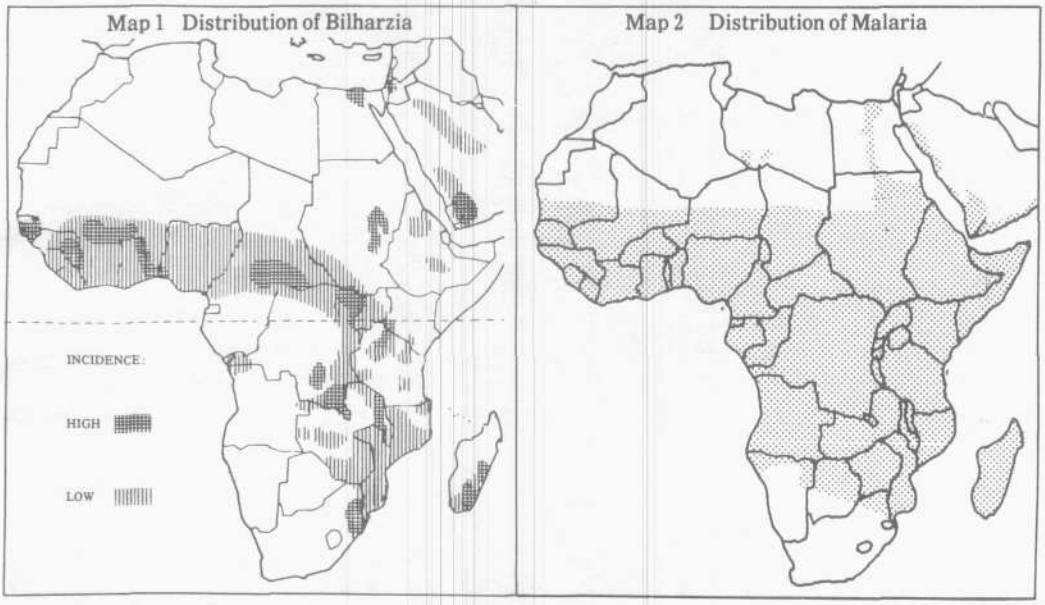
André Dodin

If there is a particular region of the world where the contribution of a few can improve the health of millions of individuals, it is Africa. Disease can be conquered by the organization of public health. Already in the first half of this century, spectacular progress has been realized, with a lavishing of human energy, minor economic means, and most often the support of the population (but sometimes also with coercion, it must be admitted).

The period of hesitation which followed the independence of the African states saw within a few years an extraordinary revival of a great number of epidemic diseases, showing what not to do and calling attention to the problem.

It must be pointed out that any disease, no matter of what origin, is part of a formidable ecosystem which must be attacked at its most sensitive point, without disrupting the equilibrium, established over the millions of years which served to determine African man in his environment.

Most African diseases are due to a total ignorance of the nature of the given affliction on the



part of the population, which often integrates it into their lives and even their physiology.

I will give you as an example the case of *bilharzia*. In Africa there are two types of bilharzia: one urinal and one intestinal. The parasites are very similar, and their cycles in nature are identical: the affected individual eliminates by urine or bowel movement the eggs of the parasite, which hatch in water, find a mollusc to which they attach themselves as parasites, multiply: and after 40-45 days they assume forms infectious to the human beings who come into contact with the contaminated water, and develop in the human body the male and female forms which propagate the next generation of eggs. This is how the species schistosome perpetuates itself at the expense of the human race.

There are two or three medications by which bilharzia can be effectively treated; but think about the fact that there are certainly 250-300 million victims of this parasite all over the world. I would emphasize the problem of ignorance more than the cost of treating all these cases (comparable to that of an interplanetary rocket).

I treated an entire population in a tribe in Madagascar, and had certain difficulties with the ex-President Tiran Siran (who belonged to the same tribe). Due to the parasite, all children urinated blood at least once a month, from the age of 5 to 6 years on upwards. This phenomenon had become so "physiological", that when the treatment had stopped the emission of blood in the urine, I was accused of having sterilized the boys, while the girls' cycle was undisturbed. It was necessary to explain the real situation by radio, cinema and by discussions in the villages, after which I easily obtained the support of the villagers for a more serious struggle against the disease. This battle turned out to be very simple, and consisted entirely in requiring the inhabitants to urinate and defaecate at least ten meters from any source of water. The eggs fell to the ground, where they died; this interrupted the cycle at the level of the mollusc, and within several years, fatalities decreased.

I don't think that death rates are much influenced by the fight against bilharzia; but every child eliminates several hundreds of millilitres of blood, with numerous eggs of the parasite whose formation was at the expense of the host. The synthesis of these eggs takes elements essential for the synthesis of nucleoproteins, which are thus denied to the afflicted child, who often besides this suffers from protein deficiency. This is a real catastrophe, for the intellectual

as much as the physical development of the child. As Paul Valery wrote: "The combined development of the themes of the helix and of the spiral is the sign of the ordering of the world". The nucleoproteins have a helicoidal form, here the poet joins the researcher.

Another obstacle to economic development in Africa is *Paludism*, or *malaria*. This parasite, transmitted by the bite of mosquitos, can also be attacked by the weapon of knowledge, especially of medications and chemical products. The African individual has been selected through centuries by numerous attacks of Paludism, and he is today an individual who frequently lives in equilibrium with the disease. This equilibrium occurred to the detriment of certain genetic characteristics, making him, paradoxically, particularly sensitive to certain chemical compounds, including those used against Paludism. Thus the medication often destroys the equilibrium *to the detriment of the individual*.

Of course, the ridiculous mosquito-net is a minor element, but it is also very effective when combined with a campaign centered on the mosquitos, in larva or adult form. This battle includes the control of swamps, drying out certain water holes, and proper urbanization. Hard as it is to treat Paludism in a dispersed population, it is just as hard to deal with it in a poorly urbanized area, as the density of inhabitants acts as an amplifier of the disease.

There are other diseases proper to Africa whose elimination depends on combatting the mosquitos and other winged carriers (vectors). These include *yellow fever, sleeping sickness, arborivus, filariose* and *leishmaniose*.

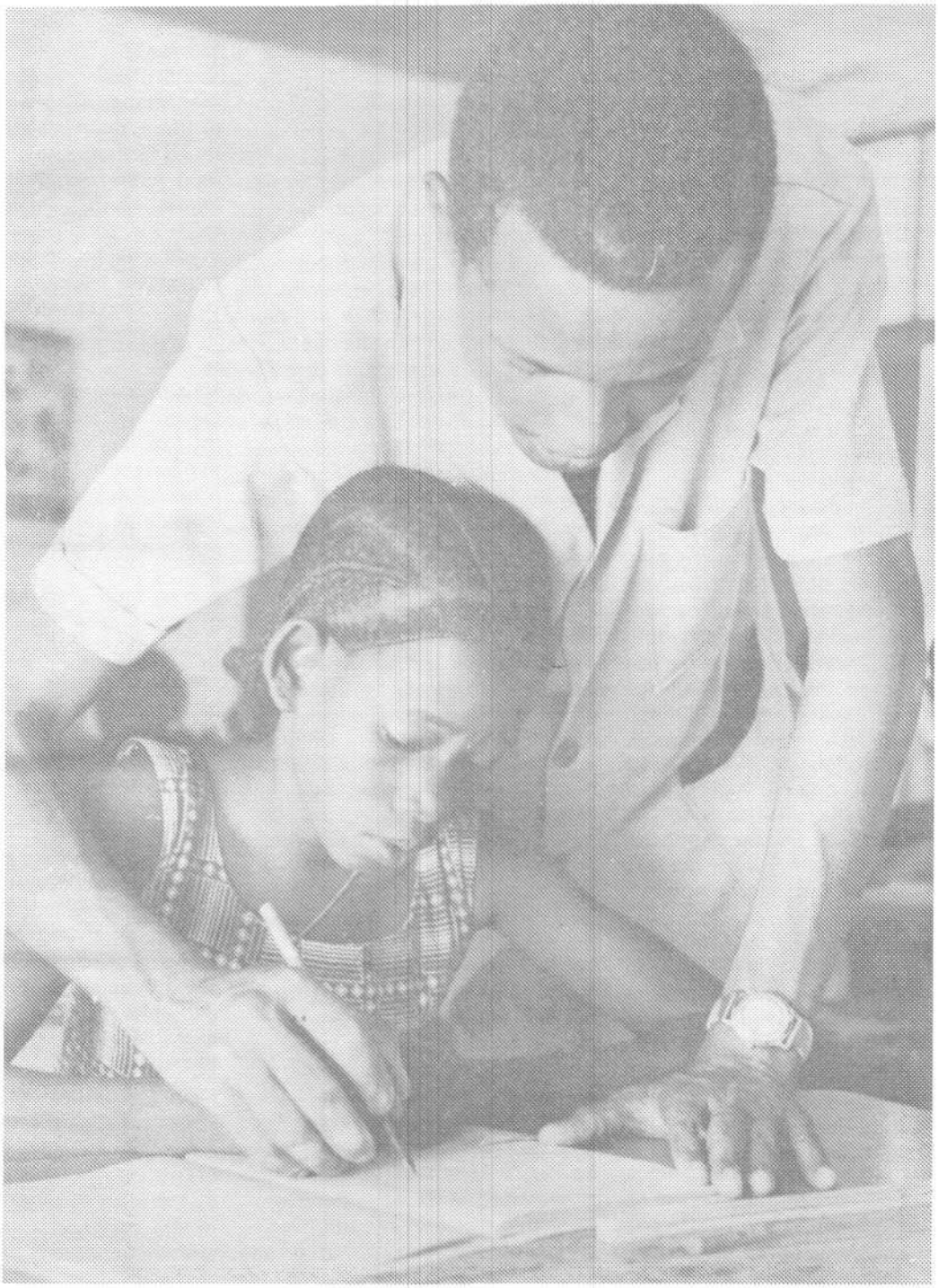
A certain number of diseases have the air as vector, with transmission occurring by air and close contact: *meningococcia, variole, rougeole*. Preventative treatment by vaccination is very effective, but it will not be any easier to reduce rougeole and *rubeole* in Africa than we have been able to accomplish in Europe.

On the other hand, the domain where the help of industrialized nations and of modern technology can effect a spectacular reduction in African mortality rates, is in the prevention of diseases carried by water, among which we include those of dirty hands. These include all the *diarrhetic* and *dysenteric* diseases, from ordinary diarrhea to *typhoid* and *cholera*. The requirements for prevention and eradication are simple, but certainly also expensive.

I would first emphasize the treatment of waste materials, whether human wastes or animal waste, waste from slaughter-houses or industrial wastes.

Sewers, depots for waste material with effective treatment, are absolutely necessary to prevent pollution, since the pollution of water and the environment must be absolutely avoided. This is 50% of the effectiveness of water control. Just the creation of effective latrines improves water sources at a radius of kilometers. In a city with enormous mires and piles of refuse, water purifying stations are always insufficient. Sterilization by chemical treatment is not only imperfect because numerous germs are either resistant or develop resistance; the chemicals also contribute to the pollution. Presently, research is being done on the use of high energy radiation (linear particle accelerators) which, when applied to residual mires, kill absolutely all germs, eggs of parasites and parasites themselves without injuring the environment, and requires only a small expenditure of energy. Such systems, or the classical systems, could make the water drinkable.

There is no doubt that African health policy will concentrate first on the water system, and then on preventative vaccination of the population.



"The nation creates its productive forces out of the mental and physical powers of its individuals."

(Friedrich List, National System of Political Economy, 1841)

The Importance of Social Services for African Health and Population Polh Policy

Jürgen Spahn

Assuming that no major catastrophes, such as transregional wars or epidemics, occur over the next 20 to 25 years, and taking into account that the present growth-rate in Africa remains approximately constant, there will be a population of more than 800 million people on the African continent by the year 2000. (1) If one considers that today a population of half that size is provided with neither adequate amounts and qualities of food nor other consumption goods, it becomes brutally clear what tremendous efforts are required to supply the future population of Africa with an adequate standard of living.

The question of what an adequate standard of living means, is not a matter of personal taste or ideological opinion, but has a strict scientific criterion: the rapid development of the labor power. Low levels of productivity constitute the essential bottle-neck for the developing sector — and therefore every serious economic policy proposal for that sector must place its emphasis on the development of the labor power. In economic terms, labor power subsumes the mental and physical capabilities of a workforce, its skill, its creativity, flexibility, its talent to

improvise and to organize, its moral and discipline. Throughout history it has been the technical realization of scientific inventions which succeeded in increasing the overall productivity of society. The mechanization of agriculture, for example, meant that ever larger agricultural yields could be produced by a smaller and smaller part of the population. In this way a growing number of people could be set free for the construction of industry whose expansion and development provided the goods which in turn increased the productivity in agriculture.

A peasant who lives in a rural area, without social contacts reaching beyond his own local tribe, who manages by the work of his whole family a standard of living near the level of self-subsistence, who feels threatened and dominated by inexplicable natural forces — this peasant necessarily develops corresponding cultural, religious and social ideas. Such a mystical, backward world view is detrimental to economic development and must be changed. Transfer of industrial technology therefore has to go hand in hand with a transfer of industrial culture. This does not mean, however, "that European technological superiority requires Africa to import, kit and caboodle, each jot and tittle of existing habits of thought and daily practice of the industrial nations".(2)

It rather means that Africa must assimilate the Platonic dialogue i.e. the method underlying all those aspects of the culture of the industrialized sector which enabled these countries to rise from rural feudalist entities up to industrialized world powers. Plato's emphasis on the development of creative mental powers brought about the most progressive periods in the history of mankind. The present situation of the African population is characterized by a vicious circle: when the African nations gained independence, they inherited from colonialism both poverty and education levels close to zero. The resulting low productivity of the labor force meant low income and inadequate standards of living. This in turn is the reason for the continued lack of skills and consequent poor productivity. In order to break through this deadlock a comprehensive policy on the following issues is necessary:

A. Health policy measures to reduce infant and child mortality and increase the life expectancies of adults.
B. Establishment of a general school system (including high schools and vocational schools) and a literacy program for the adult population.
C. Raising the level of consumption to the standard of the industrialized nations as a prerequisite for the mental-creative development of the African people.

The African population has today an average life expectancy of not more than 50 years. The crude birth rate of about 45 per 1000 inhabitants vis-á-vis a crude mortality rate of 15-20 per 1000 inhabitants has led to a situation where a little less than 45 % of the population is younger than 15 years (!) The main problem which arises from this development is a growing imbalance in respect to the so-called "generation contract". This means that presently 100 people of working age must supply between 85 and 90 other persons, a dependency which will even worsen over the next decade. (In comparison: the relation for the industrialized sector presently is 100:59 (3)).

One of the priorities of any development program therefore must be to decrease mortality rates and at the same time to increase longevity. This must at least include the following points:

"— promotion of proper nutrition and an adequate supply of safe water,
— basic sanitation
— maternal and child care, including family planning,
— immunization against the major infectious diseases
— education concerning prevailing health problems and the methods of preventing and controlling them
— appropriate treatment for common diseases and injuries." (4)

But it is important to keep in mind that no isolated medical programs can offer satisfactory solutions; because of the vast dimensions of the problems involved, it is indispensable to

embed direct health measures into an integrated development system in which medicine is only one aspect. An increase of the standard of living,accomplishments in communications and infrastructure, a higher education level as well as scientific and technological transfers add as much to overall improvement of the health status of the labor force as for example direct eradication programs against endemic and epidemic diseases. A health program — as we understand it — therefore comprises the following factors:

Health policy: The emphasis must lie on preventive medicine. The problem of adequate and sufficient nutrition has been covered in the presentation of Miss M. Goodwin. A food program plus long-term supervision and care of pregnant women and young mothers will already drastically decrease mortality rates in the newborn and the mothers themselves. In this context, a discussion of family planning is useful. Family planning must not be oriented toward zero population growth programs (as propagandized by institutions like the World Bank, IMF, Brandt-Commission and Club of Rome); for, Africa has no problem with so-called overpopulation, but in reality is heavily under-populated. On the contrary, family planning plays an important role in lowering the mortality of infants and mothers by prolonging the periods between the single births. The mothers have more time to physically recover after a birth, and the chances for the next child to survive increase significantly.

In his speech, Dr. Dodin dealt with eradication programs which must be completed by vaccination programs and veterinary medicine.

One sector of medical care which almost totally is left out of consideration is the department of social medicine. "The complex of health problems originating from the process of industrialization in the developing countries allows the following classification:

1. occupational diseases and accidents at work,
2. medical care, rehabilitation, reintegration, and social security for the ill,
3. individual psychological stress-conditions and their consequences for the adaptation to industrial processes.
4. effects of the horizontal and vertical mobility of the workers and their families." (5)

Environment: In addition to health measures, extensive water projects are necessary to provide sufficient irrigation and solve the sewage problem. The individual house or apartment must be equipped with modern kitchen machines — not only to reduce the work time for the housewife in order to give her free time for her own education; in the tropical and sub-tropical regions of Africa a refrigerator for example is absolutely necessary to minimize food storage and waste problems.

Education: Increasing labor skill levels play an important role in extending longevity, since the proportion of hard manual labor is more and more reduced. Also, the higher the educational level, the better are precautions taken in handling food and health problems. Qualification improvements also influence the birth rates. Well educated people take into account what the prospects for the future are, and decide accordingly about the size of their families; it is a characteristic feature of underdeveloped societies to consider children as a cheap workforce and as social security for the old age of the parent generation.

Pointing to the extent of the problems involved, and particularly to the fact that 20% of the developing countries population receives 80 % of all health program resources, the WHO is demanding a decentralization of the health care and propagandizing "barefoot medicine", appropriate technologies, a "juster" distribution of the small resources presently allotted.

Besides the ideological fallacies involved, it can easily be demonstrated that such an approach is completely impractical. In order to economically develop a medical infrastructure within any region, i.e. with reasonable per-capita-investments, a certain minimal population density is needed. Imagine a region with 100.000 people which is serviced by one hospital, located in the region's center. assuming a population density of 250 inhabitants per km^2, this

region would extend over an area of 400 km^2. The radius of that area would be 11,3 km. Were the population density reduced to 25 people per km^2, the same hospital would be sitting in the middle of a circle with a radius of 35,7 km. The area itself would be ten times larger (4.000 km^2). (6)

As is described in various speeches during this conference, the FEF development proposals emphasize a centralized approach based on high technology. Starting from development poles, integrated subcenters are built up which in turn promote the development of the surrounding countryside. For the year 2000, the FEF proposes 136 agriculture-based Nuplexes (agronuplexes), involving 2 mio. people each ((192 mio.). In the year 2000, therefore, a total of 464 mio. Africans would live and work in highly developed regions, with 351 mio. still to be integrated.

The standard model of an agro-nuplex (which must be modified according to the existing environment and necessities in a given region) includes:

— "metropole" with 250.000 inhabitants,

— 16 subcenters of 50.000 inhabitants each,

— each subcenter would be surrounded by 30 villages of 2.000 inhabitants each.

The standard model of the industrial nuplex includes a central metropole of up to 2 million people with 5 to 6 major cities (600.000 to 800.000 inhabitants each) in the vicinity.

The centers of the regional health system will be located in the metropoles: the university medical schools, research centers, central blood bank, pharmaceutical industry, vaccination institute. In the center of each agronuplex for example, a technical university with faculties of biology, agriculture, engineering, chemistry and veterinary medicine will play a key role.

In constructing these centers (and subordinated cities as well) it is important to avoid the so-often-observed uneven distribution of age and sex´structure. Usually the first phase of the demographical development of a newly built city is characterized by a preponderance of single and married men who have left their families in rural areas. There is a high proportion in the age range 20 - 40, with a considerable risk of immigration back to the country-side. In a second phase, large numbers of wives and children migrate into the cities, and the population pyramid shifts to the female age group of 15 to 25 years. It is only 10 to 20 years later, after a major economic boom, that the population pyramid stabilizes.

As the negative example of black mining workers in South Africa teaches, it is indispensable — from the strict viewpoint of preventive medical measures — to organize the process of city-building in such a way that from the very beginning, the whole family can move into the city. Even if in the first phase, prefabricated barrack towns house the workers, they must be big enough to include the families of these workers, and they must be supplied with clean water, electricity, medical ambulatories (which can be mobile units), schools and social service institutions. The effect will be that seasonal migration of the workers will be limited, and with longer stays in the city it will be much easier to rapidly integrate people from different tribes — this social function of the city is in itself a means of development which cannot be overestimated.

One immediate step to prevent a migration of more people than the central city can bear in terms of employment, is to start simultaneously with the construction of the subcenters. These smaller cities will serve as "transmission belts" between the rapidly developing "metropole" and the still less developed villages.

Anyone who still believes that the enormous tasks, which the African countries are facing, could be fullfilled by various small-scale projects scattered here and there, should look at Figure 1, which compares the demand structure for the year 2000 (*only considering the 464 million people which are supposed to then*

Figure 1 MEDICAL SUPPLY

	1978	2000
Doctors	46,000	900,000
Beds	700,000	4,600,000

Figure 2 NUMBER OF STUDENTS PER 1000 INHABITANTS

	1960	1970
Africa	7	12
Asia	27	48
Latin America	27	57
Europe	73	135
World	55	97

live in the developed regions of the nuplexes; which is not even 60% of the overall projected population) with the presently existing supply.

In terms of education, the present situation in Africa (disregarding certain differences between the different states) is even worse; actually it is generally the worst in the world. When colonialism "ended" in 1960, in most countries not more than 16% of the African children and youth had ever visited a school. 80 to 85% of the population over 15 years were illiterate — a rate which in 1972 had only come down to 73.7% (7). Northern Africa excluded, there was a grand total of 12 university institutions in Africa on the eve of independence. The number of students was trebled from 1960 until 1970, which corresponds to approximately 12 per 1,000 inhabitants. The corresponding figures for the other continents are shown in Figure 2.

Presently the number of universities in Subsahelian Africa is approximately 50. A detailed survey can be seen in Figure 3.

In 1975 more than 80 % of African women were illiterate, and in primary schools, not more than a third of the pupils are girls. According to a 1968 economic report by the United Nations, out of the small number of pupils enrolled, 68 % do not finish, but drop out of school. As the main reason one has to blame the overall poverty of the African population. This is not only because the families cannot afford school books and/or fees; with prevailing primitive agriculture, children are usually needed in the fields. Poor nutrition and hard labor diminish concentration span and energy for learning. In addition, parents who themselves are illiterate often have little motivation in sending their children to school, especially since such an investment does not pay back immediately. They may also reason that the backwardness of their mode of production does not require well trained, high skilled people.

The first conclusion to be drawn is therefore that the education system has to be free of charge. Especially for the low income layers, the lessons, books and materials as well as meals served in school must be free. It is obvious that the costs of building up a general school system are astronomic! Given the very rapid increase in the number of pupils (corresponding to the high population growth rates), a rapidly growing number of teachers will be needed, as figure 4 illustrates:

Figure 4

PROJECTED NUMBER OF TEACHERS (in millions)

	1980	1990	2000
youth (5 - 14 years)	122	162	216
teachers	3	4	5.4

Education is a very skill-intensive sector! It needs a large number of talented people who have to be drawn into teaching, and who otherwise would be in urgent demand in other sectors of the economy. Furthermore, the prolongation of education results in a postponement of the entrance of potential workforce into the work process. Assuming the African states succeed in building up such a general school system by 1985, this means that all of the pupils of that year are already born! Given an average education of 10 years these would only be

available for work in 1995!

There is no doubt about the benefits of a primary school system. For example, according to a Soviet study, general education increases productivity much more than on-job-training: 1 year in school increases productivity 2.6 times more than 1 year on-job training. Despite the huge demand for well-educated people, the African continent cannot wait with massive industrialization until a whole generation has passed through a general education system (the productive output is of course the precondition for financing large parts of the education system). Therefore, the creation of a general education system must be accompanied by task-oriented training.

By literacy programs and specific training programs for specific skills, the qualification level of the already existing work force must be rapidly raised, in order to prepare the labor force for the tasks of industrialization. The requirements of skills will be determined by the nature and direction of investment. By introducing advanced technologies one sets up tasks which in themselves challenge the mental and practical development of the labor force. When daily work hours are reduced, the individual can more easily adapt to new situations and finds time for further education.

To speed up public education, all modern means of teaching, including courses via mass media (radio — but because of the possibility of showing pictures,*especially TV*) will be used. A certain problem will come up in choosing the appropriate language. In the least developed areas — those regions with lowest population density, which electricity, communication and infrastructure are slowest to reach — teaching of young people will occur in the local language. In the nuplex centers and subcenters, however, it will be indispensable to use a national language. National pride and understandable bitterness toward the colonial powers have led many African countries to look for an African language and to reduce the influence of English or French. In spite of this, it must be recognized that the international division of labor will proceed further, spatial distances will lose significance, and therefore the ability to communicate in the present internationally used languages will be a prerequisite for participating in the global process.

What was said with regard to the health system also holds true for the education program. It is a part of the overall development policy, and can only be effectively pushed forward if it is centrally organized. Governments must decide upon the priorities for investments into the productive sector. This determines the quantity and quality of the skills of the present and future work force. How much of the available finances can then actually be transferred into the education system to meet urgent requirements, must be coordinated with the other necessary payments. One central measure will be to create incentives to reverse the brain-drain!

Already the Draft Resolution of the "Group of 77" demanded for the fourth UNCTAD: "Developed countries should refrain from pursuing policies which might encourage the exodus of trained personnel from developing countries,since this is seriously jeopardizing their progress..." and "...in order to compensate for the reverse transfer of technology resulting from the exodus of trained personnel from the developing countries, now amounting to several billion dollars, arrangements should be made to provide, on a cost-free basis, the necessary financial means to create the infrastructure to retain qualified personnel in the developing countries..." (9)

The brain-drain from Africa to Great Britain was well over 10,000 between 1964 and 1972! Such an immense exodus is a two-fold economic loss for the developing sector. First there is the investment into the education and training of these highly qualified people. Calculations for 1972 show that the costs for education of the personnel drawn away by the USA, Canada and Great Britain amount to more than 10 billion dollars! Secondly, the persistent drain destroys the manpower basis for the developing countries' own expanded reproduction of scientific capacity. For 1972 the total real economic loss from brain-drain must be estimated to be at least 20 billion dollars (all developing countries).

Figure 3
UNIVERSITIES AND OTHER INSTITUTIONS OF TERTIARY EDUCATION IN AFRICA

	Universities*	Other tertiary institutions		
		Technical	Spec. subjects	Teacher training
Ethiopia	2 (1)	1	4	3
Angola	1 (–)	–	1	–
Benin	1 (–)	–	–	–
Botswana	1 (–)	–	–	–
Burundi	1 (–)	–	–	1
Ivory Coast	1 (1)	2	4	2
Gabun	1 (1)	–	4	–
Ghana	3 (2)	1	3	–
Guinea	– (–)	3	9	1
Cameroun	1 (1)	–	2	–
Kenya	2 (1)	–	–	–
Congo	1 (–)	–	–	–
Lesotho	1 (–)	–	–	–
Liberia	1 (1)	–	1	–
Madagascar	1 (1)	2	1	–
Malawi	1 (1)	–	–	–
Mali	– (–)	2	3	2
Mauretania	– (–)	–	1	1
Mauritius	1 (–)	1	–	1
Mozambique	1 (–)	–	–	–
Niger	1 (–)	–	–	–
Nigeria	6 (4)	8	–	8
Upper Volta	1 (–)	1	1	–
Reunion	1 (–)	–	2	–
Ruanda	1 (1)	–	–	1
Zambia	1 (1)	3	3	–
Senegal	1 (1)	–	1	–
Sierra Leone	1 (1)	1	–	1
Somalia	1 (1)	–	–	1
Sudan	3 (1)	9	14	4
Swaziland	1 (–)	1	2	1
Tanzania	1 (1)	1	1	1
Togo	1 (1)	–	–	–
Chad	1 (1)	2	3	–
Uganda	1 (1)	1	2	–
Centr. Afr. Empire	1 (1)	–	–	–
Zaire	1 (1)	10	–	11
	45 (26)	49	62	39

* in parentheses, members of the International Association of Universities.

Source: International Association of Universities: World List of Universities, other institutions of Higher Education and Unversity Organizations 1975–1976, 12th edit., Paris 1975.

It is definitely justified when the developing countries demand measures to improve the terms under which science and technology are transferred from the developed countries,and to stem the reverse transfer of technology (i.e. the brain-drain) that mutual exchange programs should be integrated into development aid programs.

To conclude, I want to add some remarks on the significance of a high standard of living for the development of a society. We have stated above that a continuous development of the creative powers of the labor force is the decisive criterion for the speed and quality of the overall development. This demand, however, will only be met by securing the individual a standard of living which contributes sufficient "free energy".

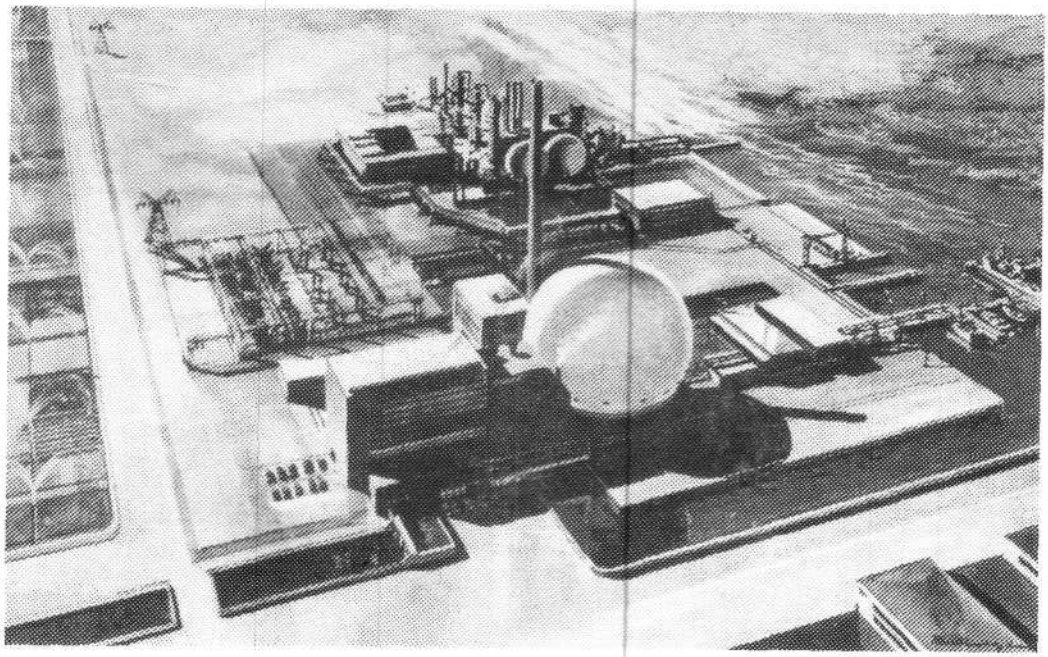
It is unrealistic to expect anybody to develop his mental capacities when he or she lives together with three, four or even more people in a small narrow hut with no room to retire for studying, with hardly any protection against climatic conditions, with no possibility to store fresh meat, milk products and fruits to save them from rotting. How can parents teach their children anything which goes beyond their own environment when there is no infrastructure and transport system, no radio or TV? And how can a person culturally develop without a library, a theatre and music halls? The situation described is not at all a specifically African problem; it is also in the most economically backward regions of the developed sector that the rural population is the least developed. Take for an example Bavaria, the southernmost state of the FRG.

Given the urgent necessity of developing African labor power, and the "human right" to living conditions appropriate to creative human beings, we therefore consider as a "basic need" for each African family a house or apartment with the optimal space of 20 m^2 per person. A bathroom and toilet must be standard, as well as heating and/or air-conditioning according to climatic necessities. Each housing unit must be supplied with electricity. The kitchen must be equipped with modern technology i.e. refrigerator, washing machine, a modern oven. This is not only necessary for the proper preparation and storage of food, it also reduces the women's work-time in the household, which will be an important improvement since the relatively small male workforce of Africa will eventually require the integration of a large part of the female population. On the basis of an average of 6 persons per household, the demand for selected consumer goods in the year 2000 looks as follows (again, only the 464 millions people living in nuplexes are taken into account):

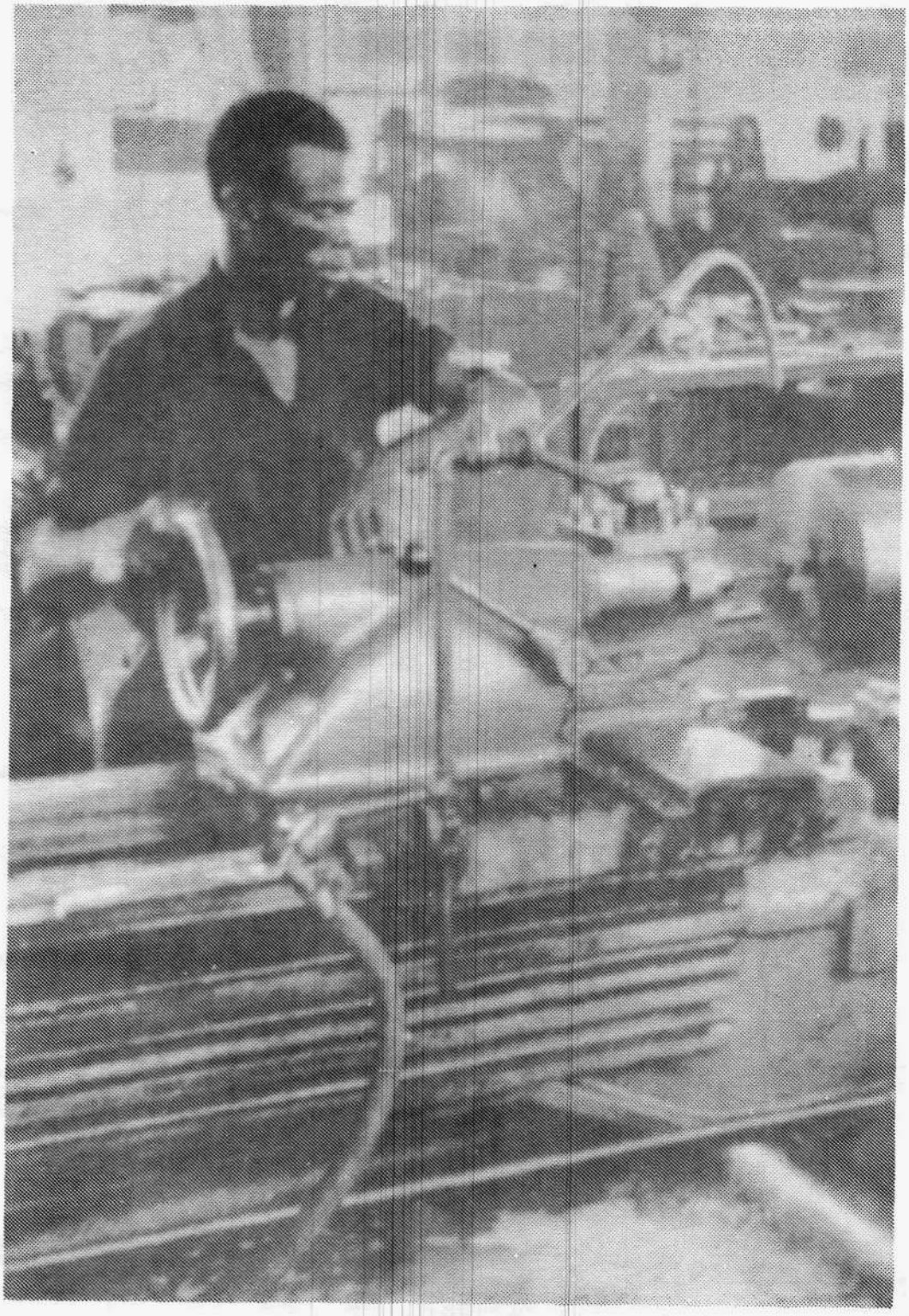
— 65,700,000 radios
— 69,600,000 refrigerators
— 38,700,000 washing machines.

Notes

(1) Population Prospect of the United Nations, medium variant.
(2) Lyndon H. LaRouche, Jr.: "A Theory of Development for African Labor", *FUSION*, June 1979.
(3) H.Schubnell, Report on the 1. African Population Conference, B. Rundschau.
(4) Primary Health Care, Report on the Occasion of an International Conference in Alma Ata, USSR, Sept. 1978.
(5) H. J. Diesfeld, "Gesundheitsprobleme im Industrialisierungsprozeß in Entwicklungsländern", in: Arzt und Patient in der Industriegesellschaft, Suhrkamp 1973.
(6) H. J. Diesfeld, Medicine in Developing Countries 1.
(7) R. Baumann, W. Mehnert, "Zum Problem der Schulpflicht und zur Alphabetisierung in nationalbefreiten Staaten Asiens und Afrikas",in: Asien, Afrika, Lateinamerika Bd.4, 1976.
(8) W. Küper, "Higher Education in Africa in the Service of Development", Education, Vol.18.
(9) Conference of Nairobi Declaration and Programs of Action, UNCTAD, TD/195, 1976.



III. Blueprint for the Industralization of Africa



"We set progress into motion by providing a climate of the benefits of technological progress. We afford the most backward peasant a credible experience of the benefits of progress. The benefits that are important to him will make the kind of thought necessary to comprehend in the new practices a desirable quality of mental activity."

(LaRouche, A Theory of Development for African Labor Power, 1979)

Introduction: A Strategy for the Industrialization of Africa

Hans Bandmann

The aim of our project is not to give a detailed exposition of specific individual projects nor a detailed plan for individual African countries either. We focus, instead, on elaborating concrete concepts about the *necessary dimensions of an industrialization of Africa* and the problems which result from that. Our blueprint intends to concretize what an economic policy approach based on the "industrial system" means for Africa, as opposed to the "neo-Malthusian" approach presently dominating the discussions on "development" strategies for Africa.

The quantification of various economic parameters in this context has an essentially heuristic function. The basic consideration is this: the basis of all economic considerations is the population in its development-dynamic, taken in the time period we have chosen — two decades. As consumers, the population determines the structure and extent of more than 50 % of the gross production, and, therefore, the structure and extent of the entire production process to a great degree. As total labor power, the population determines, in turn, the efficiency of this process of production. Two causal connections, often not taken account of, are

especially important for judging economic development and appropriate rates of growth.

Rapid growth of the population, which will be the case for Africa in the coming decades, is no problem, given a corresponding growth of the productive forces, because this growth will bring about continuously new relationships between the system of reproduction of the population, the economy, on the one hand, and natural resources, i.e., the ecology, on the other hand. The increase of productive forces permits a growth of the material and energy flows appropriate to the growth of the population without causing problems for the ecology or raw material supplies. Only if the development of the productive forces lags behind the growth of population due to stagnation in scientific and technological progress and appropriate industrial investments, i.e., under conditions where the economic forms of interaction remain the same with a merely quantitative expansion of production, do critical developments occur — density stress (1) — such as that we witness in the Sahel zone.

We have discussed the second relevant causal connection, the mutual dependency between labor power and standard of living, in detail in Chapter II.

Taking these considerations as a foundation, we have assumed per capita consumption figures in our Blueprint for various goods which have an indicator-function for respective levels of economic development. The significance of these numbers is not in their absolute value, but rather in the growth of these values. These growth values reflect, in turn, in a simplified form, the essentially more complex growth process of the productive forces, which is to be viewed as primary.

The figures we have calculated make clear that the neo-Malthusian strategy, based on
— employment of labor-intensive "appropriate" technologies,
— decentralized agricultural development schemes,
— a connected de-urbanization strategy,
— a concept of *self-reliance*,
predicated on a far-reaching de-coupling of the African economy from the industrial nations and their highly-productive capital goods, will have catastrophic effects. The per capita consumption figures, representing values, which characterize the transition from an agricultural to an industrial society in the context of a real development strategy, cannot be achieved by such a Malthusian economic strategy. The African population, on the other hand, will reach a critical density threshold which increases the density-stress, making this transition absolutely necessary if the worsening "Malthusian crisis" is to be overcome in the 1980 s. The "Blueprint for the Industrialization of Africa" can serve as a measure for judging the various notions of the political and economic development of Africa.

Conditions for the Industrialization of Africa

In this Blueprint, we have presumed that the necessary economic and political conditions for an industrialization of Africa can be created in the course of the 1980 s by means of a successful policy — a Grand Design — for world-wide industrial development. We do not conceive of these merely as arbitrary assumptions just in order to be able to play through a fictitious scenario for the industrialization of Africa. Instead, we understand that which I am going to present now, in the form of assumptions, as a programmatic conception which must be implemented as fast as possible by industrial and developing nations jointly.

1.) At the beginning of the 1980 s, the introduction of a gold-based monetary system will occur on the basis of the *European Monetary System* and the *European Monetary Fund*. In the course of a number of intersteps, the new arrangement will replace the present monetary system and will establish a new world monetary order in which nations of the COMECON will also participate on the basis of a gold-parity. This will be made possible by the participation of such economically strong nations as Japan, OEPC nations, i.e., also Nigeria and the Northern African countries, Mexico, and others of the so-called threshhold countries. Such an approach provides a stable basis for the successive integration of the economically

weaker developing countries to which the majority of the African countries belong (compare Fig. 1).

2.) The general stabilization of the monetary system through (a) the re-introduction of the gold-standard, (b) the introduction of Hamiltonian banking policy (2) at the international as well as national level, coupled with (c) currency reforms on a national level, including debt moratoria and debt consolidation with low interest credits will lead to rapid economic recovery in the states and regions participating in this arrangement.

3.) The present constraints in North-South and East-West trade will be eliminated. On the basis of the improved monetary situation, a massive expansion of world credit, trilateral trade agreements, etc., completely new patterns of world trade will evolve. The new world-wide division of labor will result in massive structural changes of all economies and, in general, will increase the productivity of the world economy as a whole.

Figure 1

Per Capita GNP Production of African Countries (of 1975)

COUNTRY	Per Capita GNP (in U.S. Dollars)	COUNTRY	Per Capita GNP (in U.S. Dollars)
Nigeria	330	Zambia	340
Egypt	310	Niger	130
Ethiopia	100	Senegal	370
Zaire	220	Ruanda	90
South Africa	1200	Chad	120
Sudan	150	Burundi	100
Morocco	520	Somalia	100
Algeria	680	Benin	140
Tanzania	170	Sierra Leone	200
Kenya	220	Libya	4700
Uganda	250	Togo	270
Ghana	460	Cent.Afr.Emp.	230
Mozambique	400	Liberia	410
Madagascar	190	Congo Rep.	500
Cameroon	330	Mauritania	310
Zimbabwe	510	Lesotho	180
Ivory Coast	500	Namibia	980
Angola	580	Botswana	290
Upper Volta	100	Guinea-Bissau	330
Mali	100	Gabon	1760
Tunisia	760	Swaziland	420
Guinea	130	Gambia	180
Malawi	150	Equat.Guinea	260

These three aspects, points 1 through 3, upon which everything else depends, will be extensively elaborated in Chapter IV. There is, therefore, no need for a more detailed elaboration here. In order to make clear that improved economic conditions for Africa on the basis of a new world economic order in a Grand Design of world-wide industrial development cannot be derived from a simple, linear extrapolation, but will be determined by a qualitatively completely changed situation, it is necessary to take up the other assumptions in somewhat more detail.

4.) The improved economic situation will make it possible to realize an investment-boost, stalled up to now by the world economic crisis. In the course of the 1980 s, this will lead into the beginning of a new industrial revolution. On the basis of an accelerated development of fission reactor systems such as the fast-breeder and the High Temperature Reactor, and an improvement of nuclear fuel-cycle technologies, a sufficient availability of cheap energy on a global scale can be guaranteed despite the rapid depletion of oil and natural gas resources. Besides the general anti-inflationary effects of low energy prices, the availability of especially cheap electric power will lead to the introduction of new industrial production processes, using laser and plasma technologies with extremely high energy densities. The introduction of fully automated magnetic levitation trains on a broad scale from the beginning of the 1990 s onward will revolutionize the transportation system, together with the expansion of technologies already available, such as pipelines for solid-body material transport.

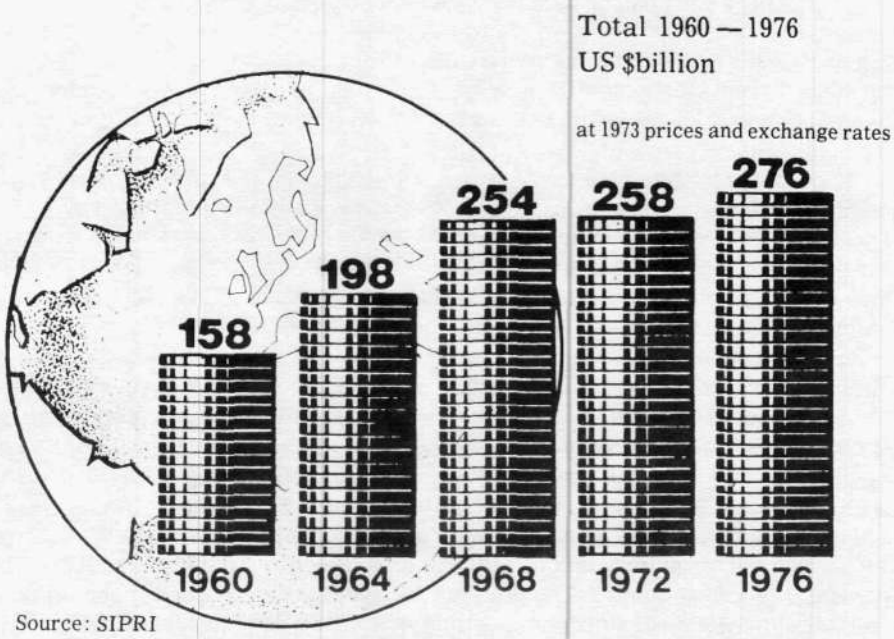
The availability of microprocessors will, at the same time, reduce production costs massively by replacing unskilled human labor. On the basis of such a development, new boundary conditions will be created for basic research work such as fusion research, thereby increasing the chances for early availability of nuclear fusion for energy production and raw material processing.

The possibility of compensating for decreasing concentration of ores by higher energy inputs, with low energy prices, together with improved recycling technologies, will lead to a re-evaluation of raw material deposits, with far-reaching economic implications. Massive expansion of space research will lead to new insights into the location of raw material deposits; into the development of weather and climate, which will help improve agricultural production; and much more. Improvement of old, and development of new technological systems, together with mass-production of capital goods on an assembly-line basis, will totally change economic conditions and parameters. In the context of the above-indicated monetary, credit, and trade policy arrangements, these changes will especially favor the transfer of advanced, high-technology capital goods into the developing sector.

5.) The recovery of the world economy in the first half of the 1980 s and the economic tasks ahead will lead to rapid progress in disarmament efforts, that under present world economic circumstances are considered unrealistic. The liquidity committed to unproductive, and therefore inflationary, armaments expenditures (compare Figure 2) will be increasingly freed for productive investments. Highly modern industrial capacities that are fully utilized for arms production can be converted to production of the most modern capital goods. Since economic growth is a function of productive investments, the massive impetus given the capital goods sectors of industry plays a key role in accelerating world-wide economic growth. In addition to releasing labor power immediately bound up with arms production, that labor power now devoted to research and development will be set free to develop new production technologies, etc. If one considers that over half of all scientists and engineers in the world work in the armaments sector, it is obvious that an immense productive potential can be opened up by such a development. Additionally, there are the labor forces tied into military service world-wide and, on top of the financial burden to public budgets, are prevented from employing their productive potential in an economically effective way. Even the deployment of pioneer troops of various states on infrastructure projects in critical places in the developing sector would be an immense help. (3)

6.) A change of the world political situation in this way, i.e., reduction of East-West and North-

Figure 2 WORLD ARMAMENTS EXPENDITURE



Source: SIPRI

South tensions, will also lead to settling down the political crises shaking the African continent. Present conflicts in Africa are, indeed, caused by the underdevelopment of Africa, and the resulting social, ideological, political and economic tensions. But the crisis-dynamic of these conflicts are determined by the fact that developments in Africa can change global strategic constellations of forces, thus motivating direct and indirect intervention from the outside.

Just as these interventions, resulting from the present world political situation, threaten to escalate into much larger conflicts, the improvement of global political relations will lead to containment of the conflicts and their accelerated solution.

This is of crucial importance, because comprehensive industrial intervention requires not merely political stability, but at the same time an expanding integration of African states into, initially, regional economic communities which, in the end, enable increasing continental economic and political integration, which is the basic prerequisite for large projects that promote the comprehensive development of the continent.

Although none of the conditions mentioned above are realized at this time — to the contrary — it must be emphasized that the preconditions cited here in no way may be dismissed as unrealistic. The cited technological innovations and the mass-production methods for production of capital goods are either already technologically realized or will soon be realized. Whether or not they are employed on a broad basis in the course of the 1980s and 1990s, depends solely on global economic developments. The necessary development, however, is given by the establishment of a new world economic order in the sense specified above. There are no basic objective problems with respect to the cited monetary and credit policy measures. Economic upswing and related changes in world trade structures are the immediate results of these measures. There is, furthermore, a positive immediate connection between economic growth and rates of investment. And, finally, in this and only this monetary and economic policy context, is a rapid world-wide disarmament possible.

It is impossible to realize the measures we have proposed as isolated and individual political

steps, formulated by us in the form of assumptions for our industrialization scenario. The realization of the package of proposals, however, is a quite realistic option for the near future; the proposed monetary and credit policy measures will, when successfully realized, set a self-strengthening economic and political process of development which will establish not merely a new world economic order, but a new world order as such in the course of the first half of the 1980s. Such changes, therefore, do not merely lead to further changes in certain economic parameters, but will create fundamentally new economic relations and structures which cannot be extrapolated from today's determining structures. Now, what does that mean concretely for the development of Africa?

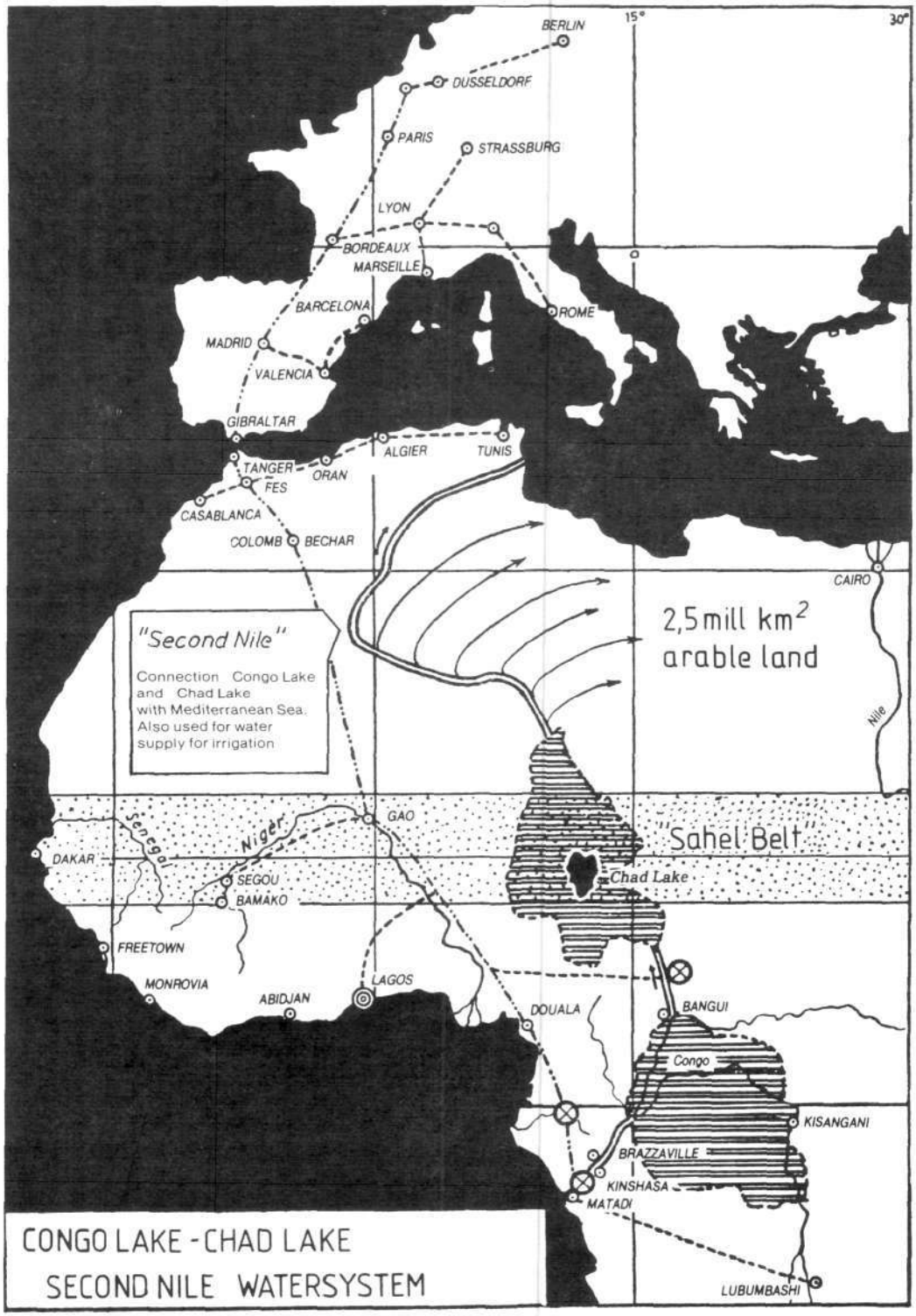
It is as impossible to measure necessary developments in the 1980s and 1990s according to standards appropriate to the 60s and 70s, as it is to make predictions about the development perspectives for Africa by simple extrapolation of the trends of the two preceding decades. For that reason, we begin with the question of how the world economy and the international order ought to look by the turn of this century, and what role Africa can play in this process.

Our intention with this question is to illustrate in quantitative form that the next two decades, which we take as the reference point of our Blueprint, must be viewed as a comprehensive, historical whole. The industrialization of Africa which we propose is not the final goal, but rather the necessary prerequisite to be able to reach the more comprehensive goals resulting from long-term global developments. If one takes this as the reference point, it soon becomes clear that the industrialization of Africa, in the dimensions we propose, is an appropriate response to present, and especially future problems. It is, namely, only by means of massive industrialization that Africa can attain the production capabilities necessary to solve the problems which will result from, among other factors, the growth of the world population in the first decade of the next century to more than 10 billion persons. Such global economic development requires world-wide economic efforts of a totally new quality. Construction, for example, of nuclear energy centers in the terra-watt range, space-colonization projects, and other large projects which have global effects due to their gigantic dimensions, and only realizable under global cooperation, then become world economic and political necessities. The level of development which the productive forces of Africa must attain in the next decades in the context of such a global perspective, the political maturity of African states necessary with respect to international cooperation, can be illustrated in terms of the already-mentioned *Congo Lake/Chad Lake/Second Nile Water System*. A short description of this immense continental project makes the dimensions in which a real economic development of Africa should occur clear.

The Congo Lake/Chad Lake/Second Nile Water System

According to the testimony of geologists, the Congo Basin was once a huge, hundreds of thousands of square kilometers large inland-sea, i.e., larger than today's Black Sea. Over centuries, the Congo eroded its way through the lower-Guinea ledge separating the Congo Basin from the Atlantic Ocean, and shrank to its present size of about 500 km^2, Malebu near Brazzaville/Kinshasa. Construction of a dam in an appropriate place where the Congo flows through the mountains can reverse this process and assure that the Congo Basin is again filled with water. This artificial creation of a Congo Lake, as an individual project, but especially as part of other projects, has manifold advantages for developing a new, continent-wide water system. The loss of land resulting from a new inland sea with a water surface-area of about 1 million square kilometers would be more than made up for.

The area which the water would cover is, with the exception of some towns, hardly settled today. Huge swamp areas and tropical rain-forest, with daily rainfall and tropical climate do not make this area especially suitable for settlement even in the future. Since re-filling the Congo Basin with fresh water would take more than 100 years, there would be plenty of time for the


BERLIN
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VALENCIA
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ALGIER
TUNIS
TANGER
FES
ORAN
CASABLANCA
COLOMB BECHAR
CAIRO
"Second Nile"
Connection Congo Lake and Chad Lake with Mediterranean Sea. Also used for water supply for irrigation
2,5 mill km²
arable land
Nile
Senegal
Niger
GAO
"Sahel Belt"
DAKAR
SEGOU
BAMAKO
Chad Lake
FREETOWN
MONROVIA
ABIDJAN
LAGOS
DOUALA
BANGUI
Congo
KISANGANI
BRAZZAVILLE
KINSHASA
MATADI
LUBUMBASHI
CONGO LAKE - CHAD LAKE
SECOND NILE WATERSYSTEM

population in the area to resettle somewhere else, as well as for mining minerals and removing wood which is there.

The new Congo Lake, connected with river and canal systems in all directions, would become the axis of inner-African transport. The immense hydro-electric potential of the Congo would be doubled, in comparison with its potential under only conventional exploitation. This, in turn, would not only open up a regenerative energy source of gigantic dimensions, but one that would be highly economic, as the hydro-power production would be merely a subordinate aspect of what humanity would gain from this project. Far beyond the transportation and energy aspects, the more comprehensive importance of the project is to be seen in the fact that the immense quantities of fresh water which the Congo dumps into the Atlantic over a relatively short distance could be utilized much more advantageously for the world population by creating a second drain for the Congo Lake in a northerly direction.

There, where the right-hand tributary of the Congo, the Ubangi, near the city Nagi, forms a bend toward the north,the Congo River system,later the Congo Lake, approaches the mountain chain of the northern equatorial ledge which represents a water-shed. With nuclear mines like those successfully tested by the Soviet Union in their own water system projects, a channel can be blown, connecting the Congo Lake with the huge depression at whose center lies Lake Chad. Today, Lake Chad, which is nearly dried out, is one of the shallowest freshwater lakes in the world. The depression surrounding it is itself surrounded by a mountain chain, making the depression into a self-enclosed basin at a height of 400 m above sea-level. By increasing the water in-flow, the water depth of Lake Chad could be increased from its present height of 240 m above sea-level to the full altitude of the natural basin ridge of the depression. The Congo Lake could supply enough water, since even today four times the amount of water in the Rhine River is dumped from the mouth of the Congo into the Atlantic Ocean. So, in combination with the creation of a Congo Lake, a Chad Lake could also be created which would have a coast line of about 6,400 km. The outlet from the Chad Lake could then run over a naturally formed river bed into the Mediterranean, approximately parallel to the Nile. The Sahel zone and the Sahara could be irrigated by additional tributary canals. This would *permit cultivation of about 2 million square kilometers of land, more than five times the size of* Japan, where 100 million people live today.

It is obvious that such a project confronts the participating states with immense scientific, technological, economic and political challenges. Naturally, too, it is only possible to get this continental water-construction project going on the basis of precise hydrological, climatological and ecological investigations. Fundamental progress in these areas of science are necessary to be able to make secure forecasts about the effects of such an intervention into the water-cycle. At the same time, progress must be made in an entire spectrum of technological areas to make such a project economically realizable despite the immense economic expenditures required. This signifies, especially, that Africa's economy itself must be developed to the point that it is able to provide an adequate standard of living for a growing population, and, beyond that, capable of contributing to the expenditure necessary for the realization of such an international project.

The Role of the Nuplex Centers

The nuplex centers form the core of this development strategy.

In order to clarify why the construction of nuplex centers plays such a pivotal role in industrializing the developing sector, it is necessary to lay out more precisely, initially from the technological and economic side, just what constitutes under-development. The following three aspects are especially relevant here:

1) Sectorally, the total economy of most African countries is diversified to a merely very slight degree. The extractive economic sectors still dominate, largely as a heritage from the colonial period, i.e. agriculture, forestry, fishing (to a slight degree), and mining.

Agriculture often soaks up more than 70% of the total labor power of a country.

2) Productivity in most economic sectors is extremely low, and therefore their contribution to the total economic net surplus is also low, primarily due to insufficient education, but especially due to lack of efficient machines. "Human" energy, i.e. labor-intensive small-technology predominates by far over "technological energy". Agricultural production, which by and large hardly reaches the subsistence level, contrasts with a few, somewhat further developed, export-oriented, exceptional cases in production, but these have hardly any effect on the otherwise underdeveloped economy.

3) The low level of development of the productive forces necessarily results in a decentralized economic and settlement structure, which in turn, leads to a further reduction of total economic productivity.

It is obvious that the systematic development of the productive forces of Africa, i.e. to assure Africa's ability to continuously increase its economic expansion-potential, *must lead to a* fundamental change in this situation.

The present controversy over "solar technology instead of nuclear technology" for the developing sector, or, more generally, the "soft, appropriate technologies instead of hard-technologies" argument, must be seen in this total economic context. The implicitly formulated alternative there is simply: we either change this situation by means of concentrated industrialization, or we maintain the present situation, actually worsening the condition of the population under conditions of further population growth. These alternatives, also formulated in the apparent alternative of agricultural or industrial development, are not ideological questions of political or cultural taste. The Fabian accusation that industrialization of the developing sector with the aid of the northern industrial nations is a new form of imperialism is, given the real economic situation in Africa, Asia and Latin America, absolutely absurd.

The unconditional necessity of using nuclear technologies and other hard, energy-intensive large-scale technologies, becomes immediately clear if one comprehends the material process of production which creates the material conditions for the reproduction and further development of a population as a thermodynamic process.

The entire material process of production, from obtaining minerals and fossil-fuels, or agricultural and forestry raw materials, through transformation of raw materials into industrial stock into finished consumer and industrial products, is nothing but an interconnected thermodynamic process through which raw materials are transformed over various chemical and physical stages of production by inputting energy so that they contribute to the reproduction of the population and the expansion of the productive powers of the economy. As a thermodynamic process, production is, therefore, essentially determined by the energy-flow and its density. In one or another form, all production inputs can be understood as energy-inputs. Human labor power in the form of muscle-labor, as "human energy"; materials of production as well as means of production as "indirect energy" stored in chemical or physical form, electricity, process-heat, etc., as "technological energy".

Increasing energy input per working place increases the productive power of the individual operative by factors in the hundred-thousand range, i.e., depending upon capital and energy input per working place, the individual operative is able to do the work of a hundred or even a thousand other operatives. Since the developing countries have immense requirements of various goods, it is nonsensical to see this as a cause of unemployment. The real cause of unemployment is the inadequate availability of capital.

The increasing replacement of "human energy" in the form of simple muscle work by "technological energy" has, however, an even more far-reaching consequence. By freeing people from stupid, monotonous manual labor, free energy becomes available to the population to be able to develop their real human potential, their creative powers. This is the real significance of industrialization. Qualitatively high grade energy available at favorable prices, therefore, plays not only a key role in the economic development of a country, but also

in its spiritual and cultural development. There are clear, unambiguous criteria for judging which energy technologies create the optimal conditions for this to occur.

The economic efficiency of various energy technologies, like any other technology, depends immediately on their density, i.e. the density of energy flow. This becomes immediately clear if

Figure 3 POWER DENSITY

(MW per squaremeter)	
Solar (biomass)	0.0000001
Solar (earth's surface)	0.0002
Solar (earth's orbit)	0.001
Solar (solar orbit of 8 mio km)	1
Fossil	10
Fusion (today's designs)	2—100
Fission	50—2000
Fusion (theoretical)	trillions

one considers the various technologies for transforming energy. Figure 3 shows that the hard energy technologies have the highest productivity density.

Those energy transformation facilities with the highest productivity densities are precisely the ones which pay back the energy invested in their construction the fastest. While this "energy pay-back time" (4) amounts to merely a few months for a nuclear power plant, it is between five and ten years for a solar energy facility, at best. Energy production using a nuclear power plant is thus significantly more economical than using solar energy, windmills and other "alternative" technologies. If we assume that energy needs will massively and rapidly increase in the context of a real development strategy, then it is decisive to assure a long-term economically, i.e. favorably priced energy production. For this reason, use of nuclear energy in the developing sector as rapidly and comprehensively as possible is the most favorable energy strategy.

Just as the economic efficiency of diverse energy transformation and transport technologies is determined by their productivity densities, it is also this density which determines the economic usefulness of technologies which transform materials chemically and physically.

The productivity density of a technology is not the only factor which is decisive for economic production; the size of the production facility must also be taken into account. Modern technologies only develop their total potential if they have a high production capacity. The cost degression caused by a simple increase of the size of production is often extremely remarkable. It is therefore necessary that the developing countries especially utilize this economy of scale in their industrial and agricultural production.

Together with the spatially close positioning of the diverse production processes, another advantage of large production units will increasingly become more important. Large production units create large amounts of the same kinds of waste materials. If this amount is large enough, and if the transport routes are short enough, a critical value is reached which makes it economical to reprocess these materials, directing them into other production processes in which they form the starting materials.

Other considerations also speak in favor of territorial concentration of industrial and agricultural production to the extent that the technological level of development permits this. Modern transportation for commodity and personnel transport, energy and information transport, has the effect of massively increasing the productivity of individual facilities which the infrastructure ties together into a total system. Since it is extremely costly, however, construction of such an infrastructure only pays off if optimal utilization of its full capacity is assured. This holds only for concentrated population centers with a certain population density and density of production sites. Such an infrastructure in a decentralized settlement and economic structure is far too costly to the total economy to be economical.

The prerequisite, therefore, for the development of the productive forces of Africa is the development of centers of economic concentration which function as poles of economic development. Nuclear energy facilities must be constructed to supply the energy required by the industrial and agricultural production concentrated there. The goal of the following two articles is to portray the Nuplex concept as the heart of territorial production complexes which function as catalysts for the entire economic development of Africa.

Notes

(1) The term *Density Stress* comes from biological and behavioral research, and the postulation of an isolated environment for every member of any biological or social system. If the overall area and resources of the system are fixed and growth occurs within those limits, these environments will begin to overlap each other at a certain point of time, diminishing the living conditions of the competing individuals. The phenomenon of *Density Stress* then leads to the destruction of large parts of the population of the system.

This static conception is wrong, and in reality the *Density Stress* is a necessary step in the development of any system or society, and generally leads to totally new forms of social interaction based on new resources, allowing better living conditions for much higher population densities than before. The development of humanity is an example of such qualitative growth.

(2) Hamiltonian credit policies, the policy theorized and implemented by America's first Treasury secretary, *Alexander Hamilton*, consisted and consists in pooling available liquidity in the hands of a central agency, — the "First National Bank of United States" at that time — and relending it long-term at low rates of interests, strictly for such enterprises that will engage in production of tangible wealth, and the services that go with that, so that credit is deliberately channeled towards those activities that foster generation of absolute profit, added, new wealth. Hamiltonian credit policy favored especially investments in high-technology sectors of industry and agriculture while penalizing speculative and other unproductive investments. The development of the US economy in the periods 1791 - 1828, and under the Lincoln administration, are directly attributable to Hamilton, and his disciples, the *Careys*.

(3) "More than $300 billion a year is spent on arms and other military expenditures throughout the world ... $300 billion would build 600,000 schools, with a capacity for 400 million children; or 60 million comfortable homes for 300 million people; or 30,000 hospitals with 18 million beds; or 20,000 factories with jobs for more than 20 million workers; or an irrigation system for 150 million hectares of land — that, with the application of technology, could feed a billion of people. Mankind wastes this much every year on military spending." (Fidel Castro, Keynote Speech to the Sixth Summit of Nonaligned Nations in Havana, Sep. 1979).

(4) Energy pay-back time refers to the time necessary for an energy system to produce an amount of energy equal to that which went into its construction (including building materials such as steel, cement, glass, etc.).

"Under conditions of primitive farming, inertia characterizes the mind of the laborer, and clumsiness the body; rigid attachment to old ideas, traditions, habits and usages is the rule, along with a lack of education, prosperity and freedom. The manufacturing and trading state, by contrast, is characterized by the spirit of striving for a continuous increase in material wealth, and in mental and cultural richness, under conditions of competition and freedom... And under the influence of industrial manufacture, also agriculture elevates itself to the level of becoming a real business, based on the skillful application of science."

(Friedrich List, National System of Political Economy, 1841)

The Role of Agronuplexes in African Development

Marlene Goodwin

The overall development of Africa necessitates a rapid transformation of African agriculture to the most modern, intensive kind. It is impossible to have development and industrialization without simultaneous advances in agricultural production, as traditional forms of agriculture demand and can support only low qualities and quantities of labor power. The low level of productivity of traditional agriculture necessitates that a large proportion of the working population be engaged in agriculture if the society is to feed itself. Modern intensive agriculture requires a much smaller, but more highly qualified labor force, using advanced scientific+industrial inputs, to feed a given population. The labor force freed from agricultural production is demanded by the scientific, industrial, and services sectors of a modern economy in order to produce a highly qualified labor force that is capable of both utilizing presently advanced technologies, and of creating new technologies for the further advancement of mankind. Thus the problem to be solved in this chapter is how to bring about this rapid transition from traditional to modern agricultural production.

The key lies in the use of agro-industrial nuplexes.

Scientists at the Oak Ridge National Laboratories in the U.S. developed the notion of agro-industrial complexes, as briefly outlined in Insert One, and stated that such complexes could play a role in development. The Fusion Energy Foundation (FEF), realizing the potential of such complexes for acting as the seed crystal for bringing about the process of rapid overall development, has elaborated and refined this notion further. The FEF has thus placed a much greater emphasis on the use of nuclear power of all kinds for the energy-dense power source, as the development of fusion power is the only solution for meeting man's increasingly energy-dense energy needs. This is signified by the use of the term "nuplex". The FEF has also more tightly defined and placed greater emphasis on the interrelationships and processes that link and increase a population's labor power potential, standard of living in its widest sense (including its cultural and social aspects), its mode of production, and its knowledge.

In view of the tremendous acceleration and growing intensity of attacks of all kinds from those forces whose interests are opposed to science, technology, and progress, it is of historical importance that policy makers and the population at large are aware of the reality of the situation. This is especially true with regard to the scurrilous propaganda that is put out by leading international institutions supposedly attempting to solve the problems of traditional agriculture and underdevelopment of the Third World countries. To present the necessary scientific understanding that is essential for policy makers to grasp and hold sufficiently firmly to so as to avoid disastrous compromises and pitfalls, the following chapters on nuplexes have been divided so as to define and clarify the essentials of development and development policy. The divisions were made so as to highlight the close interrelationships between critical key areas, and to emphasize that all these must be subsumed within one overall development policy for development to be brought about successfully.

What is Agriculture?

Agricultural production is based upon man's deliberate control of biological processes such as photosynthesis and respiration. For the near future, there is unlikely to be any major shift away from these processes as the cornerstones of agricultural production. Maximum production efficiency is set by optimizing the conditions for photosynthesis and respiration for the various plant and animal species and varieties chosen and developed by man as the suppliers of some of his various needs.

In traditional agriculture, production conditions are predominantly set by the environment (see Figure 1), as the farmers' intervention capacities are relatively low, owing to the low level of technology employed, so that overall productivity levels per man and per hectare are set by factors largely out of his control. With man's present level of science and technology, it is technically possible to create completely artificial controlled environments for optimizing plant and animal production. Its economic feasibility depends upon a cheap, plentiful, dense supply of energy, such as will become available with the commercial development of fusion power. As the work of Slesser indicates, for a given production level, increasing energy density as mediated through the use of higher technology (e.g. irrigation, fertilizers, pesticides, etc.) can be substituted for environmental resources, such as land, rainfall, soil fertility, etc. (see Figure 2). Even with presently used advanced agricultural practices, today's land resources could produce enough food to provide many times the global population of the year 2000 AD with an adequate diet. To accomplish this requires adequate energy, industrial production, and skilled labor power. Today, there is no reason for agriculture itself to be an inhibiting factor in the process of development.

Traditional agriculture uses relatively few, low-quality inputs, places little demand on the quality of the labor force, produces extremely variable harvests according to weather, pests and diseases, with generally low levels of productivity per man and per hectare. Thus a large part of the population must be engaged in agriculture, whose production is mainly for domestic

Insert I
Agro-Industrial Complexes

In 1967, scientists at the Oak Ridge National Laboratory in the U.S. developed the idea of combining industrial complexes, built around an energy-dense power source, with highly rationalized agriculture based on the use of desalted water. They reasoned as follows: energy costs greatly affect the economics of many industrial processes, thus it is of great importance to minimize the cost of energy. Hydroelectric and fossil fuel power plants have to be built with great consideration for their energy sources and transportation opportunities. From non-energy considerations, their locations must not necessarily be the most advantageous ones for industrial complexes and agriculture. Nuclear power, however, is not subject to a fuel cost penalty of this kind, as the volume of fuel to be transported is reduced to a minimum. Thus there is greater freedom to locate industry according to other criteria. It also provides development opportunities for those countries which lack rich reserves of fossil fuels.

An industrial complex, by bringing together many industries, can utilize larger size nuclear plants than would otherwise be the case. This in turn provides cheaper energy for the industries. The close proximity of industries, apart from reducing transport costs, opens up the advantages of using the products and by-products of one plant as raw materials for other plants, allowing greater integration of various production processes, and in some cases eliminating certain processing steps altogether. The sharing of common facilities also provides important economic advantages. The interlacing of industry with agriculture creates similar economic advantages. Nuclear power opens up the possibilities of economic desalinisation of water for use in conjunction with high-value crop production, thereby increasing the area available for agriculture.

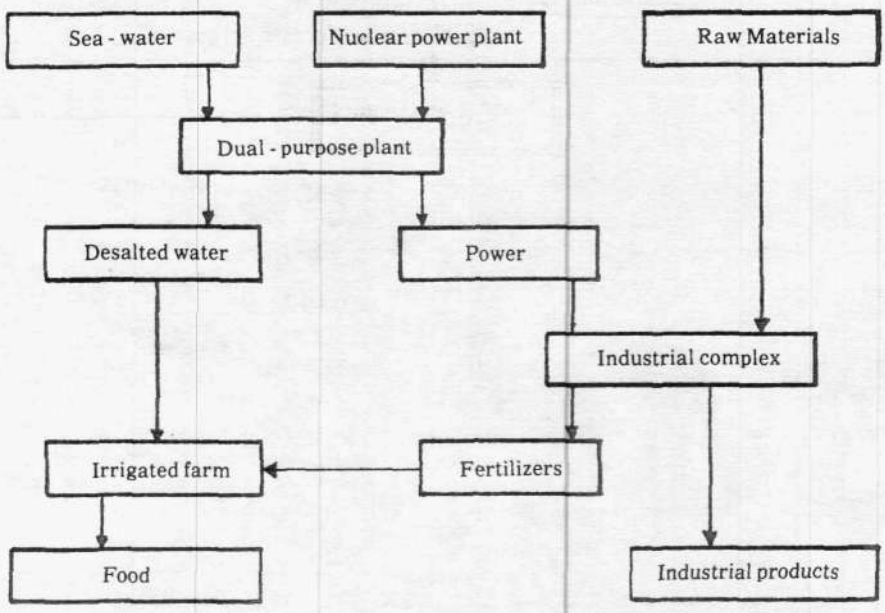


Figure 1a TRADITIONAL AGRICULTURE (plant production)

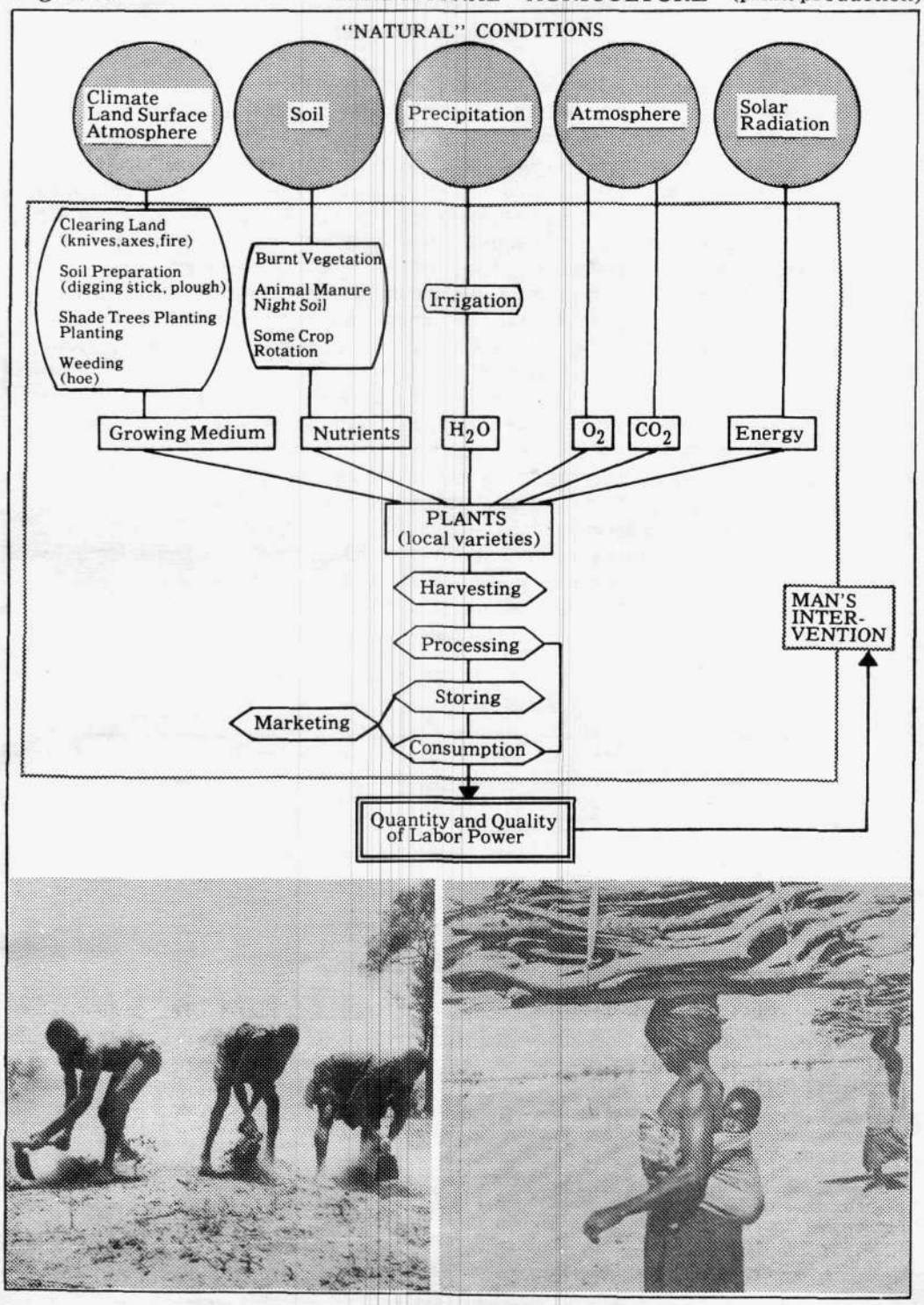
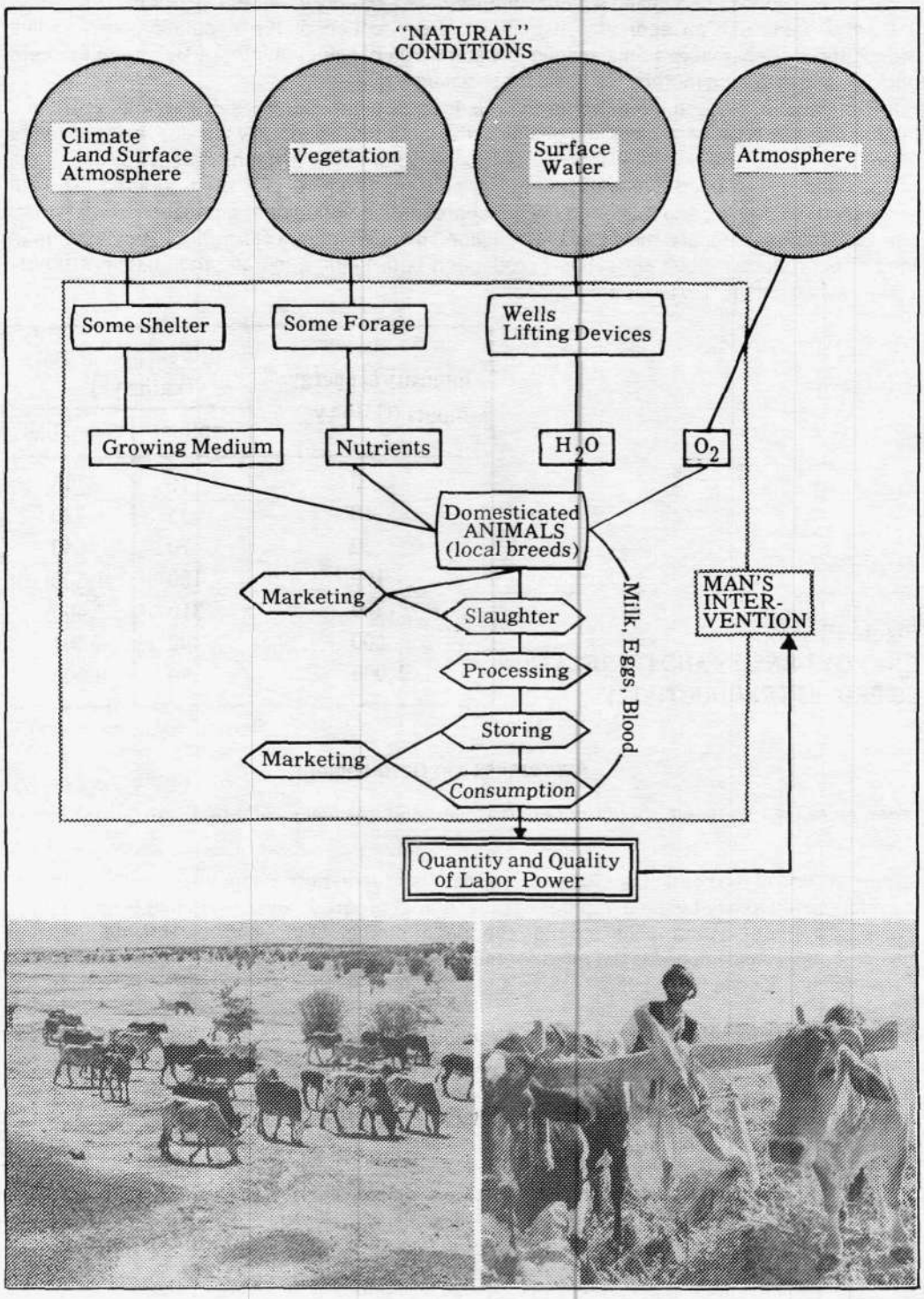


Figure 1b TRADITIONAL AGRICULTURE (animal production)



consumption, with little processing and marketing. There is thus little buying power to affect other sectors of the economy. Traditional agriculture, therefore, from its operational requirements, does not demand a highly differentiated, deeply integrated economy, nor could it help sustain such an economy. It holds a large section of the population in primitive production modes, that can only sustain low standards of living, deleteriously affecting world outlook, and providing thereby the basis for social unrest.

In comparison, modern intensive farming uses increasing quantities of ever higher-quality inputs, places a great demand on the quality of the labor force generally thereby, and produces large, reliable harvests with high levels of productivity per man and per hectare. Thus only 3-5% of the work force need be engaged in agriculture. Produce is sorted, graded, stored, processed, packaged, and marketed over vast areas. The agricultural population can afford a high standard of living, and the population engaged in other sectors can afford to buy the cheap food thus produced. Such agricultural production both helps generate and sustain a highly differentiated and deeply integrated economy.

intensity of energy inputs (GJ/ha yr)	protein productivity (kg/ha yr)	
	animal	vegetable
3	16	115
10	35	280
30	70	640
100	150	1,500
300	310	3,400
600	490	5,600
1,000	680	8,000

Figure 2
ENERGY DENSITY AND ITS RELATION TO PROTEIN PRODUCTIVITY

Slesser, Food Policy, May 1977.

Approaches to Development

Agricultural development should continue slowly and gradually, otherwise social unrest is created.

Implicit, and at the heart of this approach is the false separation of agricultural from industrial development and city-building in order to prevent real progress and development from taking place, so that existing political and economic stranglehelds can be maintained and strengthened. Also implicit is the need for reduced population growth rates; and the means is provided for accomplishing this — starvation, epidemics, and war to aid any "voluntary" measures.

It has been put bluntly enough by some leading institutional spokesmen engaged in so-called "agricultural development": the developed countries should only allow those LDCs to *industrialize that have run out of agricultural land, and are thus threatened with social unrest* and revolution. For Africa, it was pointed out, this would mean that only four to six countries should be *industrialized*. Obviously, such people are not talking about or intending that actual development of any kind should take place.

The isolated introduction of an improved input into the agricultural sector of the economy, eg., plows, herbicides, etc., reduces the labor requirements for a given production level. If the labor thus freed cannot find employment either through expanding or intensifying the area farmed, or else moving into another sector of the economy, social unrest is an inevitable result.

Thus food-for-work and other labor intensive infrastructure projects have been established, under strong pushing from the IMF and other monetarist forces, whose aim is the sopping up of such unrest as opposed to concern with real development. As detailed below, agricultural development, as a subsumed aspect of overall economic and social development, cannot take place without the associated development of industry, infrastructure, etc. Agricultural development per se could only occur, in a very limited sense, with continued importation of agricultural inputs. In the medium- to long-term this would place too great a strain on a country's balance of payments for it to be continued.

In Africa, the rate of increase in food production due to agricultural development is falling behind population growth rates. Taking the "slow approach" condemns the population to expansion of subsistence farming, with all that that implies in terms of quality of labor power, productivity levels, and standard of living. Many areas, such as the Sahel, are already marginal for this kind of activity, and are breaking down from the growing pressure of people held in this mode of reproduction, as the resources, defined by that mode of reproduction, are pushed to their limits, resulting in starvation, epidemics, and war, as what remains of the biosphere can no longer support even the remaining people. Not content with this level of population reduction in marginal areas, this example is used as an argument for the reduction in population growth rates everywhere, masking the real fact that it is a call for the halt of progress and development, an imposition of the Dark Ages, which in turn ensures the eventual reduction and emiseration of the remaining population. Any given technological mode defines an associated set of resources which will be exhausted at some point, no matter how slow the growth of that population. "Running out of . . ." is an emotive phrase, used in conjunction with Malthusian examples, that is calculated to induce fear and panic in the population that will overcome their understanding and reason of how the world and social reproduction expand and grow. Present resources must be used so as to ensure that populations can move ahead to a new technological mode, that will provide a new resource base able to support increasing numbers of people with expanding standards of living.

As part of an overall development strategy for Africa, agricultural development must proceed as fast as possible, both to alleviate and improve the nutritional situation of that continent and begin to aid that of others, and to improve the overall quality of labor power of the population.

Linear acceleration: history should be speeded up, but cannot be bypassed.

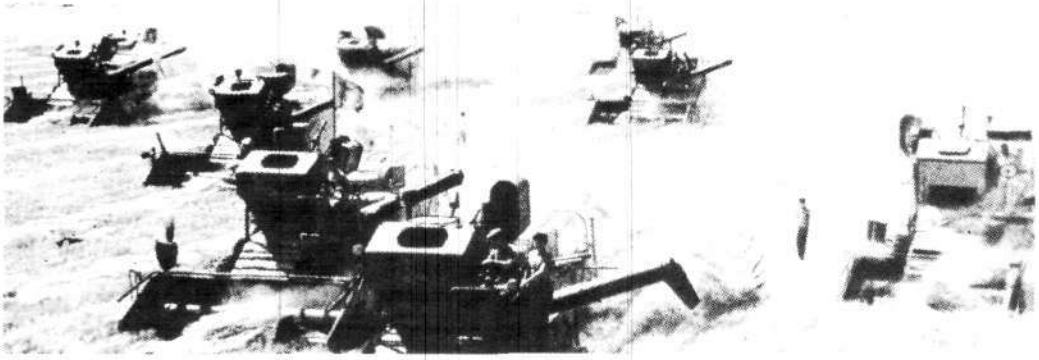
Despite emphasis on speed, the lack of understanding and deliberate falsification is the same as in the "slow approach". Basically, the developing countries are supposed to repeat, a little more quickly, the history of the industrialized countries, i.e., first an improved digging stick, then the plow, advancing to animal power with the use of oxen, and ultimately, in 50-75 years time, if there is enough fuel and industry left to produce them, tractors! If this were epistomologically correct, that man had to learn by repeating all the lessons of history, then we would not be where we are today.

The academic formalism of viewing people and events as things-in-themselves makes history a sterile, though maybe titillating study. The usefulness of history lies in the understanding of people and events as singularities, branching points, and invariants that initiate and mediate **processes**. The process of development is not a fixed chain of events and people. Oxen power is not a necessary stage through which each developing agricultural sector has to pass before it can move on to tractors. Sound research, understanding, and thorough educational programs are the key for establishing new, shorter paths through which the process of development can take place.

The introduction of relatively improved technologies and practices will not have the same effect in the LDCs today that they had in countries of a few decades or centuries ago, as the metric of the global economy is set by the mix of production methods in use at any given time, and development involves increasing participation in the world economy and global division of labor of today.

Modern technology

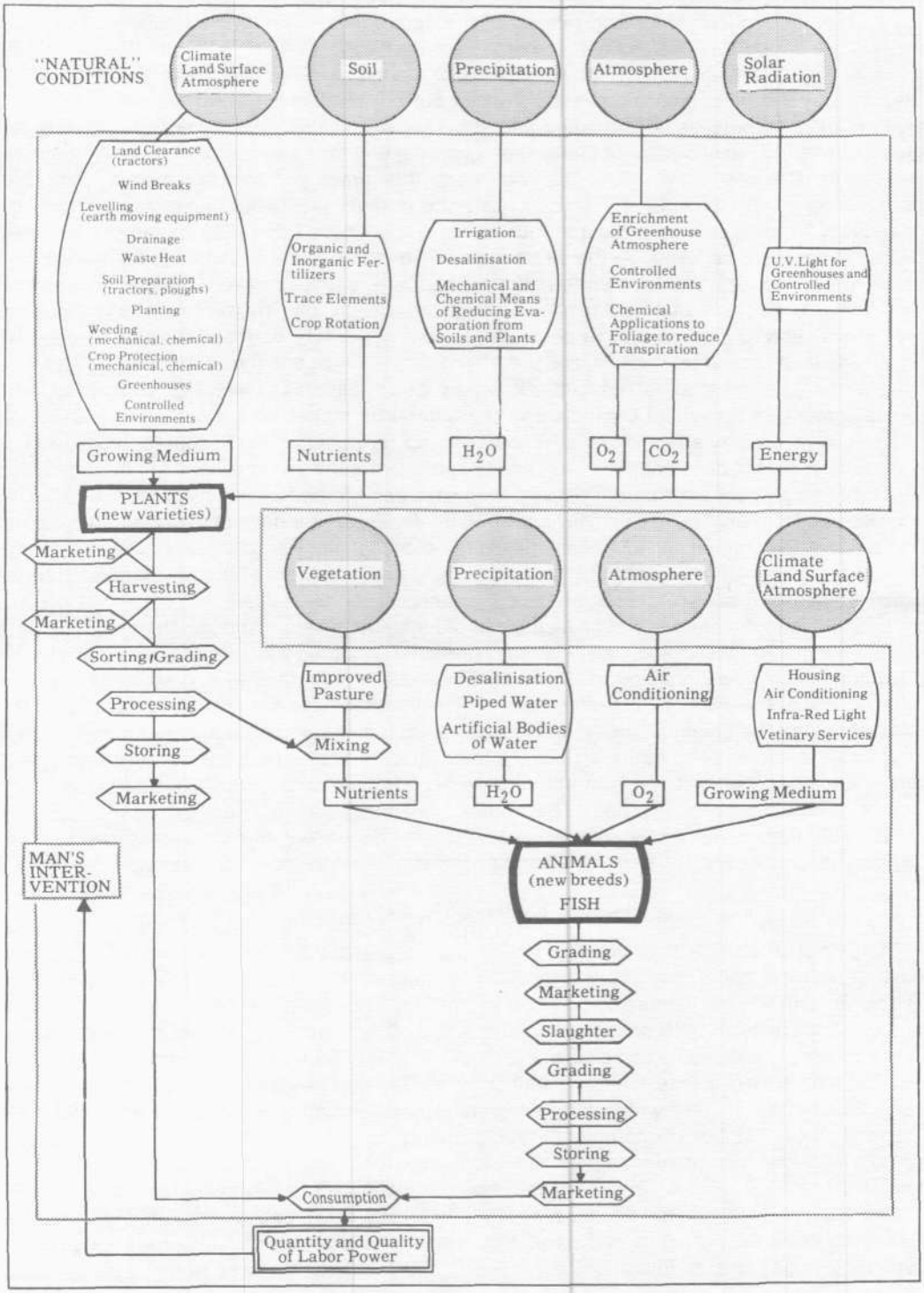
Just as the "historical" approach cannot bring about development, being fixated on things-in-themselves, so is the problem with the isolated introduction of single aspects of modern technology. The introduction of tractors per se does not mean that now there is modern farming where previously there wasn't. Key technological breakthroughs necessitate breakthroughs in other areas — that is the reason for their importance and significance. When improved fertiliser production enabled the greater, more widespread usage of fertiliser, development of new plant varieties became necessary that could utilize the now available fertiliser more efficiently for man's needs. But where greater vegetative production per area is made possible by this means, demand for water increases, thereby necessitating irrigation in areas where formerly non was necessary. Greater vegetative production expands the base for pests and diseases, thereby necessitating fungicides, pesticides, etc. In this sense, technology comes in a package form. The productivity of the system is far greater than the sum of the productivity increases due to each input in isolation from each other. Simple linear introduction of inputs is **not** how development of any kind occurs, and indeed, the introduction of only one input may have deleterious effects — for example, the use of irrigation without provision of adequate drainage may lead to soil salinization and subsequent yield reduction; mechanization without adequate education may lead to soil erosion, etc. Such events provide fertile ground for the environmentalists to have a field day for their infantile rage against technology.



As illustrated in Figure 3, modern intensive agriculture is based far more widely than just on the modern inputs and outputs of agriculture itself. Its degree of differentiation and depth of integration within the economy and society is very great. Thus an overall development package must be planned that is capable of creating enough free energy within the economy to make possible a quantum leap forward (move into a higher manifold) in the development process, i.e., that can create sufficient surplus to meet the needs of the population, repay investments, and still have some for further reinvestment into surrounding areas. Anything less will mean that the pole remains an isolated island of development, incapable of radiating development into surrounding areas, and at worst, being a disproportional burden on the economy.

This is why a few large modern model farms or post-colonial plantations in the developing countries have failed as focii of development. They have been a poor compromise between those forces that have fallen for the idea that development is something to do with laisser-faire economics, that development cannot be rigorously comprehended or planned for, and those forces that have succumbed to the ultimate slander that dirigism is associated with authoritarianism / communism / socialism (whichever is most appropriate in the circumstance), and therefore the necessary comprehensive planning becomes out of the question, and so hope that a good example will do. There are enough examples in the world to show what constitutes good, modern, intensive farming under a variety of environmental conditions. Certainly peasants will be initially inspired by the success of modern farms, and

Figure 3 MODERN AGRICULTURE



will be tempted to learn and adopt the methods they see used. They may even be able to derive some benefit from the input, transportation, and processing facilities that were initially established to service the farms and plantations. That this is not enough is more than well illustrated throughout Africa and other LDCs, where, within an individual country there still exists two economies, distinct and separate from each other: a monetary cash flow economy, based largely on the export of extractive raw materials, employing varying degrees of technology and skills, alongside a subsistence / barter / traditional market economy.

Why didn't a process of upgrading and superseding occur? Laisser-faire proponents are either linked to the anti-science and anti-progress faction, or else they are believers in magic and fate. Obviously, the magic did not work this time, or possibly history, fate has something else in store for mankind at this point in time, they would rationalize. There are specifics for each country of course, but common to all have been the problems associated with fianancing at all levels. At the international level, the conditionalities and limitations that have been imposed by various international financial insitutions have defied all reason and scientific principle. What is the point of giving credit for irrigation projects and not simultaneously giving enough to cover the known necessary drainage works? Inadequate drainage leads to soil salinization, and thereby reduces yields, and thus the country's ability to repay the original loan is reduced. Obviously such institutions are not concerned with development, but only that repayment is guaranteed no matter how, even if this means the looting of a country's raw material resources and its population. Of course repayment is necessary, but the development of labor power potential is the only means of guaranteeing this for both the present and future. Policy makers have been forced by this monetarist weapon to back down from what is scientifically known to be necessary for development, but this cannot be allowed to continue any longer as it leads to holocaust and war. Leaders of the developing countries must help organize the governments and policy makers of the developed sector to give credit on this scientific basis, and reject monetarist conditionalities.

In addition to the problems of financing and of technology per se, a population must be able to handle modern technology, and eventually reach a condition where it can contribute to the development of new technologies. This demands a vast improvement in all conditions of life for the people of the developing sector, both physically, mentally, and socially. Education does not consist of the empirical trial-and-error use of equipment, and production certainly cannot be based on this. The population cannot learn quickly and adequately when it is hungry, malnourished, diseased, living in overcrowded conditions, spending many hours a day fetching water and collecting fuel. The nuplex concept, as elaborated by the FEF, is the singularity that, by encompassing all these aspects, and generating the necessary preconditions and processes, will permit the transformation of the developing countries.

The Agronuplex

As part of an overall development program, agricultural development has two related tasks: that of meeting man's food and non-food requirements, and of upgrading the quality of labor power employed both in this particular sector and more generally throughout the economy. In order to accomplish both of these tasks in Africa, it is essential and feasible that today's modern agricultural production be in use throughout poles of development by the year 2000 AD, so that the needs of at least the equivalent of the African population of that time (approximately 800 million) can be met with such improved production. As a heuristic device, take the example of a nuplex concerned at first primarily with the development of agricultural production. Common, modern agricultural production utilizes energy densities of the order of 30-100 GJ / ha.y. The higher energy density figure reflects poor basic environmental conditions for agriculture (lack of water, drainage, soil fertility, etc.) which must be overcome by additional inputs of fertiliser, irrigation, etc., and also the intensity of agricultural production (multi-cropping). For optimum utilization of the large capital investment needed for such items as

irrigation, drainage, transport, etc., production should be intensified to the greatest extent possible, and the increased returns therefrom used to expand such production outwards into surrounding areas. At this order of magnitude of energy usage, electricity transmission is economic up to a distance of 100 km from its source. This would define a maximum physical area that an agronuplex could cover (3.14 million hectares), assuming a central power source (i.e. a minimum size agronuplex).

In order for the African population to be able to utilize this technology, and develop its labor power potential, its standard of living must be drastically increased. In the development centers this means that by the year 2000 AD living conditions must approximate those found in the developed countries today in terms of education, health, housing, sanitation, transportation, etc. In order to make the supply of these economical and to allow the necessary social life, a minimum population density and organization is required. It was estimated that a present population of just over one million people, doubling by the year 2000 AD, would be necessary. It was supposed that at first the population would be dispersed in numerous small villages and

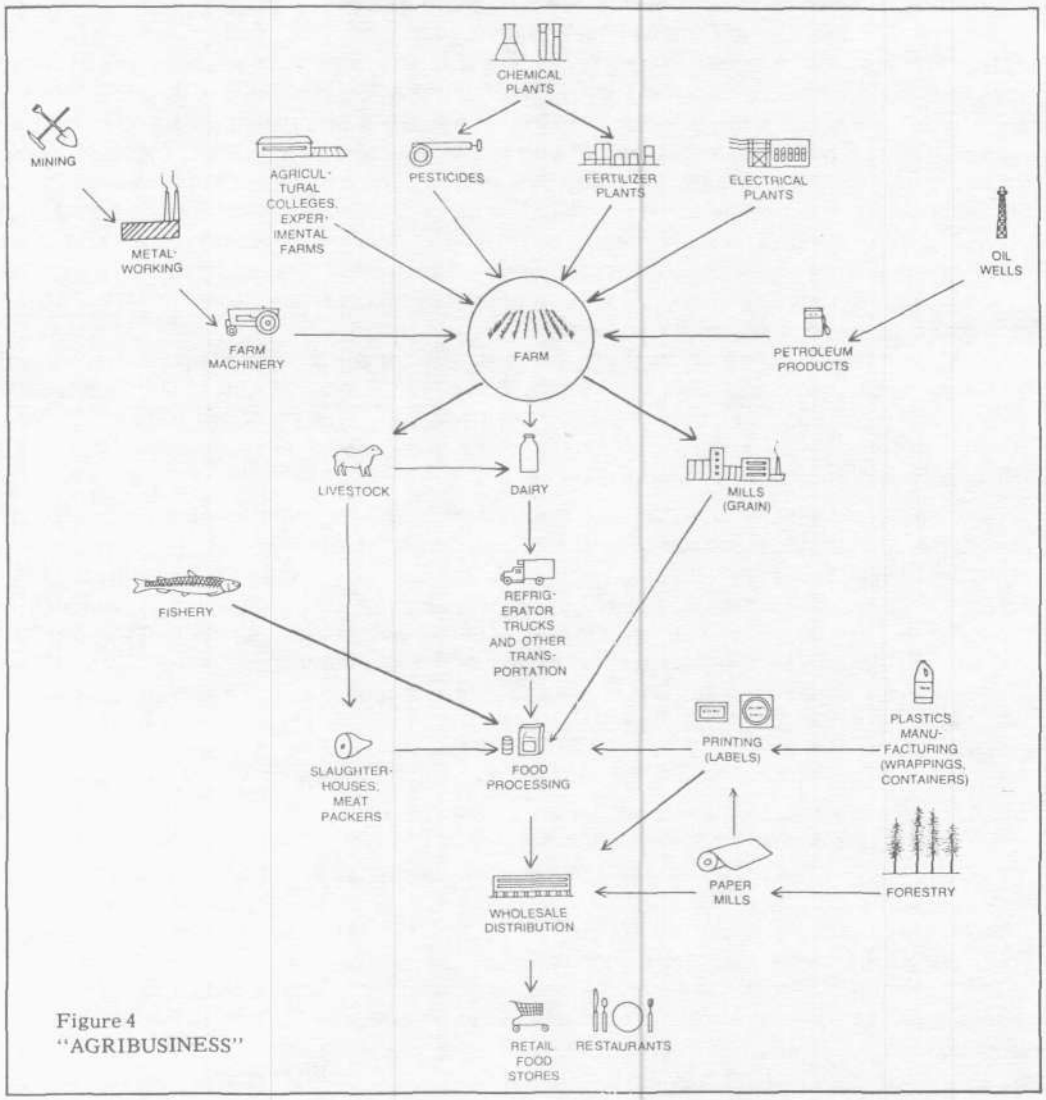


Figure 4
"AGRIBUSINESS"

towns. Through a deliberate program of increasing urbanization it is proposed that by the year 2000 AD approximately 12% of the population (250,000) be drawn into the major city of the agronuplex, about 40% (800,000) in approximately 16 towns of 50,000 people each, and with 48% (950,000) still living in villages of approximately 2,000 people each, with one town serving approximatley 30 villages.

The city would serve as the main center for the whole of the agronuplex. There would be located the main planning, research, and education centers, regional administration and social services headquarters, the main energy supply, and most major industries (consumer, infrastructural, etc., and those linked to agriculture, see Figure 4). As urbanization is a deliberate policy, towns and cities will be planned and built with expansion in mind, with a net minimum standard of housing and other facilities, that will enable whole families to move to productive employment, thereby avoiding the worst problems of present day shanty towns and slums, with workers separated from their families, reduced to crime and prostitution for lack of work etc.

As industrialization and modernization are planned to proceed apace, part of the workforce must be able to leave agriculture without upsetting food production, i.e. agricultural productivity per farm worker must be increased. Those people who remain in agriculture will do so as a result of the new perspectives that improved agriculture and general overall development will open up. This will place the greatest demand on education of all kinds. Also, through this means, the presently delicate question of land reform will be overcome. As people leave the land for jobs in industry, areas will become free, enabling the enlargement of remaining farms into viable modern economic units. Development cannot take place when land is being subdivided so as to provide a minimum area for the maximum number of people to scratch out their most basic biological needs. Necessary social and infrastructural services cannot be economically or physically provided to a dispersed population, with undifferentiated production, low productivity levels, and incomes.

Towns will serve in a sense as transmission belts between the city and villages. They will act as service, distribution, and collecting centers. Some typical requirements of such a town are indicated in Figure 5. Villages must be sufficiently large to warrant at least an elementary school, road, and postal service. As development and population increase continues, some towns will become cities, and some villages towns.

For rapid development to be able to take place, the population must be healthy and adequately nourished. Health and nourishment are closely interlinked. Apart from leading to nutritional diseases in extreme cases, malnourishment also reduces the body's ability to resist disease or make use of certain vaccines, etc. Illnesses such as diarrhea, fever, parasitic infections, etc., may lead to a condition of malnourishment in cases where nutrition is already on the borderline, and thus a vicious cycle is established that not only reduces the quantity and quality of today's labor force through short- and longer-term debilitating and crippling effects, but also through the effects on mothers and children, reduces the labor power of the next generation.

Health and nutritional programs are thus a vital investment for today and tomorrow, and should be closely coordinated with each other for maximum effect. The nutritional requirements of a population of two million are indicated in Figure 6. Programs for nutritional and health education, food preparation, hygiene, etc., must begin immediately so as to make best use of the resources that are available at that time. If nutritional needs cannot be met initially, food supplements must be imported and distributed through mother-and-baby centers, schools, canteens, etc., until domestic production can meet requirements. Legumes and grains, although they contain a variety of essential amino acids, are not complete, and require careful balancing, preparation, and consumption to ensure a healthy diet. Such a diet may often be deficient in fats. The simplest, most complete sources of amino acids that the human body needs are found in eggs, milk, fish, and meat, so that their production must be rapidly

Fig. 5 SOME REQUIREMENTS FOR A TOWN (50,000 inhabitants)

9,000	apartments
3 - 5	shopping centers
2	markets
3	post offices
6	primary schools (total of 100 classes)
2	secondary schools (total of 60 classes)
2	high schools (total of 100 classes)
2	technical schools (total of 40 classes)
3	hospitals (total of 900 beds)
90	doctors
1	public health center
	recreation facilities
	social services

Figure 6 NUTRITIONAL REQUIREMENTS OF TWO MILLION PEOPLE (in mio t/yr)

Energy	1.8 bio kcal/yr
Carbohydrate	0.28
Fat	0.52
Protein	0.06
Cereals	
Animal feed	1.40
Human consumption	0.23
Total	1.63
Pulses	
Animal feed	0.28
Human consumption	0.02
Total	0.30
Roots	0.10
Fruit and vegetables	0.10
Meat	0.05
Milk	0.24
Eggs	0.01
Fish	0.01

Need to allow for wastage

Figure 7 AGRICULTURAL INPUTS NEEDED TO PROVIDE FOOD FOR 2 MILLION PEOPLE

Fertiliser (N,P,K,)	2.00	mio t/yr
Pesticides	0.06	mio t/yr
Tractors	4.50	mio HP
Workforce		
-industrial inputs	112,000	workers
-farm	75,000	workers
-processing industry	150,000	workers

expanded. Egg production and intensive fish farming can be rapidly brought on line, followed by milk, poultry, pork, lamb and beef production. With the development of single-cell protein production and increasing availability of food-processing by-products for use as animal feed, some pressure will be taken off arable farming for the production of fodder crops, enabling more crops to be grown for direct human consumption whilst still increasing the supply of animal products, thereby reducing the luxury nature of the latter items. Fruit and vegetable production should be expanded to provide the necessary vitamins, minerals, and variety that the human body needs.

With energy densities of 30-100 GJ / ha.y, using modern agricultural methods, good yields of five tons of cereal per cropped hectare can be obtained. Assuming that 75% of the agronuplex area is available for agriculture, and depending upon the extent of multi-cropping that is possible, between six to twelve million people could be provided with an adequate diet. However, agriculture produces not only food crops, but also a whole range of non-food crops and by-products. The extent to which their production is substituted for food crops will depend upon a whole range of regional, national, continental and global considerations. No adequate financial and development policy will tolerate the production of crops for export at the expense of domestic food crops that endangers directly or indirectly the nutrition of the population.

Apart from the basic industries that are associated with all development such as outlined above, the kinds of industries that are necessary for and associated with modern intensive agriculture are indicated in Figure 4. To produce merely the food needs of two million people (see Figure 6) will require inputs of the order of magnitude as indicated in Figure 7. Which of the inputs will be produced in the agronuplex itself and which will come from industrial nuplexes will depend upon a variety of factors. It must be remembered that the two nuplex examples presented in this blueprint are extreme cases. In reality, there will be many instances where aspects from both are taken up in one nuplex. For example, the size and resources of a particular country may or may not allow the development of more that one nuplex at this particular time. The political relations between countries will affect the degree to which a country tries to be self-sufficient, and the degree of cooperation it is prepared to accept or offer to other countries. Also, despite the emphasis placed on industrial development in the industrial nuplexes, in fact agricultural development will tend to occur there, where environmentally possible, as ready markets are provided by the population engaged in industry, and the necessary educational, infrastructural and social improvements are made. For the most rational development to occur, there must obviously be overall planning and cooperation between nuplexes, both at the national and international level.

Initially, heavy machinery and equipment will be produced in the industrial nuplexes and exported to the agronuplexes. Depending upon location and transportation, assembly plants could be built up in the agronuplex in conjunction with the expansion of various related production capacities in the industrial nuplex. Light engineering and smaller equipment production, such as pumps, etc., could easily be developed in the agronuplex itself. Major, large equipment repair facilities are essential within the agronuplex itself. Major fertiliser production will depend upon the location of raw materials, and will be associated mainly with the large chemical complexes that form the basis of industrial nuplexes. Some fertiliser production will be associated with the agronuplex, utilizing by-products of the food-processing industries. Agronuplexes will contain large fertiliser mixing, packaging, and distribution industries at the break of bulk points. Herbicides, pesticides, etc., will also tend to be located with major chemical complexes, together with the pharmaceutical industry, although this latter will usually take a little longer to develop.

In order to utilise the increased agricultural production to its maximum extent, economically and socially, storage, sorting, grading, packaging, and processing industries must be established. Initially, canning, smoking, and drying will be the most important processing industries for domestic consumption until domestic refrigeration is widespread. An idea of the

Figure 8
MAGNITUDE OF INDUSTRIES REQUIRED TO PROCESS THE FOOD NEEDS OF TWO MILLION PEOPLE

industry	Quantity	size of plant (tons per year)	cost per plant ($million)	total costs ($million)
grainmills	26	70,000	30-35	780-910
fodder plants	6	300,000	25-28	150-168
dairy plants	2-3	100,000	---	----
meat processing plants	2	25,000 (processed)	120	120

order of magnitude of the processing industries involved can be gained from Figures 6 and 8. Nearly all of this should take place in the agronuplex in order to minimize transportation, maximise quality for processing, and take advantage of the integration that is possible by using by-products, e.g. the use of what remains from pressing oil seed to produce cake for animal feed. Non-food industries, that can utilize blood, bones, skins, etc., for making soaps, pigments, glues, leather, etc., should also be established in the agronuplex.

An essential precondition for such a program is adequate financing, as outlined elsewhere in this blueprint, effective from the global, international level, down to the individual. Nuplexes should be located within the framework of national and international development considerations and known resources. A research and planning center for each should be established, located in what is to become the city of the agronuplex. Such centers should keep in close touch with each other, and with main government and international institutions. They should pull together presently available data for the nuplex area, which should be used in conjunction with the epistemology exemplified throughout this blueprint to identify short- and long-term goals, means, and areas of further research, continuously updating each on the basis of new information and advances in technology and production methods.

Acting in this capacity, based firmly on the reality of what is and what needs to be done, the planning center would be the most suitable university, incorporating both practical and theoretical research, and teaching. They would also serve as the main headquarters of the farm extension services, and would be the planners and coordinators of various experimental farms. As the center of the educational system in general, they must also develop all forms of education, for both children and adults, as rapidly as possible, so that the maximum use of available resources and facilities may be made. Visual and oral means (posters, visits, theaters, radio, films, etc) will be of great importance until literacy is achieved. Of the greatest importance is the development of the love of learning within the population, and the creation of the necessary social environment for this, so that even when living conditions are far from the best, the desire for useful knowledge and improved practice will help to overcome this shortcoming until it can be remedied; aided by that increased knowledge and skills. In a mentally healthy population there is already this tendency, but in many of the developing nations of today, enforced lack of development and associated propaganda has stifled and warped this urge for progress, turning it into cynicism, fatalism, stoicism, and cultural relativism, that must be overcome, by the use of education in conjunction with actual progress and development.

In order to facilitate the flow of goods, ideas, and people, transportation and communication must be immediately improved and expanded. Key critical inputs and people will need to be imported into the agronuplex, and communications opened up with the outside world in order to get production and development underway; and then, with expanded production, export of

goods and ideas will become possible.

Basic industries, such as cement production, etc., must be gotten underway and-or expanded as a prerequisite for the improvement of infrastructure and living conditions generally (for roads, sanitation, drinking water supply, hospitals, schools, housing, factories, etc.).

Figure 9 indicates an approximate phasing for the agricultural sector. All of the development must be closely coordinated with the development of the energy sector, an outline of which is provided on page 225.Maximum use should be made of the possibilities of linking production cycles of various kinds so as to achieve a more even load (e.g. irrigation pumping during the evening, adjustment of shift working, etc.). This could be stimulated by differential tariff rates and special negotiated agreements between industry and the electricity utilities.

To provide the equivalent of the population of Africa in the year 2000 (a little over 800 million) with their food and agriculturally produced non-food needs would necessitate approximately 136 agronuplexes as described above. (50 agronuplexes, working at full capacity, with 2-3 crops per year would be an absolute minimum.) To provide the consumer- and heavy-industrial-

Figure 9 PHASING

First Phase

— Import necessary animal protein and protein supplements to cover the population's minimum requirements.
— Improve storage and transportation facilities to reduce wastage and permit greater flow of goods.
— Set up university, research and breeding centers, experimental farms, extension and veterinary services.
— Import suitable new seed varieties if these exist, and core breeding stock of dairy and beef cattle as the basis for building up herds kept in modern intensive systems.
— Begin programs for introducing fodder crop production into the arable sector.
— Import fertiliser, herbicides, pesticides, and farm machinery until these industries can be completed in the nuplex areas.
— Begin local water control projects, and research further for large river basin projects.

Second Phase

— Improved agricultural practices developed for particular areas brought into general use.
— Domestic production of fertilisers, herbicides, pesticides, and farm machinery come on line and reduce needs for importation of these commodities.
— Chicken, egg, fish, and fish production come on line and reduce needs for animal protein imports. Milk production and dairy products begin to make a contribution to the diet.
— Modern integrated food processing and storage facilities established. Waste products utilized for animal feed, organic manure, etc.
— Continued work on large river basin projects.

Third Phase

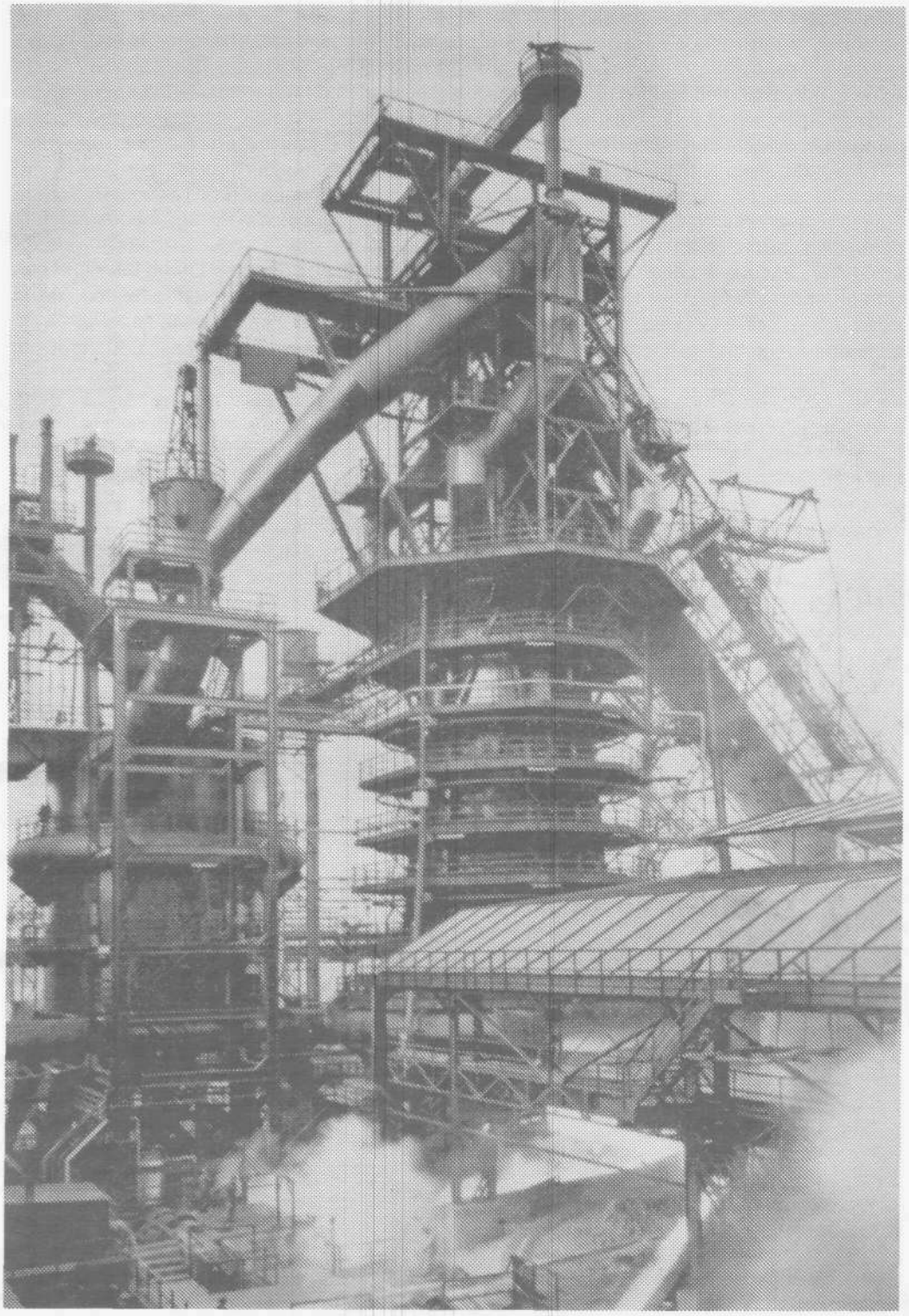
— Begin exporting this process of development into areas surrounding the nuplexes.
— Animal and human diseases reduced through the impact of industrialization and modernisation.
— Large herds of beef and dairy animals now established.
— Massive expansion of industrial and export crop production and associated processing industries.
—Completion of large hydrological projects.
— Broadening of agricultural research and facilities generally so as to be ready when fusion power becomes an economic reality.

goods, approximately 32 industrial nuplexes, as described in the following chapter, would be necessary. Approximately 272 million inhabitants would be living in the agronuplexes, and 192 million in the industrial nuplexes, i.e. approximately half of the population at that time would be living in nuplexes, and supplying the needs of the equivalent of the whole African population. The remaining half of the population, their labor power potential rapidly increasing, represents the fast growing free energy of the African economy and society, at that point in time.

It is not the aim that there should remain a continuing distinction between agronuplexes and industrial nuplexes. As mentioned above, agricultural development will tend to occur within the industrial nuplexes, where this is environmentally possible. Industry in the agronuplexes, with continuing development, will increase and differentiate out from immediately related agricultural inputs and outputs. Also, industries that are not so dependent upon interlinkages with other heavy industries for their economy can be brought into the agronuplex. Industries that are heavy energy users, such as aluminium production, may also be established there. In addition, agriculture is increasingly becoming a user of the most sophisticated, modern technology. There will no longer be a rural environment in the sense of the traditional farmer. Food producers will be scientists and technicians, requiring access to computers, satellite information, aircraft, etc. Farms of several hundreds and thousands of hectares make nonsense of small agricultural hamlets and villages. Gone is the image of the farmer stood at his farm gate with a straw in the corner of his mouth. Look at farming in Oregon, California, Florida, Australia, etc. When fusion power becomes economical, agriculture will be completely transformed. Single cell protein production and use of food processing by-products will largely take the place of fodder crops, thereby freeing 60-75% of the arable area. With such a cheap source of abundant energy, controlled environment production of food crops for human consumption will become economically possible. The environment will be transformed. No longer will agriculture be a dominant determinant of the scenery we see around us. Investments into the environment for man's recreation and living space will become increasingly important.

Certainly there are problems for agriculture specific to various tropical environments, but none that cannot be rapidly overcome with the correct methodology and research; and with the perspective of fusion power, there will come a point when these problems are largely irrelevant for agriculture, as the environment for man's food productions becomes totally man-made and man-controlled.

Not every African, even by the year 2000 AD, will be reached by all the fruits of this development. There will still remain remnants of nomadic groupings, subsistence farmers, isolated areas. However, by this time, the existing nuplexes should be reaching full production capacity, able to spill over into the surrounding areas, with massive, rapid effects; beginning to replicate those processes that were initiated in the nuplexes, a self-subsisting, self-developing process will have been established within the economy and society. By this means, the distinctions between developing and developed countries, between rural and urban areas will be eliminated.



"It is an important, though at present state insufficiently recognized truth, that the manufacturing industry of a great nation makes up an interconnected whole, from which no single part can be removed without severely damaging the other parts."

(Friedrich List, Character and Value of our national productive forces, 1840)

The Role of Industrial Nuplexes in African Development

Helmut Böttiger

It must be the goal of African industrialization to raise that continent rapidly to a level where its role in the world system of economic and cultural cooperation corresponds to the potential of its population. The only viable means to this end is the creation of highly concentrated development poles in the various regions of the continent. Such centers, once functioning, will serve as the basis for the successful planned development of the surrounding regions.

These development poles must be industrial centers, in which the most important industrial processes have been integrated and concentrated in a way that the threshold levels for productivity, necessary for a self-subsisting industrial culture, have been reached.

An "industrial nuplex" is such a development pole, in which the main energy source is nuclear power.

The Industrial Nuplex as an Integrated Industrial Center

The industrial nuplex has the task of providing its own population as well as that of the surrounding region with the means of production and long-life consumption goods necessary for their development. While the agronuplex will mostly concentrate on the production and processing of agricultural goods, the industrial nuplex will above all be engaged in the processing of mineral raw materials. Necessary textiles, food and other agricultural products will be imported into the industrial nuplexes from the agronuplexes, in exchange for manufactured goods.

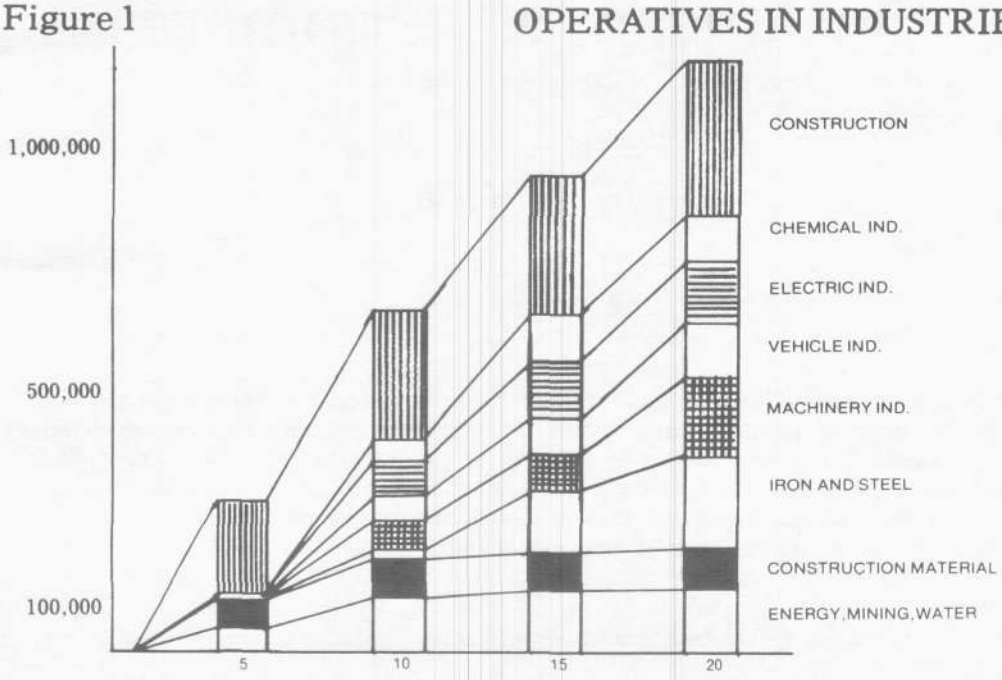
We propose 32 such industrial nuplex centers for the African continent, which in the year 2000 will have to supply a population of over 800 million (Map 1). The industrial nuplexes will of course differ according to the different regional boundary conditions, as well as according to the demands of the world-wide division of labor. Nevertheless, certain necessary common structural features can be described here.

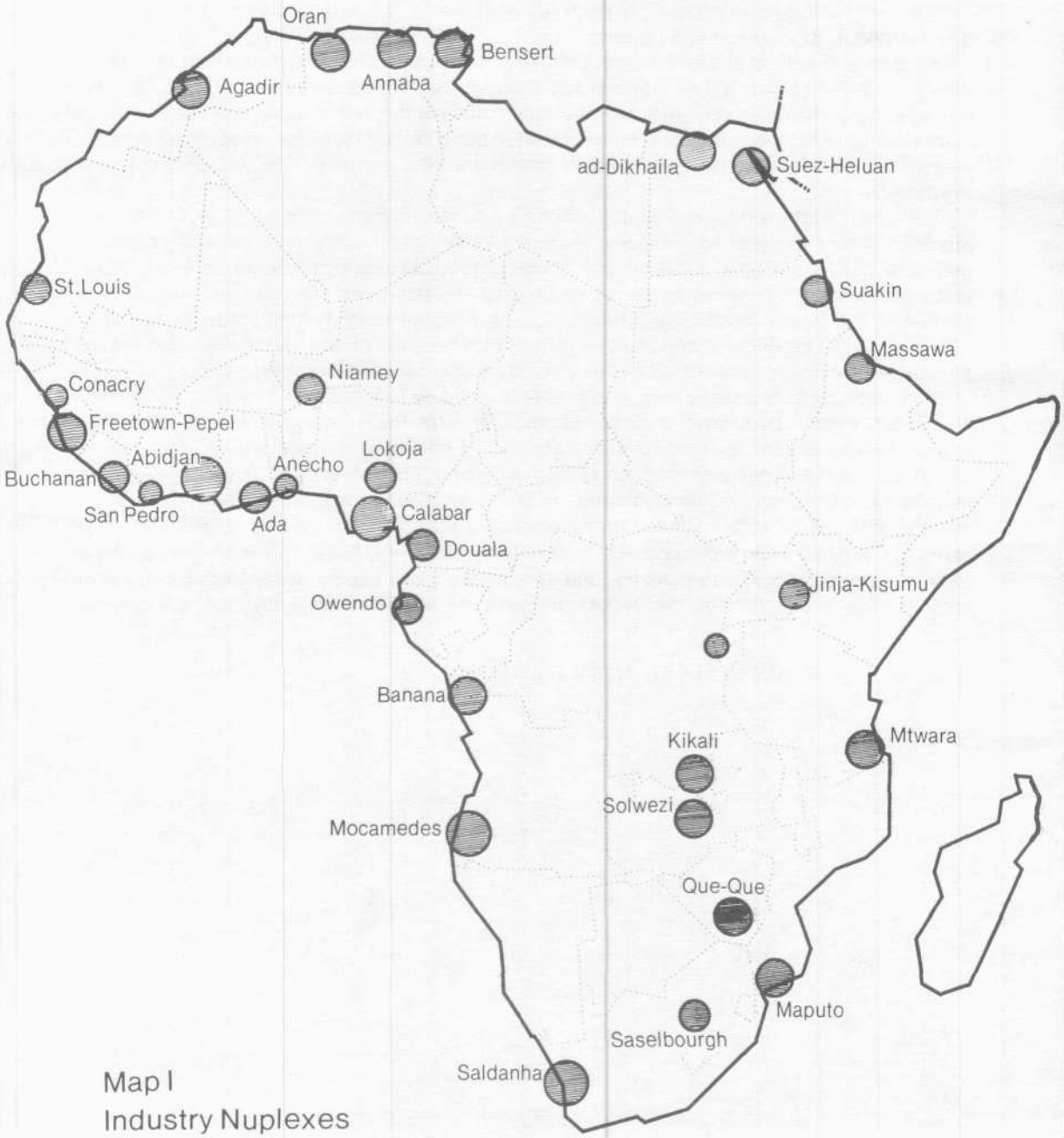
Each industrial nuplex will provide for a region with approximately 25 million people. In the nuplex area itself 6 million people will live, out of which 2 million will be employed, 1.2 million in the productive sector. The percentage distribution of labor in the various branches of industry will approximate that found today in large industrial regions in the advanced sector (Figure 1). Plant capacities will be determined by the most favorable combination of the various industrial branches integrated in the nuplex, in order to ensure maximum possible productivity.

The nuplex development center will organize the industrial production necessary for a large region around a unified system of cities (Figure 2). Approximately 2 million people will live in the central city. A dense system of transport and communication will connect it with 5—6 satellite cities at a distance of approximately 50 kilometers. The regions between the cities will contain recreation centers as well as agricultural activities such as market-gardening for the supply of fresh vegetables.

The center of the nuplex system will contain a deep sea harbor (in the typical case of a coastal location), an airport and a railroad nodal point, with connections radiating out into the

Figure 1





Map I
Industry Nuplexes

surrounding region and joined to the continental rail system. The commercial area of the Central City will be the site of facilities such as the regional university, the planning and administration centers, banks, offices etc. In the satellite cities, meeting places, concert and theater facilities, libraries, scientific museums and other facilities will also be provided with easy access for the entire population. Each city will have an extensive industrial area, serviced by a heavy-duty modern transport system.

The various industrial facilities will not be distributed randomly among the industrial areas of the cities. Their location will be planned so as to minimize necessary transport. The material-intensive basic materials industries will be located close to the harbor in the Central City, while plants involving finished materials will be placed in more distant locations. In addition, specific energy requirements will play an important role in determining the geographic distribution of the industries.

No modern, high-technology plant functions as an isolated production unit; such facilities are always interwoven in an extensive system of other industrial processes and scientific-technical services. These systems can be described as organized flows of energy and materials through differentiated series of productive operations. The more dense such a system is, the more economically it functions. For, in a dense, integrated productive system, not only can the products of one plant be further processed in others, but the waste products and waste heat of many processes can be utilized as inputs for other processes.

Flaws in the proper arrangement of plants lead not only to increased transport costs; they also mean higher investment and maintenance of infrastructure and cause pollution and energy losses. Given the enormous demands of Third World development in the coming decades, and the consequent necessity of maximizing the efficiency of resource use, it is mandatory that industry be concentrated in the development poles and organized there according to a unified scheme. Even in the advanced sector today, rational reorganization of material flows has allowed considerable cost reductions (in the USA in 1976, cost reductions of 29% in the food processing industry, and 10% in the tool industry, were obtained by such means). The production of the industrial nuplexes will, despite individual differences,

Figure 2 SCHEME FOR A NUPLEX REGION

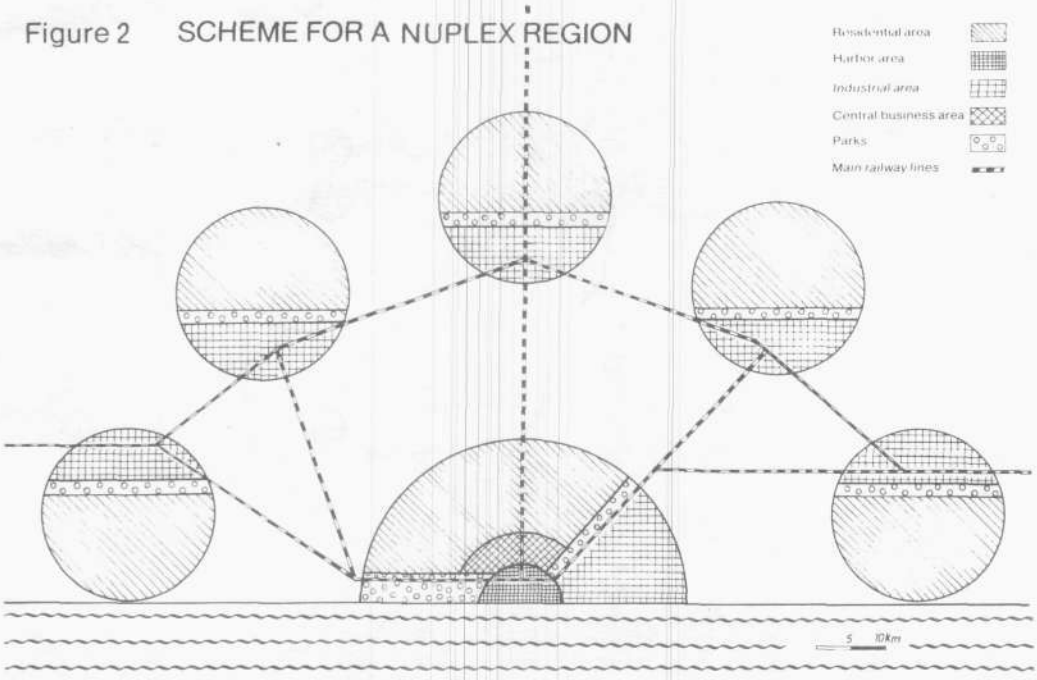
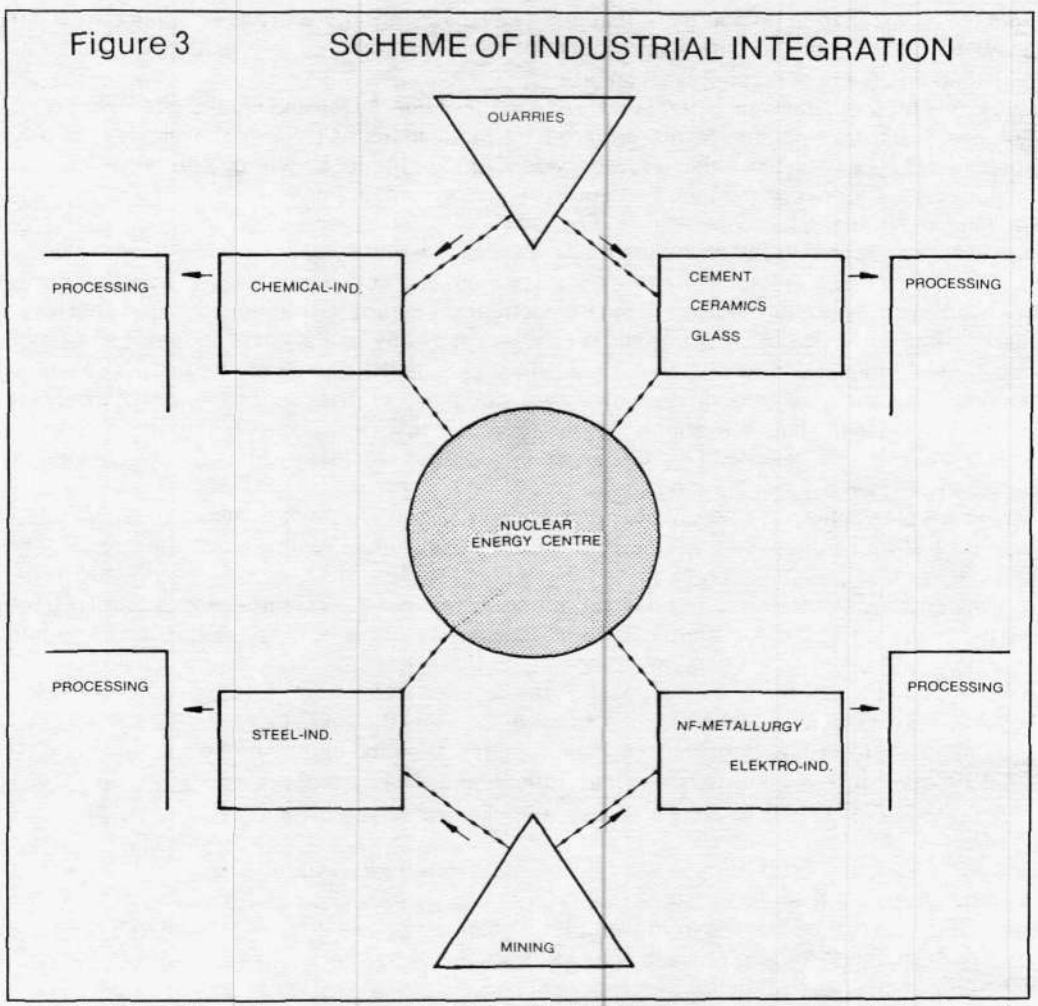


Figure 3 SCHEME OF INDUSTRIAL INTEGRATION



generally follow the scheme pictured in Figure 3, which features the main material flows involved.

Apart from energy, raw materials and infrastructure problems, the scarcity of highly qualified labor, typical of developing countries, likewise requires the greatest possible geographical concentration and coordination of productive activities. In this way, repair and maintenance personnel can rapidly be rotated between plants, so as to serve a larger area. Operating personnel can be monitored and further trained via service centers; here prompt aid and information can be dispatched in cases of malfunction and accidents.

The systematic organization of all plants within the industrial nuplex will enable the inhabitants to gain an overview of the entire productive process, qualifying them to make programmatic economic decisions in the future. The concentration of ingenious, industrious individuals will further the creative solution of all types of problems: scientific, technical and cultural. A new urban culture will develop.

Integrated Energy Supply and Basic Materials Industries

The basis and the starting point of all industrial production is energy supply. The necessary industrialization of Africa alone places such enormous demands on energy production — as

detailed in the chapter on energy — that locally available energy sources are only part of the answer. The importance of the Nuplex concept for Africa emerges clearly from the following consideration of the world energy situation.

In the short term, the supply of relatively cheap fossil energy (oil and natural gas) is assured. But given the consumption levels required by rapid industrialization, the easily available sources will be exhausted within a few decades. Among the fossil energy sources, only coal could provide a long-term perspective. However, coal is also raw material for an important, fast-growing sector of the basic materials industries. Hence, in the long-term, only nuclear energy can assure an adequate and environmentally favorable energy supply.

In the nuplex concept nuclear energy is combined with coal in such a way that processed coal serves as an energy mediator in the high temperature range. The processing of coal takes place primarily in the basic materials sector — especially in the steel industries. Carbon compounds produced in part using nuclear power give up the energy stored in their chemical bounds on their way through the industrial complex, ending as raw materials for the petrochemical industry. The supply of electrical energy in the industrial nuplex is more straightforward. The basic load will be carried by the usual nuclear technology, supplemented during peak loads by fast-operating gas turbines.

Figure 4 shows the scheme of coal processing. The starting point is natural coal, which in most of the African nuplexes will have to be imported from abroad. Part of the coal will be coked in form-coke units, operating with the latest processes for higher coke output and larger raw materials tolerances. Coking gas will be collected in a Gas Center, and the coke itself mostly delivered to the metallurgical industries. As we show in detail in the next chapter, economic and energy considerations recommend that steel production be mainly based on a modified blast furnace process, at least in the foreseeable future. This modification of the modern heavy blast furnace will improve its integration into the overall system.

Up to now, efforts have been made to maximize the utilization of the *energy content* of coal in steel production, releasing CO_2 into the atmosphere. Today, coal is rather regarded as a *chemical catalyst* in the reduction of iron ore. Conversely, iron acts as a catalyst in the gasification of coal.

In the future, the blast furnace will be operated with pure oxygen instead of hot air. The thereby increased oven temperature will be reduced by injecting carbon dioxide (CO_2). The necessary, optimal quantity of form-gas will be obtained by injecting additional coal. Besides raw steel, this blast furnace process will produce a nitrogen-free top gas containing 80% CO, to be fed into the gas distribution center.

The necessary oxygen for the blast furnace and steel-plants — approx. 500 kg per ton of steel — will be produced using nuclear energy, partly from the air and partly through the splitting of water. As long as the most economical process for the splitting of water — catalytic thermal splitting — is unavailable, known electrolysis and related processes will have to be employed. The proportional relationship of the two main oxygen sources will be adjusted according to the requirements for nitrogen relative to hydrogen in the chemical industries.

In the Gas Center, the inflowing gases are cleaned and prepared for their next use. Where subterranean conditions allow, reserve gas storage containers should be installed underground. The Gas Center will provide synthesis gas containing CO and H_2 to industries with a high temperature profile. By the combustion of this gas, H_2O is freed into the air, while remaining CO_2 will be returned to the Gas Center for further processing. Industrial processes which require temperatures not exceeding 600 degrees C — that is, a majority of industries — will be able to use the heat freed by the methanization of CO and H to CH_4 and H_2O in special units. In the Gas Center, the CH_4 will be re-combined using CO_2 to 2CO, H_2 and H_2O, the necessary process heat of 760° C being provided by a high temperature reactor. Alternatively, CH_4 could be split with H_2O into CO and H, when specific gas demands require.

The petrochemical industry will be the final consumer of CO and H. Using the old Fischer-Tropsch process and its later modifications, nearly all the lighter oil fractions can be syn-

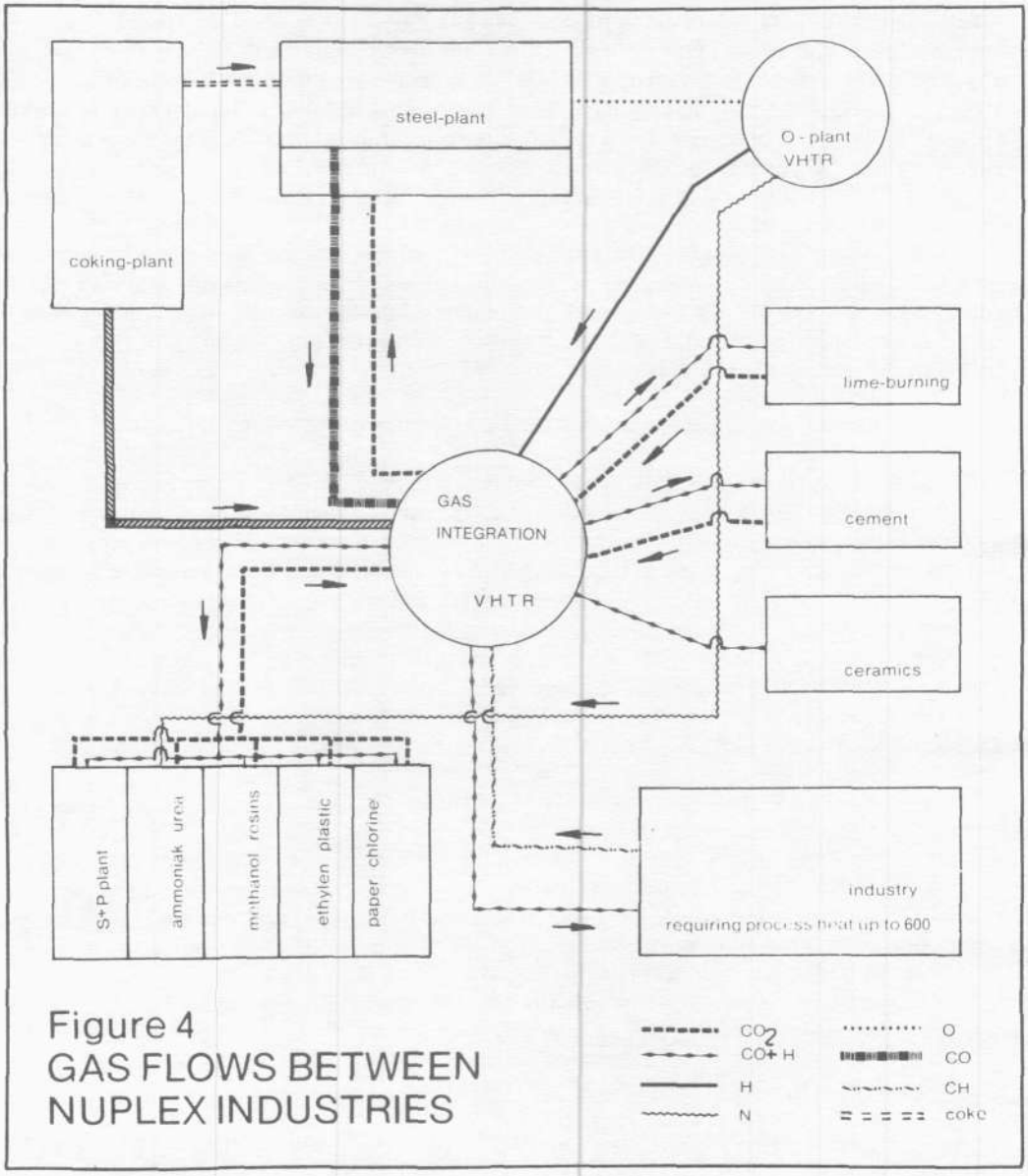


Figure 4
GAS FLOWS BETWEEN NUPLEX INDUSTRIES

thesized.

The CO_2 remaining in the Gas Center, which cannot be utilized for CH fractionalization or for the cooling of the blast furnace, will serve as a heat-carrier from the high temperature reactor to the form coking plant. There part of the heat will go toward reduction of CO_2 into CO, which is somewhat better than pure oxygen for coking. Leftover CO_2 can finally be used in closed bioreactors as the main component of an artificial atmosphere for the rapid production of biomass (e.g., algae and related simple organisms); biomass which can be utilized as an industrial raw material and as a basis for animal feeds.

The closed CO_2-system just described will help to bring one of the most important environmental problems under control: the danger of climatic changes through massive releases of CO_2 into the atmosphere. The use of nuclear process heat makes this economically feasible.

The quantitative parameters of the nuclear-gas-system will depend on the specific industrial composition of the given nuplex. One of the main determinants will be the steel complex essential to the system. Today an optimal blast furnace system produces 10 million tons of raw steel yearly, requiring roughly 4 million tons of form coke and 2 million tons of coal, as well as some 4.5 million tons of oxygen and 5 million tons CO_2 for injection. The plant produces 8—10 million tons of CO_2 as a by-product. In addition to this, the Gas Center will obtain CO_2 from processes such as the burning of lime and cement production, further reducing the release of CO_2 to the atmosphere.

The various processes for the transformation and changing composition of gases within the system can be adjusted continously according to the changing industrial structure of the nuplex. The Gas Center will also benefit the planned infrastructure of the nuplex industrial area, where, beside transport, water and electricity networks, pipe systems for the most important industrial gases will be installed.

Labor Power Development and the Construction of the Industrial Nuplex

The realization of nuplex-centers as development poles in Africa involves two special challenges. First, the planning and direction of construction must be thoroughly prepared. This includes considerations which, in comparable enterprises in advanced countries today, would tend to be ignored and regarded as belonging to the humanities and social sciences. Secondly, the enlistment and most importantly the education and training of the labor force must be planned so as to simultaneously create a workforce for the industries being constructed.

The most favorable site for the construction of an industrial nuplex is a thinly populated coastal region having the natural preconditions for a deep-sea harbor, and located not too far from major population centers. Given the present mobility of the work-seeking population in Africa, it will be easier to recruit labor from afar than to reorganize the property structure of a heavily populated area.

The construction of such complex facilities as those included in the industrial nuplex, will confront the preparatory and organizing groups with a whole universe of problems. Not only must the natural and other existing conditions of the nuplex site be researched and examined in all their aspects, but also in the interaction of the nuplex activities with nearby and distant regions. The integration of a wide variety of production processes presupposes a very detailed knowledge of the scientific principles involved. Furthermore, the planning of the city must harmonize with the requirements of the industrial structure, and vice versa.

The native population in the nuplex site and surrounding regions must be prepared for dramatic changes in their living situation, which the construction of the nuplex will and should cause. This demands first of all a comprehensive literacy campaign, together with education programs which acquaint the population with the elements of how an industrial society functions.

The curricula for education and continous training of the labor force will be designed by the planning group in cooperation with foreign experts involved in the construction and later operation of the nuplex plants. Worker education must be regarded as an essential part of the work, and developed in parallel with actual construction activities.

Besides the immediate task-orientation to the construction process, educational work must emphasize the development of a humanist culture, including music, art and literature, throughout the growing nuplex population. The great construction sites will form the background of a social and cultural process which integrates people with strongly differing backgrounds into a unified working organism in rapid creative intellectual development.

These extremely difficult tasks cannot be accomplished by some tiny group of planners. The complexity of the problem requires basic research within the nuplex itself, which must be done by a large international staff of researchers and scientists. The work will proceed through intensive discussions with a larger staff of experts directly involved in construction, and will draw

in even larger numbers of motivated young people. Thus, the planning process functions like a large university of a new type. Here, fundamental research, applied research, project studies and practical problem-solving can be optimally combined in the context of the concrete reality of nuplex construction.

Thus, the planning staff constitutes the kernel of a new type of university, one which will come much nearer to the original idea of a university than such prestige-oriented imitations as Cambridge and Harvard. Following the completion of the first phase of nuplex construction, the planning staff will concentrate on optimising and further developing the nuplex, building on experience in the nuplex itself as well as from the industrialization of other regions. Research work will be directed toward improvements and fundamental innovations in process technologies.

Having gone through the demanding process of preparing and directing the process of construction and initial operation of the nuplex, the planning staff will form the kernel of the future administration and political leadership of the nuplex region.

Although the designated educational institutions of the nuplex will play an indispensable role, the main educational activity in the region will be the construction and operation of the nuplex industry itself. A factory is not only a place where various goods are produced; it shapes the intellectual development of its workers. This general truth will come to the forefront in the industrial nuplexes of Africa. Not only the construction process, but the addition of new plants and new technologies, will at every step place new demands on the creativity and flexibility of the skilled workforce.

Main Construction Phases for an Industrial Nuplex

Here we limit ourselves to the four main phases included in Figure 6.

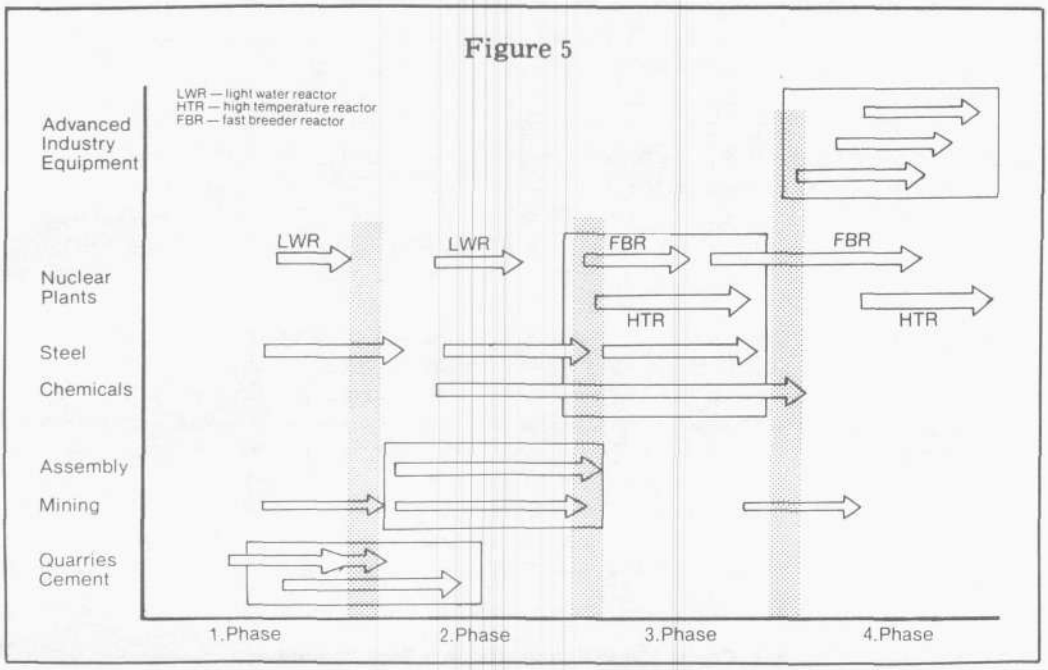
Phase 1: First the sites of the nuplex industries will be prepared. At the same time, large stone quarries must be opened and an efficient, large-scale construction materials industry, especially cement production, set up. The first roads and water systems will be built, under relatively difficult conditions. Once concrete and prefabricated component plants have come on line, the construction of city sections and of the industrial area will begin.

In this phase the types of work as well as the energy supply and other technologies involved will be largely traditional; thousands of Africans are today engaged in comparable activities, operating heavy earth-moving equipment, tower cranes, and other heavy construction machines. The new aspect here will lie only in the size of the construction sites and the complexity of the interacting construction activities. This coordination will involve the first, most important educational process for the labor force.Living and working activities for more than 60,000 workers on the gigantic construction site must be organized at a high level of sanitation, safety and discipline, and above all with a view toward cultural and social development. In particular, working hours should be limited in order to allow appropriate time for vocational and general education as well a sports and cultural activities.

Phase 2: The first manufacturing plants, now to be located in the industrial park, are assembly plants for heavy machines and household equipment. Parts of assembly will be imported according to agreements providing for a limited period. These assembly plants will not only help to reduce the costs of construction and of transportation of heavy goods; in addition, they will constitute an important element in the training of the workforce.Thereby, the crucial step of eliminating any remaining mysteries in the minds of the workers about the functioning of machinery - mystical notions arising when poorly educated Africans are merely trained to operate imported equipment - will be accomplished. Such attitudes will disappear rapidly when machinery is put together on location. At the same time, workers will assimilate a sensuous understanding of the laws and applications of mechanics. This understanding will be developed into scientific knowledge through educational programs.

The construction of large production facilities will demand new skills and abilities from the

Figure 5



workforce. The installation of reactor columns, steel plant construction etc. demands a high degree of precision and quality of work, including the correction of work through measuring equipment. This will require intense cooperation between the native workforce and qualified experts supervising the projects.

Phase 3: The startup of large plants in the basic materials industries will again transform the character of the nuplex region and the quality of work. This will mark the rapid expansion of industrial production throughout the nuplex region. Numerous plants for the processing and forming of basic materials , for the production of parts for the assembly plants etc. will be established. The differentiation and cooperation of labor will go beyond the individual heavy industries and embrace a wide variety of production facilities in a single interacting system.

The work force in the basic materials industries and associated processing industries will be confronted with processes of more "hydrodynamic" than mechanical character (as in the second phase). Work will consist in the steering of production flows, the productive action of controlled mechanical, chemical, electrical and electronic processes on the flow of materials.

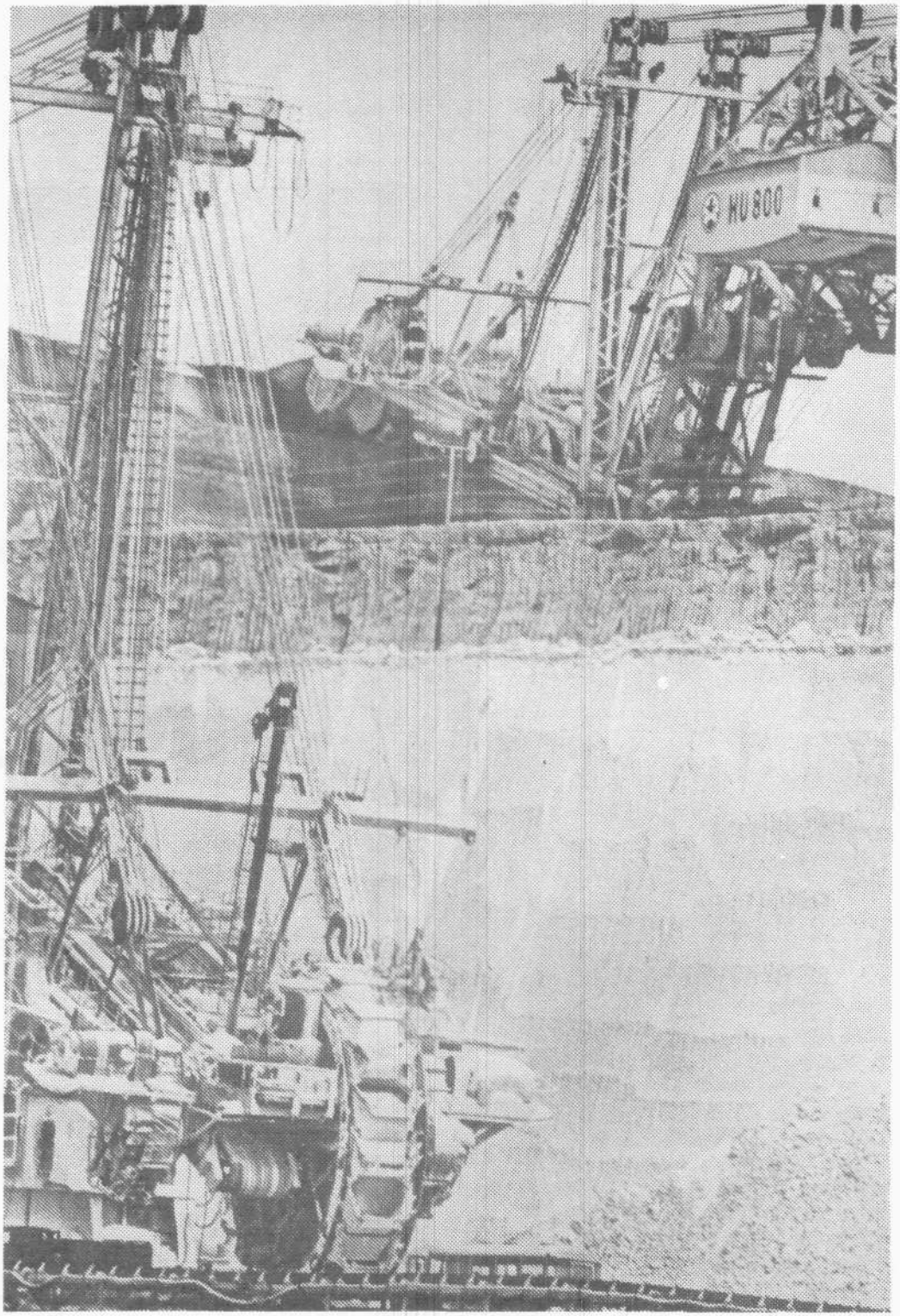
Through appropriate educational programs, attention will shift from individual objects, as was the tendency in earlier studies on mechanics, onto *processes* as primary. Included usefully in this phase of study will be the theory and technique of measurement and control, thermodynamics and hydrodynamics, and other relevant areas of natural sciences. Here again, the interaction between theoretical instruction and the operation, expansion and improvement of industrial facilities will play a key role.

Phase 4: This is the phase of independence; the inhabitants of the nuplex will no longer need the help of foreign experts. In this phase the industrial processes will be thoroughly harmonized, and gaps and "bugs" removed from the production chain. The machine and instrument manufacturing sector especially will be expanded. Special machines, machine tools and measuring instruments, suited specially to the demands of the nuplex, will be developed and manufactured. The nuplex will develop its own plant construction industry, offering its rich experience to the world market in materialized form, and assuming responsibility for the further development of the nuplex itself. Instruments, control systems, electronics and

automatization technologies, as well as the construction of scientific laboratories, will assume ever greater importance.

The most highly developed sector of the labor force will organize itself into technical and scientific societies, to further cooperation in scientific research and the development of new technologies. Fundamental research and studies of epistemology will now become the basis for the further education of these advanced cadres.

The opening of nuplex exports to the world market, and increased orientation toward the latest scientific and technical progress all over the globe, will lead to an intense development of new ideas and projects, laying the ground for the future self-subsisting development of the nuplex. It is not to be expected that people who have experienced and taken part in a rapid transformation of their whole environment over a twenty year period, will suddenly prefer stagnation. No, they will desire further progress, and work toward realizing their own experience in developing other parts of the world. This will be the real "debt repayment" to the industrial nations, on whose initiative the construction of the industrial nuplex has to depend.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"If mankind were ever to loose the use of the metals, then every possibility to provide and to obtain health, and to lead a life appropriate to our culture, would also vanish. Without the metals, men would lead the most horrible and miserable lives, even worse than those of the wild animals. Such an existence would be completely unworthy of man's best and most beautiful gift from nature, his faculty of reason."

(Georg Agricola, Vom Berg- und Hüttenwesen,1556)

Mining in Africa

Helmut Böttiger

Raw materials, the starting point for all industrial processes, must necessarily play a crucial role in any development scheme for the African continent. In the following we shall give, first, an overview of Africa's potential as a raw materials supplier to the world economy; second, the demands which Africa's own industrialization will place on raw materials supplies; and third, what investments are necessary in the raw materials-producing sector of Africa, to meet both internal and external demands in the coming decades.

Africa's Potential as a Raw Materials Supplier

It appears very likely that Africa will become *the* raw materials supplier of the future. Not only does the African continent contain 25 percent of the total land mass of the earth (excluding areas covered continously by ice), but the particular geological structure of the continent promises vast mineral deposits, waiting to be found and exploited. The African plate is

remarkably old and stable, and the geophysical processes by which the continent developed were especially favorable to the formation and preservation of high-quality deposits.

Nevertheless, the mineral exploration of most African regions has until now been minimal. During colonial times prospecting was mainly oriented towards diamonds, gold and other precious metals. Even though other minerals were later included, the results of explorations were not always put at the disposal of the population and relevant governments.

The case of South Africa is indicative of Africa's mining potential. A well-known expert in South African mining has estimated that the raw materials output of that country can be quadrupled, given a more thorough exploration of just the southern regions. (1). If the standard of mining and exploration work in South Africa today were extended to the entire African continent, the results would be even more dramatic (see Figure 1).

Figure 2 shows that already today, Africa plays an important role in world mineral supply; this is especially the case for diamonds, gold, cobalt, platinum and vanadium. Recently discovered deposits promise to add uranium to this list; the same is true for chromite, while African magnesium is decreasing in importance due to large discoveries in other parts of the world (especially under the oceans).

Even today, there is a sizable gap between known African deposits, as a percentage of total world reserves, and African mining output (see figure 3). For example, Africa holds 50 percent of world bauxite reserves, but delivers only 15.2 percent of world production. Thus, African production could be greatly increased even without further prospecting, given favorable market and other conditions.

Estimated Optimal Mining Capacities for the Year 2000

Africa's mining industry faces two basic types of demands: it must meet the growing consumption of Africa's own industries, and it must also deliver raw materials to the advanced sector in return for imports of capital goods. It is important to realize that the increase in advanced sector exports to Africa will also raise raw materials consumption levels in the industrialized countries.

In the case of iron ore, we estimate for the year 2000 a yearly consumption of no less than 480 million tons for the African steel industry alone, an amount far exceeding present production, which is mainly exported. New mines with a total capacity of more than 400 million tons of ore per year will have to be opened, requiring large investments in construction and related infrastructure. This does not include exports to Europe and the U.S. which will remain important both as a source of income and, more importantly, as a means of exchange for coal.

Apart from some deposits found in Algeria (near the Moroccan border) and less important reserves in Nigeria, Africa's main coal deposits are in the mountains of South Africa. Total coal reserves in Africa are estimated at 52 billion tons. This would be enough to supply the African steel industry, which according to our estimates will have a yearly coal consumption of 200 million tons. Even if present South African export capacities are increased from the present 12 million tons per year to a possible 90 million tons, however, West African steel mills will most likely get their coal from Europe and North America. Exchanges of coal for iron ore would cheapen both commodities considerably; we envisage iron ore exports of approximately 100 million tons per year around the turn of the century.

In addition to iron ore and coal, modern steel-making requires a number of special metals for use in alloys. Africa is already a leading exporter of such alloy metals as manganese, chromium, nickel and vanadium. Based on our projection of an African steel production of 320 million tons per year by the year 2000, internal African demands for these metals will amount to 12 million tons of manganese, 4 million tons of chromium, and 10,000 tons of vanadium annually. This means that manganese and chromium production will have to be considerably increased.

Two other metals will play a key role in the industrialization of Africa: aluminium and copper.

Figure 1 SOUTH AFRICA'S SHARE OF MINERALS AS PERCENTAGE OF WORLD PRODUCTION (1974)

Gold	70%	Uranium	16%
Vanadium	50%	Copper	10%
Diamonds	35%	Asbestos	9%
Chromium	34%	Lead	6%
Platinum	30%	Flourspar	6%
Manganese	21%	Zinc	6%
Antimony	21%	Tin	2%

Figure 2 AFRICA'S SHARE OF WORLD PRODUCTION OF KEY MINERALS
1,000 metric tons (1976)

Country	Chief producing Countries in Africa	World	Africa	%
Diamonds	Zaire, South Africa	40	29	72
Gold (in tons)	S.A.R.,Zimbabwe,Ghana	1 240	760	61
Cobalt	Zaire,Zambia,Morocco	26	14	54
Platinum(in tons)	S.A.R.,Ethopia	186	84	45
Vanadium	S.A.R.,Namibia	24	11	45
Chromium ore	S.A.R.,Zimbabwe	8 611	3 017	35
Manganese ore	S.A.R.,Gabon	24 759	8 194	33
Uranium ore	S.A.R.,Niger,Gabon	27	7	25
Phosphate rock	Morocco,Tunisia	106 931	25 781	24
Copper	S.A.R.,Zambia,Zimbabwe, Zaire	7 921	1 477	19
Antimony	Morocco ,S.A.R.	69	12	18
Bauxite	Guinea, Ghana	80 492	12 251	15
Mercury	Algeria	8	1	13
Asbestos	Zimbabwe, S.A.R.	5 055	578	11
Tantal (in tons)	Zaire,Zimbabwe,Ruanda	390	43	11
Oil	Nigeria, Libya	2 925 815	268 423	9
Iron ore	Liberia,Mauritania,SAR	878 000	71 300	8
Nickel	S.A.R., Botswana	779	51	7
Beryllium(in tons)	Zambia,Zimbabwe,Ruanda	2 800	177	6
Tin	Zaire,Nigeria,S.A.R.	212	13	6
Zinc	Zaire,Namibia,Zambia, S.A.R.	6 025	292	5
Lead	Morocco ,Namibia,Zambia, Tunisia	3 520	142	4
Natural gas (bio m^3)	Algeria, Libya	1 372	15	1

Both are needed in large quantities for the electrification of the continent. In addition, aluminium is an essential construction material, among other things for a wide variety of household utensils which will be manufactured in Africa. Accordingly, the next decades will see a vast increase in the demand for these two metals; rough calculations of the sort carried out in the chapter of the African steel industry lead to a copper consumption of 3 million tons and an aluminium demand of nearly 12 million tons for the year 2000.

This means a *tripling* of present African copper production and a *quadrupling* of present bauxite production — *not* counting exports!

In addition to supplying the metallurgical industries, African mining will have two other major customers: the chemical industry and the construction industry. The requirements of the chemical industry are discussed in a separate chapter; as for the construction industry, a simple calculation based on the demands of housing construction alone leads to astonishing figures. In the year 2000 there will be approximately 815 million people in Africa. Calculating 20 square meters of floor space per capita (equivalent to approximately 50 sq.m. of constructed surface per capita) and 75-80 kg cement and 363 kg of other construction materials (steel, glass, etc.) per m^2 of erected surface, we arrive at a total of 210 million tons of limestone, 50 million tons of clay and 500,000 tons of gypsum in yearly consumption between now and the year 2000. This does not count an additional 600 million tons of various other construction materials which will have to be produced and transported yearly as part of the housing construction program. The construction of roads, public buildings and factories will at least double these amounts.

With its huge mineral reserves, Africa will not only be able to meet most of its own needs; it will also be a major supplier of raw materials to the rest of the world, including other developing

Figure 3 KNOWN WORLD RESERVES OF KEY MINERALS (1977)
in 1000 tons

Mineral	World Reserves	Western Reserves	African Reserves	%*	%**
Antimony	6 000	1 666	300	5	18
Asbestos	180 600	130 214	14 450	8	14
Bauxite	24 359 000	23 750 000	12 335 000	50	51
Cesium (in tons)	54		16	30	
Chromium ore	3 813 760	3 698 200	3 661 210	96	99
Cobalt	1 443	1 143	606	42	53
Columbium	12 000	12 000	1 130	10	10
Copper	417 715	344 000	53 480	14	17
Diamonds (carat)			734 000 000	97	99
Fluorspar	132 140	118 590	46 250	35	39
Gallium	109		45	41	
Garnet	2 040	1 580	916	45	58
Gold (in tons)	32 300	26 600	18 860	57	71
Graphite	9 100		916	10	
Iron ore			25 000 000		
Kyanite	308 090	229 500	107 831	35	47
Manganese ore	6 566 000	3 910 000	3 480 000	53	89
Nickel	98 063	71 660	18 632	74	77
Platinum group	40	34	33	83	98
Potash			18 140	.1	.1
Soda ash			120 600	.1	.1
Sulfur			20 330	1	1
Tantalum	75	70	50	67	72
Titanium	130		42	31	
Vanadium	16 000	8 628	7 765	49	90
Zirconium	25 000		6 218	24	
Clay	87 900 000		5 275 000	6	
Coal			52 000 000		
Gypsum	1 810 000		72 560	4	

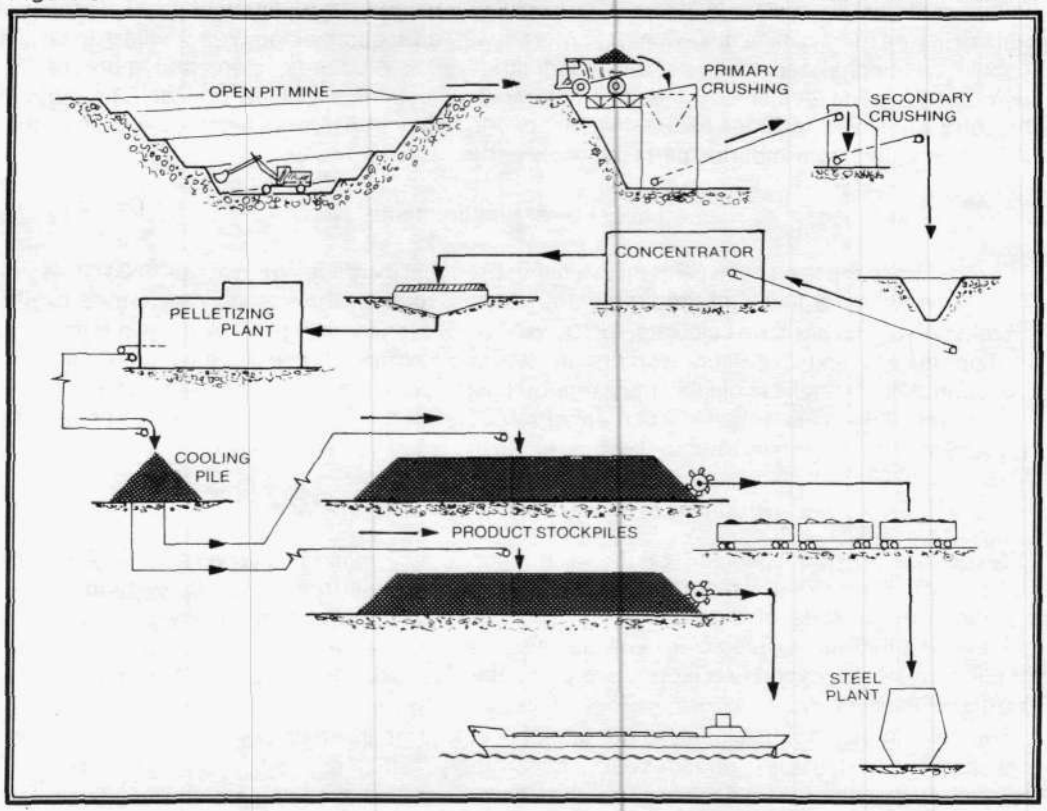
* African reserves in % of world reserves
** African reserves in % of western reserves

Figure 4 PROJECTED DEMAND OF MINING CAPACITIES IN AFRICA IN THE YEAR 2000 (in 1,000 tons)

	Minerals	Internal Demand	Export Potential	Required mining Capacities	Present Production
1	Coal	200 000*	80 000	150 000	12 000
	Iron ore	480 000	100 000	580 000	71 300
2	Manganese ore	12 000	14 000	26 000	8 200
	Nickel	300	200-500	500-800	51
	Vanadium	11	13	24	11
	Chromium ore	4 300	13 700	18 000	3 000
	Copper	3 000	1 500	4 500	1 500
	Bauxite	48 000	26 000	74 000	12 200
	Uranium ore	18	0	18	7
	Platinum (in tons)		295	295	85
	Cobalt		47	47	14
	Tantal (in tons)		500	500	40
3	Phosphate rock			160 000	25 781
	Fluorspar	1 500	1 000	2 500	575

*including imports from Europe for West and North Africa

Figure 5 SCHEME OF A MINE



regions whose raw materials requirements will rise rapidly as world-wide industrialization proceeds. It is reasonable to expect that Africa's contribution to world raw materials supplies will correspond roughly to its percentage share of world reserves. Figure 4 shows estimates of total world demands for basic raw materials in the coming twenty years.

Future Investments in African Mining

The opening of a new mine is a difficult and time-consuming process; normally 9 years must be calculated from project commencement to the marketing of the first tons of ore. Depending on the geographical area, exploration projects can cost up to 20 million dollars, with only 1-3 projects out of every 100 leading to a functioning mine. Therefore, in view of the massive expansion of mineral production which African development will require in the eighties and nineties, exploration work must begin as soon as possible, and be aided by the most modern prospecting technologies, including the use of satellites.

Investments for mine construction and equipment differ according to the concentration of the ores and local soil and rock conditions. The lowest investment costs, 30-40 dollars per ton per year installed capacity, occur where wheel excavators can be employed with capacities up to 24, 000 sq.m. per day. Hard rock mining, assuming a high ore concentration and good mining conditions (and in most cases of iron ore mining) requires investments of 200-500 dollars per ton per year capacity. When ore content is low, investment costs can shoot up from several thousand dollars to as much as 35,000 dollars per ton installed capacity. On the basis of the figures given in Figure 4, investment costs for installing needed mining capacities up to the year 2000 will be distributed roughly as follows: 64 billion dollars for mines of the first two categories and 42 billion dollars for the mines of the third category. Calculating infrastructure investments as the typical 25 percent of mine investments, the construction of necessary infrastructure for this mine development program will run at approximately 26.5 billion dollars. It should be emphasized that as African industrialization proceeds, more and more of the necessary mining equipment and other material investments will be provided by African industry itself. This includes mining machinery and heavy trucks, which can be assembled in African factories from imported parts relatively early.

Labor Power Requirements

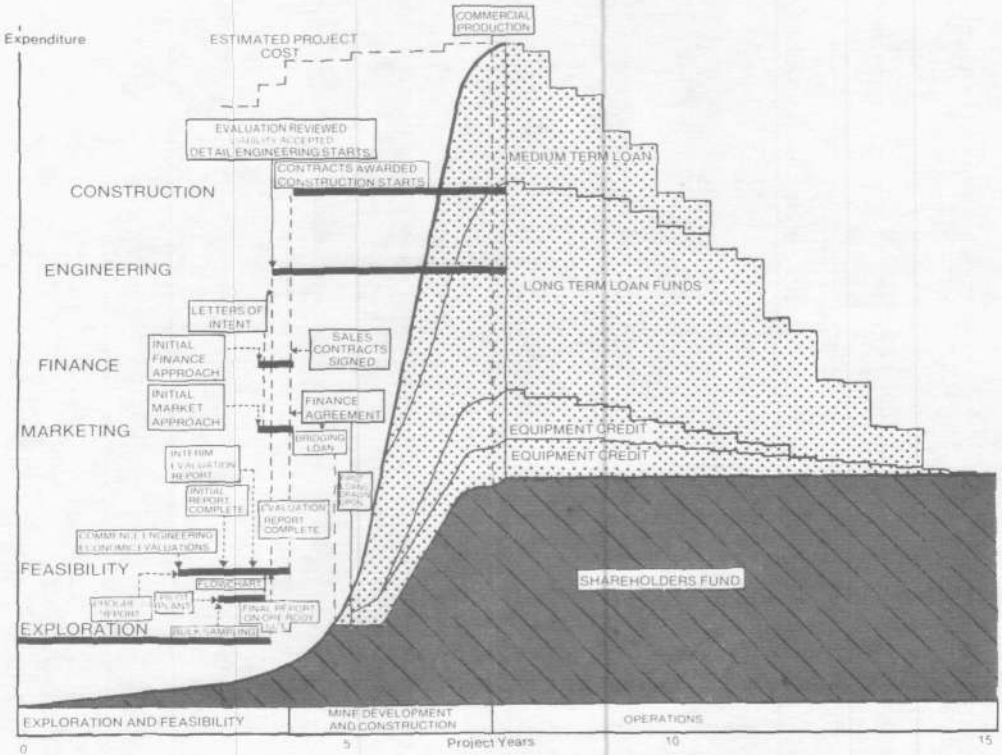
According to the level of investment in a mine, productivity ranges from about 10,000 tons per worker and year for mines of the first type, to 4, 500 tons for the second and 55 tons for the third type. On this basis we calculate, for the year 2000, a total workforce in African mining of 1.6 million miners and 1 million workers in the ore treatment plants (e.g. production of concentrates). Of these about half must receive basic education in the physical and mechanical processes of the mine. Roughly 8 percent of the workforce will require a specialized scientific education at the university level.

Problems of Mining Sector Expansion in Africa

Given the present condition of the world economy, mining is a very risky field for investment. Even given a rapid economic upswing, risks will remain relatively high in the coming year. In spite of this, and in spite of the very large capital required, the mining expansion program outlined here will be extremely profitable; even given present price conditions, mining exports receipts could amount to approximately 45 billion dollars yearly by the end of the century.

The costs of mining development will be especially large in Africa due to the initial lack of transport and industrial infrastructure. Accordingly, efficiency must be maximized by centralized planning of each mining operation and integration of mining projects within overall

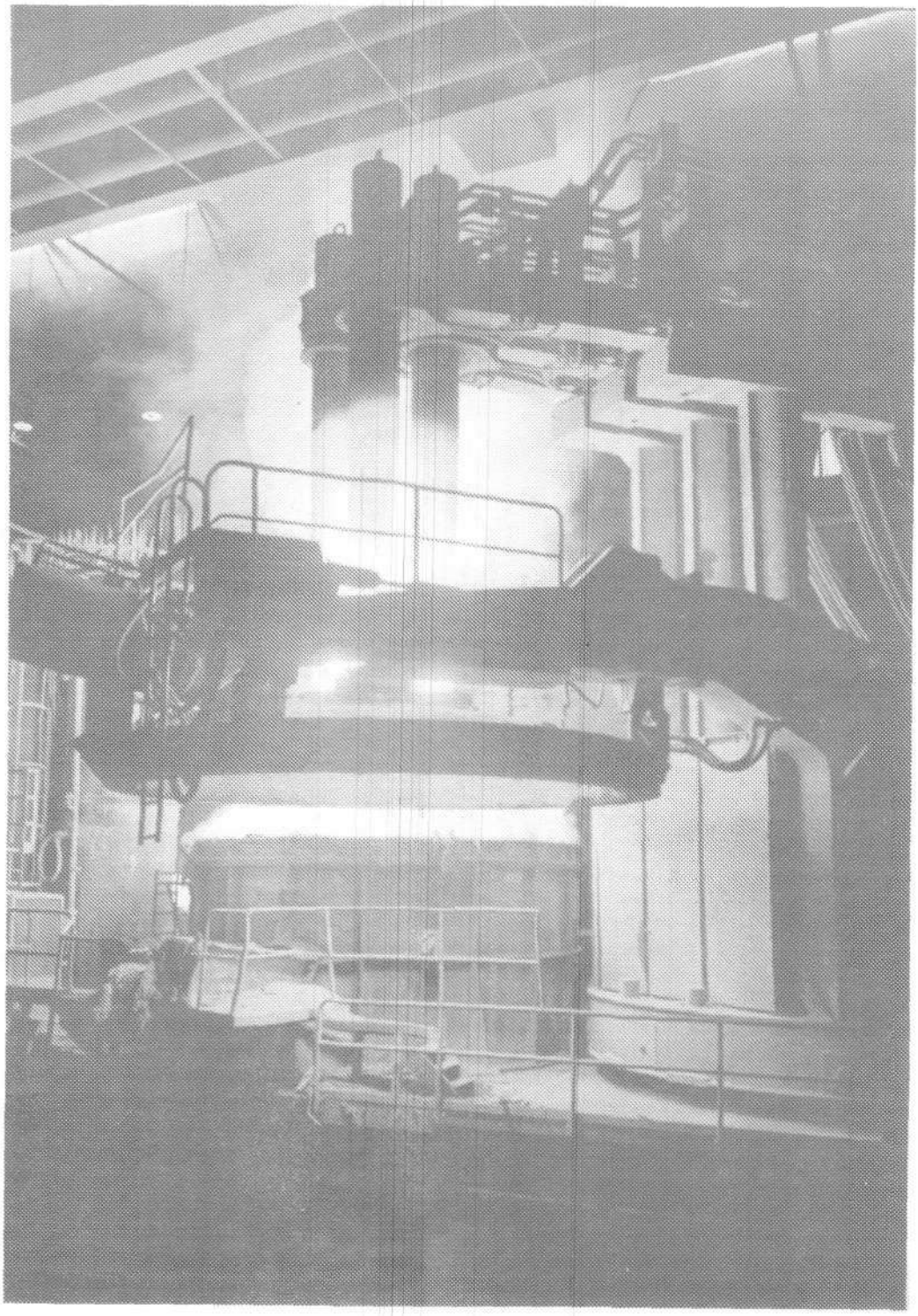
Figure 6
MINE DEVELOPMENT AND FUNDS DEPLOYMENT CHART



regional development plans, especially with respect to infrastructure, the energy grid and the siting of industrial centers. We recommend the formation and further consolidation of regional, transnational mining commissions for large regions of Africa (e.g. North Africa, West Africa etc.) The site of such a commission, which would coordinate all aspects of mining development and operation in the given region, should coincide with a major university, where the scientific aspects of mining processes can be studied and new technologies developed. Such a combined mining commission-university should also include an institute responsible for all geological studies and prospecting of the region. In addition, a central maintenance station for the heavy mining equipment of the region should be established. From here trouble shooters could be dispatched by plane to any trouble spot in the area. Such a center should also serve to mediate the introduction of new technologies into the African mining industry.

Notes

(1) P.L.Lloyd: Mining and Development in Africa, Johannesburg 1977.



"Priority list of preconditions for industrialization: Knowledge and skills. And once more knowledge, skills and experience. Then in addition some iron and steel. Plus cheap domestically produced electricity."

(Jamshedji Tata, Indian industrialist, 1876)

Steel for the Development of Africa

Helmut Böttiger

"As steel goes, so goes the nation" — this old saying is still true today, and it is true for the developing countries in particular. It has also been said that steel is the "key to power". This may be true, but it is more important to realize that steel is the key to industrialization, economic development and a better future for the inhabitants of any region. Hardly any productive investment can be conceived which does not involve steel directly.

Today most steel consumed in industrial development is produced by the "Three Giants in Steel": Japan, the Federal Republic of Germany, and the U.S.A. In a process of rapid industrialization of the developing sector, a vast demand for steel will be created, which could not possibly be met by the "Three Giants" alone. Hence, the creation of huge steel complexes all over the developing sector is not only desirable, but is a necessary precondition for the success of the New World Economic Order. As the developing countries become self-sufficient as a whole in basic steel production, today's advanced sector steel industry must take up new challenges. The placement of the first orbiting smelting furnace, the Soviet "Splaw 1" outside

the gravitational field of the earth, a major step towards the production of entirely new materials of vital future importance to the world economy, shows in what direction such tasks will be located.

I. What Steel Production Capacities Must Africa Develop?

As the United Nations Industrial Development Organization (UNIDO) correctly declared at the 1975 Lima Conference, it is totally unacceptable that 70 % of the world's population contributes only 7 % of the world's production of industrial goods. UNIDO concluded with the demand that at least 25 % to 30 % of world steel production should come from the developing countries. Significantly, however, UNIDO presented no real argument against 40%, 50% or even 70%, instead of only 30 % (1). There are also great divergences in estimates of future world steel demand; some predict that global steel consumption will rise from 710 million tons in 1974 to 900 million tons in 1980 and 1.1 billion tons in 1985, while projections for the year 2000 range between 1.4 and 1.75 billion tons. Accordingly, Third World production is projected at between 350 and 525 million tons for the year 2000.

Our program for the African steel industry, on the other hand, is based on a strictly scientific approach. Taking the requirements of real economic development in Africa as the point of departure, we first study the relationship between quantity and quality of steel production and level of industrialization in existing and historical cases. Then we determine which parts of the steel "menu" required for African industrialization can suitably be produced in Africa during the coming decades, and which will have to be imported for a long time. Next, we look at the steel required for various essential goods and infrastructure as the basis for formulating an optimal steel production plan for Africa.

The General Structure of Steel Consumption

Per capita steel consumption in the world differs very greatly according to region (Figure 1). If we look at the steel "menu" of the most advanced countries, such as the U.S. (Figure 2) whose economy has a very high "steel content", we find that special steel for machine tools and other highly sophisticated equipment make up only 16 % of total steel output. Most of the remaining 84 % is rolled into rails, pipes, wires, sheets, plates and similar products. This trend can be expected to continue in the future. Figure 3 further illustrates the relative quantitative importance of construction materials, transport equipment, containers, pipes etc. in the steel "menu" of an advanced sector economy. The most important conclusion to be drawn from this, for our purposes here, is that the bulk of advanced sector steel output is processed by rolling mills — plants which can easily be established and operated in Africa as part of a basic steel industry.

Steel Requirements for Development Projects

Given the relative lack of infrastructure, modern housing and industrial plant in Africa, and given the large area of that continent relative to the population, per capita demand for steel for infrastructure and construction will actually be *higher* there than in many industrialized countries. Figure 4 should give a sensuous picture of what enormous quantities of steel Africa will require, in terms of specific applications, in order to build the foundation for an industrial economy. The list includes only such products for which relatively simple steel processing is required.

Such data show us that, given a process of rapid industrialization of the Third World, the steel demands of the African economy will far exceed both the amounts which reasonably could be imported from the advanced sector, and the production envisaged in existing steel expansion plans of African countries (see Figure 5). Taking into consideration the good iron ore supply situation of Africa, and other parameters for the establishment of a large steel industry in Africa within the context of nuplex-centered industrialization, we envisage a total African steel

Figure 1 PER CAPITA STEEL CONSUMPTION IN VARIOUS COUNTRIES (kg/cap)

Country	1971	1974
France	429	472
West Germany	607	595
E.E.C.	443	477
USA	617	680
Japan	551	688
Soviet Union	471	546
South Africa	223	213
Africa (average)	32	31
World (average)	164	173

(Source:UN-statistics and IISI)

Figure 2 US SUPPLY OF STEEL MILL PRODUCTS (in % of total supply)

Products	1955	1970	1973
semi-finished	5.3	5.4	5.5
shapes, plates	14.1	16.4	15.4
rails	2.5	1.6	1.4
bars, tool steel	15.9	16.1	15.4
pipes, tubing	11.7	9.6	8.3
wire,wire products	5.5	4.0	3.4
tin mill products	6.9	7.4	5.9
sheets, strips	38.1	39.5	44.2

Figure 3 PRESENT AND ESTIMATED DEMAND FOR US-STEEL BY END USE (iron content)

	1968	1970		2000	
	mio t	mio t	%	mio t	%
construction materials	32.0	29.0	25	65.0	30
transport equipment	30.1	26.3	23	60.0	27
industrial machinery	21.4	20.4	17	32.0	15
cans and containers	7.9	8.5	7	12.0	6
pipe tube equipment	5.6	4.9	4	11.0	4
household appliances	6.1	6.0	5	10.0	4
others	16.9	21.8	19	31.0	14
total	120.0	116.9	100	221.0	100

Figure 4 EXAMPLES OF STEEL REQUIREMENTS IN CONSTRUCTION AND INFRASTRUCTURE

item	steel/unit
pipeline, 400 mm ø	60t/km
railway line, one way, heavy rails	120t/km
waggon	20t/u
concrete bridges, 100-300 m length	454kg/m²
transmission line, 110 KV	18.9t/km
transmission line, 380 KV	53.0t/km
shed hall (textil industry)	46kg/m²
middle size hall (light machine industry)	108kg/m²
heavy hall (heavy machine industry)	454kg/m²
office building (more than 10 floors)	168kg/m²
housing (8 floors)	66kg/m²
tin for canned food	95g/can

production of 320 million tons per year by the year 2000. This figure may appear very large, but in per capita production terms, it amounts to only 400 kg/cap. year, which is still considerably below the average level which the industrial countries had reached before the onset of the depression in the late 70's (549 kg/cap.year). The figure of 400 kg per capita year should be considered a minimum for a serious industrialization process of the African continent.

II. What Technologies Should Be Used in the African Steel Industry?

The self-evident principle that new industrial plants should generally be based on the most advanced technologies available, is not sufficiently applied to the developing sector. Given that our overall approach to African development will create the financial, political and social conditions in which rapid industrialization can take place, the principle must certainly be applied to the African steel industry. So we must answer the question: what is the highest level of technology available for the construction of a large steel industry today?

In answering this question, the following criteria are essential: The chosen technology should not be oriented to the present African economic situation, but to what it could be and will be, when the process of rapid industrialization gets off the ground. We need a combination of technologies which is as efficient as possible, with maximum attainable productivity to meet

the vast demands of African infrastructure development.

Given the general paramenters of the world energy economy, the most appropriate energy source for the steel industry — the most energy-intensive of all major industries — will be nuclear energy. Assuming that the use of carbon as a reductant cannot be avoided, that technology, which allows us to use the carbon coming out of the steel production process as a feedstock for other industries, must be considered optimal.

The central focus of steel production is the "redox" process. Iron is found in nature largely in the form of iron-oxide ores. The main task of steel production is to remove the oxygen from the ore (reduction) through the oxidation of some other substance, called the reductant. Iron ore reduction takes place at temperatures of between 600 and 1100°C, with carbon, or even better, carbon monoxide and hydrogen, as the reductant.

The relative global scarcity of coal suitable for metallurgy has led to the consideration of various redox processes which do not require metallurgical coal, and especially not coke, but which instead depend on oil, natural gas, brown coal and lignite. The availability in the Middle East of natural gas ordinarily flared off in the process of oil extraction has also stimulated the development of such direct reduction processes. Besides these, there is smelting reduction and direct plasma reduction — the latter lying half-way between chemical reduction and the potentially more efficient process of direct dissociation of Fe and O atoms through ionization in a high-energy-density field.

The Blast Furnace/Basic Oxygen Converter Line

The blast furnace is basically a big shaft furnace. Processed iron ore — mainly in the form of sinter — is put into the furnace at the top of the shaft, together with some limestone or dolomite. Hot air is blown in from the bottom to burn the coke, likewise included in the furnace charge, down to CO_2. As this gas passes upward it is further reduced by coke to CO, which

Figure 5 PRESENTLY PLANNED CAPACITIES FOR STEEL PRODUCTION IN AFRICA

country	capacities (mio t/year) 1980	1985	1990	2000
Algeria	2.0	4.5	12.0	
Egypt	3.5			
Libya		1.0		
Tunisia		1.5		3.0
Morocco	1.0			3.0
Sudan	-	- (despite large ore reserves)		
Mauritania	1.0			
Nigeria	3.5			5.0
Zaire		o.25		
Tanzania	0.2			
Zambia	0.25			
Uganda	0.02			
South Africa		13.3		

(Source: Industrie et Traveaux D'Outre-Mer, Dec. 1977)

finally reduces the ore. The reduced ore flows to the bottom of the furnace, where it is let out in the form of molten pig iron. From here it runs into a mixer which maintains a continuous quality of product, and from there into the BOP converter, where carbon and other impurities are burned out of the iron by blasts of pure oxygen. The purified metal flows next to a laddle where specific quantities of other metals are added to form various alloys, and passes thereafter to the continuous casting machine. The slabs coming out of this machine go to the rolling mill for processing into semi-finished materials for the manufacturing industry.

More than 90 % of world steel production follows this process. This is due to the high productivity of the production sequence, and especially the blast furnace, which reaches capacities of 15,000 tons of liquid pig iron per day, and the BOP converter which can run 300-400 ton charges once every 12 minutes. The high productivity of the blast furnace is intimately linked with the properties of the coke employed; the coke must keep its shape and stability until the end of the reduction process, keeping the way open for the passage of gases throughout the furnace shaft.

Thus the availability of suitable coke places an effective limit on the attainable scale of this steel line. Only 30 % of world coal reserves are suitable for coking, while the remaining 70 % contains too many impurities and lack other necessary physical properties. Accordingly, modifications of the line just described have been worked out, which reduce coke input requirements by employing substitute fuels (sources of CO_2 and heat), and allow the use of low grade coal through benefication methods, including briquette charging and form coke manufacturing using non-coking coal as a main constituent.

Direct Reduction and the Electric Arc Furnace

"Direct reduction" means the reduction of iron ore in solid form by means of a reductant other than coke — mainly gas, lignite or oil. The reductant must be preheated to the temperatures required for reduction: 600-1100° C. The end product is metallic sponge iron, which can be melted down and separated from the gangue in an electric arc furnace. In addition, the sponge iron can be used instead of scrap as a temperature reducer in BOP converters, or mixed with iron ore to improve the efficiency of a blast furnace.

Figure 6 lists the direct reduction processes which, out of a total of some 40 different processes studied and developed in the last 15 years, have reached the stage of commercial applicability. Existing direct reduction plants have largely been determined by the availability of various forms of energy. As a result, 90 % of existing direct reduction plants run on gaseous reduction, with the remaining 10 % using solid reductants such as lignite.

At present, the importance of the direct reduction process is concentrated in two aspects.

Figure 7 COMPARISON OF VARIOUS REDUCTION FACILITIES

	production density (t steel/m³ capacity)	energy consumption (kWh/t steel)
rotary kiln	1.0	4 500
fluidized bed	1.5	
blast furnace	2.5	5 000
retorte hyl	3.3	4 500
shaft furnace	8.0	3 500
midrex	8.0	

Figure 6 COMPARISON OF DIRECT REDUCTION PROCESSES

Process / Item	Fluidized bed	Rotary kiln	Shaft furnace	Retort furnace	Moving grate	Electric furnace	Smelting reduction
Principle	Fine ore is reduced by fluidizing it in large quantities of reducing gas. Powdery material can be handled as a fluid.	Fine or lump ore charged into a kiln together with carbonaceous matter is reduced by the solid carbon produced.	Countercurrent reduction of lump ore.	Bath type gaseous reduction of ore in a retort furnace.	Reduction is performed using pellets containing solid reductant and utilizing partial combustion heat of the reductant.	Using solid carbon as a reductant, heating is accomplished by electric power.	Reduction after smelting.
Advantages	1. Fine materials can be handled as fluid. 2. Ease of continuous operation.	1. Reduction by oxidized flame firing is also possible. 2. Size enlargement is easy.	1. High productivity. 2. Simple construction of equipment. 3. High gas utilization factor	Same as shaft furnace.	1. High productivity. 2. Strength of charges need not be high.	Ease of operation control.	Suitable to small-scale iron making.
Problems and disadvantages	1. When reduction approaches completition, the gas utilization factor is decreased. 2. Sintering is likely to occur at high-temperature fluidized bed. 3. It is necessary to flow excess gas. 4. Low productivity. 5. Product is briquetted.	1. Excess carbon is required. 2. Recovery of sensible heat of product is not easy (cooling). 3. Formation of ring. 4. Selection of products.	1. Ore supply and discharge mechanism. 2. Smooth descent of charges. 3. Charges must be high in strength. 4. Gas composition is limited to a certain extent	Same as shaft furnace, except that equipment cost is high.	1. Constituents of solid reductant are carried into products. 2. Problems associated with desulphurization.	1. Electric power must be cheap. 2. Difficulty is encountered in enlargement of operational scale. 3. Problems associated with refractories.	1. Large quantities of industrial pure oxygen are required. 2. Problems associated with refractories. 3. Problems associated with desulphurization.
Typical examples	H-Iron process, HIB process, FIOR process.	SL RN process, Krupp-Sponge process.	Midrex process, Purofer process, Armco process, Wiberg-Soderfors process.	HYL process.	D-LM process.	Albert de Sy process, Lubatti process, Baglio-Tradardi process.	Eketorop process, Cyclo-Steel process, Jet smelting process.
Possibility of utilization of the heat of nuclear energy.	Usable for preheating of ore, production of reducing gas and preheating of circulating gas.	If temperatures above 1,500° C are obtainable, the heat can be used for heating of rotary kiln.	Usable for production of reducing gas and preheating of circulating gas.	Usable for production of reducing gas and preheating of circulating gas.	Possibility of utilization is low.	Possibility of utilization is low.	Possibility of utilization is low.

(Source: Nippon Steel Technical Report Overseas, Nr.10, Nov.1977)

First, it frees steel production from the availability of metallurgical coal. Hence, mainly countries lacking such coal and holding large reserves of natural gas, oil or lignite, are interested in direct reduction plants. Secondly, the direct reduction process is especially suited to the application of nuclear energy. Nuclear process heat can be used for the reforming of fossil fuels into reductants such as CO and H_2 and as the heat source for the reduction process itself. Furthermore, nuclear-produced electricity could run the electric arc furnace and the production of hydrogen directly from water. Using nuclear energy could eliminate carbon entirely

from the reduction process. (Presently, all direct reduction processes use fossil fuels.)

On the other hand, relative to the blast furnace line, available direct reduction processes place severe restrictions on the size and composition of the charge, which must be maintained within narrow limits. Above all, the acid gangue content must be low and the iron content as high as possible. With iron concentrations lower than 66 %, the energy consumption of the electric arc furnace is drastically increased and productivity accordingly reduced. Hence, a much more costly pretreatment of input materials is required in comparison with the blast furnace line. In addition, charge size in the direct reduction process is effectively limited to 1,500 tons per day, largely due to the fact that the elimination of coke reduces the potential gas throughput.

The fluidized bed technology will be especially important for the application of the direct reduction method; this technology will be used for the direct reduction of metallic dusts produced in the steel plants themselves; such dusts constitute a significant percentage of iron input.

Other Steel-making Technologies

Two other processes for steel production should be briefly mentioned here, even though their present stage of development does not make them suitable for large-scale application in Africa in the period covered by this program. Africa's steel industry, like that of the advanced sector, must necessarily orient itself to these coming technologies.

One is the *smelting reduction process*, pictured in Figure 8. Here iron ore is reduced by the injection of various reductants within a highly energy-dense liquid iron bath. Besides the heat created by oxidation of the reductants, hydrogen plasma arc heaters will be used. Electrodynamic pumps will move the liquid iron through a series of retorts for special treatments. At present, basic engineering problems must be solved before this process can be commercially exploited.

Even further away, but certainly of greater importance for future developments, is the *plasma direct reduction process*. Here, highly concentrated, finely powdered ore is blown through a hydrogen plasma torch with a temperature of approximately 15,000° C; the resulting "shock reduction" occurs some 200 times faster than in the normal reduction process (see Figure 9). This development will be a serious step toward the realisation of the most revolutionary breakthrough in steel technology: the direct application of fusion reactor plasmas at temperatures of several million degrees. Within such a plasma torch, materials will be ionized and immediately dissociated into their elemental components. The chemically pure elements would then be separated and transferred for further processing.

Conclusions

For the purposes of our industrialization program, we must therefore determine the role of the two main technologies presently available: the *blast furnace oxygen converter* (BF-BOP) line, and the *direct reduction/electric arc furnace* (DR-EA) line.

Based on the above outlined criteria, we find the following results:

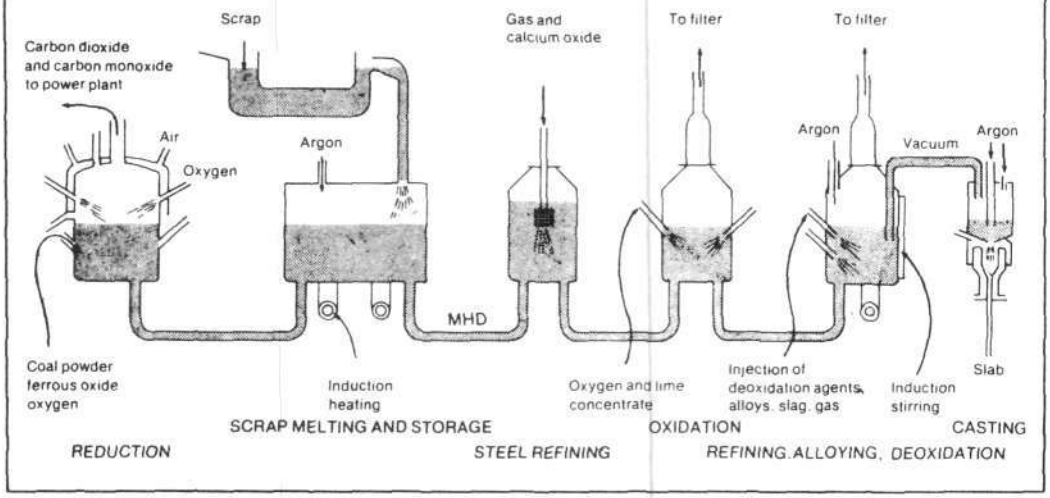
In terms of productivity and production density, the BF-BOP line is about 10 times superior to the DR-EA line; one BF-BOP unit produces as much steel as ten DR units; this has particular importance for Africa, where most steel will be of the mass-produced variety.

Although the DR line initially seems to be most suited to the application of nuclear energy, this advantage can also be gained for the BF-BOP line through a modification of the blast furnace which allows it to be used as a combination of nuclear-powered steel producer and coal gasifier.

This advance is mainly due to Prof. *Spolders* in the early sixties and *R. Jordan* in the early seventies. The basic concept is very simple: pure oxygen, instead of air heated by BF top gas, is injected at the tuyeres, with the resulting extra heat being removed by pumping in CO_2 recycled from other industries. By keeping nitrogen out of the process, the furnace gas func-

Figure 8

CONTINUOUS PROCESS LINE USING SMELTING-REDUCTION



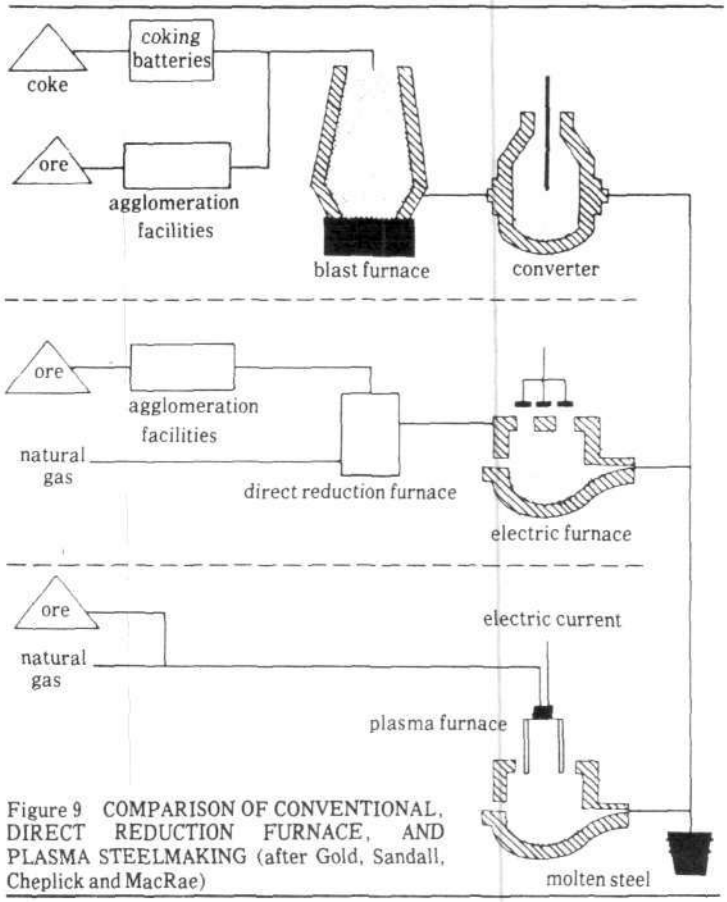


Figure 9 COMPARISON OF CONVENTIONAL, DIRECT REDUCTION FURNACE, AND PLASMA STEELMAKING (after Gold, Sandall, Cheplick and MacRae)

tions 100 % as a reductant, speeding up the whole process. Most importantly, the top gas then consists of more than 75% CO together with hydrocarbons and H, while the remaining CO_2 and H_2O can be recycled within the process.

When the required energy is provided by a nuclear reactor, the plant will function overall as a nuclear coal gasifier, delivering valuable feedstock for petrochemical and other industries. This system will have the special advantage of using the coal only as a chemical reductant, and not as an energy source. This modification of the standard BF-BOP line appears feasible for application in Africa.

Finally, it should be noted that in spite of their complexity, modern BF plants are highly reliable — generally in the order of 97% or more. Automatization has been developed so far, that in the Oita II plant in Japan not a single worker is to be found on the production floor. Such automatization potential favors the integration of steel plants in complexes of industries.

We conclude that the BF-BOP line, including the above modifications, is best suited to be the backbone of the African steel industry.

III. The integration of African Steel Plants into Nuplex-complexes.

The industrialization strategy outlined in this report is based on the use of highly concentrated development poles powered by nuclear energy and incorporating an integrated network of modern industries surrounded by mechanized agriculture. The question we now must answer is: how will steel industries fit into this scheme? First we will sketch the main features of the future African steel plants themselves, and then go on to show the materials and energy flow links between the steel plant and other industrial processes in a typical industrial nuplex (see also the chapter on Industrial Nuplexes).

A Typical African Steel Plant

The steel plant under consideration will have a yearly output of about 10 million tons of steel, in the form of slabs, sheets or profiles, and pipes. The plant will be linked to a highly efficient transport system, in order to handle the huge materials flows involved. Except when iron ore and coal deposits are locally available, the plant will be located by the sea and linked to a harbor where large ore and/or coal carriers can be unloaded.

The ore will be prepared in a large sinter plant, while the coal will be coked in a bank of 220 conventional coking chambers. If form coke is to be used, the corresponding facilities will have to be set up.

The pig iron will be produced by two large blast furnaces, each with a diameter of 14-15 meters, and then run via a pig iron mixer to two pairs of Basic Oxygen Converters, each taking a 300 ton charge. The crude steel will then pass through a laddle where further refinement takes place, and from there for four continous casting facilities to emerge in the form of slabs. These slabs will finally be processed in 8 rolling streets into the desired semi-finished and finished products.

For the processing of dusts (67.5 kg per ton of steel), a direct reduction plant will be included in the steel complex, producing 600.000 tons of sponge iron per year. This sponge iron will be used together with scrap as a coolant in the oxygen converter.

Several auxiliary facilities will be linked to this main line. Gas from the coking facilities, the blast furnace and the converter must be washed, and CO separated from CO_2 at a pressure of about 23 bar. 2 million tons per year of oxygen must be produced for use in the blast furnace and the converter. For every ton of steel produced in the plant, 190 m^3 of water must be circulated, of which 25 m^3, consumed in the process, must be replaced. The whole system will be steered by a central computer system which coordinates the microprocessors controlling each individual machine.

The highly reliable energy supply crucial to the operation of the steel plant, will be provided by a system of *High Temperature Reactors* (HTR's). These will provide process heat for the coking or form coke production units, steam and electric power for various other processes in the plant, and the energy required for oxygen separation (0.035 KWh per m^3O; see Figure 10).

Of greatest importance for the integration of the steel plant will be the further processing of the various plant outputs.

First, a wide variety of manufacturing plants will process into finished products that part of the 10 million ton output which is not immediately used in various types of construction (e.g. railroads, pipelines, etc.). In addition to the steel, some 7 million tons of liquid slag will be produced, which can be utilized as an important component in various construction materials, especially stone wool for insulation.

The key integrating link, however, will be the 12 million tons of CO which the steel plant will produce every year. This gas will be led from the steel complex via pipelines to the chemical industry, among other locations, where it will be utilized in the production of nitrogen fertilizers and methanol. The latter substance can be used as a fuel for tractors and other machines involved in the agriculture of the nuplex region, as well as a feedstock in the petrochemical in-

Figure 10 ENERGY BALANCE OF AN INTEGRATED STEEL PLANT (per 1 ton rolled steel)

	coke oven battery	blast furnace	oxygen steel plant	rolling mill
input	54.2 kWh_e 475.6 kWh_{th} 375.0 kg coal	63.5 kWh_e 126.3 kg steam 400.0 kg O_2 300.0 kg coke 150.0 kg coal 450.0 kg CO_2	80.0 kWh_e 16.5 kg steam 18.6 kg coal 47.5 m^3 O	4.7 m^3 O 0.877 Gcal nuclear process heat
output	111.0 m^3 gas =1084 kWh_{th} 300.0 coke	1200.0 kg CO 1800.0 kg liquid pig iron 640 kg liquid slag	65.0 m^3 gas =325 kWh_{th} 1080 kg steel	1 ton rolled steel

Figure 11 LABOR FORCE REQUIREMENTS FOR AFRICAN STEEL INDUSTRY (FEF-Program)

year	operating	construction	total
0	160 000		
		440 000	600 000
5	337 000		
		720 000	1 057 000
10	670 000		
		980 000	1 650 000
15	1 064 000		
		775 000	2 075 000
20	1 320 000		

dustry — particularly for the production of synthetics. The petrochemical industry will also use the hydrogen produced as a byproduct of oxygen separation in the steel complex. In addition, the combustion of CO and H will supplement the HTR system as a source of process heat for various other industries, especially cement and glass production.

Labor Force Requirements for the African Steel Industry

The education of a suitable labor force will be a major problem in the establishment of a large-scale steel industry in Africa.

Productivity per worker differs widely in the steel industries of the advanced sector. The largest steel works in Belgium, for example, produces only 200 t/man-day, compared with 255 t/man-day at National Steel in the U.S. and 524 tons /man-day at modern Japanese mills (2). Of course, productivity per man will be lower in Africa than in Japan, where a very highly educated workforce is available. We estimate a minimum of 1.6 million employees for the African steel industry in the year 2000 will be needed (see Figure 11). About 8 times that number will be employed in industries which process the output of African steel plants.

The example of the highly automatized plant Oita II shows that the labor force problem is more a question of educational quality than of quantity. A large and growing part of the steel labor force will work as engineers and skilled technicians engaged in the continuous improvement of processes and products. Even in present modern steel plants, over 22% of the workforce consists of scientists and technicians,with another 25% highly skilled workers.The remainder of the workforce not engaged in administration can be trained on the job, provided that they have been given some basic scientific background knowledge. Only a small number of unskilled workers will be needed for loading and transportation tasks not run by automatic devices.

The highly efficient processes of the modern steel plant involve flows of very large quantities of materials per unit time and includes heavy machinery functioning at high speeds. This requires precision, vigilance and flexibility in the workers, which again depend on moral qualities and a deep understanding of the plant organization.

Such aspects of required education are related to the general cultural background which must be created for the workforce in terms of music, literature, art and in terms of living conditions of the worker and his or her family. The nuplex, as a modern urban center with full cultural and educational facilities, whose population is engaged in the construction, operation and perfection of the steel complex and other advanced industries, will uniquely provide the optimal mental environment for the development of a morally qualified workforce.

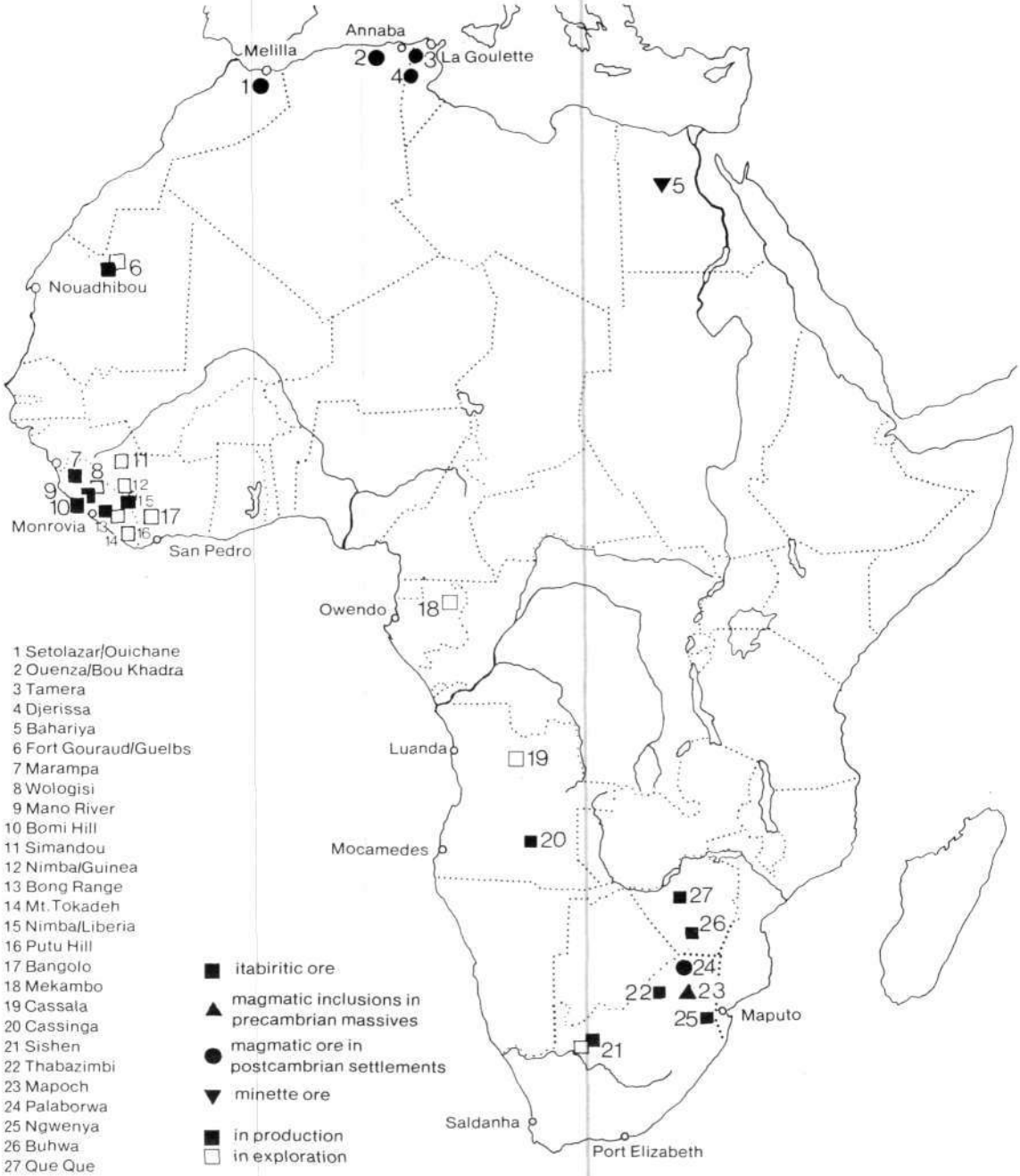
The possibility of developing a highly skilled workforce out of an originally backward peasant population in single generation has also been proven historically in the building up of the Ruhr region in Germany in the 1950's, in the establishment of the Soviet and Japanese steel industries, and more recently in the erection of large steel complexes in Southern Italy.

IV. Location and Construction

We now consider the question of how concretely Africa is to reach a capacity of 320 million tons steel produced yearly, through the establishment of large steel plants integrated into nuplex centers.

The main features of the industrial nuplex have been outlined in an earlier chapter. In considering the location of such steel-producing nuplexes, the large material flows which will be generated must be taken into account. Such nuplexes will mostly be located in coastal areas with connection to high-quality harbor facilities. In addition, the existence of iron ore mines, coal mines and limestone deposits in or near the planned nuplex region will increase its attractiveness, although modern transport systems for cheap bulk goods transport have reduced the importance of this criterion. Of greater importance will be the supply of fresh water; but even where this is lacking in sufficient quantities, desalination via nuclear energy remains a

Map 1
Iron Ore Mining in Africa



possibility. Salt and other minerals removed from sea water by these means would represent valuable raw materials for the chemical industry. (See Figure 12, Figure 13 and Map 1.)

In the chapter "Industrial Nuplexes" we present our preliminary proposals for the location of the largest industrial nuplexes (see Map of that chapter) including steel plants; they are based on geographical considerations, population structure, and to a lesser degree, raw materials availability.

The most famous example for the sort of rapid expansion of steel production we are proposing for Africa is Japan, where steel capacity rose from 6.5 million tons in 1956 to more than 150 million tons in 1976. The Japanese steel industry is presently the most modern and efficient in the world. It functions economically even though essentially all raw materials must be imported from abroad. This example shows that the establishment of an African steel capacity of 320 million tons over the next two decades is by no means utopian.

The buildup should proceed approximately as follows:

The first step must be to upgrade and expand existing African steel plants, in order to meet the initial steel demands for construction and reduce the amount of imported steel necessary for the development process. The steel industry of South Africa could be expanded to 10 million tons in the beginning of the eighties, while Helwan in Egypt expects to reach 4 million tons by 1980. In Algeria, plans already are worked out for a 10 million ton plant; construction should be initiated immediately.

Once the decision to erect an industrial nuplex in a given region has been taken, the first step in establishing the steel plant should be to import a direct reduction plant — one that later will process the dusts from the blast furnace units. A firm in Chicago offers DR plants of capacities up to 600.000 tons/year, mounted on floating platforms. The DR plant could be run on oil or natural gas, or on coking gas from installed coking chambers.

The first new BF-BOP lines will come into operation about 10 years after the initiation of the program. They will begin at the level of 4 million tons, increasing to 8 million tons 3-4 years later, and finally reaching full capacity of 10 million tons in approximately the fifteenth year of the project.

Given the vast demands on the export capacities of the advanced sector, which the provision of large parts of the necessary industrial equipment for African development will create, the nuplex cities will not all be constructed simultaneously. The first four steel nuplexes will probably be distributed as follows: one on the West Coast (e.g. Buchanan in Liberia), one at Mocamedes in Angola, another in Mozambique, and one in East Africa (e.g. Jjinga in Uganda). By the thirteenth year of the program, another 7 steel nuplexes should be running at half capacity, including one in Egypt, one in Algeria, 3 on the West Coast and 2 in Southern Africa. 10 more should come on line by the fifteenth year, and another 9 up to the year 2000, giving a total of 30 (see Figure 14).

In order to optimize the efficiency of this expansion program, and increase spinoffs for the development of other regions of the world, the construction process and plant design should become more and more standardized. In this way, steel plants could be built much cheaper, faster and more reliably than at present, without hindering the introduction of new techniques.

V. Investment

Due to the lack of a large existing steel industry and the absence of a steel plant construction industry operating on the African continent, the first stage of development will require the importation of most of the necessary equipment from the advanced sector. However, this situation will change. In Belo Horizonte in Brazil, for example, a facility for the construction of large industrial components, such as steel-making equipment, was established in the space of only two years. The facility costs only about 35 million dollars and employs 600 people. By the establishment of similar plants in Africa, the importation of the necessary equipment could be substantially reduced. In the famous case of the Rourkela plant in India, more than half of the

Figure 12 COAL RESERVES IN AFRICAN COUNTRIES
(in billion tons)

South Africa	25.0	(metallurgical)
Zimbabwe	1.7	
Nigeria	0.5	
Mozambique	0.1	
Zambia	0.07	
Africa	52.0	(total)
	27.0	(metallurgical)

Figure 13 EXISTING IRON ORE MINES IN AFRICA

Country	Pit	Reserves (mio t)	Iron Content (%)	Railway Distance to Port	Port
Morocco	Setolazar	11	54	35 km	Melilla
	Ouichane	30	60	25 km	Melilla
Algeria	Ouenza	130	45-49	187 km	Annaba
	Bou Khadra		56	193 km	Annaba
Tunisia	Djérissa	62	54		La Goulette
	Tamera	12	58		La Goulette
Egypt	Bahariya	195	49-59		
Mauritania	Fort Gouraud	136	64-68	650 km	Nouadhibou
	Guelbs	500	65	670 km	Nouadhibou
Guinea	Nimba*	?500	64	290 km	Lower Buchanan
	Simandou*	?800	64	700 km	Benty
Sierra Leone	Marampa	290	64	85 km	Pepel
Liberia	Bomi Hill	10	64-66	67 km	Monrovia
	Mano River	100	56-59	144 km	Monrovia
	Bong Range	400	65	80 km	Monrovia
	Nimba	185	63-67	270 km	Lower Buchanan
	Mt.Tokadeh	400	65	270 km	Lower Buchanan
	Wologisi*	?200	64		
	Putu Hill*	250	65	120 km	Greenville
Ivory Coast	Bangolo*	300	65	305 km	San Pedro
Gabon	Mékambo*	860	65	620 km	Owendo
Angola	Cassinga	105	62-65	555 km	Mocamedes
	Cassala*	50	64		Luanda
South Africa	Sishen I	637	67	880 km	Saldanha
	Sishen II	2-3000			
	Thabazimbi	80	62		
	Palaborwa	20	68		Maputo
	Mapoch		65		
	Postmasburg	3000	67	970 km	Pt.Elizabeth
Swaziland	Ngwenya	45	64	300 km	Maputo
Zimbabwe	Que Que	200	56-65		Maputo
	Buhwa	134	66		Maputo

*projected

construction steel (35,000 tons out of a total of 55,000 tons), of the refractories (25,000 tons out of 43,000 tons) and nearly 30 % of needed machinery for the second phase of the plant could be delivered from existing steel industry. For similar reasons, construction costs for new steel plants are relatively low in Japan.

In the case of a "greenfield" steel plant, investment cost calculations differ widely, largely due to the different plant designs chosen as the basis for the estimates. For example, P.E. Schneider of International Venture Management calculates the investment costs of an integrated steel plant at U.S. $1,400 per ton annual capacity; this is for a plant on the order of 4 million tons capacity. Japanese calculations based on capacities of more than 10 million tons yield 800 dollars per ton per year.

Taking into account the specific parameters of the African steel program elaborated above, we estimate the total investment for a 10 million ton/year steel plant at approximately 4,5 billion dollars. Total investment costs are given in Figure 15.

Notes

(1) The declaration of Lima, accepted at the II General Assembly of the United Nations Industrial Development Organisation, March 1975, ratified at the VII General Assembly of the UNO.

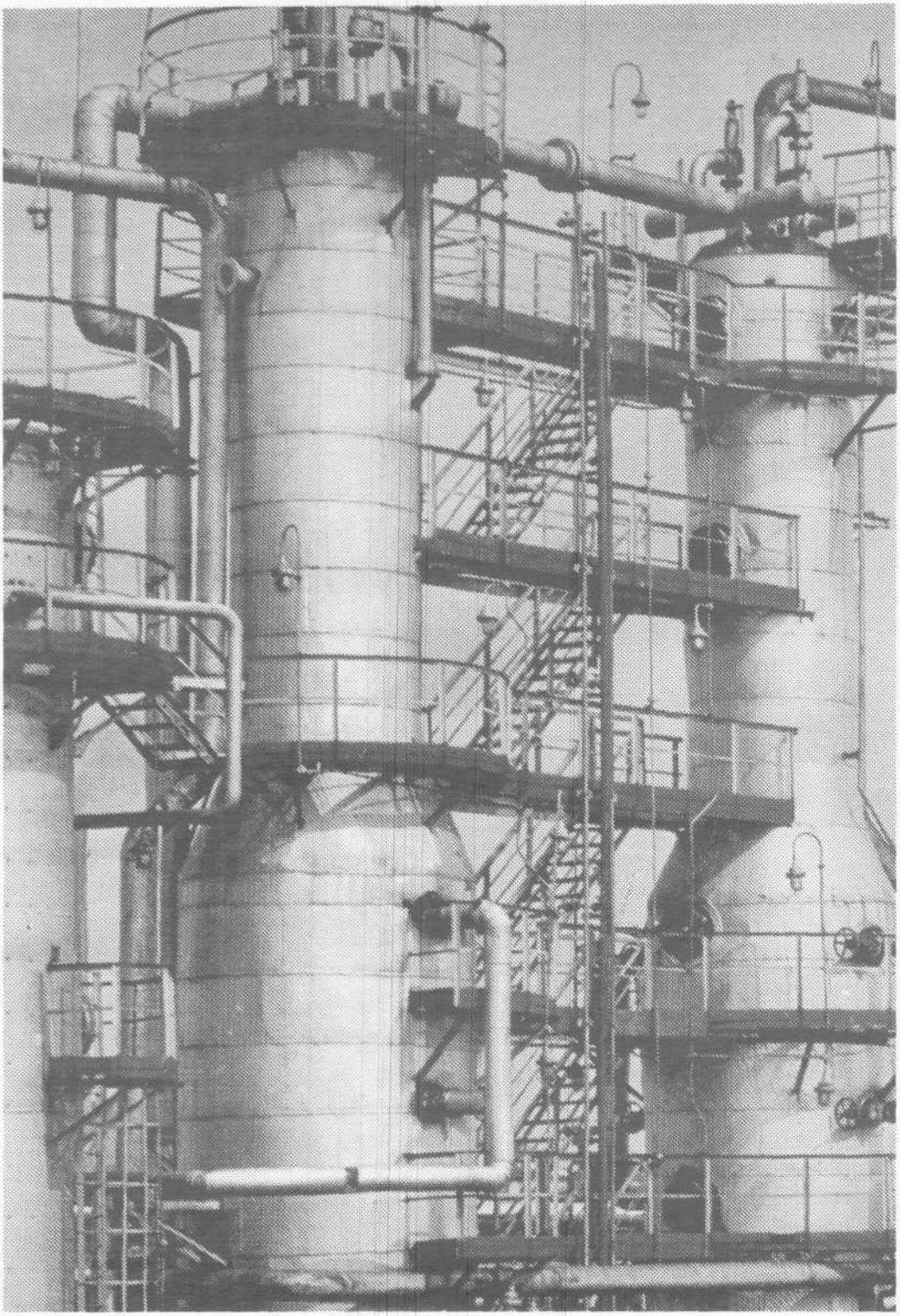
(2) In: European Community, November 1977.

Figure 14 GROWTH OF AFRICAN STEEL CAPACITIES (FEF-Program)

year	capacities (mio tons)	
	constructed in 5-year period	total, available at year indicated
0		18
5	40	58
10	70	128
15	90	218
20	110	328

Figure 15 INVESTMENT COSTS FOR AFRICAN STEEL DEVELOPMENT IN $ BILLIONS

to year	costs for imports	total costs
5	16.5	18.0
10	25.2	31.5
15	32.1	45.0
20	24.3	40.5
total	98.1	135.0



The Chemical Industry in Africa

Jonathan Tennenbaum

I. The Role of the Chemical Industry in the Development of Africa

The present high standard of living in many advanced sector countries would be impossible without a large-scale chemical industry. This is evident from a careful look at any modern household: from the food on the table, which was produced using chemical fertilizers and pesticides, the paint on the walls, the soaps, detergents and medicines in the bathroom, the glass windows, the books on the shelves, to the innumerable plastic objects, from pens and pencils to electrical fixtures and insulation, radios and television sets — all these depend directly for their production on the chemical industry. Yet, unseen are the hundreds of industrial chemicals which are consumed in intermediate steps of the production process. Over 12 tons of sulfuric acid alone is consumed yearly in industry, for every family in the advanced sector, without a single drop entering the household.

Figure 1 shows the role of the chemical industry in the hierarchy of production - together with

the primary metallurgical industries, the chemical industry forms the first layer of transformation of raw materials. The strategic role and vast material flows of the chemical sector have determined this industry as one of the most capital-intensive in the advanced countries. In order to keep the unit prices of bulk chemicals as low as possible, plants with capacities running into hundreds of thousands of tons per year are built, utilizing economies of scale and a high degree of automatization. Clearly, the same must hold for the future African chemical industry.

To get a fully adequate concept of the role chemical technology must play in the process of African development, we must go beyond the above static characterizations. Historically, the emergence of what we now call "chemical engineering" during the 19th century allowed industry to leap beyond the previous limitations, already observed by Leibniz in a comment (1), of merely assembling products and machines from the materials given by nature. With chemical engineering, the ordering process of human industry penetrates down to the "micro" level of matter, reorganizing atomic structure to synthesize substances which never before existed on earth, or never in appreciable quantities. Seen from this "invariant"standpoint, the development of African chemical industry is not primarily a matter of constructing large process plants to cover "basic needs"—rather, it is the "transfer" to the emerging African labor force of the power to deliberately transform its entire material environment, down to the "micro" level.

The example of the fertilizer industry brings the profound implications of these observations for African labor power into clear focus.

Besides water, the quantitatively most important chemical components of plant tissue are nitrogen (N), phosphorus (P) and potassium (K). Upon crop harvesting, very considerable amounts of N, P and K are thus removed from the soil, which have to be replaced to keep the land fertile. Now, while there are a number of mechanisms in the "natural ecocycle"—such as nitrogen-fixing bacteria, the decomposition of animal remains and dung, etc.—which constantly reintroduce these elements, the relatively fixed rates involved impose a slavish, bestial existence and, eventually, starvation on any population which depends on such "natural agriculture" for its subsistence. The introduction of chemical fertilizers based on N, P and K explode such Malthusian limits by accelerating the flow of those elements far beyond "natural" rates, multiplying crop yields even on good soils.

The overwhelming proof of the efficiency of science and technology to improve the existence of the human race, contained in this overthrow of the "natural ecosystem" in agriculture, is the fundamental reason why the introduction of chemical fertilizers is widely recognized as one of the most effective means for initiating a broad education process in rural populations. When the "model farm" concept is suitably combined with basic education on plant biology, tours of fertilizer plants, etc., to allow a full overview of the entire production process, the educational impact will be enhanced far beyond previous experience. This is exactly what will happen in African nuplexes.

A similar process must accompany the introduction of the other major categories of today's chemical products, especially the plastics, through to the point when Africa's own research and development capabilities begin to flood the continent with entirely new products, suited to the growing specific needs of African development (see also Section V of this chapter).

To sum up the main conclusions of the preceding discussion:

1. The establishment of a fully differentiated, large-scale chemical industry in Africa is inseparable from any dramatic overall improvement in living standards.
2. The African chemical industry must be at least as capital-intensive as that in the advanced sector today; similarly for automatization, technological level and plant scales.
3. Initially, emphasis must be on installing basic capacities for known products, based on proven technologies, to meet required Bills of Consumption for the population. At the same time, however, the revolutionizing effects of the chemical industry on the structure of the

economy and on labor power must be taken into account and exploited as a crucial element in overall development policy.

Figure 1 HIERARCHY OF INDUSTRIAL PRODUCTION

LEVEL	EXAMPLES
RAW MATERIALS	CRUDE OIL, IRON ORE, COAL, SULPHUR, ROCK SALT, PHOSPHATE ROCK, SAND, RAW COTTON, WOOD
PRIMARY PROCESSED MATERIALS	REFINERY PRODUCTS (e.g. ETHYLENE, GASOLINE etc), RAW STEEL, GLASS, SULPHURIC ACID, SODIUM HYDROXIDE, AMMONIA, PHOSPHORIC ACID, CELLULOSE
SEMI-FINISHED MASS GOODS	NPK FERTILIZER COMPONENTS, PLASTICS, ROLLED STEEL(SHEET, TUBE, PIPE and WIRE), SYNTHETIC FIBERS, ARTIFICIAL FIBERS, DETERGENTS, WINDOW GLASS
LIGHT MANUFACTURES	PLASTIC GLASS, METAL ARTICLES (e.g. KITCHEN UTENSILS, HAND TOOLS), BULK ELECTRICAL EQUIPMENT(LAMPS, RADIOS etc.), FURNITURE, CLOTHING
MASS-PRODUCED MACHINES	HOUSEHOLD MACHINES, AUTOMOBILES, TRUCKS, BUSES, TRAINS, AEROPLANES, TRACTORS, OTHER FARM MACHINERY
HEAVY EQUIPMENT	MACHINE TOOLS, STEEL and CHEMICAL PLANT COMPONENTS, NUCLEAR REACTORS
MAJOR SCIENTIFIC EQUIPMENT	PROTOTYPE PLANTS, PARTICLE ACCELERATORS, FUSION REACTORS, SPACE VEHICLES

II. Targets for the African Chemical Sector

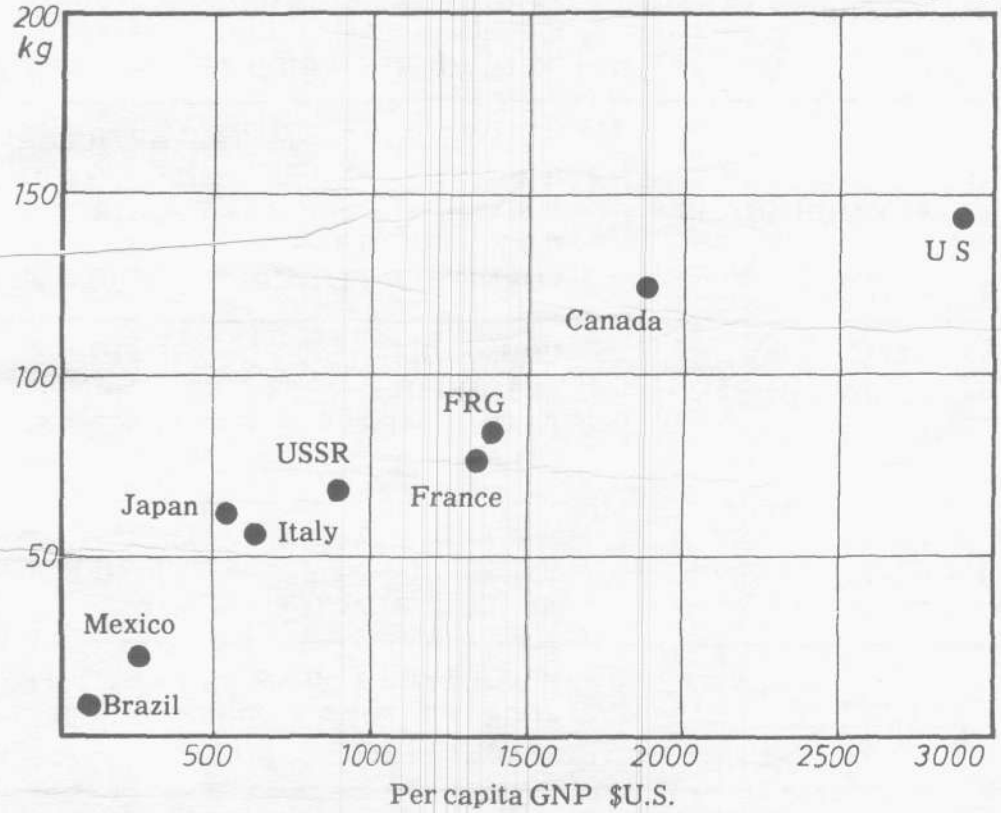
The attainment of "take-off" conditions for the African economy requires a certain minimum Bill of Consumption for African households. By working back from such consumption figures to the amounts of various chemical products necessary to produce the needed consumer goods, we obtain an estimate of the magnitudes and types of chemical industries that must be built up as first priorities in the present development program.

To accomplish this, we make use of three types of data. First, statistical correlations showing the per capita production of various chemicals in different countries as a function of living standard. Second, statistical correlations between production of various industrial sectors and the flows of chemical products to and from those sectors. Lastly, causal relationships showing how certain amounts of various chemicals are required in the production of one unit of a given product.

For example, Figure 2 shows per capita consumption of sulfuric acid (H_2SO_4) plotted against per capita GNP for a number of large countries. Although the empirical approximately linear relation is not to be taken too seriously, in view of the notorious deficiencies of GNP measurement, the pattern nevertheless reflects the enormous variety of essential uses of that substance in all branches of industry.

Figure 3 shows the use pattern of soda (Na_2CO_3) in a number of countries; the consistently large concentration on use in the glass industry reflects the simple causal relationship, that approximately 1/4 ton Na_2CO_3 is consumed in the production of each ton of ordinary window glass. Another example of direct consumption figures is given in Figure 4, where the amounts

Figure 2 PER CAPITA CONSUMPTION OF H_2SO_4



of various chemicals required for the production of a standard detergent are listed.

In applying such data to the case of the African chemical industry, it must be remembered that, first, the completely novel situation of rapid industrialization—under climatic and other conditions specific to Africa—make most purely statistical correlations, based on advanced sector experience, unreliable for more than very gross estimates. Secondly, the method of direct causal relationships is impractical in general, since many chemical products are consumed in hundreds and even thousands of different industrial processes, which would be impossible to plan out and quantify precisely.

Nevertheless, by using a combination of methods, depending on the product involved, it is possible to arrive at reasonable rough estimates of the production figures which must be reached under the assumption of the present program. The results of our calculations are summarized in Figure 5, which gives projected per capita consumption figures for basic items in the Bill of Consumption; in Figure 6, which gives per capita production targets for the year 2000 for basic heavy chemical products; and in Figure 7, which pictures the main features of the flow of chemical products to be established in Africa. Here we are considering the chemical plants of the entire continent as part of a single overall flow; the location of distribution patterns of individual units is a complicated matter, which will not be considered here.

Figure 3 USE PATTERN FOR SODA 1966 (in %)

Country	chemical industry	glass	cellulose	steel	soaps, detergents	others	total consumption (1000 t)
Finland	2	33	61	-	4	–	69
France	31	45	3	8	7	7	861
Japan	29	50	3	3	2	13	750
Netherlands	16	36	6	2	12	28	134
Sweden	19	49	14	2	4	12	117
USA	33	39	–	2	1	25	6,128

Source: OECD Publication: The Chemical Industry 1966-1967.

Figure 4
MATERIALS NEEDED FOR DETERGENT PRODUCTION

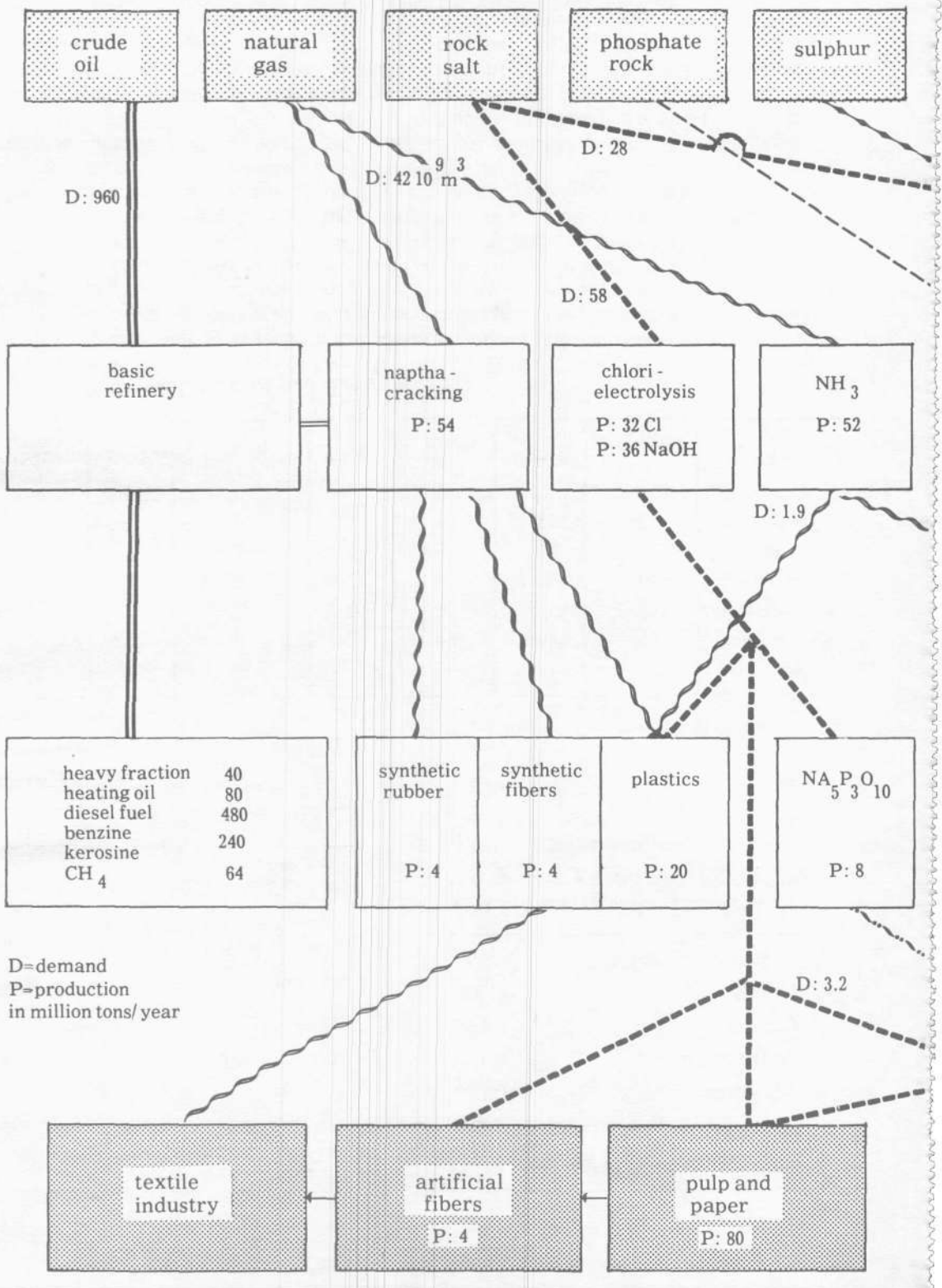
Sodiumtriphosphate	0.500
NaOH	0.200
Oleum	0.150
Sodium silicate	0.125
Alkylbenzene	0.080
Fatty alcohol	0.010

(tons per ton detergent)

Figure 5
BASIC CONSUMPTION LEVELS

Product	kg/cap-y
NPK fertilizer (average composition 2:1:1)	126
soaps and detergents (high detergent ratio)	20
cement	600
glass	40
pulp and paper	100
plastics	25
artificial fiber	5
synthetic fiber, rubber	10

Figure 7 PROJECTED



STRUCTURE OF CHEMICAL INDUSTRY

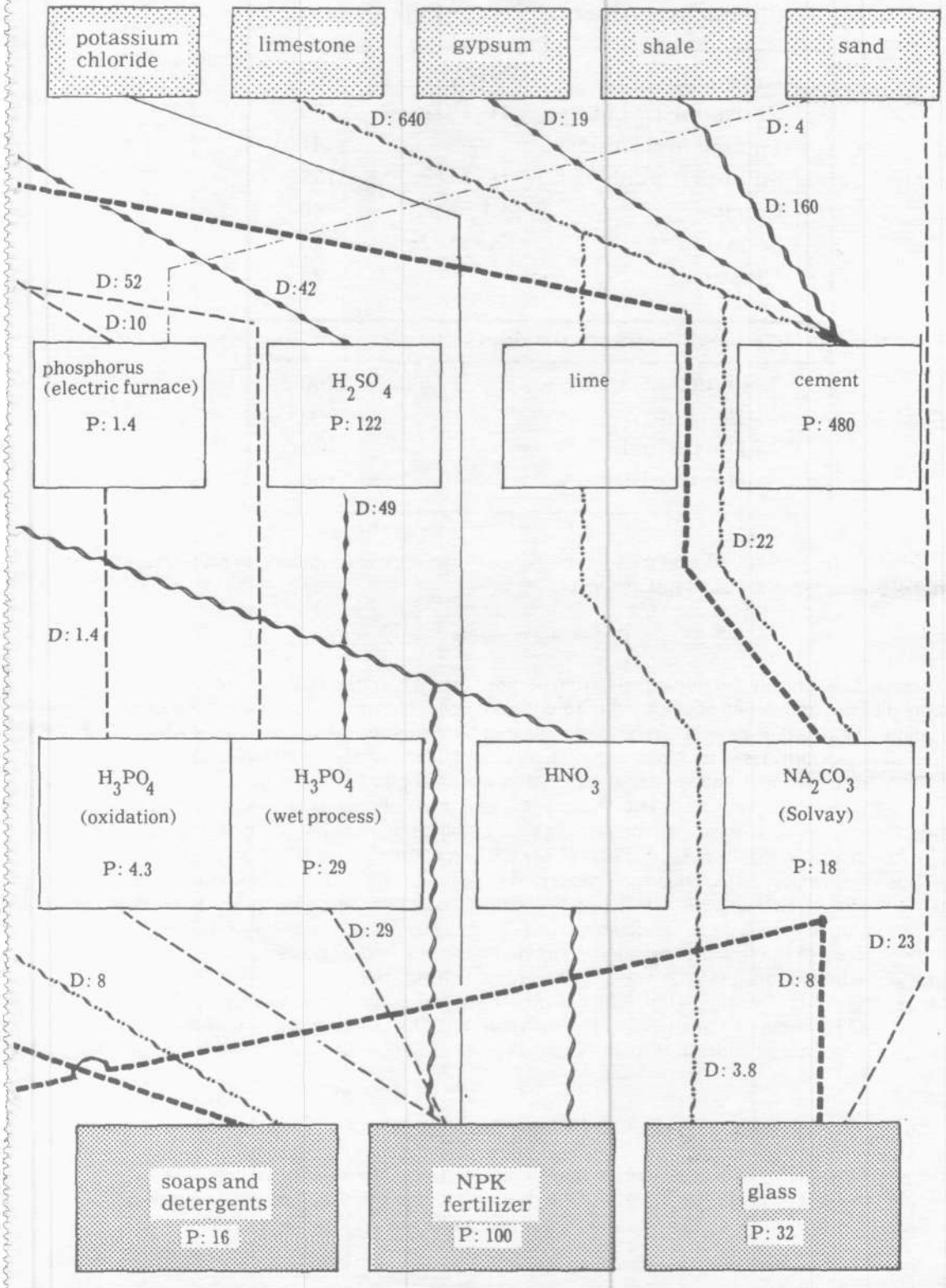


Figure 6 PER CAPITA PRODUCTION TARGET

Chemical product		kg/cap-year
Ammonia	NH_3	65
Phosphoric acid	H_3PO_4	38
Potassium chloride		41
Sulphuric acid (1)	H_2SO_4	153
Clorine	Cl	40
Soda ash (2)	Na_2CO_3	23
Plastics		25
Crude oil refinery products		
Total crude oil capacity		1200
—Benzene		300
—Diesel fuel		600
—Heating oil		100

(1) and (2) see Figure 9

In what follows we shall take up the main branches of the chemical industry, in roughly their order of priority in the African development process.

Chemical Fertilizers

There is a continually developing spectrum of more than a hundred fertilizer products, with widely differing properties and suitability to different soils, climate, crops and modes of application. The scientific selection and development of fertilizers for various regions of Africa is one of the top priority tasks for African agricultural research institutes, model farms and related facilities in the coming decades—a task which must not be aborted by the domination of world "market forces." We will not go into this matter here, but only note that complex fertilizer products, containing all essential soil additives for one-time application, will certainly play a major role in African fertilizer use, due to their simplicity and saving labor and machine time.

Almost all chemical fertilizers are composed of the elements N,P and K, bound to various "carrier" molecules, together with fillers, solidifiers, coatings, etc., for desired physical properties, together with certain trace elements needed by plants (e.g. magnesium). The basic building blocks of the fertilizer industry, ammonia, nitric acid, phosphorus, phosphoric acid and potassium chloride, and the corresponding production network, can be seen in Figure 7.

Regardless of the final forms of fertilizer produced, the relative amounts of N, P and K required can be roughly estimated from the yield levels and food production requirements set down in the Chapter on Agriculture for the year 2000; the resulting values are included in Figure 6.

Refined Hydrocarbon Fuels

Although the substitution of electricity, nuclear process heat and steam, and synthetic fuels produced using nuclear energy, in place of the combustion of oil, gasoline and natural gas, will

Figure 8 PER CAPITA PLASTIC PRODUCTION IN VARIOUS COUNTRIES (1975)

	kg /cap - yr
Fed.Rep. Germany	77.0
USA	52.0
France	47.0
Japan	40.0
USSR	11.0
Brazil	2.5
India	0.1

Figure 9

PROJECTED CAPACITY OF AFRICAN CHEMICAL INDUSTRY

Process	capacity required (mio t y)	number of plants	investment ($mio,1970)
NH_3,Haber-Bosch catalytic synthesis	53	98 (1500 tpd)	2280
H_3PO_4 by electric furnace[3]	30	45 (1800 tpd)	5500
H_3PO_4 by wet process[1]	30	45 (1800 tpd)	1872
H_2SO_4 contact process[1]	125	170 (2000 tpd)	1020
chlorine electrolysis	33	27 (2725 tpd)	4070
Na_2CO_3 Solvay process[2]	19	34 (1500tpd)	2850
basic refinery, atmospheric destillation	crude 977	65 (15000tpd)	13,024
petrochemical complex[4] with steam cracking	naphta 55	31	18,720
total			43,836

(1) Assume all phosphoric acid for fertilizers is produced by wet process; producing all phosphoric acid by electric furnace would save 30% of total sulphuric acid consumption.

(2) This figure assumes relatively small production from natural sources. However, if the vast natural soda deposits in Kenya (Lake Magadi) and other deposits are fully utilized, a much smaller Solvay capacity will suffice.

(3) Assumes all phophoric acid produced by electric furnace.

(4) The figures refer to the "standard chemical complex" formulated in Jülich studies of the application of HTR process heat, having a capacity of 1,766,000 tons per year of naphta, 656,000 t/y plastics, 133,000 t/y synthetic fibers and 130,000 t/y synthetic rubber.

play an increasing, crucial role in the Arican energy economy (see Chapter on Energy), nevertheless, the demand for refinery products will grow rapidly in the first decades of development. This will be especially due to the demands of the rapidly expanding farm machinery fleet and the development of basic transport infrastructure.

Heavy Inorganic Chemicals

As already noted in the case of soda, the consumption of basic inorganic products—sulfuric acid (H_2SO_4), chlorine (Cl_2), caustic soda (sodium hydroxide NaOH), soda (sodium carbonate $NaCO_3$)—is directly linked to the production of essential goods such as fertilizers, glass, paper, artificial fibers (e.g. rayon), soaps and detergents; these relationships are summarized in Figure 7. Here we have omitted such intermediary substances as hydrochloric acid, calcium carbide, sodium sulphate, etc., which are either losing importance as bulk chemicals in the advanced sector, or are produced in relatively small quantities compared with the bulk chemicals were are concentrating on as the basic elements of our program.

Petrochemicals

As we saw above, the saturation of an economy with synthetic materials such as plastics is an essential precondition for reaching modern living standards. Although the number of different plastics produced today runs into the hundreds and, especially to suit the specific needs of Africa, new synthetics will be constantly developed, it is likely that in the initial industrialization phases considered here the standard plastics, polyethylene (PE), polyvinylchloride (PVC), polystyrene (PS), and polypropylene (PP), will remain the basic products of the synthetics industry, together with the synthetic rubbers SBR, CPB, EPR and the synthetic fibers polyester, nylon and acrylnitril. Figure 8 shows per capita plastic consumption in a number of countries. It can be assumed that the African economy with its vast market for synthetic consumer articles, packaging materials for mass distribution of foods and other goods, for electrical equipment, etc., will require per capita plastics production on the level of the advanced sector countries like the Federal Republic of Germany today. We have chosen 25 kg/cap-yr of plastics for Africa in the year 2000, and figures for synthetic rubbers and fibers roughly in the proportions produced in the advanced sector.

III. Technology Evaluation

The technologies employed in the African chemical industry must be the most modern available which permit reliable operation of large-capacity plants utilizing economies of scale. In the initial phases of industrialization, this means the transfer of known, highly-productive technologies and basic plant organization from the chemical industry of the advanced sector. Figure 9 gives the basic plant types and capacities corresponding to the chemical network in Figure 7. Nevertheless, these technologies must be "tuned" for integration into the highly energy-dense Nuplex centers where most African chemical plants will be located. In this section we shall examine the most important technological features of the African chemical industry which will differ from those presently common in the advanced sector. The main reasons for the differences are:

1. the decreasing role of hydrocarbon fuels and increasing use of process heat and electricity
2. the high degree of industrial integration in Nuplex centers, where individual industries are adapted so as to maximize the productivity of the Nuplex as a whole
3. specific needs and problems of African development.

Electric Furnace Phosphorus

Due to the large amounts of cheap electricty which will be available from hydropower stations and Nuplex reactor parks, and due to the probable shortage of sulfur in Africa for use in the

standard "wet process" for producing phosphoric acid as a basis for fertilizers, the electric furnace technology for extracting elemental phosphorus from phosphate rock will be much more widely employed in the African fertilizer industry than is the case anywhere today (2). Besides its cheapness and economizing of sulfur, the electric furnace process has the advantage of utilizing low-grade phosphate ores, and producing a highly pure product which can be used in other industries.

Hydrogen Production

Large-scale production of hydrogen by electrolytic and catalytic splitting of water will play an increasing role in the chemical industries in Nuplex centers, both for synthetic fuels and for the synthesis of ammonia and other substances. In this way, hydrogen fertilizer production can be freed from dependence on natural gas supplies. Even with present hydrogen processes (which can be expected to vastly improve in the course of the 80s), the economics of hydrogen production for a number of industrial uses is favorable, when combined with cheap hydroelectricity or nuclear power in off-peak periods.

Integration of Chemical Industries with Other Industries in Nuplex Centers

The advantages of integrating chemical industries, already embodied in the modern petrochemical complex, will be exploited much further in African industrial nuplexes (see Chapter on Industrial Nuplexes). In addition to linking petrochemical and fertilizer complexes (through ammonia production and use), and combining caustic-chlorine and related industries with large-scale desalination and extraction of valuable minerals from sea water, technologies such as the Jordan steel process will allow the complete integration of metallurgical industries with chemical industries (see Chapter on Steel).

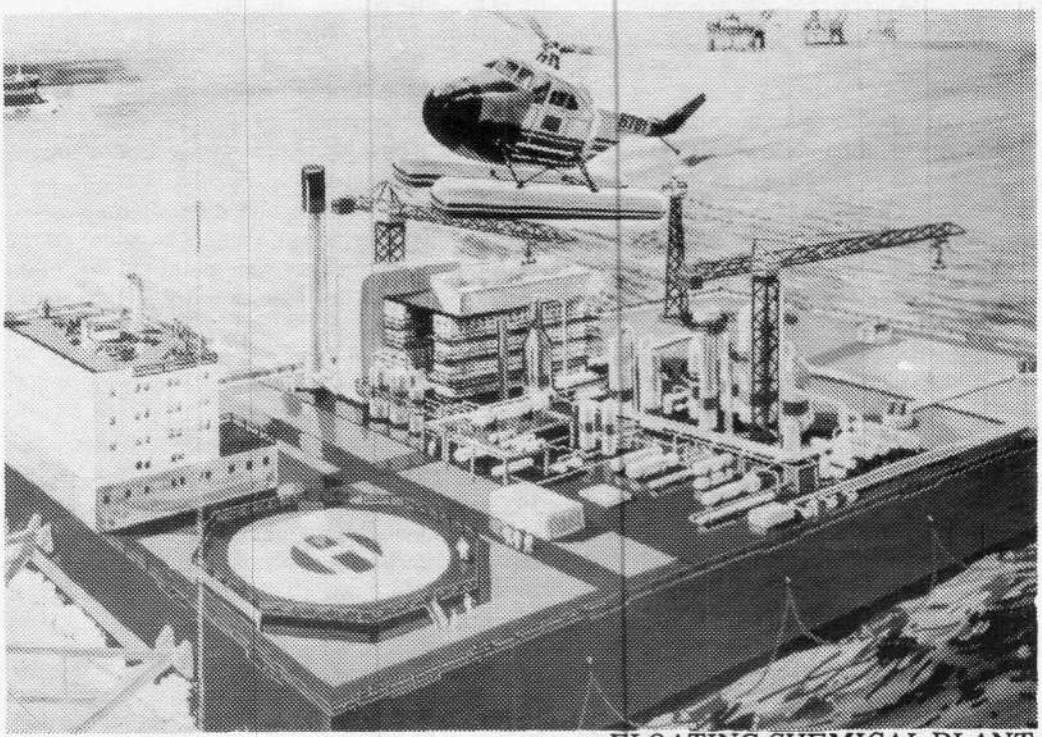


Figure 10 FLOATING CHEMICAL PLANT

The floating plant concept developed by a number of firms, especially in Europe and Japan, will be important, especially in the early phases of African development. Complete, turn-key units such as ammonia and urea plants, mounted on barges, can be assembly-line produced in the advanced sector and floated to coastal sites in Africa, alleviating bottlenecks of infrastructure, labor and construction materials which would otherwise slow expansion of these and other vital capacities in many areas. Figure 10 shows one such floating plant design, a 1000 ton per day ammonia plant designed by Haldor Topsöe. In addition to turn-key plants, larger projects such as refineries and petrochemical complexes can be assembled from large-mounted components constructed in the advanced sector.

IV. The Development Process of the African Chemical Industry

Having established production targets and technologies for the chemical sector in the first decades of the African project—estimates which have only the character of a first approximation, and will have to be revised constantly in the course of the actual development—we now turn to the process of building up the required basic capacities. Figure 11 shows a comparison between some recent production figures for Africa and those which will be required in the year 2000 according to our overall program. Obviously, a very rapid expansion indeed is required—in some cases by a factor of over 100. Nevertheless, there are relevant historical examples of such rapid development (see Figure 12). In addition, it should be noted that in spite of its relative insignificance in quantitative terms, Africa taken as a whole has a good representative selection of basic branches and processes of the chemical industry, which provides an excellent basis for building further.

The chemical industry's plan of development will follow the evolution of demand according to the overall plan for Nuplex construction described in the Nuplex chapters. Figure 13 gives an approximate timetable for the expansion of various branches of the industry.

Large chemical projects must be exploited throughout as key educational centers for African labor power. As projects are completed, part of the labor force involved will remain as operators and maintenance personel, and part will go on to further projects. In this way, the necessary labor force for the African chemical industry will be generated.

Most of the problems now apparently blocking chemical development in Africa—for example, lack of transport infrastructure, reliable energy and raw material supply, qualified labor force—are solved by the Nuplex approach. Beyond the assured markets and distribution system provided by Nuplex centers, stable regional markets, similar to those commonly developed for utilities (especially electricity), must be provided for chemical plants whose output far exceeds the absorption capacity of a single Nuplex region, or even a single country (e.g. caustic chlorine production, where a single 2725 MTPD plant corresponds to the consumption of over 30 million people at the per capita levels prescribed in Figure 6). An example of the sort of international agreements which will be required is the Andean Subregional Integration Agreement of 1969, between Bolivia, Chile, Columbia, Ecuador and Peru (3).

V. Boundary Conditions for the African Chemical Industry

To assure the adequate functioning of the chemical industry, bottlenecks must be avoided in the crucial "boundary conditions" of *labor force, energy and raw materials supply, transport infrastructure* and *repair and maintenance capability*. Here we shall summarize the basic requirements to reach the development level described in Sections II—III.

Labor Force

The African chemical industry, like that in the advanced sector today, will be run by a highly skilled, specialized workforce, working with highly automated equipment. Concepts of making

the chemical industry more labor intensive, for example by eliminating certain automatic equipment, creating more batch operations, etc., considered in various studies, are totally inappropriate to our development strategy for Africa, where there will be *shortages of all grades of labor power*. Roughly estimated, with present levels of technology, the state of chemical development projected for Africa in the year 2000 will require approximately 5 million

Figure 11 COMPARISON OF 1975 AFRICAN PRODUCTION WITH FEF PROPOSALS FOR 2000 (mio t / yr)

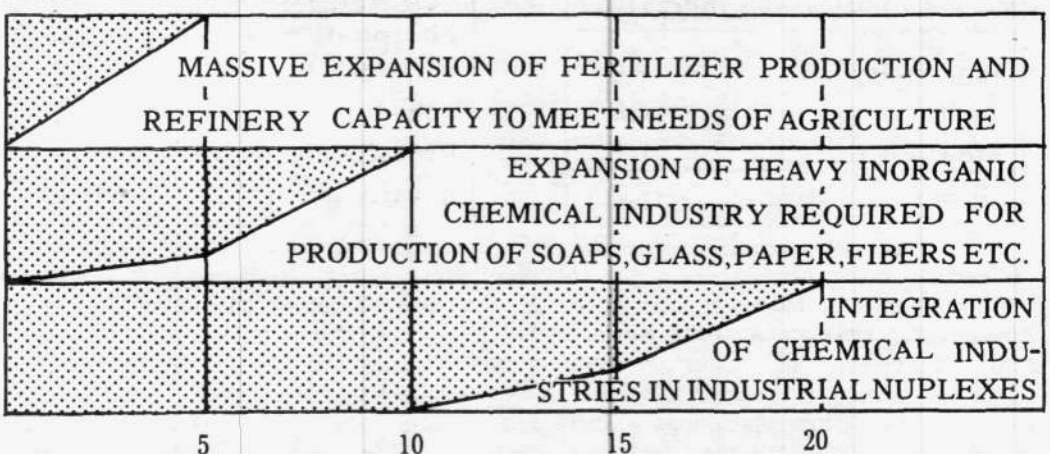
Product	1975 Production	FEF-projection for year 2000
NPK fertilizer	1.8	103
Cement	23.5	489
Sulphuric acid	1.3	125
Petroleum refining capacity	67.6	977

Figure 12

INCREASE IN USSR PRODUCTION OF BASIC PRODUCTS 1940 - 1970

Product	Production in mio t / yr		
	1940	1960	1970
Chemical fertilizers	3.2	14.0	55.0
Resins and plastics	0.01	0.3	1.6
Cellulose	0.53	2.3	5.1
Cement	5.7	46.0	95.0
Sulphuric acid	1.5	5.6	12.0

Figure 13 ROUGH SCHEMATIC TIMETABLE FOR AFRICAN CHEMICAL INDUSTRY EXPANSION



skilled workers, including plant operators, repair and construction crews, transport and storage personnel, administrators, salesmen, educational personnel, health and safety experts, etc. While this number represents only a small percentage of the total workforce available in 2000, the high skill levels required present a substantial training problem. On-job training, educational programs in the advanced sector and general use of all industrial plants as educational centers, together with an ambitious program of technical, scientific and broad humanist education in African schools and universities, must be implemented in the initial decades of development. With the growth of heavy industrial nuplex centers, a social environment will be created in which the recruitment and training of sufficient numbers of skilled workers to operate, maintain and expand chemical industry (at least at *present* technological levels) will no longer present a problem. In the meantime, various measures must be taken to reduce as far as possible the skilled labor tied up in the chemical industries; for example, by the use of elite "flying squads" of specialist trouble-shooting teams, able to service a number of geographically separated chemical complexes, and by introducing the highest possible levels of automatization and built-in reliability.

Energy

Figure 14 summarizes the energy inputs required by the chemical network, output level and capacity structure prescribed in Figures 5,6 and 7. Although the figures for the entire chemical sector, including all the specialized industries based on the products of the network in Figure 7, will be somewhat higher, Figure 15 covers the most energy-intensive, large-scale processes, and gives the right order of magnitude for the energy consumption of the entire industry. As noted above, the earliest possible integration of nuclear energy, especially the *High Temperature Reactor*, into chemical complexes is an essential element in making African chemical production cheap and reliable. If the entire energy requirements of the African chemical industry were to be provided by the electricity, steam and process heat output of 2000 MW (th) nuclear reactors, then over 100 such reactors would be required!

Figure 14
REQUIRED ENERGY INPUTS

	10^9GJ/y
electricity	1.6
heat	4.5
steam	1.1
total	7.2

Figure 15
REQUIRED RAW MATERIALS

	mio tons/year
crude oil	960
rock salt	87
sylvanite KCl 35	84
phosphate rock	64
sulphur(1)	43
coke	33
limestone	23
natural gas (in m^3)	$64 \cdot 10^9$

(1) see Figure 9

Raw Materials

In the Chapter on Mining and elsewhere, we have pointed out the difficulties in gauging Africa's actual raw material wealth. However, it is already clear that for the first quarter century of African development, adequate reserves of most materials required by heavy industry — notably phosphate rock, potash (sulvanite), rock salt, limestone, oil and natural gas, coal and water — exist for the continent as a whole. Figure 15 lists the consumption of various raw materials required by the chemical production envisaged in Figures 5, 6, and 7. The main

bottleneck which may appear is the supply of sulfur for the production of sulfuric acid; although substantial amounts should be available from pyrites in connection with copper mining, and much sulfur can be saved by utilizing the electric furnace process for phosphoric acid, large amounts of sulfur may have to be imported (see Section III above; about 30% of the sulfur production of the advanced sector goes into wet-process phosphoric acid).

As African development proceeds, and the continent is for the first time thoroughly explored, immense mineral wealth, far beyond that known today, will certainly be discovered, leading to vast mining and industrial projects which cannot be foreseen here. However, a number of important sources of raw materials for chemical production are presently known and should be developed fully; for example:

1. vast deposits of phosphate rock in North Africa, especially in Morocco and Tunisia
2. oil and natural gas along Africa's West Coast
3. large trona (soda) deposits at Lake Magadi in Kenya
4. potash deposits in Ethiopia
5. the Kiwi Sea in East Africa, potentially a major source of methane

Other important sources will be chemical by-products of metals mining (e.g. sulfur,zinc and lead from copper mining) and minerals extracted from sea water in connection with desalination.

Transport Infrastructure

At present, lack of adequate transport infrastructure in Africa is a major obstacle to the development of the chemical industry, not only with respect to the distribution of chemical products and raw materials — totalling over *2 billion tons per year* for the basic network of Figures 5, 6, and 7 — but also for the transport of heavy and bulky components for plant construction and maintenance. This problem is essentially solved by locating chemical production in the nuplex regions, where infrastructure development is coordinated with overalldevelopment of markets and industry. In addition to the basic transport network described in the Chapter on Transportation, pipelines to transport chemical products (e.g. sulfuric acid, hydrogen, naptha) and raw materials (e.g. coal slurry, oil and gas) will be built between the different industries of a nuplex as well as between nuplex regions. Such pipelines are already common in the advanced sector, and will be even more advantageous for the highly integrated nuplex industry.

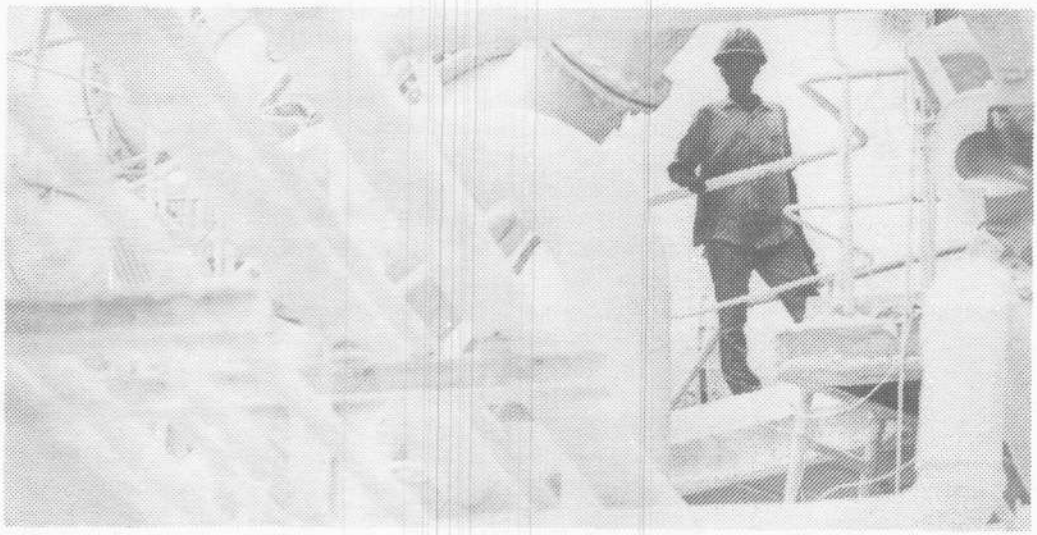
In addition to the usual container ships, numerous specialized vessels for the transport of chemical products and raw materials — notably liquid ammonia, urea, methanol, LNG — will be required for bulk transport among nuplex centers and to and from other parts of the world.

Repair and Maintenance Infrastructure

Chemical plants require constant maintenance and improvements, including regular replacement of reactor vessels, pumps and valves, etc. which are subject to corrosion and chemical degredation. Depreciation rates from 6 %to 10 %, which means that the dollar value of a plant must be renewed (by replacement) every 10 — 17 years. This is the reason for the very close link between chemical and metal-working industries in the advanced sector, a link which will be equally important for African industry. Here the concentration of chemical industries in integrated complexes in the nuplex centers will allow a pooling of repair and maintenance shops, providing for a more constant rate of exploitation and higher-capacity machinery. In the early stage of development, large components must be imported from abroad, while the high rate of industrial growth envisaged for Africa will mean that by the late 1990's, most components for standard chemical plant construction, repair and maintenance will be supplied by African industry itself.

VI. The Future of the African Chemical Industry

As we stressed elsewhere, the organic development of industry in Africa need not, and will not, copy exactly the forms of industrialization of the advanced sector. When the minimal industrial infrastructure has been set up to raise the African economy to "take-off" levels, African industry will embark on its own, new path of development, led by a flourishing independent scientific and technological capability, in harmony with the qualitative advancement of the world economy as a whole. In this process, the chemical industry — which we have defined invariantly as the industry of deliberate transformation and ordering of matter down to the atomic level — will become a key center for technological development. For example, the rich wealth of metal deposits on African soil, made crucial for the world economy by rapid expansion of space exploration and colonization and the creation of new fusion-energy-related industries, will require entirely new metallurgical processes, based on new products of the chemical industry. The mastery of the enormous biomass production potential of the African continent will require new chemical soil additives and new insecticides. The organic synthesis industry and the developing bioengineering industry will play a crucial role in eliminating the formidable array of biological pests presently standing in the way of full realization of Africa's agricultural potential. Further, the bioengineering industry will produce entirely new species of plants and even animal life, to provide un-imagined levels of productivity in food production. These are only a few directions of development which we can be sure of even today, that require a highly developed chemical industry as their point of departure.



However, it is likely that even within the next few decades, with the spread of fusion technology, the basic notion of chemistry and the chemical industry will be completely transformed by a revolution in fundamental physics. Probably, today's physical chemistry will become a subsumed aspect of "negentropic plasma physics", and today's chemical technology will be replaced by the kinds of highly-ordered, steered processes represented today by lasers and superconductors. Our concept of matter will also be revolutionized, and truly new substances, not built out of atoms as we know them today, but based on a total reordering of the structure of space in the small, will become the "plastics" of the future. To these developments, the coming generations of African chemists and physicists will make an immortal contribution.

Notes

(1) Leibniz, Monadology, Art.64
(2) Planning and Organization of Fertilizer Use Development in Africa, FAO Soils Bulletin, No.26 Rome 1975
(3) Problems and Prospects of the Chemical Industries in the Less Developed Countries, American Chemical Society, 1970

212. ... The Conference stressed the exceptional importance of international cooperation among the nonaligned and other developing countries in the field of peaceful use of nuclear energy. ...

213. The Conference affirmed the inalienable right of all States to apply and develop their programs for the peaceful uses of nuclear energy for economic and social development in conformity with their priorities, interests, and needs.

(Economic Communique of the Sixth Conference of Nonaligned Nations in Havana, 1979)

Energy Economy

Ralf Schauerhammer

The energy economy is of decisive importance in the process of industrialization. Previous examples of industrialization were centered at the very sources of energy, around the coal mines of the Ruhr region in Europe, or Pittsburg in the United States. The Soviet Goelroplan (1) attests to the fact that the development of energy technology has even increased in its importance for industrialization. The drastic rates of economic growth in the Soviet Union in the 1920s and 1930s is inexplicable without the centrally forced electrification of the country.

Even more recent examples, like the industrialization of Iran, or Mexico, Brazil and India, further demonstrate the central role of the energy economy. Iran announced an energy program in mid-1975 which was to have achieved the installation of 67 GWe by the year 1992. The proportion to be carried by nuclear power facilities was 34.4 GWe, i.e. more than 50%. In the 1970s, the annual growth of capacities was to have been between 28% and 42%, and in the 1980s, between 11% and 25%. Economic growth rates of over 13% were already achieved in the first years of the program. This positive development, however, was undercut by

opponents of the policy of industrialization of the developing countries, from outside of Iran; undercut in order to be propagandistically used by those same forces as a "deterrent example of the dangers of too rapid industrialization".(2)

Mexico is pursuing a similar industrialization policy, also employing oil reserves for the development of the nation. Here too, the central focus of the energy policy is construction of nuclear power capacities of 20 GWe in the 1990s. Since the country enjoys domestic political stability, it is, even today, certain that this plan cannot be thwarted. Development of energy technology in Brazil and India is already far advanced, and interfaced with the total economy in a mutually fruitful way. The question of development in every developing country will be essentially decided by the issue of whether it is possible to construct a modern energy economy.

Energy-Economic Prerequisites in Africa

Accessibility of fuels and the levels of development of the energy economies are extremely diverse in Africa. There are functioning energy economies in the urban centers of North Africa and in the South African Republic, while in large parts of the continent it is difficult to find even the beginnings of commercially economic energy production.

The African continent as a whole is in a rather favorable position with respect to energy supplies from fossil fuels, especially crude oil. There are 14.4 billion tons of known oil reserves, amounting to 16 % of world reserves, which can secure the continent's energy supply over the long run. Africa is presently a net exporter of crude oil since it itself consumes only 60 million tons of the 250-300 million tons annual production. Production in the coming years could be significantly increased, to be stabilized in the 1990s at a value sufficient to cover Africa's own requirements. The reserves are regionally concentrated in North Africa (Egypt, Libya, Tunisia, Algeria, Morocco) and on the West Coast (Nigeria, Gabon, Zaire to Angola). Additional off-shore finds on the West Coast are expected. Coal reserves are concentrated in the Republic of South Africa,which is pursuing a massive coal mining program.Natural gas is to be found primarily in Algeria and Nigeria, whose production has been strongly oriented to exports, of which the LNG-facility in Bonny (Nigeria) produces nearly 17 billion cbm per year.

Africa has quite adequate potential with respect to production of electrical energy in hydro-power plants. Numerous large projects have already been realized, the best known of them being the *Asswan-Dam* (Egypt), the *Volta-power plant* (Ghana) and the *Cabora-Bassa-Dam* (Mozambique). Additional projects are in the construction phase, of which the *Inga-project* in Zaire has the largest potential by far. It will be crucial, in the context of the industrialization of Africa, to realize this project, not step-wise, but as comprehensively and rapidly as possible, in order to firmly establish one of the energy centers of the continent.

Principles for the African Energy Economy

The situation in the Sahel zone is not only an example of the problematic situation of parts of the continental energy economy, but rather also motivates us to recognize the principally correct and feasible solutions for the development of the energy economy. The well-known economic problems of the Sahel arose because of the use of decentralized, pre-industrial modes of technology at a point when the population-density had already passed the limit-value for such uneconomical modes. In the meantime, deforestation, under conditions where fire-wood was used as the primary source of energy, has so affected the ecosphere that climatic changes have arisen, leading to spreading deserts. Conditions of life in the Sahel zone are, therefore, deteriorating even further. There have been attempts to reduce the use of fire-wood by introducing solar-collectors. Construction of such collectors is being carried out, for example, in Niger by ONERSOL.

Such an energy policy ignores the actual dynamic of the ecological-economic process. It is a universal law of nature that linear growth (to which "zero" growth also belongs) is not possible over the long run, and, instead, qualitative development of the economic structure is necessary. In this way, limited resources (fire-wood in the Sahel zone) are replaced at a level of higher productivity. This means that the less developed parts of Africa must, with respect to the energy economy, construct a central and efficient energy economy. Solar collectors, fire-wood and bio-reactors do not solve problems like the development of the Sahel zone. In order to assure that things do not deteriorate so far in other parts of Africa, fossil fuels and, later, nuclear energy, must be commercially introduced, and the electrification of the entire continent must be carried out.

The proposals for Nuplex-centers made at the *Atoms for Peace* Conference of 1960 (3) provide the basic conception for how this would look, for example in terms of the development of Niger. Niger is taken to be one of the poorest countries in the world; it is poor in fossil fuels, but possesses uranium reserves which, at 150.000 tons of uranium, amount to more than half of the African reserves today. Mining has been going on in Arlit and Akouta for years, and mines in Immouraren and Tassa N'Taghalgue are to begin production in the '80s. An industrial center supplied with nuclear energy, along the lines proposed at the Atoms for Peace conference, is an obvious idea. It would especially produce fertilizers to be used on artificially irrigated farmland. This can be linked with the irrigation project planned jointly with Mali in Kandaji. Hydro-cultures for producing proteins for cattle feed would also be produced. The surplus produced by this center will be a solid foundation for the infrastructural development of the entire country.

Energy policy decisions for the next decades are to be considered on the basis of this concrete example. The development will occur under the following general conditions:

(1) The necessity for rapid growth makes employment of technologies with short pay-back times (4) necessary. A value of 3 to 5 years, as is the case for alternative technologies, is intolerable.
(2) The average level of industrialization in Africa will still be relatively meager even in the 1980s. Thus, a strongly polar and central energy economy is necessary. This, in turn, makes cost effectiveness analysis hardly applicable (a point which is crucial for judging rural electrification (5)).
(3) The limited numbers and skills of the labor force create problems which must be solved by crash education projects.
(4) The time coincidence of the industrialization of Africa with the global transition to the post-fossil fuel era in energy economy is of decisive importance for judging the various energy options

As a secondary energy source, electricity has a singular character. Within the industrialized nations, electricity consumption has grown far more rapidly than overall energy consumption. In the context of the industrialization of Africa, electricity will assume an additional structure-building character, so that by the year 2000, 30% of the entire African commercial energy consumption will be in the form of electricty. This presupposes both the development of hydro-power potential of Africa, and the development of nuclear energy (see Figure 1).

The gas economy has a similar importance. The relatively minor investment costs for natural gas are one advantage in the initial phases. Investments for constructing an integrated long-distance and city-supply system will increase rapidly in the mid-1990s. Natural gas will be increasingly replaced by production of synthetic gas in the Jordan Process and High-Temperature Reactors. (6) This development will continue beyond the turn of the century, and peak in the construction of a world-wide hydrogen-energy economy.

Sufficient coal is available over the long run. Use of coal, however, involves high investments in transportation. Nevertheless, coal is important in connection with steel production, and coal mining should orient to the growth of steel production. The main problem with oil is that its con-

Figure 1 **PROJECTED ELECTRICITY PRODUCTION**

Year	Production		Installed Capacity (GW)			
	(TWh)	Annual Growth	total	Hydro	Fossil	Nucl.
0	165	5.0%	37	10	27	0
5	330	13.9%	66	20	39	7
10	765	16.8%	141	50	65	26
15	2 065	19.9%	340	70	100	170
20	4 255	14.5%	670	90	130	450

sumption must be rapidly increased at the beginning, but must also be stabilized again after a relatively short time. Employment of fossil fuels is advisable to balance the high initial investment costs of nuclear facilities. Profitable energy production must be assured, however, for the entire life-span of the fossil fuel facilities. A short-sighted dispensing with nuclear technology, even in developing countries, would take rapid economic revenge at around the turn of the century. Aside from that consideration, nuclear energy, even today, provides possibilities for industrialization independent of fossil fuel reserves.

Hydro-power is the only useable form of "renewable" energy. Connecting this power with agricultural irrigation projects and regulation of rivers is advisable. The extended construction times are problematic, making forced-construction projects in Africa necessary from the start. We propose 70 GWe hydropower available by 1995.

Construction of an energy distribution system and reserve-reservoirs can be most easily accomplished by means of centralized development. At first, autarchical supply islands are to be created whose supply security will later be assured by a continentally connected system for electricity and gas supply. A centralized approach is, however, especially important because of the problem of skilled labor power.

A specifically targetted education and training program must be pursued in Africa, especially with respect to the use of nuclear technology. This ought to occur in cooperation with the IAEA, which already conducts training programs on a small scale. With the exception of Egypt and South Africa, no country in Africa has any significant number of nuclear technicians. Experiences of developing countries like India, which have developed their own nuclear technology, shows how the labor-power problem can be approached. Early construction of research reactors is important. The Research Centers must, at the same time, create the conditions for quality-control and security. Training of the labor-force must build on already existing qualifications in other areas of technology and industry.

Development Goals and Development of the Energy Economy

The following provides a quantitative estimate of expected energy consumption in Africa up to the year 2000 of 3,2 tce (A) primary energy, we calculate a goal-value of 2.600 million tce, and the absolute consumption values given in Figure 2. The value of 3.2 tce is roughly comparable to the present consumption in Italy, but it must be remembered that, due to rapid industrialization in Africa, only 25% of this will be household and related consumption, while over 55% will be industrially consumed. If the basic preconditions for the development of Africa outlined in Section III are to be even only approximately fulfilled, this per capita consumption is an absolute minimum.

Estimates of the UNO, IIASA and WEC (8) do indeed lie under this value, but according to calculations made by the FEF, an economic policy founded on coming technological

Figure 2 **PROJECTED CONSUMPTION OF PRIMARY ENERGY**

Year	Per Capita (tce)	Total (mio tce)	Annual Growth (%)	
			Per Capita	Total
1975	o.35	140	-	-
0	0.54	250	8.7	11.6
5	0.85	450	9.1	11.7
10	1.34	825	9.1	12.1
15	2.22	1 575	10.1	12.9
20	3.20	2 600	7.3	10.0

Figure 3a **PRIMARY ENERGY CONSUMPTION**
(in mio tce)

Year	Coal	Oil	Gas	Hydro	Nuclear	Total
1975	71	60	5	4	0	140
0	100	115	16	19	0	250
5	120	240	34	38	18	450
10	140	420	72	95	98	825
15	170	642	153	135	425	1 525
20	210	803	252	170	1 165	2 600

Figure 3b **PRIMARY ENERGY CONSUMPTION**
(percentage share)

Year	Coal	Oil	Gas	Hydro	Nuclear	Total
1975	50	43	4	3	0	100%
0	40	46	6	8	0	100%
5	27	53	8	8	0	100%
10	17	51	9	11	12	100%
15	11	40	10	9	30	100%
20	8	31	10	6	45	100%

innovations will lead to an average electricity consumption by the year 2000 of 10,200 kWh/a per capita. Africa, with 5,200 kWh/a, will achieve about one half of this value.

This minimal target-value, nevertheless, leads, together with the rapid population growth, to considerable absolute growth rates for the energy sector: 11 % annually. Thus, for example, an annual increase in oil production of 9 % is to be expected, increasing production in the 1980s to 740 million tons annually, and stabilizing after that at about 1 billion tons annually. With such a strategy, the amounts to be promoted from Africa up to the year 2000 run at 10 billion tons, a value which, in view of today's known African reserves of 14.4 billion tons, should not be exceeded. If we assume a rapid development of coal mining and a 60 % utilization of the African hydro-power potential, there remains 40% of primary energy needs that will have to be covered by nuclear energy in the year 2000 (see Figure 3). This can only be realized on the basis of the proposed strategy to construct Nuplex centers. We propose the construction of 32 Industrial Nuplexes and 132 smaller Agro-nuplexes. Envisaged construction of power plants is illustrated in Figure 4. This includes 2 GWe from High Temperature Reactors (HTRs) for the year 1985, to be run as two-cycle facilities with conventional steam turbines. Construction of these power plants will especially serve to develop the labor-force and gain necessary know-how for the more rapid development in the next phase, in which process steam from HTRs is used by industry. The sodium-cooled fast-breeder reactors' 2 GWe to be constructed by 1990, has a similar function. The proposed nuclear program will require somewhat less than 370,000 tons of uranium up to the year 2000, which is why early employment of the fast-breeder is necessary. In addition, a plutonium factory, based on fusion-fission-hybrid technology, should be producing 30 tons of plutonium for Africa already in the 1990s.

Investments in the energy economy are, on the whole, very high. In the advanced sector, they amount to about 30 % of investments in industry. In Africa, an average of 140 DM per capita per year will be necessary up to the year 2000. This value exceeds recent years' European averages by a factor of 2.5 to 3.

Figure 4 CONSTRUCTION OF NUCLEAR POWER REACTORS

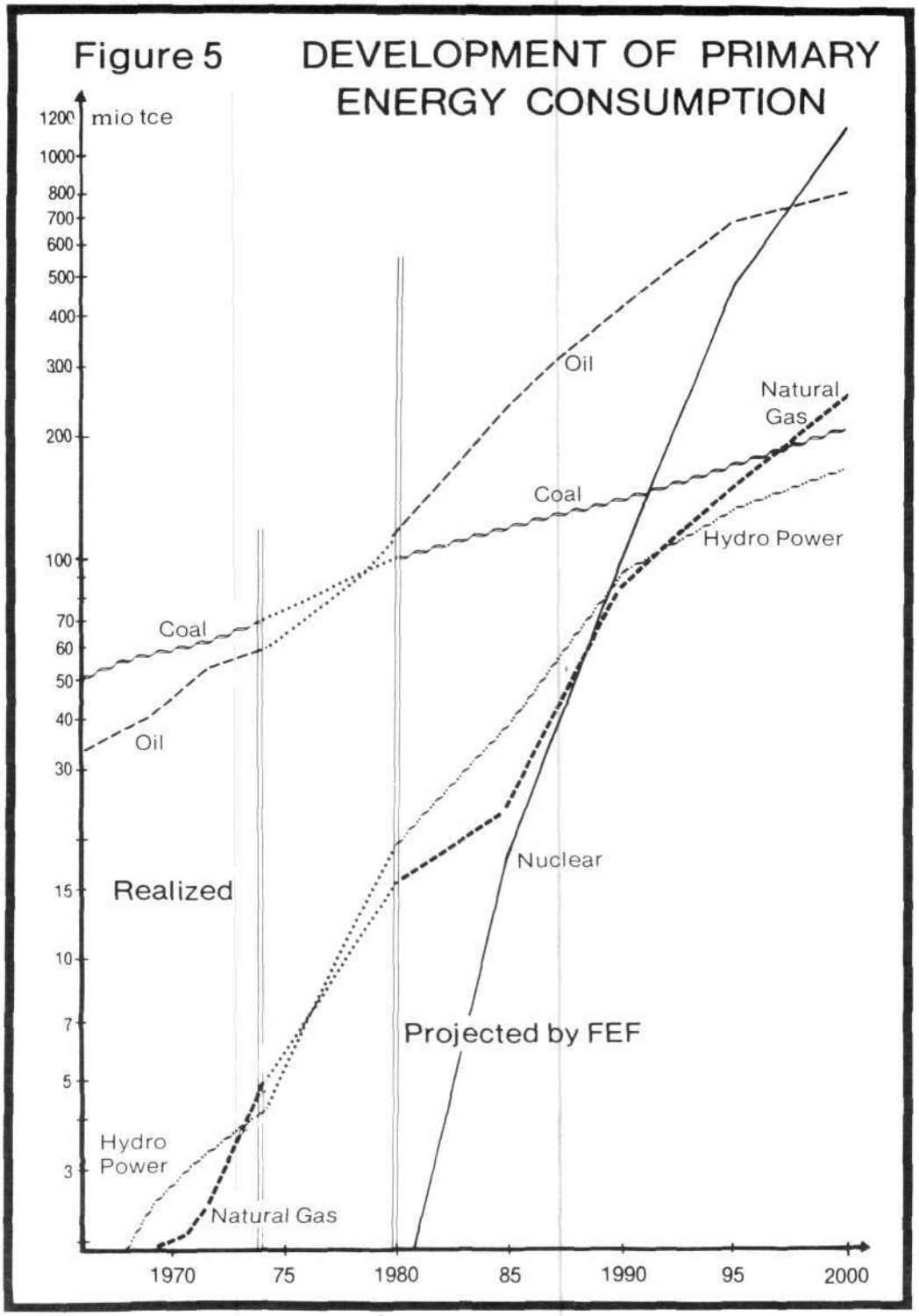
Year	Total (GW_e)	LWR (GW_e)	FBR (GW_e)	HTR (GW_e)	Process Heat (GW_{th})
0- 5	7	5	0	2	0
5-10	19	14	2	3	34
10-15	144	71	20	53	36
15-20	280	30	110	140	70
0-20	450	120	132	198	140

Points of Emphasis in the Development Phases

In the **First Phase**, up to the year 5, emphasis will be on increasing production from already existing energy sources, especially oil and natural gas (see Figure 5). Simultaneously, an international prospecting project must be launched to locate additional fossil fuel reserves.Projects already planned or in advanced stages of projection should be begun immediately. The 7.1 GWe nuclear power capacities projected by the IAEA for 1990 should be realized, as far as possible, in this phase. Preparations for the coastal installation of floating nuclear power plants must be completed.

Additionally, sufficient capacity in energy-transport systems must be created in this phase, so that construction can begin on the planned industrial centers of the next phase. Con-

Figure 5 DEVELOPMENT OF PRIMARY ENERGY CONSUMPTION



struction must also begin on 60 GWe hydro-power facilities.

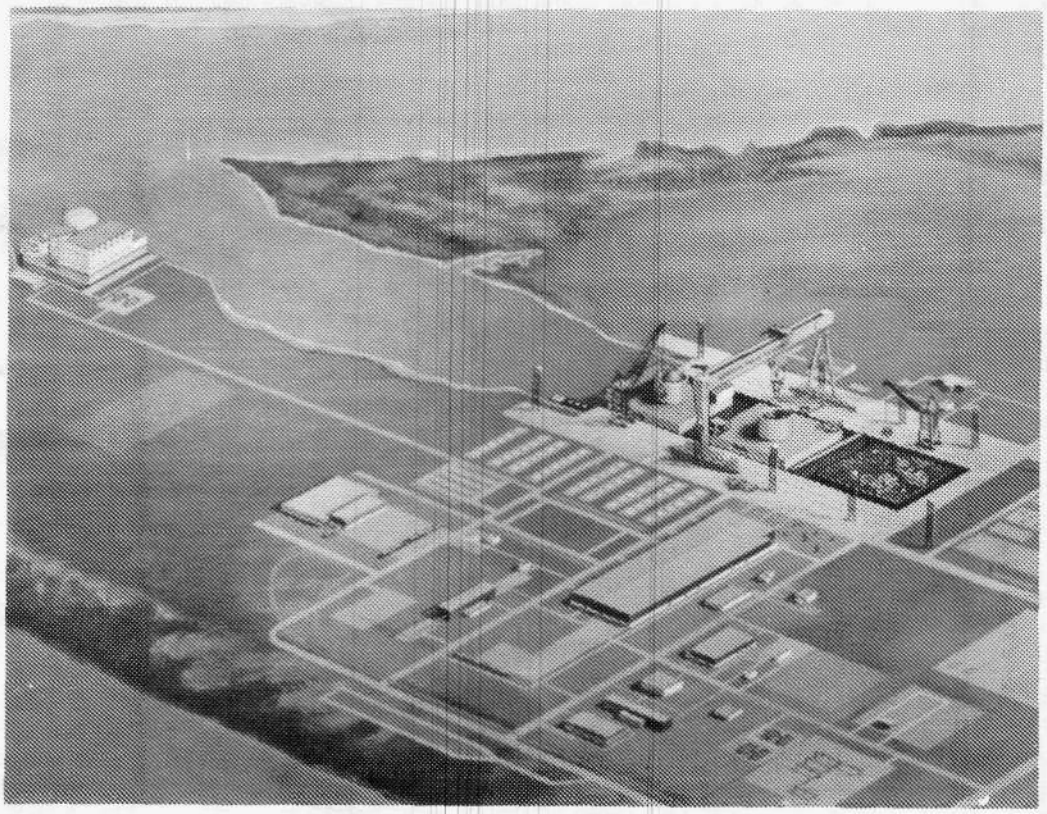
In the **Second Phase**, up to the year 10, new energy potentials must be realized to secure supplies for production in the coming decades. Uranium mining will begin on a large scale. The first nuclear power plants for the industrial complexes come on line. Local distribution systems will be completed, functioning as islands .(9) A major portion of the hydro-power projects will, toward the end of this phase, come on line.

The most important point of emphasis in this phase, however, will be a broadly conceived educational program which will prepare for massive expansion of the energy economy in the next phase.

The **Third Phase** will be characterized by nuclear energy. The nuclear energy program now comes into full force. Construction of supra-national grids begins at the same time. International forms of organization and political management of the energy economy will be necessary.

The same holds for the development of the long-distance natural gas system, whose construction begins in this phase, and is based on the gas supply systems of the industrial nuplexes.

In the **Fourth Phase**, all basic elements of the energy economy are essentially available. Quantitative development will be accelerated in accordance with the growth of the economy, as a whole. Attention will be paid to completion of continental integration of the energy system. The fuel cycle of the African nuclear industry will be closed. Research activities will come increasingly to the fore.



Production facility for floating nuclear plants

Notes

(1) The *Goelroplan* was proposed by Lenin in 1920 as a ten-year program for electrifying the entire USSR. Key to Lenin's conception of Goelro was the educational impact of electrical technology on the rural population.
(2) See the speech of *Helga Zepp-LaRouche* in Part II.
(3) See also the 1971 UN/IAEA Conference on the Peaceful Uses of Nuclear Energy.
(4) Energy pay-back time refers to the time necessary for any energy system to produce an amount of energy equal to that which went into its construction (including building materials such as steel, cement, glass, etc.). The energy pay-back time of modern fission power plants is in the range of 1-2 months, which means that over a life-time of 30 years, a nuclear power plant produces over **200 times** the energy used in its construction. This compares with a factor of less than 6 for known solar technologies over a comparable 30-year period.
(5) See the chapter on Agro-nuplexes.
(6) See the chapter on Industrial Nuplexes.
(7) tce=tons coal equivalent. 1 tce corresponds to 29.3 Mega Joule.
(8) See for example: World Energy Conference, Istanbul 1977, "Report on World Energy Demand for 1985-2020", New York 1978.
(9) An energy "island" is a local energy network not yet integrated into a larger regional grid. This would include localities supplied temporarily with gas turbine generators.

Construction on the Transgabonese railway

I am deeply convinced that the Transgabonese railway forms the main axis of our development, the lever through which we shall be able to turn our country into a modern nation and to decisively improve the fate of our people, which has always been our primary goal ...

The Transgabonese railway ... is the backbone of our economy and the cement of our unity.

(His Excellency El Hadj Omar Bongo, President of Gabon, 1978)

Transport Infrastructure in Africa

Heinz Horeis

Without the construction of a modern transport system, neither the USA nor Germany and France, nor any other developed nation could have attained the characteristics which today place them beyond all other nations: prosperous economies with extensive trade, advanced production and high living standards.

This close, insoluble connection between industrial development and the building up of effective transport systems holds true also for the Third World: there can be no real development unless massive infrastructural projects are made an integral part of the overall development process.

No industrialisation of Africa without infrastructure — it would be pointless to repeat this obvious truth, if there did not exist certain circles and entrenched viewpoints which deny exactly such a connection. These are the proponents of the "British System" who see Africa and the underdeveloped countries generally only as suppliers of raw materials and

possible markets for exports. This was the characteristic of the colonial period, and it remains the pattern today. In spite of the nominal independence of former colonies, the "British System" still rules over large parts of Africa, particularly through such institutions as the World Bank and the International Monetary Fund. With their control of credit, these institutions represent the greatest hindrance to industrial development for the African continent.

The following examples, chosen out of many, serve to illustrate the point involved for the case of infrastructure.

— The World Bank refuses to finance the hitherto largest railway construction project in Africa, the "Trans-Gabon Line", claiming that the expected transport volume is too small. On the one hand, this justification is without foundation since the proposed line would open rich iron, mangan and uranium deposits as well as enormous wood reserves. On the other hand, financing is thereby being denied to a project which, coupled with the construction of industrial units, is intended by the government of Gabon to serve as a primary means to bring Gabon up to the level of a modern nation.

— In late 1978, on the recommendation of outside consultants (World Bank), *Sierra Leone* shut down its main rail line (from Freetown to Pendembu), and was thus robbed of its most important East-West connection.

— Perhaps the most dramatic case is the *Benguela Railway*, whose operation is of crucial importance not only for Africa, but especially for Zambia and Zaire. The collapse of this line has two main causes: first, the 90% holder of the line, *Tanks Consolidated Investment* (controlled by a consortium of London Banks — Barclay's, Rothschild, Baring and Midland Bank) withdrew the entire staff of technicians following Angola's independence; secondly, after the formal reopening of the railroad in late 1978, regular transport has been prevented by terrorist attacks by *UNITA*, which operates with logistical support from South Africa and is connected to the London banking interests named above. This situation is especially responsible for the economic collapse of Zambia, a landlocked country dependent on transport connections to the sea.

These case are expressions of a general strategic conception of the World Bank and the IMF, a concept identical with the "British System" of the colonial period: *Africa must be kept at the level of an underdeveloped raw materials supplier. With no industry to demand large transport volumes, railway transport systems are superfluous.* In this way, of course, the underdeveloped sector gets neither the one nor the other. In accordance with this concept, the *World Bank preferentially finances roadbuilding*: over 50% of the one billion dollars of credits which the Bank provided in 1978 for transport projects for the whole of the Third World, went for the construction of roads; especially in connection with *"rural development"* and the *development of small scale industries*. The priority has been given to repair of the existing, insufficient road network. Rail transport received only 30%, where it is to be noted that there is at present not a single new, major railroad construction project being financed in Africa. Instead, *"appropriate infrastructure"* policies are being practised, appropriate to underdeveloped rural regions, and never infrastructure as a lever for real development, for industrialisation.

I. General Principles for the African Transportation System

There is a direct connection between economic development and transportation capacities: economic growth both affects and increases the volume of transportation, and this increasing volume of transportation is, at the same time, an essential prerequisite of economic growth. If the entire process of economic development is not to stagnate, an adequate infrastructure must be available.

A first approximation of the requirements of African transportation by the year 2000 can be derived from transportation densities in the industrial countries: this amounts to 17—20 tons per capita, per year. More differentiated, the figures would be 8 tons per capita per year in

agricultural regions, and 40 tons/cap-y in the industrial centers. Relative to the African population active in Nuplexes in the year 2000, the following transport volumes are to be expected:

Figure 1

132 Agro-nuplexes	270 million inhabitants	transport volume 2.2 bio tons
32 Industrial Nuplexes	192 million inhabitants	transport volume 7.7 bio tons

The volume of goods transported in the year 2000 will, therefore, be around 10 billion tons, not including short distance distribution within 20 km (primarily by means of trucks). This — taking the Federal Republic of Germany, with 30 tons per capita, per year, as the reference point — will presumably amount to an additional 14 billion tons.

Roads, railways, inland-shipping, and pipeline transport can be used, at present technical standards, to transport this volume of goods. In the Western industrial countries, each of these modes of transport accounts for the following percentage of total transport capacities (Figure 2).

Means of transport	Share
Long range trucking	36%
Railway	33%
River navigation	23%
Pipelines	8%

Figure 2
PERCENTAGE SHARE OF MAJOR TRANSPORT MEANS IN TOTAL HAULAGE (FRG 1976)

Despite the fact that they are quite economical, pipelines and inland shipping will play no decisive role in the initial phase because they are not as versatile as other modes of transportation. Railways are especially suited to this initial phase, according to the above parameters (Figure 3), at least an order of magnitude better than road transport.

As mentioned above, most present investments are made into road construction in Africa: 60% of the expenditures for infrastructure fall in this area. The arguments brought forward to justify this policy are the higher flexibility of road transport and the smaller initial investments for road construction. The first argument only holds if the railway system does not function effectively, which is, indeed, the case in many African countries. The education of skilled railway personnel, however, and the resulting capabilities for effective management, can solve this problem.

Figure 3 ECONOMICS OF VARIOUS TRANSPORT SYSTEMS (1)

Means of transport	Average specific consumption of primary energy (g tce/tkm)	Transport density 1000 tkm per km network+year	Employed per 1 billion (tkm)
Trucking			
-long range	45	200	2 800
-short range	90		
Railway	20	23 800	600
River navigation	16	7 700	304
Pipeline	9	7 400	65

Secondly, the higher initial investment-costs for railways can only be justified if there is a large guaranteed transport volume, and thus high capacity-utilization. This is certainly not the case in backward, stagnant agrarian regions; no railway will be needed here. For an industrial society, however, and for areas like Africa which are beginning industrialization, a functioning railway system is the decisive prerequisite and means to further this development. The higher initial investment costs are paid off through the increased economies of the system.

There are numerous other facts which speak in favor of transport via railway rather than roads:

(1) The fact that oil reserves are going to be exhausted in the immediate future, especially under conditions of economic growth parameters such as those necessary for global industrialization,will necessitate a shift to other forms of energy. Electrified railway lines, driven by nuclear-produced electricity, will enable a significant reduction in oil dependencies, even aside from the fact that the energy consumption of railway systems is less than half that of equivalent road transport systems.

(2) 70% to 80% of the transport volume of an industrial economy consists of mass transportation of basic goods, and such transport is only economical via mass-transport-line railways, pipelines and inland-shipping.

(3) The rationalization of parcel-goods transport by means of containers will accelerate loading, shunt-stops and transitions from rail to road so much that these goods, presently transported by truck in most industrial nations, will be more rationally and economically transported over long distances by rail.

(4) Beyond the year 2000, inter-African transportation flows will continue to increase steadily, and it will not be possible to meet this demand by simply linear extensions of existing systems. As a "connected system", the railways will be able to significantly increase transport volume through automatization, use of computers,etc.: the sort of development which is not possible in road transportation.

The railway system, therefore, must become the backbone of Africa's industrialization process as well as of the future African industrial economy. A rational transport system for long distance transportation will have something like the structure indicated in Figure 4.

Means of Transport	Share of transport (%)	Transport capacity (bio tkm)
Railway	65	1 900
River and coastal navigation	20	700
Pipelines	10	500
Others	5	

Figure 4 PROJECTED DISTRIBUTION OF LONG RANGE TRANSPORT

Gauge		Length (km)
Imperial	1067 mm	52 000
Normal	1435 mm	13 000
Meter	1000 mm	15 000
	1000 mm	1 000
Total		81 000

Figure 5 THE PRESENT AFRICAN RAILWAY SYSTEM

Long-distance road and highway transport is of little significance in this structure. Local truck transport will, however, continue to be important. Basically, *the road and highway network should be constructed as a feeder-system* to the railway network. This holds for agricultural regions, where the relatively light transportation volumes makes a dense railway network uneconomical, and for industrial regions, for loading and unloading from railways.

Such a rational conception of the transportation system is also connected to certain political measures. Infrastructure is too important for the development of any country to be left to "free market forces." The fact that uneconomical truck-transport has taken the upper hand in Western industrial nations, and the progressive disintegration of the American railways, ought to be properly deterring examples. What is to be striven for, instead is a *dirigistic* management of the transportation system, i.e., *creation of a central, state-run institution, which controls all means of transportation, from the railways to highway transport, and which designs the transport system according to the criteria of social efficiency for the entire society.*

II. The Railway System

In terms of its structure, the present African railway system has hardly gone beyond that inherited from the colonial era, as a brief glance at Map 1 indicates.

(1) No interconnected railway network exists. As a rule, the individual lines run from the coast inland, according to the economic conceptions of the former colonial masters, who looked upon their colonies as mere suppliers of raw materials. This situation is particularly grotesque in West and East Africa, while South Africa, and, to some extent, North Africa, have an actual network.

(2) The present railway system is over-aged; about 90% of the lines were built during the colonial period.

(3) Track-widths differ, depending upon who the colonial masters were. Figure 5 summarizes the relative distribution proportions of these various systems. Such variations in track-width (gauge) naturally make construction of a unified African railway network extremely difficult. Additionally, 85% of the entire network consists of narrow-width track, which may have been adequate, at the lowest possible investment-costs, for raw-materials transportation, but which are completely inadequate for a developing industrial economy.

(4) Another severe problem confronting today's African railways is the result of hidden "recolonialization" by institutions such as the IMF and World Bank. Lack of investments, due to restrictive financing and debt-service policies, has led to accelerating disintegration of infrastructure in large parts of Africa, especially disintegration of the railways. With the exception of Southern and Northern Africa, and some countries in tropical Africa, the railways have deteriorated to such an extent that hardly any regular transportation can be maintained.

(5) The last problem is a simple one: underdeveloped Africa has too few railways, as the comparison with industrial nations shows (Figure 6). The present average track-density of 700km/1 million inhabitants in Europe compares with 150 km/1 million inhabitants in Africa. This comparison becomes even less favorable when one considers that lines in the industrial countries consist of two or more tracks, while, as a rule, in Africa they are only single track. The resulting contrast between 1,400 km / 1 million inhabitants in Europe to 150 km in Africa illustrates the actual size of the gap which has to be closed.

The first problem to be solved is that of *different gauges.* The railway network will remain only piece-work unless an obligatory standard gauge is agreed upon.The majority of African countries tend to favor the narrow "Imperial Gauge" as the standard, first of all because 60% of the existing track is of this width (construction of narrow gauges is cheaper than the broader ones). This may appear reasonable on the basis of short-term considerations, but over the long-term —especially with respect to an industrialized Africa— it is a very bad decision. We

Figure 6 RAILWAYS OF SELECTED COUNTRIES

Country	Network-length (km)	Network density	
		km/1000 km²	km/1 mio inh.
Africa (without SAR)	59 000	2.7	150
Zaire	5 200	2.5	200
Nigeria	3 500	3.8	45
West Germany	31 600	127.0	510
USSR (without Siberia)	134 000	11.0	520
France	37 000	67.0	710
ČSSR	13 200	100.0	890
USA	320 000	35.0	1400

propose the **normal gauge of 1435 mm** as the standard for all of Africa, for the following reasons:

(1) Construction costs for the narrow-width track can be 33-66% cheaper than the normal gauge, but the higher investment costs for the normal gauge will pay off better in the future; the normal width permits higher velocities, higher axle-loads and therefore higher transport utilization than the narrow gauge. This may not be an important consideration at the present volume of African transport, but the railways of developed Africa will have capacities several times greater than this present volume.

(2) Africa's railway system should be seen in connection with neighboring regions (Europe and the Middle East), where the railways are nearly all normal-gauge. With increasing development, direct railway connections between Africa, Europe and Asia will be constructed. A standard gauge will be an important prerequisite.

(3) Africa's future railway network will be over 0.5 million km in length. Compared to that, the present track, amounting to 45,000 km (without S.A.R.), which has to be converted to the normal gauge, is downright meager, even disregarding the basic repairs needed on most of the track stretches.

African governments like that of Gabon, which constructs the new "Transgabon Railway" with normal-width track, or the government of Nigeria, which plans to totally convert the country's narrow gauge to normal, are exemplary for their foresight.

Assuming a population of 462 million living in Nuplexes at the end of the 20-year period, and taking European transport-density standards of 700 km railway network per 1 million inhabitants as a comparative base (see figure 5), we calculate an African network length of 320,000 km for the year 2000. Taking into account two-lane track for the main lines of the network, and more than that in the nuplexes, we get 650,000 km of track length. This network density, 11 km per 1,000 square kilometers or 400 km/1 million inhabitants, is still considerably less than the prevailing density in industrial nations. Nevertheless, presuming industrial centralization as forseen for the Nuplex concept, it will be both adequate and attainable: an estimated transport-volume of 6.5 to 7 billion tons per year corresponds to a utilization of about 5 million tkm/km of track, and can, given a certain degree of efficiency, be multiplied (compare Figure 3)

Railway construction will have two points of emphasis:

(1) Creating a dense network in the Nuplex-centers, where the railway will carry the largest proportion of the transport tonnage. Construction of a total of 250,000 to 300,000 track-

Map I Present African Railways

kilometers will be necessary in these centers alone. A network just as dense, if not quite as compact, will be necessary in densely-populated regions like West Africa and in the North African coastal region.

(2) Construction of an interconnected continental rail network: regions far from the coasts and landlocked countries will obtain effective connections to the ports, and thus to the world markets; international lines will connect individual national networks to each other, and will thus form the *backbone of the economic and political unity of Africa.* Figure 7 shows the main new international lines to be constructed; these will equip Africa with continous North-South and East-West connections, and will, thus, connect the continent with Europe and Asia. A *Gibraltar tunnel* will allow rail transport from Western Europe to the Cape, and connections with the Arab region will exist via Egypt to the East European and Asian regions.

Figure 7 MAIN INTERNATIONAL RAILWAY LINES OF AFRICA

"Trans Sahara"	Fes-Bechar-Niamey	2700 km
"Atlantic Line"	Makurdi-Douala-Kinshasa-Luanda-Windhuk	4000 km
"Trans Sahelien"	Bamako-Niamey-N'Djamena-Nyala	3600 km
"Trans Westafrica"	St.Louis-Kankan-Parakou-Ngaoundere-Bangui	4400 km
"Westafrican Coastline"	Dakar-Freetown-Abidjan-Lagos-Douala	3800 km
"Trans Centralafrica"	Yaoundé-Bangui-Pakwach	2400 km
"Trans Eastafrica"	Addis Abeba-Nairobi-Quelimane	3600 km
"Pacific Line"	Mombasa-Dar-Beira-Maputo	3000 km

In the following, we will sketch the phases of construction of the African railway system. This is confined to a period of 20 years,the period in which the nuplexes will be built. The major construction will begin in the third phase, in the 10 th year. About 50% of the planned construction will occur in the fourth phase. The reason for this is the development process of the industrial nuplexes: their export capabilities will become significant only after the 15th year, resulting in steadily increasing railway transportation; additionally, after the 15th year, the construction of the nuplexes will have proceeded far enough to enable a significant share of the materials required for railway construction to be drawn from the nuplexes' own production.

Construction activity in the **first phase** will emphasize two points:

(1) Conversion of available narrow-gauge track to the normal gauge. An initial exception will be South Africa, because the track here is in good condition. Since all track concerned is single-lane, conversion will mean new construction parallel to the old line, a process which will permit continued use of the old track and, in many countries, will make repairs of the old track superfluous.

(2) Construction of new lines, especially to the landlocked countries and those regions at longer distances from the harbors, which will be sites for agricultural-nuplexes.The projects included can be seen on Map II.

First phase construction will amount to 56,000 km.

In the **second phase**, parts of the network will be laid in two lanes. This applies, firstly, to densely-populated regions with certain development advantages, like Nigeria and North Africa.The double-lane track will be extended to connect important harbors with extensive inland regions:

Map II Projected Railway Network Phase 1 and 2 (Main Lines)

West Africa	
Senegal—Mali	Dakar—Kayes
Ivory Coast	Abidjan—Ferekessedougo
Cameroon	DoualaYaounde
Central Africa	
Zaire	Banana—Kinshasa
East Africa	
Sudan	Port Soudan—Khartoum
Kenya—Uganda	Mombasa—Kampala
Ethiopia	Djibouti—Addis Abeba
Tanzania	Dar—Mbeya
Mozambique—Zambia	Beira—Lusaka
Mozambique—Zimbabwe	Maputo—Salisbury

Newly constructed stretches will have the function of:

(1) Developing further access to areas of agro-nuplexes and connecting them with surrounding regions. This includes the following projects:

West Africa	
Mali	Bamako—Mopti—Gao
Mali—Niger	Gao—Niamey
Togo—Upper Volta	Blita—Niamey
Ivory Coast	San Pedro—Odienne
Cameroon—C.A.R.	Yaounde—Bangui
"Transsahelien"	Bamako—Nayala
Central Africa	
Sudan—Zaire	Wau—Kindu
Angola—Zaire	Malange—Kananga
Angola	Malange—Dilolo
East Africa	
Sudan	Sennar—Juba
Uganda—Ruanda—Tanzania	Lira—Kigali—Mpanda
Sudan—Ethiopia	Roseires—Addis Abeba
Ethiopia	Asmera—Addis Abeba
"Trans East African"	Nairobi—Quelimane

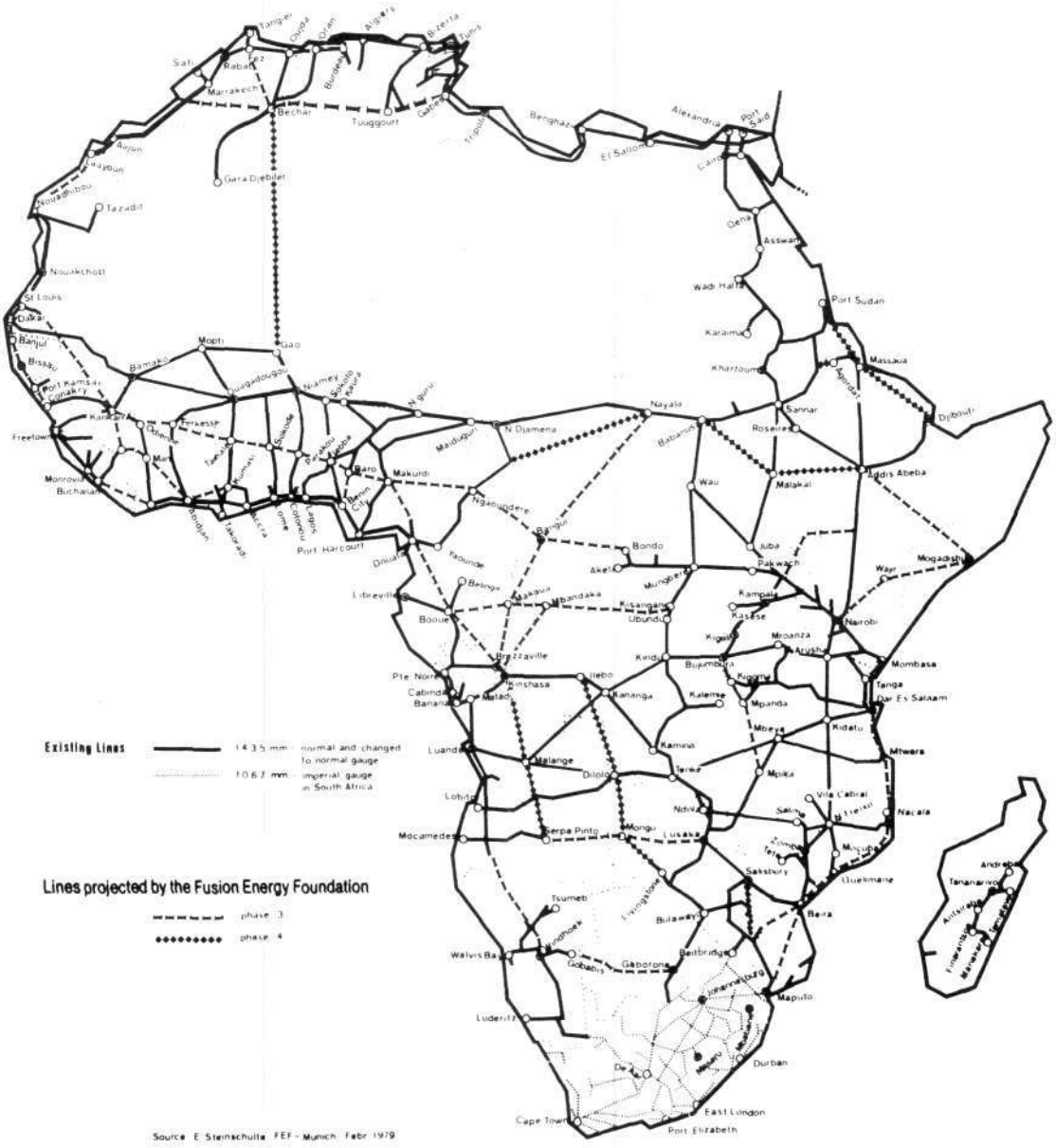
(2) Some lines will open additional ports for inland regions, such as the Freetown (Liberia), Kankan (Guinea) line to Bamako (Mali) in West Africa, and, in East Africa, the connection of Tenke (Zaire) and the port of Mtwara in Tansania, to be developed. Zambia-Malawi will be connected to Port Nacala with the Nova Freixo-Salima-Ndola line.

(3) The remaining large projects of this period will aim at providing industrial nuplexes with trans-regional railway connections. This means the partial construction of the *West Africa Coast-line*, the construction of the *Atlantic Line* from Matardi to Lubango, construction of the already projected railway from Marakesh to Laayoun and the connection Nouadhibou—St. Louis.

Construction volume in the second phase will amount to a total of 61,000km.

In the **third phase**, construction activity will be massively expanded. This will be due to the increase in exports from the agro-nuplexes, and also exports from the industrial nuplexes, which will increase rapidly from the 15th year, so that a connected, even if somewhat loosely-meshed, *African railway network must exist.During this phase, materials needed for railway* construction will increasingly be derived from internal production, reducing import dependency; concrete, reinforced concrete and, partially, the rails themselves, will be produced in Africa itself.

Map III Projected Railway Network Phase 3 and 4 (Main Lines)



The first aspect to be emphasized will be construction of about 50% of the international network, consisting of two-lane track; additional construction of international lines will result in a track-network approximately as indicated on Map 3.

The main emphasis in construction activity, however, will be in the nuplexes. In the 15th year, the agro-nuplexes should have about 700 track-kilometers at their disposal, including the accessible main lines. Production facilities in the industrial nuplexes will be provided with a dense network of track-connections and links to the main lines, and construction sites for satellite cities will be connected by rail. This signifies construction of about 1,000 track-kilometers for each industrial nuplex. The total volume of construction is then as follows:

Double-track construction	45,000 track-kilometers
New track construction	25,000 track-kilometers
Rails in the nuplexes	100,000 track-kilometers
Total	170,000 track-kilometers

The railway construction program in the **fourth phase** will create a rail network for the developed regions which measures up to European standards, i.e., construction of 350,000 track-kilometers to achieve a total network of 320,000 and a track length of about 650,000 km. This phase cannot be sketched here in much detail, because construction will concentrate primarily upon increasing the density of the national systems and developing a rail network in in the nuplex areas. The trans-regional network will also be expanded; Map 3 illustrates the entirety.

The end of the fourth phase by no means signifies the end of railway construction in Africa. The network of 320,000 km is calculated only for the nuplex regions and their population; the development of the population lying outside of the nuplexes and the expansion of available and construction of new industrial and agricultural nuplexes in the following years will be accompanied by a doubling of railway network capacities.

III. Costs of FEF-African Railroad Construction Program

In the following, we will provide a first approximation of construction costs, material and labor force requirements in two tables. The calculations are based upon the following parameters:

(1) A construction cost of $1 million per 1 km of track is assumed (in 1978 prices). This value is far below the European average, but higher than the present costs of African railway construction of $0.5-1.0 million. This higher assumed average is appropriate because increasing economic development will also bring increasing labor costs. These construction cost figures are for total costs; they include the first wagon parks, buildings, temporary infrastructure, etc.

(2) Material calculations are based on the following values:
120 tons steel per km of track, 60 kg rails,
180 cbm wood per km using wooden sleepers (1,600 sleepers/km track),
400 cbm (910 t) concrete per km track for bridges, tunnels, etc.
The value for concrete requirements should only be taken as a rough parameter, because it can vary greatly according to local conditions.

(3) Labor power requirements are taken as 70 man-years/km. This includes all activities involved in construction of a stretch of track, temporary infrastructure, auxiliary construction, etc. 70 man-years is calculated on the basis of capital-intensive methods, whereas labor-intensive methods, such as those used by the Chinese in building the *Tanzam*, would result in a calculation of 200 man-years. The skills-structure is as follows: 5% highly-skilled, 35% skilled, 65% basic-trained and auxiliary manpower. The values in figure 8 always give the labor force requirement of the last year of the respective 5-year period.

Figure 10 shows required rolling stock, corresponding costs, steel and personnel requirements. The parameters for calculation are taken from European railway statistics. For comparison, figure 9 provides present average values for Africa.

If we consider this construction program in connection with the development of the industrial nuplexes, it turns out that the largest part of materials required can be covered by domestic production. Cement for concrete will be available in the very first years, and deliveries of steel for rails and vehicles can be expected from the 10th year onwards; production of transport and personnel vehicles, and later even locomotives, can begin in the third phase.

Figure 11 illustrates the extent to which materials requirements can be met by domestic production.

Figure 8 THE AFRICAN RAILWAY BUILDING PROGRAM

	Initial Capacities		Construction in 5-years period (km)	Costs bill $	Steel mio t	Wood mio m³	Concrete mio t	Construction labour force
	Network-length (km)	Track-length (km)						
0	13 000							
5	69 000	69 000	56 000	56	6.7	10.1	50.1	840 000
10	112 000	130 000	61 000	61	7.3	11.0	55.5	910 000
15	185 000	300 000	170 000	170	20.4	30.6	154.7	3 360 000
20	320 000	650 000	350 000	350	42.0	63.0	318.7	6 300 000
			637 000	637	76.4	114.7	579.0	

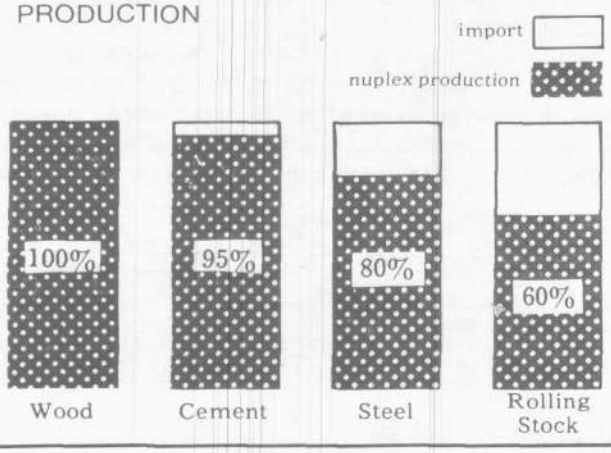
Fig.9 ROLLING STOCK DENSITY

	Number/km track	
	Europe	Africa
Locs	0,085	0.078
Wagons	4.5	0.9
Coaches	0.3	0.1
Staff	5.0	4.3

Figure 10 ROLLING STOCK AND STAFF

	Length (km) of track laid	Locs	Coaches	Wagons	Costs (bio $)	Steel (mio t)	Staff
5	56 000	4 800	17 000	250 000	21.2	7.3	280 000
10	61 000	5 200	18 000	270 000	23.1	7.9	300 000
15	170 000	14 500	51 000	770 000	64.3	22.1	850 000
20	350 000	29 500	104 000	1 580 000	132.3	44.7	1 600 000
	637 000	54 000	190 000	2 870 000	240.9	82.0	3 030 000

Tab.11 PERCENTAGE OF MATERIAL REQUIREMENTS SUPPLIED BY NUPLEX PRODUCTION



IV Road Construction

At the present time in Africa, most investments into infrastructural activities are concentrated on road construction. This applies not only to national road construction; large projects in international highway development are planned, and in part already realized.

Africa (excluding the South African Republic) has about 900,000 km of roads, of which 320,000 km are all-weather roads and 120,000 km are asphalt. Despite this, Africa is well below the standards of developed countries, and below the world average, as indicated in Figure 12.

Road construction, in the context of the proposed development program, will have three points of emphasis:

(1) Construction of a temporary infrastructure for accessing chief areas of development, i.e. for areas of nuplex or railway construction.

(2) Construction of a road network as a feeder system for the railways, especially in the vicinities of agro-nuplexes. A differentiated road network will be an important prerequisite for the development of modern agriculture, because only by this means can supplies of feedstuffs, fertilizers, machines, and transport of agricultural products be assured.

(3) Road construction in the areas outside nuplexes. This construction will be marginal in the beginning, and will only be significant when the industrial nuplexes begin to export.

Next we will look more closely at road construction in the nuplex areas. Requirements for the agricultural areas can be estimated by comparison with the road and highway structures of agricultural regions in developed countries, such as Schleswig-Holstein in the North of the Federal Republic of Germany (Figure 13)

The largest proportion of roads lies in the immediate vicinity of agricultural areas, i.e., 89%. This density corresponds to relatively small farms, as a comparison with the USA, where farming is run on a larger scale, shows. There, the density of agricultural-area roads and highways (local and commercial) is about 0.9 km per square kilometer of farmland area.

We propose the following structure for the road system of agronuplexes:

Highways	0.1 km/sq.km
Local Roads	0.4 km/sq.km
Commercial Roads	0.7 km/sq.km

These values are, in fact, below the level of the Federal Republic of Germany; but, considering the relatively low population density, they should be sufficient. The individual

Figure 12 ROAD DENSITIES OF SELECTED COUNTRIES

	Road-network length (km)	Density km/1000km²	Density km/1 mio inhab.
World	11 450 000	84	2 800
France	785 000	1 420	15 000
West Germany	466 000	1 880	7 500
Africa	320 000	13	800

Fig. 13 ROAD NETWORK OF AN AGRICULTURAL REGION (FRG)

	Length (km)	Share (%)	Density (km/km²)
Highways	5 600	11%	0.34
Regional roads	22 000	39%	1.60
Service roads	25 000	50%	1.60

Figure 14 THE AFRICAN ROAD BUILDING PROGRAM

Year	Construction activities	Length (km)	Costs (bio $)	Asphalt (mio t)	Concrete (mio t)	Construction labour force
5	Type I Type II Tarring	250 000 50 000 50 000	29	1.2	60	700 000
10	Type I Type II Tarring	150 000 300 000 150 000	37	3.6	90	1 100 000
15	Type I Type II Tarring	150 000 500 000 400 000	55	9.6	130	1 500 000
20	Type I Type II Tarring	150 000 750 000 800 000	73	15.0	180	2 100 000
Total	Type I Type II Tarring	700 000 1600 000 1400 000	194	29.4	460	

roads will be of the following types:

Type I are the highways; these are equivalent to today's national roads in Africa. They are asphalted, have a travel-width of 6 meters, and are suitable for heavy trucking traffic. They will connect the agro-nuplexes with each other, and also take over long-distance transport in those areas where no railways exist. Construction costs (1978 base) will amount to $100,000—150,000 per kilometer.

Type II: These are the local roads, connecting villages to each other and providing connections to the highways. Their widths should be 4—5 meters. Initially, they will be constructed as gravel or earth roads, but will get asphalt surfaces some time later. Construction costs will amount to $50—70,000 for the gravel version.

Type III: The commercial network which will access the farmland. These will be earth and gravel, with widths between 2 and 3 meters, on major routes 4 meters. Their construction will not play any major role in the beginning, but will become more important as mechanization increases. Since these roads involve limited, regional projects, we will not deal with them in more detail here.

The final structure of the road network in the industrial nuplexes will depend upon the space given for commercial and private vehicular traffic. This ought to be limited, because it is not economical, but in the initial construction phase of the nuplexes, local road transportation will play an important role. Taking the industrial nations as the standard, about 200 mio t per annum will be transported in the vicinity of an industrial nuplex, of which 65—70% will be materials for construction. As a first approximation, we calculate 5,000 km of well-built roads per nuplex, 60% of which ought to be available by the 20th year.

The road and highway network should be at least doubled in the areas outside the nuplexes, amounting to a network of 600,000 km. Leaving aside the immediate farmland access-routes, we calculate the following road networks:

Subtracting roads already available, 2.3 million km of new roads are to be built. The construction phases are illustrated in figure 14. (2)

In the first phase, emphasis will be on construction of trans-regional roads in the agro-nuplexes. In many cases this will mean improvement of already existing roads; some of the new roads will initially be constructed with gravel.

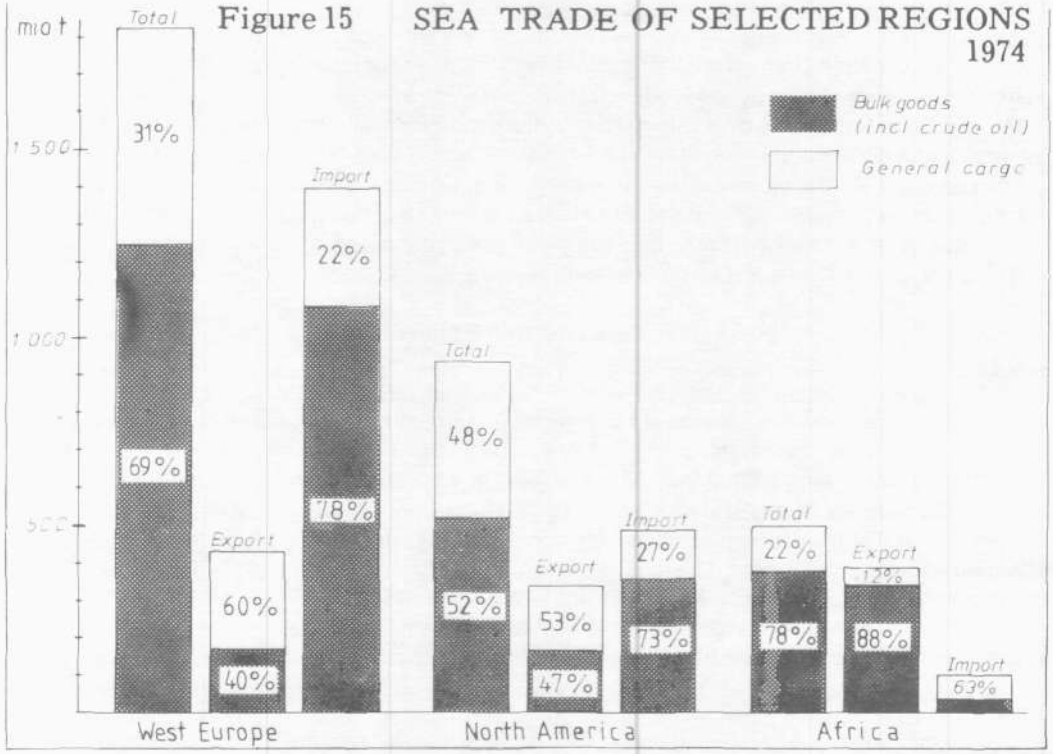
During the second phase, the first local roads will be laid, in addition to further highway construction; in the third phase, in addition to continued construction in the agro-nuplexes, there will be increased construction activity in the industrial nuplexes, as well as in the areas outside the nuplexes. During the fourth phase, construction of local roads will be completed, and asphalting begun.

It is to be emphasized that the average per-capita density for Africa, even after completion of this phase, will still be about one-half of the European standard; thus, road construction will continue even after the 20th year.

V. Harbor Construction and Development

Sea transport will play an essential role in Africa, with its 25,000 km long coastline, not only in the context of world trade, but also in inter-African commodity transport. Especially in the beginning phase, during which the foundation of African development will be technology imports from the industrial countries, development of existing harbor and port facilities, and construction of new facilities, will be crucial. The availability of an adequate port infrastructure will determine whether import and export can be managed without bottlenecks which could decisively hinder development. The infamous "congestion" of the harbor of Lagos has fully demonstrated this point.

In the following, we will describe how African harbor capacities ought to look in 20 years. To get a first approximation of the future harbor turnover, we look at the structure of sea-trade as



of 1974 (figure 15).

The high proportion of bulk-goods transport (75% on world average) makes the present structure of economic relations clear: large raw materials flow (55% of it crude oil) from the underdeveloped sector into the industrial nations, especially into the raw-materials-poor regions like Europe and Japan. The proportion of General Cargo is highest for the industrial nations, especially in exports. The proportion of processed goods in African maritime trade, on the other hand, lies well below average, a condition which will decisively change by the year 2000: during industrial development, General Cargo proportions will steadily increase, both in the form of imports of technology and export of agricultural production, industrial semi-finished and finished products. Since Africa, like North America, has enough of its own raw materials (with the probable exception of coal), the proportion of bulk goods in maritime trade will be less than, for example, in Europe. We therefore assume a relationship of bulk-goods to General Cargo, for developed Africa, of 40% to 60%.

In order to estimate annual cargo turnover volume, we employ the turnover-densities in West Europe (4.5 t per inhabitant) and North America (3.5 t per inhabitant). Africa, like North America, has an extensive internal market, so that a large volume of goods remains on the internal domestic market. Thus, the American values are probably more appropriate as a starting point than the European, even though African figures will probably be somewhat higher because of the extensive coast-line. We assume, therefore, 4 t per inhabitant, relative to a projected population of 462 million active in the nuplex areas. This gives for the year 2000 a total turnover of 1,850 mta, of which 750 mta will be General Cargo — corresponding to a tripling of present harbor capacities and a seven-fold expansion of General Cargo facilities.

The efficiency and size of the future African harbors will, to a great extent, depend on sufficient water-depths.since ships of all types are being built larger, whether these are super-tankers or bulk carriers of 250,000 tdw and 21 m draught. Very few African harbors presently have such depths (see Table 16), so that harbor construction at 15 m depths, permitting access

even for the large container ships, will be necessary in most cases. Some ports will have depths of more than 20 m, and will therefore be able to service the large bulk carriers; these harbors will serve as bulk goods feeder-ports for smaller harbors.

We shall now separately deal with harbor construction for bulk and General Cargo. The latter presupposes good natural conditions to a greater degree than bulk transport; General Cargo ports require a greater water surface area and a larger number of berths, and must have room available for expansion. Artificial harbors such as off-shore terminals or breakwater-ports, like those possible for bulk-harbors, are inappropriate. Harbor parameters are too stringent, making expansion after a certain point either impossible or, at least, very difficult.

VI. General Cargo Turnover

The increase of container transport which, in the near future, will account for 60—70% and more of the total turnover, is decisive for determining the dimensions of the cargo ports. Given 750 mta, 260 mta will be conventional, and 490 mta container turnover. Container-ship berths should be dimensioned so that they will be accessible for ships of the third generation, i.e., a wharf length of 300 m and a depth up to 15 m. Such depths should not be the rule in the beginning, but the quay walls should be constructed to allow for increased depths later. *Container turnover is about 10 times more efficient than conventional*; functioning railway connections are indispensable here for problem-free transport.

Table 16 describes the present and projected capacities of African ports. (3)

Construction costs for the harbors of the Federal Republic of Germany, presently run at $25,000 per meter of wharf for conventional, $80,000 per meter for container shipping. We have assumed a per-meter cost of $70,000, without differentiating between conventional and container facilities. Total costs calculated on this basis are twice as high as they would be at FRG standards. This is justified since in African harbors, comprehensive and costly dredging and clearing work, infrastructural connections, etc., are more necessary than in existing port structures. In many cases $70,000 will be too little, as the example of *Tin Can Island* harbor (Lagos) shows; here the costs ran at $140,000 per meter of wharf.

These construction figures are for total costs; in addition to the quay walls, they contain various superstructure, such as hangars, and transport connections, equipment, etc.

West Africa will have the largest General Cargo turnover. The difficulty here is that there are very few good natural sites along the relevant 3,800 km long coast, suitable for the development of large harbors. Between Cape St. Anne (Sierra Leone) and Lagos, there is only one port, Abidjan, which can be built up to the appropriate size. The other harbors in this section of the coast — Monrovia, Buchanan, Takoradi, Tema, Kpeme and Cotonou — are breakwater-ports and are not, therefore, as suitable, so that a large portion of the turnover of the relevant countries will have to be routed over neighboring ports like Freetown, Abidjan and Lagos. Investigations should be made to determine whether or not expandable natural harbor sites for Liberia, and especially, for Ghana, can be found. In Liberia, this could be Lake Piso in the West of the country; in Ghana, the mouth of the Volta or the Keta Lagoon are possibilities. This project could be developed together with Togo.

The most comprehensive construction projects will be necessary in Abidjan, Lagos and in the Niger delta, especially Port Harcourt/Bonny. All three harbors will be super-ports of international significance, through which the largest part of trade of the inland states of Mali, Upper Volta, Niger and Chad will be routed. Port Harcourt will play a role, especially once the Niger is made fully navigable, the port then attaining the scale of Rotterdam.

At the present time, East Africa has the smallest harbor capacities, disregarding Mozambique for the moment. East African ports must supply a large inland region, the South of Sudan, the East and South of Zaire, Zambia, Zimbawe and Malawi. Natural harbor sites, with the exception of Somalia and Kenya, should be sufficient. Mombasa can probably not be expanded to

Fig.16 PRESENT STATE AND FUTURE DEVELOPMENT OF AFRICAN HARBORS — GENERAL CARGO FACILITIES

Country/ Port	Present state: Access depth (m)	Present state: Depth in port (m)	Present state: Capacity (mta)	Future capacity: Total (mta)	Future capacity: Container (mta)	Future capacity: Conventional (mta)	Length of quays to be constructed: Total (km)	Length of quays to be constructed: Container (km)	Length of quays to be constructed: Conventional (km)	Costs (mio $)
NORTH AFRICA			38,5	205	135	70	63	18	45	4 470
Morocco			7	40	26	14	12.8	3.5	9.3	895
Casablanca	18	7-10	5	20						
Agadir*	8	6-9	0.7	15						
Tangier		6-9	0.8	5						
Algeria			16	45	30	15	5	4	1	360
Algier	16-22	11.5	7	15						
Annaba*		3-13	1	10						
Oran*	24	6-10	1.5	15						
Tunisia			3	15	10	5	4	1.3	2.7	280
La Goulette		10-12	1	10						
Gabes	13.5	10-12	0.4	5						
Libya			1	6	4	2	2	0.6	1.4	140
Egypt			10	80	52	28	30.9	6.9	24	2 165
ad-Dikheila*		17-20	0	40						
Alexandria	11	4-11	9	20						
Port Said	12.5	9	1	10						
Suez*				10						
Sudan			1.5	20	13	7	9	1.7	7.3	630
Port Sudan	25	8-11	1.5	5						
Suakin*		20-40	0	15						
WEST AFRICA			27	230	150	70	90	20.5	69.5	6 520
Mauritania				5	3	2	2.4	0.6	1.8	170
Nouadhibou*		15-20		5						
Senegal Guinea			5	20	13	7	2.7	1.7	1.0	190
St.Louis*				10						
Dakar		5-10	4	5						
Conakry		7-11	1	5						
Sierra Leone Liberia			1.8	15	10	5	5.6	1.3	4.3	390
Freetown*	11-18	11	0.8	11						
Monrovia	13.7		0.8	2						
Buchanan		10	0.2	2						
Ivory Coast			4.4	36	24	12	13.2	3.2	10.0	920
Abidjan*	11	10-11	4.0	30						
San Pedro		11-12	0.4	6						
Ghana			2.2	10	7	3	2.8	0.9	1.7	200
Takoradi	10.7	8-9	0.6	1						
Tema	9.8		1.6	2						
Ada*			0	7						
Togo / Benin			2.0	3	2	1	0.3	0.3	0	20
Nigeria			10.0	130	85	45	58.0	11.3	46.7	4 060
Lagos		6-11	7.0	40						
Calabar*		5-8	0.1	15						
Delta ports			2.0	75						
Cameroon			2.0	15	10	5	6.0	1.5	4.5	480
Douala*	6.7		2.0	15						
Gabon / Congo			2.0	7	5	2	1.5	1.2	0.3	100
Owendo*	18		1.0	5						
Pointe Noire			1.0	2						
CENTRAL AFRICA			4.2	65	44	22	28.5	6.0	22.5	1 990
Zaire			1.2	35	24	11	16.4	3.2	13.2	1 150
Matardi	7.1		1.2	3						
Banana*			0	32						
Angola			3	30	20	10	12.0	2.8	9.3	840
Luanda	30	11.5	1.2	10						
Lobito	15-36	10.5	1.0	10						
Mocamedes*	20	10.4	0.8	10						
EAST AFRICA			15.0	190	125	65	83.2	16.7	66.5	5 830
Ethopia / Djibouti			3.0	40	26	14	18.0	3.5	14.5	1 260
Djibouti		8-12	2.0	20						
Massawa*	11.9	10	1.0	20						
Kenya			2.0	50	33	17	24.4	4.4	20.0	1 710
Mombasa	12.2	10.5	2.0	20						
Unknown			0	30						
Tanzania			2.0	40	26	14	19.5	3.5	16.0	1 370
Tanga	16.0	9.0		10						
Dar-es-salam		10.0	1.5	15						
Mtwara*	20.0	9.8	0.3	15						
Mozambique			8.0	60	40	20	21.3	5.3	16.0	1 490
Nacala	20.0	13.7	0.5	15						
Beira		9.8	1.2	10						
Maputo*	12.5	12.2	6.0	30						
S.A.R.			45.0	60	40	20	2.4	2.4	0	170
Cape Town			15.0	15						
Port Elizabeth			10.0	10						
Durban			20.0	25						
Saldahna*				10						
AFRICA			130	750	490	260	268.0	64.0	204.0	18 990

*proposed Nuplex-centers

Figure 17 THE AFRICAN HARBOR BUILDING PROGRAM *mta = million tons/year

	Initial capacities (mta)*	Length of quays to be built (km)			Costs (mio $)	Steel (mio t)	Concrete (mio t)	Construction labour force	Harbour operating personnel
		total	convent.	container					
0	130								180 000
5	250	106	100	6	7 500	2.7	19.1	60 000	150 000
10	380	86	76	10	6 100	2.2	15.5	45 000	120 000
15	550	48	28	20	3 500	1.2	8.6	25 000	100 000
20	750	28	0	28	1 900	0.7	5.0	15 000	50 000
		268	204	64	19 000	6.8	48.2		600 000

the projected capacity of 50 mta; should no other developable port site be available, there is the possibility of creating a harbor site using atomic mines in a protected area and at sufficient depth.

This problem does not exist in Central Africa; Angola has excellent natural harbor sites, as does Zaire, with the already projected Banana Port.

Very little new harbor construction will be necessary in Southern Africa; and in Northern Africa; the emphasis will be on Egypt. Here there will be the super-port of ad-Dikhai-la.

Figure 17 illustrates the phases of harbor construction for all of Africa, as well as materials and labor force requirements.(4)

In contrast to other infrastructural projects, harbor construction will be considerable already in the first phase, in order to secure import of capital-goods for the construction of the nuplexes. Container transport will not play as large a role as it will at the end of phase four, so that initial emphasis will be on conventional berths.

Harbor construction will not end in the 20th year. The integration of the African population still living outside the nuplexes, together with a steady growth of imports and exports, will make a General Cargo capacity of 1,400 mta in the following years necessary. Facilities for an additional 650 mta must therefore be constructed. This need not mean a purely linear expansion; since the proportion of container shipping will increase, a large part of the expansion may well be possible through conversion of conventional to container wharves.

VII. Turnover of Bulk Goods

Bulk ports are less dependent upon natural conditions (with the exception of water depth), because they have an essentially higher density of turnover than cargo facilities. Bulk facilities with one to two berths and some 10 ha storage area can be loaded to 40 mta, in high-efficiency facilities up to 100 mta, and unloaded up to 15 mta. Under unfavorable natural conditions, breakwater ports can be used, as well as off-shore terminals, connected to the land by conveyor bridges. Bulk ports can also be projected totally independently of the general port facilities.

Water depths of 16 and 17 meters are desirable so that ships of at least 100,000 tdw have access. The largest ports ought to have depths of 22 to 23 meters; they are then suitable for bulk carriers of 250—300,000 tdw.

The construction of bulk facilities will serve two purposes:

(1) Raw material export, export of ores, bauxite and phosphates. South Africa will, additionally, export coal.

(2) Raw material imports. This will chiefly mean supplying the nuplexes with coal and oil.

Export capacities for the following amounts should be available by the year-20:

Coal	80,000,000 tons
Iron Ore	100,000,000 tons
Manganese Ore	14,000,000 tons
Bauxite	26,000,000 tons
Phosphate Rock	80,000,000 tons

Map IV Main Ports of Africa

Projected General Cargo Capacities

Africa is relatively well equipped with loading facilities for this purpose, as a glance at Figure 18 shows, even though only a few harbors exhibit water-depths adequate for the large bulk carriers.

Additionally, projects already projected must be realized: an off-shore terminal in *St. Clara* (Gabon) for export of iron and magnesium ore, with a capacity of 25 mta; an iron ore port on the island *St. Croix* in Algoa Bay (SAR) for ships up to 350,000 tdw; and an off-shore terminal in *Ponta Dobela* near Maputo for iron ore and coal loading, also for 350,000 t ships. Realization of these projects and improvement of facilities already available should suffice for ore and phosphates export. Coal export facilities must be expanded. The capacities of *Richards Bay* will amount to 40 mta by 1980, so that additional facilities for 50 mta are to be built. The turnover can be handled by constructing Ponta Dobela and an additional coal wharf in Richards Bay.

Coal imports of 200 mta will supply the industrial nuplexes. This signifies 6 mta per nuplex, each one having access to 1 berth of around 300 m of quay. Since some nuplexes can be supplied with coal by rail, 25 such facilities will have to be built.

In 20 years, the crude oil requirements will amount to 1 billion t. Regions with their own oil, like North Africa, and parts of West and Central Africa, will transport oil over pipelines. On the African coast, two terminals accessible for super-tankers should carry the major part of the turnover. From there the oil is to be transported via feeder-ships to other ports or pipelines for supplying the inland. Ponta Dobela is one conceivable site, and the second terminal ought to be constructed on the coast of Kenya.

VIII. Pipelines and Inland-Shipping

As we have already indicated, these modes of transportation will not play decisive roles in the beginning, because they are not as versatile as railways. Given a developed industry and increasing transport volumes, however, they will be more important, and will relieve the railways, especially with respect to bulk-goods. Pipelines can be used not only for fluid materials, but, at sufficient annual volumes, also for ore and coal, using "slurry-lines". The railways will then gain in capacity for carrying more semi- and finished products.

Inland shipping will be concentrated on the river-systems of the Niger, Nile and Zaire. The Nile and Niger, especially, will become as important as the Mississippi for the USA or the Rhine for Central Europe, because of their large areas of economic influence.

Notes

(1) These values hold for the FRG in 1974, with the exception of railroads; here the capacity figures of the Soviet railway system, well known as among the world's best, are used.

(2) Construction costs estimates are based on values presently holding for Upper Volta and Niger.Type 1: gravel,$100,000/km,tarred $125,000/km; Type II: gravel, $60,000/km, tarred $75,000/km. These costs assume relatively low wages; by European standards, the costs would just about cover wages alone. As development progresses, accompanied by increasing wage-levels, increasing construction costs are to be expected.
A bitumen requirement of 4 kg/sq.m is assumed, for cement 200 t/km. This latter value may vary greatly, however.

Figure 18 PRESENT BULK LOADING FACILITIES IN AFRICA

Port	Draft (m)	Max.Ship Size (t)	Loadrate	Through-put(mta)
Ore Loading Facilities				
Tunisia				
La Goulette	11.0	38 000	1300 tph	0.4
Gabes	13.7	80 000	2000 tph	
Mauretania				
Nouadhibou	15.9	110 000	3000 tph	10.0
Liberia				
Buchanan	12.8	65 000	6000 tph	13.0
Monrovia	13.7	80 000		12.3
Sierra Leone				
Pepel	13.4	75 000	4000 tph	2.0
Angola				
Mocamedes	19.0	200 000	3500 tph	7.0
Mozambique				
Maputo	11.3	40 000	1250 tph	
S.A.R.				
Port Elizabeth	11.6	45 000	1500 tph	6.0
Saldanha Bay	20.4	250 000	12000tph	15.0
Phosphate Rock Loading Facilities				
Tunisia				
Sfax	10.0	30 000	1750 tph	
Morocco				
Casablanca	11.9	50 000	5000 tph	
El Jadida		Terminal projected		10.0
El Aajun	15.2	100 000	4000 tph	
Senegal				
Dakar	11.0	38 000	1000 tph	
Togo				
Kpeme	11.6	45 000	2500 tph	
Coal Loading Facilities				
Mozambique				
Maputo	10.7	35 000	600 tph	
S.A.R.				
Richards Bay	18.0	200 000	5000 tph	20.0

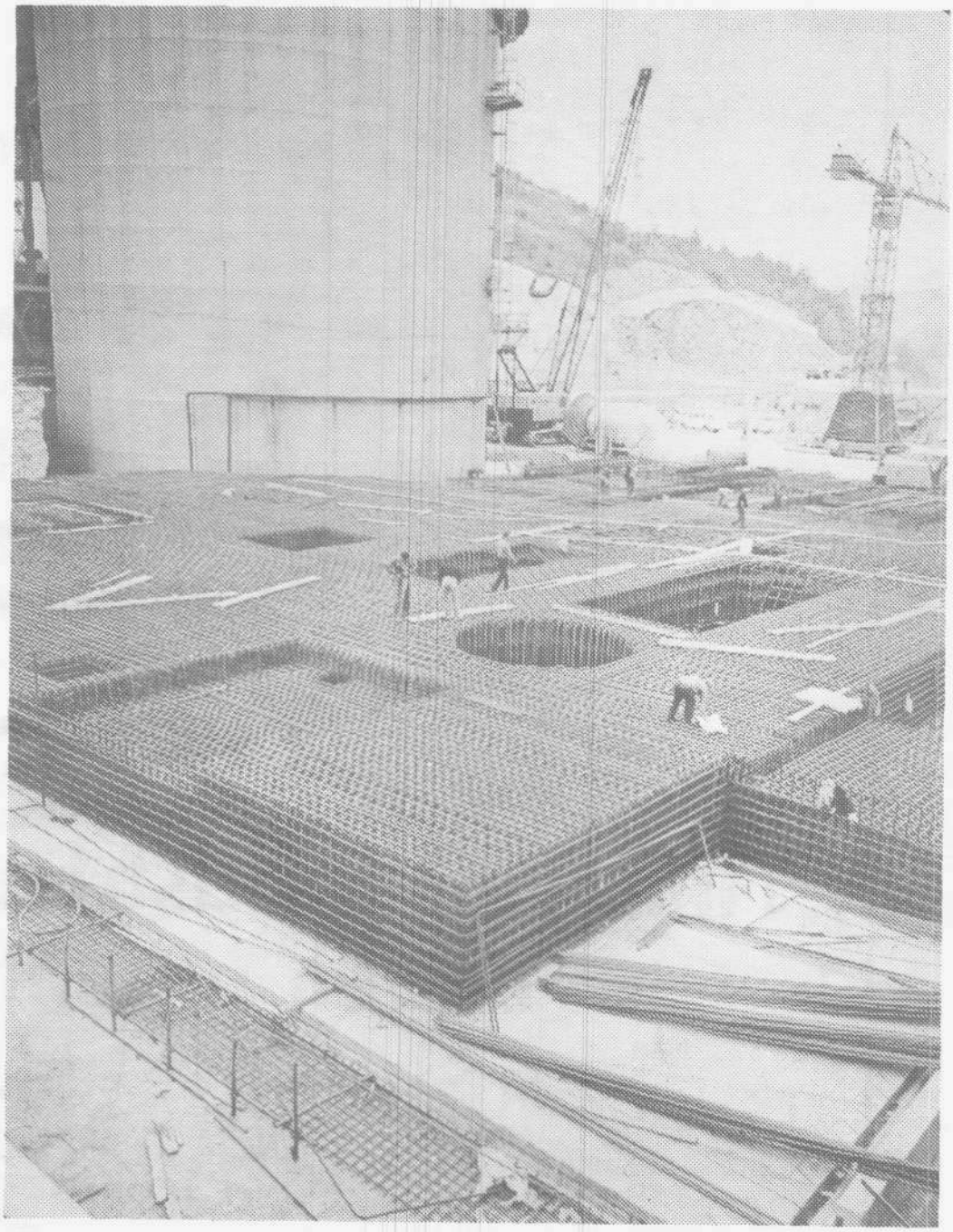
A base of 10 man-years is taken as standard for labor-force requirements for land of medium difficulty and machinery-intensive construction methods.

The *World Bank* is presently propagandizing labor-intensive road construction, with picks and shovels under conditions of subsistence wage-levels. Labor-force requirements are set at 50 man-years/km. Aside from the fact that one could deploy the labor-force elsewhere more productively, the labor-intensive method has also proven to be uneconomical: a project in Burundi has not only shown that capital-intensive methods are cheaper, but that it would even be more economical to send the large labor-force required by labor-intensive methods on paid (subsistence wage) vacation, and build the road using modern machines!

(3) Capacities and quay-lengths are calculated according to values for harbors in the Federal Republic of Germany. Calculations for conventional turnover —two shifts per day, 6-day week— are for 750 tons per annum per meter of quay, container turnover at 7,500 tons.

(4) Calculations of material requirements are based on the following values, relative to 1 meter of quay: steel — 25 tons (for quay walls and stressed concrete), *cement 80 cbm = 180 tons*. Labor-force requirement is taken at 2.5 man-years. The above values hold, for example, for the construction of Tin Can Island.

IV. Financing Industrial Development



"Without money even the best development aid policy is useless ...

Co-operation with the developing countries does not signify distribution of alms. Our contributions for projects in the Third World serve a dual purpose. They strengthen the Third World and thereby benefit us, for three-quarters of the money we place at the disposal of the developing countries flows back into our own economy in the form of orders ..."

(Marie Schlei, former Minister of Economic Co-operation, FRG)

Problems of Financing Large Industrial Projects in the Developing Countries

Mark Tritsch

It will be my task to lay before you a perspective for what techniques of financing large projects in developing countries already exist. I want to emphasize that the projects we are discussing are indeed enormous, that the African countries are presently poor and backward, and that therefore the problems are very big indeed, if we restrict ourselves to existing financing techniques only.

Figure 1 shows a comparison of the global growth of less developed countries foreign debt with their growth in Gross National Product. Normally foreign debt is compared with exports; since many LDCs have had to shift their economies to an inordinate degree across to short term increases in cash crop exports precisely in order to meet debt payment schedules, at the expense of their long-term growth potentiality, we have to find a better measure of long-term capacity to maintain a continuous growth in exports; the best measure immediately available is growth in GNP, which can be taken as a rough measure of a nation's capacity to increase its exports in the future, especially in the case of an LDC.

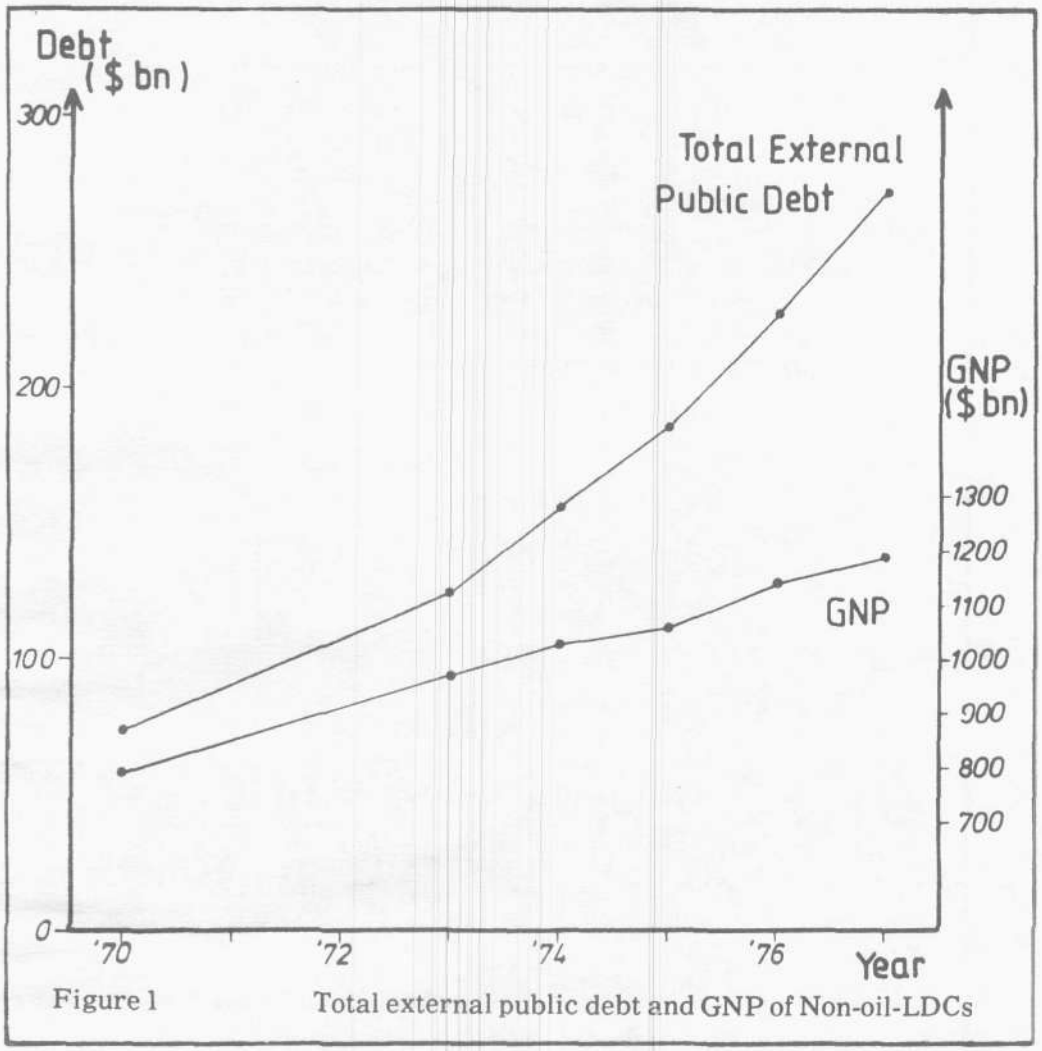


Figure 1 Total external public debt and GNP of Non-oil-LDCs

Clearly debt is rising exponentially, while GNP only rises arithmetically — a situation which must lead to a crisis of financing LDC growth in the very near future. The situation for Africa is of course much worse than general, for reasons we have already discussed here. Not only is African GNP growth much lower than the average for LDCs, but GNP itself becomes even more unreliable as a measure than usual in these cases. Large sectors of the African national economies remain outside the purview of any statistical survey; it is just these sectors which have been undergoing complete collapse in the last five years.

Figure 2 shows a computation of the effects of the 1979 oil price rise on the financing requirements of several LDCs. We have assumed for the purpose of the calculation an average oil price of $19 per barrel for 1979 ($17 for the first 6 months, $21 for the rest), which would normally end up as $21,50 per barrel at the refinery input end of the business to cover carrying and service charges. Please look especially at the figures for Brazil, Greece, Peru, Philippines, Portugal, and Turkey. In all these cases, the countries concerned will not have enough export revenue on their balance of payments to cover even the oil bill and scheduled debt payments, and will then have no funds left over at all to cover other necessary imports to carry on the process of industrialisation.

The case of *Zambia* tells a different, and worse, story which is valid for much of Africa. Our calculations show an almost incredible lack of liquidity, with currency reserves at only 1 / 10 of those required to cover oil imports and debt service. This is partly the result of the lack of any centralizing , national institutions dedicated to organizing the financial system according to the requirements of the country for industrialization. Export income finds its way through a variety of "private", often British-connected, channels to uses far-removed from the interests of the country. The interference of the IMF in the situation, with policies generally emphasizing the re-privatization of what few national, centralized corporate entities already exist, inevitably worsens the situation.

Thus the financing crisis for the LDCs which I spoke of will evidently be with us already this year, and it is under those conditions that we must discuss the access to finance for large development projects.

This conference is unique in establishing as the sole essential parameter of African development, the export of very large, industrialization "packages" to the different countries — in contrast to the futile, "drop-in-the-ocean" style of even the better aspects of existing development aid, be it cement factories or oil-seed mills. Therefore in discussing the financing

Figure 2

COUNTRY	Total oil bill and dept service per year. (bill. dollar)	Same as per-cent of export revenue for 1978	Same as per-cent of present currency reserves
Argentine	3.7	16.7	88.1
Brazil	15.4	121.3	154.0
Chile	2.0	88.3	181.8
Greece	4.3	143.3	477.8
India	3.5	54.7	63.6
Jamaica	0.5	62.5	833.3
Kenya	0.6	50.0	200.0
South Korea	7.3	57.5	347.6
Pakistan	1.3	86.7	260.0
Peru	2.3	135.3	575.0
Philippines	3.7	115.6	264.3
Portugal	2.3	100.0	176.9
Spain	12.8	97.7	148.8
Thailand	3.4	82.9	200.0
Turkey	4.6	200.0	657.1
Zambia	0.6	60.0	1,000.0

Impact on selected LDCs of a $ 19 per barrel price for oil in 1979. The first column shows the total oil bill plus debt repayment load to be expected for 1979; the second column shows this sum as a percentage of 1978 export revenues, and the third column as a percentage of existing currency reserves.

of this program, I shall entirely leave aside the issue of small scale, multi-million-dollar projects, and concentrate on the multi-billion range.

Question number one: what are the main ultimate sources of finance? We have four basic sources: the domestic resources of the LDCs themselves, the domestic capital and credit markets of the Advanced Sector countries, the international credit markets (i.e. the *Euromarket* and its offshoots like the *Asiadollar market* centered in Singapore and Hong Kong), and the so-called "official" sources (the *World Bank, Asian Development Bank (ADB)*, various OPEC-related institutions, advanced sector development aid institutions, the *Kreditanstalt für Wiederaufbau, Caisse Centrale de Cooperation Economique*, etc.).

However the critical question, which we shall now go straight to the heart of, is access to these sources. The FEF (Fusion Energy Foundation) African development plan proposes to establish 180 nuplexes within the next decade or so. Each nuplex will be an enormous project, drawing on global resources of capital, ingenuity and dedication; let us take one of these nuplexes and work through how it might be financed — what kind of financing techniques, or technologies, are available, or must be made available, for this task? Put yourself now in the position of the chief finance manager of a nuplex project in, say, Nigeria. I can promise you, your job will be as demanding in ingenuity and creative capacities as is the physical planning of the nuplex itself! Here's how you will do it.

As a pioneer in the field, you will have to find some kind of "touchstone" — some major financing operation which can serve at least as an initial "guide". The best you can find is the experience of the *German Kraft-Werk-Union* (usually known by its initials KWU), in the planning and implementation of its very large nuclear power project in Brazil. Kraftwerke Union has been responsible not just for delivering 3 or 4 completed nuclear power stations, but for the conversion of whole sectors of the Brazilian economy to the levels of skill and engineering capacity required to reproduce an economy geared to nuclear technology. In short, the KWU/Brazil project involved the reorganisation of the entire economy, which makes it indeed a useful "touchstone" for our nuplex project.

Step one of our nuplex project will be to put together the appropriate consortium of large, Advanced Sector corporations which can handle the different aspects of the program. In the KWU/Brazil case, this involved a restricted group, mainly *KWU* itself, *GHH*, *Voest*, as well as a seperate consortium centered around *Urenco* to handle the uranium fuel aspect of the operation. In our case, it will have to be much larger, and virtually the whole range of an industrial capital goods producing economy will have to be covered; it will be virtually impossible if it is not an international consortium. One can imagine *Empain-Schneider, KWU, Mitsubishi, Massey-Fergussen, Hoechst*, being members of a "model consortium" which represents the minimum constellation of forces necessary. Out of these corporations a "project-planning team" would have to be put together, whose first task would be a thorough structural analysis of the existing national industry and infrastructure of, in this case, Nigeria.

KWU undertook such a structural analysis as the basis for organizing plans for transforming major sectors of Brazilian industry — through expansions of various sectors, restructuring others, and setting in motion large company-mergers. Compared to Nigeria, this was comparatively easy in Brazil; and the Nigerian case would be rather easy in comparison with the majority of other African countries. The Brazilian case involved the restructuring of mainly the construction, light-engineering and heavy engineering sectors of industry. However the feasibility of such operations depends in Africa on whether such domestic industry exists at all, and on the financing capacity for improving it if it does exist.

In Nigeria we can expect there to be something to build on. However, it will probably not be sufficient to make a significant contribution to the program unless it is heavily supported through direct association with the major-contractors-consortium. It will certainly be necessary to set up a string of "joint ventures" between consortium members and local companies, to facilitate the transfer of the skills and technology required if the local companies are to make a dent in the tasks confronting them. Up to this point we can expect there to be no problem of

financing for the international consortium members — their own side of the joint ventures can easily be financed out of their own resources, or else through their standing line of credit with their usual bank at home. However, for the Nigerian company, there will be big problems in making any substantial equity contribution to a joint venture. The whole procedure of setting up joint ventures also raises the thorny old problem, LDC foreign investment restrictions, which we shall encounter again and again as we proceed.

In the Brazilian project, KWU had to form joint ventures to cover some aspects of the component supply for the nuclear power plants themselves, and the technology transfer involved. Their main joint venture partner was the Brazilian nuclear power entity, a fully owned subsidiary of the Brazilian Ministry of Mines and Industry. Therefore KWU's partner had full access to Brazilian government finance, which is a not inconsiderable factor. Additionally, Brazil has rather a liberal law on foreign investment, with few restrictions on use of profits.

Therefore KWU set up joint ventures with *Nuclebras: Nuclen* to develop the capacity for engineering design, and *Nuclep*. Nuclen receives blueprints from KWU in agreements on technology transfer — and at the height of the project there are as many Brazilian engineers training in West Germany as there are German engineers "on site" in Brazil. To develop the Brazilian capacity for manufacture of heavy components for the nuclear power plants, KWU and Nuclebras set up Nuclep, with also GHH and Voest being partners in the joint venture.

In the Nigerian nuplex case, we can expect the general rule to be the setting up of joint ventures between consortium partners and groups of merged small Nigerian companies, which will probably have to be either partly or fully taken into Nigerian state ownership, to both permit a reliable basis of agreement on conditions of foreign investment, and to provide access to Nigerian government finance. Here the first major finance problem will arise for the chief financial manager — what advice to give the government on covering the financial needs of the joint venture. Nigeria will have for the next decade or so substantial oil revenues, which will provide some of the liquidity necessary; an investment of oil revenues in the equity of new companies which will be partners in technology transfer agreements will be a convincing priority over their use to cover normal imports.

Part of the initial phase of the KWU-Brazil agreement was the establishing of a major research and training center in Brazil. One of the first targets for the graduates of this center is the site planning for additional nuclear power plants to bring Brazil's nuclear capacity up to the 6 or 7 GW level required to make its own full-fuel-cycle capability economically viable. The site planning is in fact a tremendous task in itself: account has to be taken of the fact that at the height of the project 10,000 people will be employed on the site, while the infrastructure has to handle a total of 600,000 tonnes of material, with maximum loads of 400 tonnes. Once more, the Brazilian government was capable of financing this center. In Nigeria and in all the African countries the task will be the establishment of a totally new educational system, with modern technical universities and engineering centers, as well as research institutes, being the "seed core" of every nuplex. The financing of this will put a major strain on the national budgets of all the countries concerned; Nigeria's oil revenues will begin to look rather small when confronted with this task.

It is at this point in our planning that we must begin to seriously consider where to go for major outside funding for the program. Up until now, raw material exporting countries like Nigeria have been able to supplement their export revenues by recourse to the Euromarket, using their raw material reserves as an assumed "collateral", although naturally not in the juridical sense of that. Nigeria had, at the end of 1978, outstanding debts on the Euromarket of nearly 1.5 billion dollars, and is now in the process of signing a new $1 billion loan.

We can not usefully consider the expansion of the Euromarket (EM) as a regular and reliable source of funding for large development projects. The EM should normally be a secondary financial market, useful for the recycling of "redundant" funds on a short-term basis. In the last few years it has grown faster than any other financial market, on the basis of US balance-of-

payments-induced offshore balances of dollars, and the large dollar-surplus revenues of the Arab OPEC countries. Thus its main driving force is not the regulated satisfaction of a demand for funds for productive investment; in fact the limiting factor on EM expansion is fundamentally supply of funds, not demand. Despite its latest hectic growth (lately to $ 0.9 trillion), its expansion is not governed by any national or international banking policy directed at stable growth, however rapid. Under conditions of "drying out" of existing EM balances, with their reinvestment through official institutions into productive uses, a few hundred billion dollars might become available on a once-for-all basis. Over a longer period of time, with the establishment of functioning international financial markets based on international agreements for the implementation of large development projects, the EM might return to its appropriate function as a secondary market for international corporate funds, and be a useful supplementary source of funds.

Nevertheless, it must be said that if the Nigerian nuplex be considered in isolation, the EM even as at present constituted could be tapped to "top up" Nigerian government financial reserves to permit necessary expenditures on schools, universities, etc. Of course, as soon as it is considered in the much larger context of the multiplied financial needs of the whole African project, that becomes impossible. Virtually no other African country, however, would be in the position Nigeria is in in relation to the Euromarket: EM banking consortia do have a minimum level of creditworthiness they demand of a borrower, and under present conditions most African countries just do not measure up: as a security against high risk levels, most banking consortia prefer to lend to the so-called "newly-industrializing countries", such as Brazil. In 1977 and 1978, taken together, banks lent 25 % of their EM funds lent to LDCs to Brazil and Mexico alone!

Having set up the organizational infrastructure, the technology-transfer arrangements, and all these other things, we now come to the most difficult task: financing the export of enormous quantities of capital goods, that make up the "meat" of the development project, into Nigeria. We can assume a minimum requirement of $ 2 or 3 billion per year, to finance these imports, in the first ten years. To get an idea of the scale of operations we are discussing, consider that the total cost in the first decade of the FEF program for Africa is likely to be in the range of $1,000 billion!

In these ranges of financing needs, recourse to the EM obviously becomes an irrelevance for the major portions of the financing package, not only because of the volumes, but also because of the interest rate levels required, and maturities. Eurodollar credits are presently issued at well into double figure interest rates, and maximum maturities usually of 7 years. But a more general problem we shall encounter is that of "project profitability".

Normal bank practice is to finance projects in which there is a calculable period over which the project itself will become profitable, and a similarly calculable level of both liquidity risk and political dependability on a responsible financial policy on the part of the borrower, the holding of a sufficient capital reserve against "hard times", and a reliable assurance of a continuing, uninterrupted, sufficient cash-flow in the project. Political risk was never easily calculable, but until the seventies, the incidence of dramatic losses through political action was generally low. But now, not only has the political risk of lending to LDCs become generally much higher, but the political destabilization of large areas (of especially Africa) has led to mostly incalculable liquidity risks as well, because financial policy has lost all semblance of "solidity". In addition to these negative environmental factors, our nuplex project can be expected to be a continuous "eater" of funds until the last years of this century. Profit-producing sectors of the economy will certainly arise before then, but generally in those sectors of the economy experiencing the benefits of the industrialization set in motion, and not in the project itself. In this respect it will resemble the general problems of LDC "infrastructural investment".

The capital goods import required for the installation of KWU's nuclear power stations in Brazil was financed in the following way: the financial manager of the project arranged a three-part package. 85 % of the funds required were provided by two loans of equal size. One was a

DM loan provided directly to Nuclebras by a consortium of German commercial banks. This was a highly unusual procedure, in which Nuclebras was given access to Germany's domestic capital market. The loan was guaranteed as if it were an export credit, by the German export credit guarantee agency, the *Hermes Insurance Company*. However, the loan was provided at a rather low, and above all, fixed rate of interest. This was accomplished through a German Federal Government agreement to break the rules concerning access to the long term capital market. Normally banks would not be allowed to draw on the so-called "Hypotheken" (long term credit) banks to finance a foreign, Third World customer. The government agreement to "break the rules" made it possible; in one way, this can be seen as the German Federal Government taking over a substantial portion of the risk for the project.

The second loan, of equal size to the first, came directly from the German development credit corporation, the *Kreditanstalt für Wiederaufbau*. Although this is the German, "official" development agency, it has the right to raise funds on the German capital market itself; it is not fully reliant on funding through the government budget. Only this gives it the possibility to issue loans of the size necessary for the KWU project. Its capacity to lend at low interest rates, and for long maturities,arises of course from the fact that its credit-worthiness is virtually 100%, and its operations are subsidized by the German Federal Government. Therefore in this case also, we can see that the Brazilian borrower, Nuclebras, has effectively been given access to the German domestic capital market through the mediation of the German Federal Government. This was possible primarily because Nuclebras, and the entire project, is government run, ensuring revenue sources for repayments.

The remaining 15% of the funds required are provided through a Eurocurrency credit arranged by the same German banking consortium. This credit is not designed to cover the import cost of the components, but rather to cover payments of principle and interest on the other two loans for the first 7 or so years, and thus provide a "grace period", in which all the loans are payment-free. The shorter term lending capacity of the Euromarket is obviously more suitable for this kind of supplementary funding.

What can we learn from this? In terms of the four sources of funds I listed at the beginning, we have already eliminated two: first, in general, the Euromarket, and second, we can also dispense with any illusions concerning the domestic credit markets of the LDCs! We are left with Advanced Sector domestic markets, and official sources. Official sources, if based only on budgetary allocations, are thereby extremely limited, and susceptible to alterations of domestic fiscal policy in the Advanced Sector. Official sources which essentially "on-lend" funds borrowed in Advanced Sector capital markets, can be regarded as extensions of the capital market operating under 100 % (advanced sector) government guarantee. Likewise, as the KWU example demonstrates, even in the most favorable cases, access via comercial banks rather than official institutions to the capital markets of Advanced Sector countries will only be possible through special government arrangement and guarantees.

Therefore we have eliminated for the moment all possible sources of funds except the domestic capital markets of the Advanced Sector. That is where the financial manager must turn. If we imagine the Nigerian Nuplex — only one of them — in isolation, it is conceivable that finance could be arranged somewhat on the model of the Brazilian operation, not necessarily in West Germany, possibly in Japan or the USA instead, or as an international operation in parallel with the main contractors consortium. In this Nigerian case we are talking about requirements of 2 or 3 billion dollars per year; the German capital market has a total volume of nearly $2,000billion, the US market is much bigger, and the Japanese is rather smaller. It is therefore feasible to think in terms of this KWU model. But as soon as we consider the FEF Africa program as a whole, the dimensions look very different.

The dimensions of the FEF Africa Program in terms of financing it are truly awe-inspiring. The energy program alone, consisting only of the nuclear generating capacity and the electricity grid, will impose financing requirements of at least $ 1000 billion in the first years, and much more thereafter. The Nuplex system is of course much more than only the energy-system it-

self, which constitutes only 30% of the whole. Therefore we must expect to cover well over $ 3,000 billion in financing needs for the Africa program in the first ten years. This of course does not include the investment in Advanced Sector productive capacity necessary to carry out the program, nor does it include parallel development programs in other underdeveloped sectors that are necessary to ensure the success of the program. That figure — $3,000 billion — can be compared again to the size of the German capital market: at the present, nearly $2,000 billion.

Let me remind you at this point of the remarks I made at the beginning about the disastrous state of LDC finances in the aftermath of the 1979 oil price rise. LDCs are going to be, at least temporarily, in the situation of relying on international finance for not only the funding of these large projects, but also to provide foreign exchange with which to buy even the most essential imports for maintaining minimally necessary living standards! Loans issued to fund such imports will rely for their repayment on essentially the taxing capacities of the debtor government. This fact, along with the before-mentioned problems of profitability of the major nuplex investments, demands that we reconceptualize the means by which the various fundings realize themselves as profitable. We shall have to conceive of the LDC industrial structure as it is built up as being predominantly state-controlled, allowing the state to develop a taxation policy for the highly-profitable private industry which develops on the basis of the nuplex centers which will reflect the actual real reflected profitability of the nuplex itself. The taxation policy will have to be implemented at first through a system of charges for services provided, and then only later in a system of direct taxation of corporate and earned income.

Putting together our conclusions that finance must be provided under state-guarantee from the Advanced Sector capital markets, through various official and semi-official institutions, and that the projects can be made profitable in the long-term, it becomes evident that we will not get by without creating new, very large official institutions operating at an international level, which can reliably provide the funds we require.

This will be an international development-financing institution issuing credits up to the level of several tens of thousands of billions of dollars in the first ten years of its operation. There will be concern about the inflationary dangers of such large volumes of credit issuance. Of course, we can demonstrate that such large volumes of finance concentrated into entirely productive ventures, are likely to have a net deflationary effect on world credit markets. There is a relevant question of ensuring that the secondary circulation of funds within the LDCs themselves takes place in such a fashion as to favor productive investments and discourage luxury spending. This is largely a question of ensuring the rapid development of an efficient banking system in the countries concerned.

But we must insist that Advanced Sector Central Banks will have to gear their monetary policies to the needs for liquidity directed at productive investments. Financing techniques must be established which allow a stable expansion of liquidity in the world's capital markets at double-digit rates of increase, without this being in the remotest way associated with inflation. That liquidity must be smoothly transferred via Commercial Banks, government and other institutions to international and national official credit issuance agencies which will lend it on to the users. That is the only way we are going to finance these projects.

"Progressive governments that are making a noble effort to develop and increase the well-being of their countries are overwhelmed and may even be wiped out by economic difficulties and unfair, unpopular conditions imposed by the international credit agencies. What political price haven't many of you had to pay because of the rules laid down by the International Monetary Fund? We Cubans, who were excluded from that institution, are not quite sure whether that exclusion was a punishment or a privilege ..."

(Fidel Castro, Keynote Speech to the Sixth Summit of Nonaligned Nations in Havana, Sept. 1979)

A Global Hamiltonian Approach to Financing

Michael Liebig

Any theory of financing can be reduced in the final instance to two conceptual approaches:
— the *John Law* approach
— the *Hamilton* approach

The fundamental difference between the two conceptions is that the latter views credit as an instrument for the promotion and extended realization of scientific-technological progress while for the first exactly this is by definition nonexistent.

I suppose in France one still remembers the disastrous effects which resulted from the activities of *John Law* in 1718-1719. Law should not be seen as some financial kook; he based his theory on Aristotle's "Chrematistics", and British banking before and after Law was never really different from what he did. In any case the reincarnation of Law is *Lord Keynes.* Keynes not only designed the principal features of the Bretton Woods System and the IMF but his ideas still determine most discussion in respect to Third World development financing. If credit creation and realization is arbitrarily disconnected from industrial-technological development,

this necessarily leaves only the monetarist activities of tax farming, government financing, mere monetary speculation and various other physiocratic schemes as the means of an entirely fictitious capital generation.

The combined monetarist-physiocratic approach is particularly blatant in the so-called RIO-study of the *Club of Rome*, that denies technological progress for the LDC's and offers them financing schemes based on large-scale Special Drawing Rights (SDR) credit expansion together with gold demonetization, taxing of advanced sector industrial production, and credit generation based on internationally accessible natural resources. The same principle is contained in Kissinger's "International Resources Bank" or the "International Seabed Bank" of the *New York Council on Foreign relations (CFR)* in its "Project 80s" study on world finance.

We can discount here all that neo-Keynesian scheming, because it has nothing to do with our theme, which is Third World development financing in terms of industrial-technological progress. The aim of neo-Keynesian finance theory for the LDCs is *not* development, but the vain attempt to stabilize and keep alive a fundamentally defunct international monetary system and the IMF. For that purpose even the most absurd monetarist-physiocratic financing scheme is good enough. Credit generation and realization is a monetarist end in itself in which industrial development is not only ignored but rejected.

The Hamiltonian Principles of Finance

We will now make a short historical case study on industry-vectored financing to come to the basic principles required for today's global development financing. Already 140 years ago the great economist *Friedrich List*, as much French and American as German, said in his "*System Naturelle*" written in French for the "Academie Francais":

> "Il n'y a pas pour les nations le plus avancées de l'Europe et de l'Amerique du Nord, de plus grand interet que celui de la civilisation de tous les pays de l'Amerique meridionale, de l'Afrique, de l'Asie et de l'Australie. Toutes pourront, par ce moyen, agrandir a l'infini leur exportation en marchandises fabriquées." *(1)*

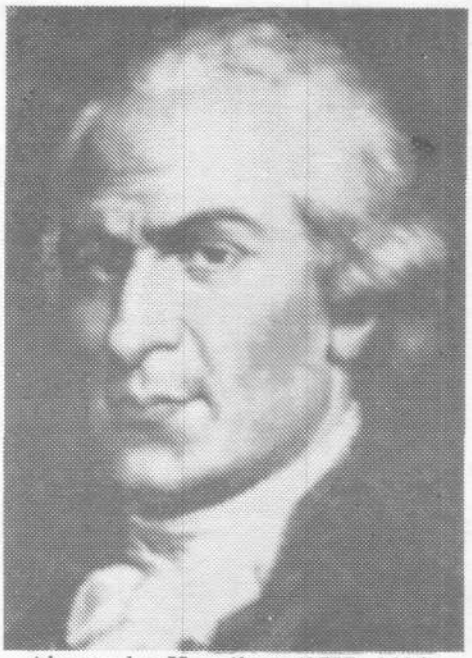
Any sound theory of credit takes industrial-technological progress as its prime parameter. "As long as investment is governed by the principle of technological progress in the expansion of production, there is no other limit to the credit which can be created for that purpose," as *LaRouche* puts it. Credit is the instrument to set in motion and to productively unite in the production process the capital of mind, the capital of productive matter and raw materials. That notion of credit is Hamiltonian.

Hamilton was the Secretary of Finances in the two Washington administrations of the young American Republic. His task was to finance the development of the politically independent but economically under-developed United States, which suffered especially from an enormous state indebtedness as a result of the War of Independance. Economic development, Hamilton knew, would not result from Adam Smith's type of "parsimony" nor from the acting out of free market forces, but only through the active "encouragement" by the state in providing cheap, long-term credit to set economic affairs into motion. Hamilton defined therefore:

(a) the aim of credit,
(b) the organisation of credit generation and realization,
(c) the functioning of credit generation.

The aim of credit is to expand national economic wealth, which he defined "by the quantity of the production of labor and industry . . . the state of agriculture and manufacture, the quantity and quality of labor and industry". The tangible surplus resulting from the stimulation of economic activity through credit must always exceed the cost of credit. Hamilton formulated that classically by saying: "The creation of debt should always be accompanied by the means of its extinction".

Concerning the organization of credit generation and realization, Hamilton constituted the



Alexander Hamilton (1757 - 1804)

Friedrich List (1789 - 1846)

"National Bank" as a "nursery for national wealth", as he put it. The "National Bank" was no extension of the government, because Hamilton was aware of the inflationary pressures too often put on credit-generating institutions too closely linked to the state administration. The "National Bank" was independent and its directors were not designated by the government. The state however provided a major share of the Bank's stock. The Bank was a sort of state-private banking "co-financing" institution. The Bank was strictly limited to financing manufacturing, agriculture and trade and excluded from any speculative transactions with goverment paper and related activities.

Hamilton conceptualized the functioning of credit generation in the "National Bank" as follows. Credit generation has to avoid inflationary as well as deflationary effects. The regular subscription to a bank of the dimensions of the "National Bank" would have necessarily absorbed much of the needed liquidity out of the country. At the same time Hamilton was reluctant to rely exclusively on "ex novo" credit creation by the government for the bank, because he feared a potential inflationary impulse. Hamilton's solution was the "converting" of the existing large-scale state debt of the United States. The stock of the "National Bank" consisted of 25% cash (bullion) and 75% government paper. This way Hamilton prevented a deflationary dry-out of the nation's available capital and simultaneously any speculative manipulations of the U.S. state debt. The holders of that debt, who placed it in the Bank, were paid interest on the government paper through the bank in addition to the dividend on the bank's activities. This way Hamilton put together the capital basis on which credit generation for the promotion of manufacturing in the United States could take place.

If we sum up the essentials of Hamilton's theory of finance we have three basic points:

(a) credit as a strict function of hard-technology development

(b) a state-private banking "co-financing" approach,

(c) "converting" of non-productively performing capital, especially state debt.

I think these three Hamiltonian principles still mean a lot for any sound approach to financing

in general and to the gigantic task of Third World industrial development financing especially. It is *Lyndon LaRouche* who took up the Hamiltonian approach and developed it further theoretically in his 1977 "*Private Banking Approach to a New Monetary System*". (2)

The Hamiltonian System Today

Hamilton, and with him *Friedrich List*, conceptualized industrial-technological development for the first phase of the industrialization of the world economy, that lasted from American independence to the first Soviet Russian Five Year Plan. In that phase, development was possible mostly in a "national" fashion, out of the nations' "own resources" so to speak. That applies for the U.S., continental Europe and Soviet Russia.

The second phase of the industrialization of the world economy, which is the industrial-technological development of the Third World, renders a purely national approach obsolete. This is principally due to the development of science and technology on the one side and the enforced backwardness of the Third World as a result of mainly the British colonial system on the other side. Stating this fact by no means is an endorsement of the "limited sovereignty" policy of the IMF and the CFR. I intend rather to suggest a "Development Entente" of sovereign advanced and developing nations.

Today there is hardly any private banker in the world who would think of LDC-financing as an area of free-enterprise banking. In the worst case the LDCs are written off as doomed anyway. In the best case the private banker has to capitulate to the sheer dimensions of the financial needs for industrial development in the Third World. A recent study by a leading West German bank, for the government, makes the point absolutely clear. The way out for these banks in their own perception is "co-financing" — but unfortunately co-financing with the IMF.

Even for the largest private international banking consortia, development, as outlined in this conference, is simply too much. For the next quarter of a century LDC-financing and development requires a massive scale of credit generation, that means an unprecedented accumulation of debts in the advanced sector for export financing and in the LDCs for import financing. *Financial equilibrium will not exist for the next decades*, and instead we will see the biggest monetary disequilibrium ever.

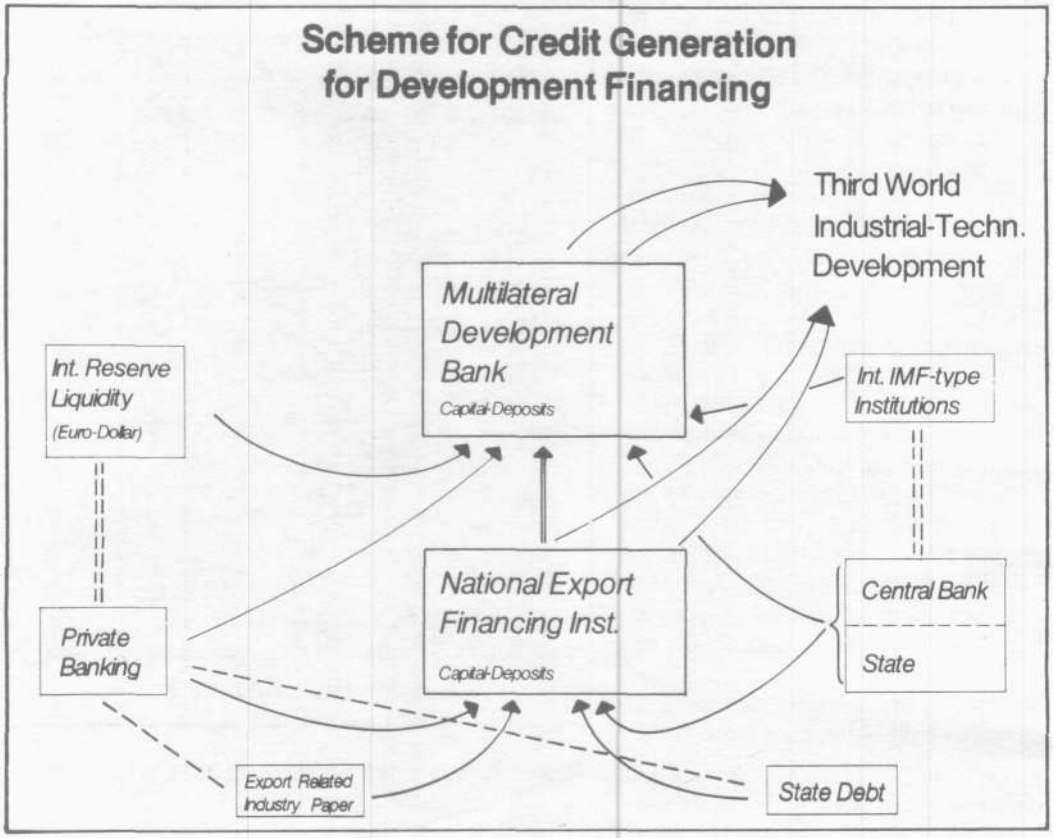
I am not talking about the present messy disequilibrium of the IMF-dominated world monetary system. This cannot be salvaged in any case, and attempts at monetarist enforcement of an equilibrium through the IMF will inevitably lead to the decay of the world economy, not just the developing sector.

In the face of IMF "conditionalities" and "surveillance" rights over balance of payments problems of especially Third World countries, let me remind you of what Hamilton said in his already quoted "*Report on a National Bank*" (1790).

> "The support of industry is probably in every case of more consequence towards correcting a wrong balance of trade, than any practicable retrenchments, in the expenses of families or individuals: and the stagnation of it would be likely to have more effect, in prolonging, than any such savings in shortening its continuance. That stagnation is a natural consequence of an inadequate medium, which, without the aid of Bank circulation, would in the cases supposed, be severely felt".

What is for us relevant is that any sound approach to development financing in the Third World has to be based on the fundamental assumption of a permanent monetary disequilibrium in the foreseeable future. But that need not be a disaster, quite the opposite. Having stated this, let us come back to the question of credit generation and realization according to Hamilton's concepts of "co-financing" and "converting".

Third World development financing is only possible on a multilateral, state-private co-financing basis. The financial resources that have to be generated in a joint state-private banking approach on a national level, must be pooled in a multi-lateral state-private banking development financing institution, a sort of "International Development Bank". Only in this



way can the total capital basis be provided which is capable of creating the large-volume credit facility corresponding to the actual needs of industrial development of the Third World. In the national sectors, existing export-financing institutions will have to be reorganized and expanded together with private banking along the principal features of Hamilton's "National Bank". These national institutions have to be viewed as "branches" of the multilateral institutions. The private banking sector will operate within and together with the "national branches" as well as the central multilateral development financing institution.

We think there are already a lot of starting points which can be developed further into such a multilateral,state-private banking co-financing institution, on the national and multilateral level. Reorganized and expanded export financing institutions in France (*Caisse Central pour Cooperation Economique*), West Germany (*Kreditanstalt für Wiederaufbau* and *Hermes Credit Insurance*), Japan, and the US-EXIM-Bank could be pooled. That pooling might develop in a regional fashion, for example with the EMF-"Phase II". There is no question that key Arab and oil producing countries would indeed join such a development financing facility. Finally the CMEA-countries might feel the political-economic weight of such an "International Development Bank" and link up with it through institutions of the type of the *International Bank for Economic Cooperation (IBEC)* of the Comecon.

In the same way, *national development agencies of the Hamiltonian "National Bank" type have to be created in the developing sector.* These institutions have to administer the inflowing credits for the development projects in their national sector coming from the multilateral and national export-financing institutions of the advanced sector. The accumulated debt of imported capital will have to be gradually channelled back by these Third World "branches" to

the extent the imported capital materializes in tangible industrial output giving these Third World nations an actual export capacity.

The question remains: how to generate the capital basis and deposit inflow for such multilateral co-financing institutions and their national "branches"?

Let us approach the problem first on the national level. A state-private-banking co-financing institution of the "National Bank" type in the advanced sector could obtain its capital basis through a mixture of state and private banking financial inputs.

First of all, the state together with the central bank has to provide a major share of the bank's basic capital. A significant amount of currency reserves and gold has to be incorporated as basic capital of this export financing bank. The bank will also have a special "window" for large-scale deposits of the state in the bank.

Lyndon H. LaRouche, Jr.

Secondly, the voluminous state indebtedness of advanced sector nations will have to be converted into the bank's capital base.

Thirdly, the private banking sector subscribes a major share of basic capital of the bank. The private sector will also make big deposits in the bank through the absorption of gold-denominated bonds issued by the bank. The national export financing institution also accepts special categories of export related industry paper and equity for discounting and consolidation.

This mixture of inputs should provide a capital base for export credit generation sufficient for the large scale needs of Third World industrialization on a national level together with a corresponding enlargement of the national liquidity volume by the central bank.

The multilateral institution, "International Development Bank", will constitute its own capital base through the transferring of a significant percentage of the capital stock of the national export financing institutions. In addition the central banks of advanced sector surplus countries can transfer some of their international reserve liquidity into this facility too. The multilateral institution incorporates also the gold and reserves still held by the IMF. Other capital held by the IMF and related institutions like the World Bank, IDA, etc., will have to be frozen, converted or consolidated on a case by case basis.

The private banking sector of course, too, will invest directly into the multilateral institution, which will also issue gold-denominated development bonds. This way the $900 billion liquidity on the Euro-dollar and related markets can be "dried out" progressively and channeled into productive development investment together with a large scale consolidation program for already capitalized Euro-dollar money.

I think such a qualitative approach along a Hamilton-LaRouche-outline makes global development financing for the industrialization of the Third World manageable, in spite of the tremendous financial dimensions of several hundreds of billions of dollars rising to several trillions of dollars in the forseeable future. As long as we stick to Hamilton's principle "The

creation of credit should always be accompanied with the (industrial-technological) means of its extinction, '', nobody ought to be terrified by Third World industrial development financing.

Notes

(1) ''For the most advanced nations of Europe and North America, there is nothing of greater interest than civilizing all the countries of Southern America, Africa, Asia, and Australia. They will all thereby be enabled to infinitely expand their exports of manufactured products.''

(2) May 1977, Campaigner Publ.

"Europe will only be able to recover its former prosperity, if it uses all its material and cultural strength for Africa. Europe must, as a collective task, open up and develop the African continent."

(Raoul Dautry, French Minister for Reconstruction, 1949)

The Restructuring of World Trade Flows in Global Industrial Development

Jacques Cheminade

Having arrived at this stage in our conference, certain of you may perhaps be thinking of the following question:

"You have specified what the developing countries must receive in terms of capital goods in order to promote the necessary process of industrial growth — in particular, nuplex city-building. But what can the developing countries *give in exchange* for these capital goods and advanced technologies? In other words, how can balance of trade and balance of payments be established? Your proposals are seductive, but aren't they utopian?"

And if you have a particularly suspicious mind, you might also think: "Isn't this a way of making Africa dependent on exports from the industrialized countries?"

In fact, if you compare present world trade, which totals about $1,300 billion yearly, with our proposal for the construction of 160 nuplexes in Africa, which will induce trade flows of approximately 3,000 billion dollars over 15-20 years, then certain questions are justified. But these must be the right questions.

For Africa alone, the trade flows induced by nuplex construction will represent approximately 25 percent of present world commerce. To the question posed above by our sceptical observer, we can reply by stressing right from the outset, that given present world finance and trade structures, we are facing a fundamental problem.

What is happening today with the world trade situation? One can observe four main phenomena — four predicates — which all derive from the fact that (and here is the fundamental problem) *at present, international transactions are not governed by the requirements of industrial development, but by the debt obligations carried by international financial institutions.* World trade is today being subordinated to a *hegemonic global system of debt service.*

The four principle symptomatic phenomena, together illustrating this fundamental problem, are the following:

1). The growth of world trade and commerce is rapidly decreasing in volume, while increasing in price. Thus there is a cancerous proliferation of fictitious value relative to the existing industrial and agricultural base. The figures of Table 1 need no commentary.

2). Apart from OPEC members, the share of the developing countries in world commerce is stagnating, while "interzonal" trade between industrialized countries is increasing. It is therefore clear that in the poorest countries, which are also the most populous, new markets have not been opened up, and that consequently about 3 billion human beings have been excluded from the process of international development — a process which itself suffers from having too narrow a base.

3). The developing countries generally remain totally dependent on raw materials as the major factor in their exports, representing about 80 percent in 1963 and no less that 70 percent today.

4). The marginal sector of non-raw-materials exports from the Third World consists almost entirely of industries operating at low wages and in a limited number of countries. Hence, the reduction of the percentage of raw materials in total exports from 80 to 70 percent since 1963 is not only marginal, but corresponds to speculation in the low cost of labor.

Finally — and this is the decisive phenomenon — the growth of raw materials exports as well as manufacturing exports from the developing countries is running parallel with the growth of these countries' indebtness. If one compares their exports with their indebtedness on one side, and with their Gross National Product on the other, it emerges clearly that the export level grows at the same rate as indebtedness, in fact *exponentially*, while the Gross National Product grows only *arithmetically*, and is loaded down with the ever greater costs of parasitical service sectors.

In sum, this means that the present growth of exports from the developing countries is uniquely the result of the expenditure of domestic resources — labor and raw materials — on the payment of external debt.

Considered within such a trade structure, the nuplex idea has about as much chance of survival as a swimmer attached to a one ton weight. Conclusion: *a fundamental restructuring of world trade flows is required, if the commercial position of the developing countries is to be made compatible with their own development needs.* In order to accomplish this, the following conditions must be met:

— the volume of world trade must grow exponentially, instead of the present stagnation.
— the share of developing countries in international trade must be drastically increased, and trade between advanced and developing nations must become dominant, substituting in part for present interzonal markets between the industrialized countries (a closed world which anyway cannot survive by itself).

Such a transformation is hardly compatible with an equilibrium condition in the balance of trade and balance of payments of the developing countries. *But this is no valid reason for rejecting nuplex development; on the contrary, this is a reason for rejecting the notion of "equilibrium".*

Figure 1 DEVELOPMENT OF WORLD TRADE

	1955 - 1964	1964 - 1968	1968 - 1973	1973 - 1978
Volume	+6,6%	+7,8%	+9,4%	+3,8%
Factor costs	+0,3%	+0,8%	+9,2%	+13,3%

Figure 2
SHARE OF DEVELOPING COUNTRIES IN WORLD TRADE

	1955	1963	1973	1976
Including oil exporting countries	26.7%	21.5%	19.2%	24.1%
Excluding oil exporting countries	—	—	13.6%	13.8%

In the framework of the New World Economic Order which is necessary for the future of the human race, trade between industrialized nations and developing nations must necessarily be in *disequilibrium*, since this trade must accompany a technological transformation in the developing sector. In fact, every advance in productive technology is necessarily of the type of a *discontinuity* — a disequilibrium — and not a linear phenomenon. This point has been developed further in the contributions of Lyndon Larouche to this conference (see p.23). He has shown that the conception of "natural equilibrium states" is totally inadequate to a process of technological development, which by its very essence involves the creation of *a surplus applied to changing the structure of the global productive system and to creating a qualitatively higher stage of world development.*

In other words, one must not think of each developing country as a black box which communicates with another black box (an industrialized country), according to the usual budget-balancing prescribed by standard accounting practice. Nor can one consider the ensemble of developing countries on one side and the ensemble of industrialized countries on the other and demand that exchanges stabilize and tend towards equilibrium.

The world is not bounded, not finite. If one denies this — if one thinks only in terms of existing resources, wealth, etc. within a finite world governed by laws of equilibrium — then the richest nation would have no reason to trade with the poorest nation, except in order to loot it. One should bear in mind that the ultimate consequence of this line of reasoning — the linear model of the London School of Economics, of Cambridge University and other institutions created on the same methodological basis — is the looting of resources until their exhaustion, with genocide an accepted consequence.

Only the perspective of creating *new resources*, with rules of exchange based on the future realization of technological potentials, has a future. Jean Bodin and Barthélémy de Laffemes already understood this superior principle of commerce at the beginning of the sixteenth century; today officers of the IMF are paid *not* to understand it!

Indeed, present institutionalized approaches to the problem of international exchange are based on the entropic principle of equilibrium for the balance of payments and trade balance of each nation — on the notion of "stability". These approaches are therefore at best totally incompetent in face of the necessity of Third World development.

To make this fundamental point more concrete, I will take up two key elements of trade and

analyse the manner in which they are treated today. These are the questions of raw materials and industrial cooperation, especially technology transfer.

The Question of Raw Materials

As I have already pointed out, basic raw materials exports continue to be of fundamental importance for the external trade of the developing countries: while only 10% of world commerce is generated by raw materials produced in the developing countries, this 10% represents 70% of the total exports of those countries.

Furthermore, the international raw materials markets are either directly controlled by the institutions of the City of London and "regulated" by the IMF, or governed by stabilization agreements which run counter to the development of the Third World.

For example, London City has total control over the prices of basic raw materials. Although the actual quantities of metal exchanged on the London Metals Exchange (LME) are very small, LME prices are the basic reference for all contracts between producers and consumers. The receipts of producer countries are thus at the mercy of price fluctuations on the LME, where since 1970-73, the volume of transactions has been rising rapidly while real supply and demand stagnate. This market is thus characterized by a rapid increase in purely speculative operations at the expense not only of the producers (for example, an African country), but also of the consumers (for example, European countries). Price rises and falls on the LME are in no way determined by any intrinsic law of the metals market, but rather by the appetites of a speculative cancer cultivated by financiers.

Thus market highs do not benefit the developing countries, but rather correspond to a phase in which the financiers are channelling money into the developing countries in order to immediately recover the same funds in the form of debt repayment. In this phase, the loser is the industrialized sector, which has no choice but to continue purchases of raw materials vital to their industrial production.

The "lows", by adding the effects of low export receipts to those of forced debt repayment, create conditions of genocidal looting in the developing countries. The victim nations have absolutely no leverage on the market, because they are obliged to sell even when prices fall — thus in fact feeding the "low" — in order to pay their debt.

In this situation, the developing countries — but also the metal-consuming industrial countries — are ruined both ways, since the speculative financier interests win in every case, like the bank in a roulette game. The prices of metals are not determined by their utility in the process of development, but by their employment as a means of debt repayment — to the detriment of developing nations, and, as the crisis deepens, to the ruin of industrial enterprises in the advanced sector. The law of this "market" is nothing but the law of speculative ground-rent. The Rotterdam market is presently the object of an attempt by the same interests which control the LME, to impose exactly the same regime on petroleum products, by sabotaging nation-to-nation oil agreements.

Two types of forces have so far been responsible for preventing the total collapse of such markets: the IMF and producer-consumer agreements.

The first, the IMF, has the unique purpose of "regulating" the disintegration of the Third World metal exporters in order to ensure that a "rational" looting process can continue down to the last ton of metal and the last drop of blood.

IMF "compensatory financing" has the following two principal characteristics:

— It is linked to "balance of payments difficulties"; in other words, it is only offered to countries which cannot pay their debts.
— It is provided in the form of relatively short-term loans (3 to 5 years maximum) and at normal IMF rates; in other words, the effect is to rapidly expand the indebtedness of nations already unable to meet their debt obligations.

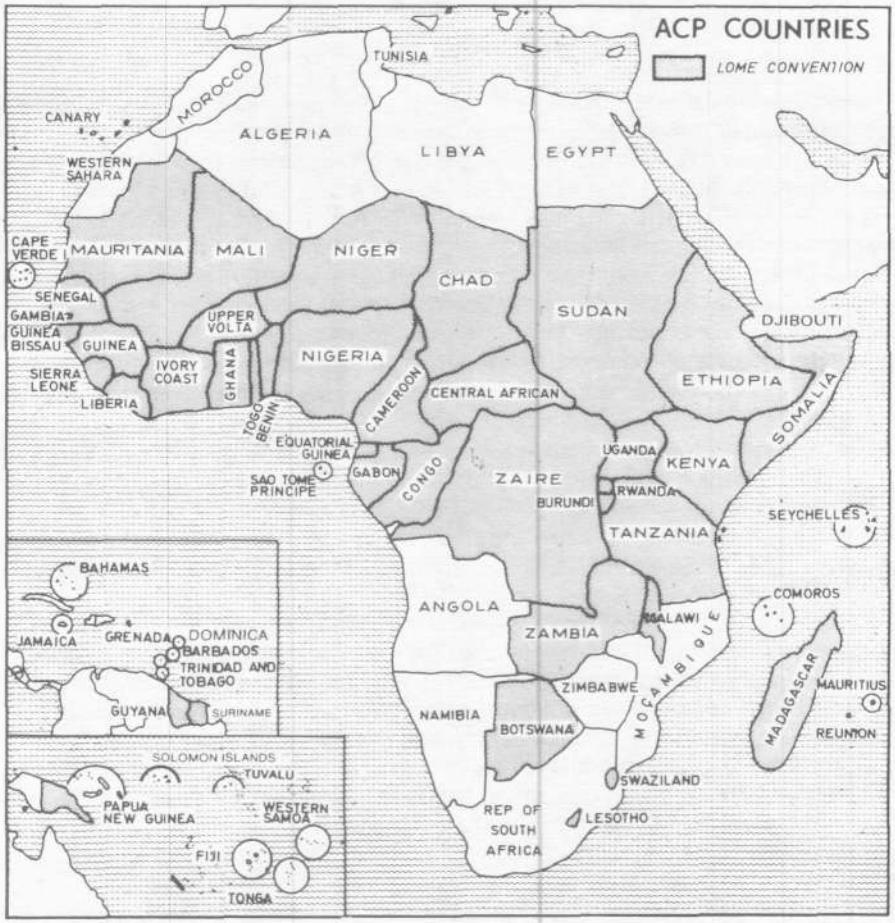
The purpose of this system is therefore to stabilize the exchange balances of a given

developing country so as to allow the ever more destructive economic and financial looting activities of the IMF to continue.

On the other hand, consumer-producer agreements do have the function of fixing raw materials prices by common agreement outside of the sphere of influence of the City of London and its banking networks. Nevertheless, they in no way solve the fundamental problem, because such agreements are signed within a global economic-financial environment controlled by precisely these London interests. Thus, for example, the International Tin Council in principle fixes tin prices through producer-consumer negotiations; but the reality remains that the refining and marketing of that metal is totally in the hands of firms based in London and New York.

The Lomé Convention between the European Economic Community and 46 nations of Africa, the Caribbean and Pacific (the ACP countries), goes one step further with its compensatory financing of fluctuating export receipts — through a system called *Stabex*. However, this step is completely insufficient, since by basing its export receipt guarantees on a past reference point, Stabex at best *maintains* given conditions, without ever departing from the notion of economic equilibrium.

Concretely, Stabex assistance is restricted each year to those products which have represented at least 7.5% of total export receipts of the country in question during the preceding year. In addition, it is required that real receipts for the given year be less than a specific reference figure: namely, the average of the receipts obtained over the preceding



four years from exports of the given product to EEC countries. Furthermore, the difference between actual receipts and the reference level must exceed 7.5% (''activation threshold'').

Thus, the Stabex agreements indeed constitute a price guarantee independent of the speculative markets dominated by the City of London and its networks of off-shore banks, and the assistance given for this purpose is not repayable in the short-term, as is the case with the IMF. In addition, Stabex encourages the further on-site processing of the products covered by the agreement (incorporation of added value) by allowing financial compensation for decreases in the overall level of raw material exports which are due to the development of industrial processing in the exporting country itself.

In spite of these positive features, Stabex remains essentially limited to agricultural and mineral products, omitting many other important export goods. More fundamentally, this system is nothing more than an ''insurance policy'', an extrapolation onto the international plane of such mechanisms as unemployment insurance systems utilized by the modern ''welfare state''.

As an insurance policy, Stabex can only guarantee the stability of ''paper'' revenues obtained from a given product , but not the maintenance or increase of the real economic value of revenues — i.e. purchasing power measured in terms of capital goods which the African countries necessarily must import for their development. The price guarantee is not linked to an industrialization process, but functions simply to maintain past revenue levels in order to ensure a general balance of payments equilibrium. Within such equilibrium structures, then, the African nations are imprisoned.

The Question of Industrial Cooperation

The same fundamental problem arises in the other key area, that of industrial cooperation. The most ''formalized'' example, and the one most often cited, is once again that of the agreements between the EEC countries and the ACP countries. The European Community dispenses development aid to the ACP countries in the form of donations from the European Development Fund (EDF), loans at special conditions from the same Fund, and standard loans from the European Investment Bank (EIB).

The theoretical distribution between gifts and loans in this system corresponds with the real economic significance of its various operations. Gifts are thus reserved for infrastructure investments, professional education, technical assistance and project studies which constitute long-term indirect costs of industrial development. Long-term loans, on the other hand, are justifiably given for the financing of productive investments in mining, energy and industrial sectors.

Nevertheless, the European Community has not been guided by any definite global conception of industrialization of the African nations, and the share of industrial projects within the total investment package (which itself is quite limited) has been marginal. In figures, the proportion of industrial project investments as a percentage of total gifts and loans of the EDF and EIB was only 1% in the first EEC-EAMA convention, then 12.7% in Yaoundé I, finally falling back to 10.8% in Yaoundé II.

Thus we have a crisis situation, with assistance mechanisms totally inadequate compared to the real problems of industrial development. This was recognized at Lomé, where a new agreement was signed which, at least formally, constitutes a complete scheme of industrial cooperation. The stated objectives and domains of action are extremely interesting: transfer of technology, assistance in the commercial marketing of African industrial products abroad, organization of high-level professional education...

Behind the signed texts, however, a pair of serious problems are lurking.

First there is the problem of *economic approach*: the agreement gives top priority principally to the creation of industries involved in the processing of raw materials and production of semi-finished goods. Such an approach is extremely dangerous, and can in no case lead to a really durable process of development. It envisages in fact a step-wise growth, passing from raw

material extraction and agriculture, to refining and other primary processing industries, and then to semi-finished products, before reaching industries producing finished products. But historically — as the examples of Europe, the U.S. and the Soviet Union show — the process of industrialization has never proceeded by such steps. Rather, it is always the most advanced forms of industrial activity which determine the growth of all others in a process of development. In this way, the nuplexes in Africa will determine the general development of African agriculture and industry.

By starting with the extractive industry (e.g. mining) as the basis for a step-by-step assembly of the entire productive network — supposing such an approach could function, which is decidedly not the case — one would create a "two-sector economy", a phenomenon well known today by Africans. For on the one hand, one would have a primitive, regressing agricultural sector oriented toward domestic needs, while on the other hand the extractive industries, and later the primary processing industries, would necessarily be oriented towards the external market. Such a system could only function as a *rationalization of looting*, the old dream of the British imperialists and the imperialist faction in France. The same is true for all projects for the transfer of "labor intensive" industries to Africa — *the strategy of industrial redeployment toward regions of cheap labor* — which envisages for Africa an almost exclusively export-oriented industry including wood, textiles, shoe-making and food products.

Our approach, which is the only true approach to development, must be the opposite: it must be determined by the objective of transforming Africa over the next approximately 25 years into a continent whose economic level is comparable to that of industrialized nations today. That is the superior hypothesis characterized by our nuplex approach, which in preceding periods was concretized in the construction of cathedrals and the original growth of textile industries in Europe, and in iron industry centers in Africa itself at one time. The various industries such as food processing, textiles etc., while necessary, should be developed exclusively as secondary elements, predicates in the overall process of industrialization, and not with the objective of exploiting low wage levels. We are dealing here with two diametrically opposed approaches to the same reality.

Nothing is more stupid than for an industrialist to search for low wage areas — because in the long run, low wage levels will ruin his industry. The great French economist of the 19th century, Charles Dupin, already understood this point completely, but unfortunately very, very few members of, for example, the French industrialists' federation the Centre National du Patronat Francais, understand it today. In fact, high salaries stimulate investments in the most advanced technologies; only high salaries ensure that the necessary highly qualified, flexible labor force can be engaged; and advanced technologies, by giving the highest rates of value multiplication, yield the biggest profit rates for the industrialist.

The second main problem in "industrial cooperation" between African and European nations, as envisaged in present agreements, is that the actual creation of industrial plants is left to private initiative, which means non-African private firms which are subject to the laws of foreign markets. On the contrary, history shows that real technological transformation has never been the result of accumulated, independant private initiatives. The Lomé Convention thus ignores the problem of formulating a global conception of African development. It avoids the necessity of a dirigistic policy of growth, which can only be based on a credit agency able to mobilize and direct a mass of private, individual initiatives that otherwise would be manipulated within the international financial environment dominated by London and New York. In such an environment, industrialists fall back into the stupid syndrome of wage minimizing, and are thereby rendered unfit to build up the network of industries necessary for African development. Let me give one example of this: the idiotic concentration on automobile assembly. In Western Africa alone, there are 15 assembly lines producing some 31 different types of vehicles. Can one leave the heavy responsibility of African development to such entrepreneurs, or shouldn't one instead control them? To ask the question is to answer it.

The Transformation of Trade Flows

We cannot, therefore approach the question of the necessary total restructuring of international commerce from the point of view of equilibrium. On the contrary, *we must be guided by the criteria of those economic consequences which our voluntarist actions must produce.* Our fundamental point of reference is the fact that, given its present economic backwardness, *the African continent is the part of the world where the introduction of advanced industrial technologies will have the greatest effect on the productivity of the entire world economy.* Africa is the greatest reserve of productivity which exists in the world. The transformation of the peasants of the savanna into qualified nuplex workers will have an unprecedented, *dynamic effect* on the world economy. This is the only competent economic criterion: this increase in productivity must be the metric by which necessary credit levels, and thus necessary *disequilibria* in trade, are measured.

The point of departure of determining trade flows should be an evaluation of the *impact of the largest projects on global productivity.*

It is by working out the parameters of the major development projects (material requirements for construction itself, infrastructure requirements, necessary technology transfer, engineering work and education of labor force) that global trade flows can be deduced. These projects determine the maximum rate of development of productivity for the entire continent. In this sense, the nuplexes will be the radiating centers, the poles of development, and will function as "exporters" to the regions in which they are located. This is the only possible method for reviving the interior of Africa, and indispensable precondition for any sustained progress in the continent as a whole.

Thereby the false distinction between "trade" and "aid" — generally made for very bad reasons — will also be surmounted.

On the one side, we must pool all available resources in the advanced sector:

1) By coordinating private and public banking resources in what are known as "mixed credits", we mobilize the most flexible existing means for development. In the second phase of the European Monetary System (EMS), participation should be opened also to the East Bloc countries. The element of gift or quasi-gift in the package of financing (taking into account interest rates, the maturities of loans and initial grace periods), will be adjusted according to the economic character of the project (construction time, rate of return on investments etc.) — export credits from banks will be combined with government loans in various proportions.
2) The present "trialogue" between OPEC countries having large financial resources, developing countries importing capital goods and Western exporters, must be extended to a *dialogue of four* by including the COMECON countries. As the key instrument for this expansion, the EMS will deploy OPEC financing, capital goods exports from the West to the East, and capital goods exports from COMECON to the developing sector, using new combinations of existing potentials to optimize the rate of development for all parties involved.

The second major aspect of trade restructuring will be exports from the developing countries: these will be determined by a "Grand Design" for overall global development, not by the imperatives of debt repayment. The flow of raw materials extracted in Africa, for example, will be progressively redirected towards the African nuplex regions themselves as increases in internal consumption, fueled by industrial growth; initially, however, most raw materials must go to the capital goods manufacturing industries and other key industries in the advanced sector. This pattern will continue until the introduction of fusion torch technology, which will open up very low quality ores to economic exploitation, changing once more the world trade structure.

Another example: in the initial period, the nutritional needs of the local population will have first priority claim to African biomass production. At a later stage, when agricultural produc-

tivity has been massively increased, and major desert regions reclaimed for cultivation, Africa will become a food exporter to the rest of the world.

After 10-15 years, the period necessary for laying the foundation for African industrialization, that continent will begin to be able to handsomely repay the effort which went into its development, thanks to the rapid increase in productivity.

Having laid out the first principles — and here only these can come under consideration — it remains for us to set the process in motion. We here today have the unique capability and responsibility, in the tradition of Leibniz and Colbert, to develop and propagate the superior hypothesis on which basis alone the industrialization of Africa is possible.

V. Appendix

The Appendix contains detailed data, additional to that in the article "*Agronuplex*" (see pp. 89), on the development of the energy-economy.

An article by *Lyndon H. LaRouche*, "*A Theory of Development for African Labor*", which expands on themes of Chapter II, "*Development of Labor Power*", is also to be found in the Appendix. This article was initially published in FUSION, Magazine of the Fusion Energy Foundation, June 1979.

Energy Development in an Agronuplex

With oil, gas, and coal becoming increasingly valuable as chemical feedstock rather than as a fuel, energy needs of all kinds must be increasingly met by nuclear energy. This is particularly true for Africa, which has a relative lack of such fossil fuels. Hydroelectric power should certainly be developed to the fullest extent possible, but this source is limited to certain locations, and has a maximum potentiality. Thus for most of Africa, nuclear energy of all kinds will play the key role. Initially, floating nuclear power plants could be produced en masse in the developed countries and towed to the coast and up certain rivers. With the development of the transportation system, it will be possible to bring nuclear power plants further into the interior of the continent. As industrial development proceeds, African industry will increasingly participate in reactor construction and assembly, eventually attaining its own fully-fledged nuclear research and industrial capacity.

For the kind of agricultural production that is planned for the year 2000, from the work of Slesser, an overall energy usage of 30-100 GJ / ha.y would be generated. Assuming that 75-80% of the agronuplex area is available for agriculture, this would result in an energy demand of 2,500-8,600 million TCE per year. Within the energy sector, this would be broken down approximately as shown in Figure II.1. As mentioned above, the higher energy figure would be

Figure II.1 ENERGY SECTOR OF AN AGRONUPLEX

	Diesel fuel	Light oil	Electricity	Total
Energy demand (mio TCE/yr)	950-3,200	1,200-4,100	400-1,300	2,500-8,600
Percentage of energy demand	37%	48%	15%	100%

generated by various shortcomings in the environment as far as agricultural production is concerned. In addition, the establishment of basic construction industries, the building up of the necessary infrastructure, etc., will require energy also, in addition to that mentioned above. Thus the higher energy demand figure would be the more realistic figure, as development will not stop in the year 2000 AD.

The electricity needs of the agronuplex in the year 2000 AD would be supplied best by 2 x 700 MW nuclear power units in a central power station (thereby easing the problems of supply associated with planned maintenance and unforseen breakdowns). Assuming 75-80% plant availability, nuclear power could supply 85-90% of the agronuplexes' electricity needs. A further 600 MW could be supplied by hydroelectric power or by fossil fuels, of which 300 MW would be used to supply the remaining 10-15% of the electricity needs, and 300 MW kept as reserve capacity.

To begin the development of the agronuplex, there must be at least 100 MW conventional electricity capacity to provide the base load associated with the construction and development of the city. The 10-20 MW capacity that is needed for the development of each of the agrotowns could be easily supplied by gas turbines. These are available in ready-to-use packaged form, and run on light oil, thereby avoiding distribution problems associated with poorly developed transport systems.

In a second phase, whilst distribution nets are being constructed in the agrotowns, work should be underway constructing a high voltage grid that links the city with its agrotowns. Thus, by the time the first nuclear unit begins production, a centralized, extended grid would already exist throughout the region. Further extension of this grid, and the bringing on line of the second nuclear unit would mark the end of phase three.

The overall capital investment for the agronuplex's energy system would be of the order of DM 4 billion, i.e., 200-270 million DM per year for the period considered (see Figure II.2).

Figure II.2
CAPITAL INVESTMENT COSTS FOR THE ENERGY SECTOR OF AN AGRONUPLEX

Power generation	Installed Capacity (MW)	Investment (mio DM/MW)	Total Investment (million DM)
Gas turbines (packaged)			
- agrotowns	(16×20 MW) 320 MW	0.4	128
- city	(2×30 MW) 60 MW	0.4	24
Conventional Power station	220 MW	1.0	220
Nuclear Power station	(2×700 MW) 1,400 MW	2.0	2,800
Total	2,000 MW		3,172
Power transmission (high voltage)	1,100 km	0.39	429

Distribution	Agrotown (million DM)	City (million DM)	
Low voltage grid	11.0	28	
Switching and transforming gear to low voltage	4.5	56	
switching and transforming gear to high voltage	2.5	14	
Total	18.0	98	
Distribution 1 city		1×98	98
Distribution 16 agrotowns		16×18	288
GRAND TOTAL			3,987

A Theory of Development for African Labor

Lyndon H. LaRouche, Jr.

Excepting British-influenced groupings in Africa, every leading force on that continent either welcomes or at least converges on agreement with the developmental perspectives associated with France's *Giscard d'Estaing* and West Germany's Chancellor *Helmut Schmidt*. All among us who are working for economic development of the African continent broadly agree that our task is not merely transferring modern technology to the developing nations. Technology is indispensable to realizing the development of predominantly long-oppressed people.

Technology transfer cannot succeed without an accompanying development of the minds and longevity of the African people generally. We may be confident, and justly so, that we might prove able to stumble pragmatically into good results without a theory of mental development. The word "might" carries with it the connotation of risk or failure; it also conveys the implication of shortfalls significantly below the level that would be attained by more thoughtful approaches.

As the use of British agent *Asharite Ayatollah Khomeini* for the destabilization of Iran warns us, the British agents and dupes in Africa, who are a significant problem in total, will use the rhetoric of "cultural imperialism" and other refuse of British colonial office "cultural relativist" heritages against modernization efforts. Putting British influence in Africa to one side, how do we aid Africans in achieving the most rapid realization of the people's mental potentialities, for mastering the advanced technologies African industry and agriculture urgently require?

We dare not risk lacking a sound theory of cultural development. This must be a theory that properly correlates scientific and technological progress with what we may loosely term cultural progress.

To reach the desired result, we must overcome two categories of obstacles. *First*, we must discredit and discard widely held delusions concerning science and culture, delusions widespread among both European and African circles. *Second*, in place of those delusions, we must supply an applicable set of policies, a set of policies made comprehensible for practice with aid of the appropriate theory.

This article is a summary of the wanted approaches to these two, interconnected problems.

My procedure here is as follows:

Through British hegemony over Holy Alliance Europe following the 1815 Treaty of Vienna, the viable currents of European continental scientific thought were either pushed into corners, such as German's Göttingen and Russia's Petrograd, or pushed out of influence among leading universities and other channels of indoctrination of educated and other citizens. This was complemented by the effects of the City of London's direct and indirect domination of most of the life of the colonial and semi-colonial nations.

British colonialist domination imposed an artificial backwardness on many nations and their people. It caused both an abnormal stagnation of cultural development and even cultural retrogressions. The effects of these London-centered influences on industrialized and developing nations have been a "set of facts". These "facts" are widely employed as evidence that purportedly proves certain delusions. In this way, misinterpretation of the actual causes for such "facts" both provides a rationalization for preexisting and prevailing conditions and employs those rationalizations as a theoretical basis for current policy judgements. *Post hoc ergo propter hoc* has become the rationalization for perpetuating old miseries in new, sometimes more hideous forms. Hence, the appropriateness of the term *neocolonialism*.

Taking this and related problems of widely held delusions into account as I proceed toward statement of my theoretical points, I begin with a review of relevant historical matters. I outline a counterhistoriography to that of *Arnold Toynbee* and like-minded British apologists.

The Atlantis Issue

Since *Francis Bacon*'s "New Atlantis", the British oligarchical faction and its allies have premised their defense of the faction's policies not only on a willful distortion of ancient Egyptian and Roman history. There has also been a significant, included element of a distorted version of an "Atlantic culture". The characteristic feature of the British hoax is the historiographers' refusal to take adequately into account such matters as the millennial conflict between the priesthoods of Amon and Thebes. With aid of wild falsification of fact, the British homogenize selected historical facts together with outright hoaxes. The effect and intended result of this fraud is to portray the course of human history as intrinsically one of yin-yang-like cycles: periods of rebirths of civilization separated by "dark ages". A distorted account of an ancient "Atlantis culture" is frequently included in such indoctrination and is almost invariably implied by given accounts.

Admittedly, the accounted rise of human civilization has known a number of dark ages.

The most recent were the 13th-14th century Dark Age, from the defeat of the *Hohenstaufen* through the Black Death, plus what can be termed the semi-dark-age of grave crisis from the closing decade of the 16th century into the 1648-1653 period. Leading British circles, most emphatically those associated with the evil *Bertrand Russell*, have adopted the perspective of a new, most monstrous "New Dark Age", to be inaugurated during this present century.

The most famous of the dark ages, and perhaps the most calamitous, occured over approximately a four-century period, from the explosion of the Aegean island of Thera during the 13th century BC to the founding of Carthage and the rise of Etruscan and Ionian culture during the 850-800 BC period. It is clear, that the rise of the Egyptian Fifth Dynasty (circa 2750 BC) refelects the occurence of another major Dark Age.

Various civilizations have indeed been plunged back toward savagery through dark-age periods of savage depopulation.

The British view is that the occurence of such a pattern of dark ages proves the Toynbeean sort of nonsense. The argument is that such catastrophes are inherent in the human condition, or in nature, or in both.

Although geological-meteorological traumas have performed a key part in the emergence of dark ages, there is nothing inherent in the human condition, or nature generally, that requires a continuation of such a pattern. The common root of the dark ages is the emerging predominance of a political faction that absorbs scientific and technological progress. This faction is best known over the ages of literary history of mankind as the *oligarchical faction*, the same faction the British oligarchy and its allies represent today.

Pending development and use of new bathyscaph technologies for exploring sunken former littoral sites of chalcolithic cultures, the following summarizes broadly what is known with certainty concerning the actual existence of an Atlantis culture. Citing this knowledge purges the intellectual atmosphere of superstitious mythologies and aids us in appreciating the importance *Plato* attached to the Atlantis matter in writing the "Timaeus" and "Critias" dialogues. That approach to historiography aids us considerably in arriving at an adequate notion of the theory of culture.

Working backward, with aid of geological data, from the time of the "Iliad" and "Odyssey" and from the explosion of Thera, we discover the long preceding period geologically as one of secular raising of the levels of the world's oceans. In Mediterranean-European history, this pattern is associated with important periodic seismic activity along the ridge running through the Mediterranean and up into the Iceland region. The trauma associated with geological catastrophes intersected the conflicts between chalcolithic maritime-littoral-riparian advanced cultures and relatively bestialized, neolithic-oriented hinterlands cultures. It includes conquests of trauma-weakened, chalcolithic city-buildercultures by the forces of backward cultures.

The evidence is essentially this. We must date the emergence of the chalcolithic to no later than some yet-to-be-determined point between the 20th and 10th millennia BC. The evidentiary problem of archeologists is that out of this chalcolithic culture emerged a global maritime-littoral-riparian culture whose key sites were, predominantly, successively inundated by the rising of the ocean levels into the second millenium BC. Exemplary is the case of the sunken sites of a megalithic maritime-littoral culture of the peoples of the sea around the now-half-sunken island of Helgoland.

There is no sunken "lost continent of Atlantis". None of the relevant ancient accounts asserts that there was. The continent is the Western Hemisphere. What is asserted in *Plato*'s account, in particular, is that there is a sunken island in the vicinity of the Azores, an island

which *Solon*'s Egyptian informant identified as a principal element of a vast, transatlantic maritime power. It is quite credible to posit the possible existence of such a sunken island in the order of 500 feet beneath the present surface of the Atlantic and to date this as inhabited territory in the vicinity of the 10th millennium BC.

Just as *Schliemann* demonstrated the "Iliad" to be a remarkably accurate historical document through his excavations, so the "Odyssey" bears up.*(1)* Using a long ship, not unlike the Viking long ships and probably copper-sheathed, *Ulysses* and his companions sailed out through the Straits of Gibraltar, reaching the Caribbean to encounter sites whose existence was known putatively to them by reputation. This coincides with the fact that the Mayan civilization, which achieved so high a degree of competence in astronomy, could not have been on the mere slash-and-burn level of agriculture.

These and other facts make a discredited wreckage of both sociology and anthropology as currently taught. What are accounted as "primitive cultures" are, at least very often, the degenerated shards of older, higher cultures. It discredits the so-called hydraulic model of early riparian civilizations, obliging us to search for the maritime-littoral cultures of which riparian developments were extensions.

Although the evidence discredits the "cultural evolution" faction of anthropology as well as the nakedly fraudulent "cultural relativist" doctrines, it does not eliminate the fact of evolutionary principles in cultural development.

What survives is a *law of cultural development*. This law specifies that cultures that fail to accomplish a certain, lawfully ordered kind of development must pay the penalties of hideous depopulation and degradation of survivor populations in the direction of savagery.

What is discredited is the autochthonous, mechanistic, fatalistic doctrine of isolated evolutionary development of cultures, in favor of a voluntarist-dirigist principle of man's obligation to willfully discover and master the lawful prerequisites of continued development.

Civilizing the Hinterlands

From this standpoint, we ought to be aided to see more clearly *Plato*'s point of concern for Atlantis in the "Timaeus" and "Critias". True, geological-meteorological catastrophes did *trigger* dark ages. The destruction of maritime-littoral centers of power of advanced culture left the survivors vulnerable to conquest and domination by backward, hinterland cultures.

Was the Biblical Tower of Babel a structure on an island-empire base situated in the vicinity of the Azores during the 10th millennium BC? That idea may be classed as speculation in and on itself. The philological and other connections among various peoples, including the Berbers, the pre-Celtian Iberians, the pre-Celtic populations of Britanny, the British Isles, plus the Helgoland-Baltic region and Central America, are powerful circumstantial evidence that a great maritime-littoral chalcolithic culture, as ancient or more ancient than the 10th millennium BC, did indeed represent a multilanguage culture. The outline of the past is clear; the details are still shrouded in dark waters and ancient mists.

The lesson to be adduced from the outline is that civilization cannot be secure unless the task of bringing modern technology and republican outlooks to the people of the "hinterlands" is accomplished. That is the central practical feature of Plato's writings, and also of the "Commedia" of *Dante Alighieri*.

Today, were the British to succeed in keeping the nations of the developing sector in the oppressive conditions of technological backwardness, whole regions of the world would be engulfed in the genocidal effects of perpetual Thirty Years Wars, with accompanying famine and epidemics. A billion or more of the world's population in the developing sector would be wiped out rather quickly and the survivors degraded to an unimaginable degree of savagery. Under these circumstances, it is probable that biological and political holocaust would sweep over the industrialized sector, thus bringing upon the earth the most monstrous of all the dark ages to date.

That, I propose, is the lesson to be adduced from *Plato*'s concern, a lesson most imperative for today's circumstances.

The 13th-14th Century Crisis

One of the clearest, best illustrations of the dark-age problem is given by the great depopulation that occurred from the point of the defeat of the *Hohenstaufen* and their allies into the resulting Black Death of the mid-14th century. Although reports usually isolate the Black Death itself as the sole cause of the depopulation of this period and estimate that merely one-

third of the population of central Europe was wiped out, the depopulation covers the entire near-century period and adds up to more than half of the population of Western Europe. It was the destruction of the economy under *Black Guelph* faction policies that so ravaged the economy of Europe, drove so many into vagabondage, and so forth — that so created the preconditions of famine and epidemic in which the Black Death was merely the final phase. *(2)*

The causes for this are not obscure. The defeat of the *Hohenstaufen* by the *Black Guelphs*, the overthrow of *Alfonso the Wise*, and the crushing of the Templars in favor of the Hospitallers marked a shift of policy from one of city-building and technological progress to a policy of zero-growth and fiscal-austerity.

The precedent for this hideous policy was the Roman Empire itself. *St.Augustine* rightly defines the Roman Empire's culture as a process of decay. *The Roman Empire did not decay; it was decay.* St.Augustine adequately defines Rome as a form of hideous moral decay. The moral imbecility of Rome's culture had an economic-policy correlative. The Roman historical republic, ruled by the Delphic cult of Apollo, was already a form of moral decay. The Roman Empire, whose pantheon of cults was dominated by the Ptolemaic cult of *Isis*, compares only with the hideousness of Old China culture as among the most monstrous forms of moral degeneracy that man has suffered in the historical record.

The period of semi-dark-age ravaging Europe into the 1648-1653 period had the same causes as the earlier 13th-14th century Dark Age.

Through the Augustinian-centered forces, the heirs of *Dante Alighieri* most significantly, the period following the Black Death into the middle of the 15th century was one of great revival, the Golden Renaissance. The influence of the Golden Renaissance reached a relative high point in the collaboration between *Plethon* and *Cosimo de Medici* centered in Padua-Florence and spread its influence for great good into the France of *Louis XI* and Tudor England. However, by the middle of the 15th century, evil was stoutly back in business. Evil, centered around the ancient "black nobility" families of Rome and their "black" Genoa allies, captured control of the monarchy of *Aragon-Castile* under Ferdinand and Isabella, and coordinated the fall of Paleologue Constantinople.

The rot of the oligarchical black nobility spread from Spain and Rome. The defeat of the forces of *Cesare Borgia* plunged Italy into a downfall from which it has not yet fully recovered. The vacillations of Queen Elizabeth in England aided the Genoa-controlled "black" factions around the Scottish lowland Stuarts and the Cecil family to grab control of England over the period into the Stuart accession of 1603. *Oldenbarneveldt* was defeated in the Netherlands.*Henri IV of Navarre* was isolated and ultimately assassinated. The Thirty Years War was the culmination of this process.

Through the parallel efforts of the city-builder *politiques* in England and France, and through the work of *Richelieu* and his heirs *Mazarin* and *Colbert*, through the rise of the Commonwealth Party to power in England, humanity was rescued from a worse disaster. Fortunately, despite the Scottish-based overthrow of the Commonwealth in 1660, the Commonwealth Party had taken a leaf from the policies of the Tudor Dudleys and the pages of Plato. Commonwealth Party colonies were established in North America, built around the most-literate among the parishes of England. During the 18th century, the mean cultural level of the population of the United States was double that of England: in literacy, in standard of living, and in social productivity. The transatlantic conspiracy of Commonwealth Party and Colbertist and Leibniz factions made the American Revolution and came near to succeeding in extending the influence of the American Revolution into Europe.

The issues that prompted the *Marquis de Lafayette* to break with Napoleon Bonaparte are inclusively key to successful British subjugation of the continent of Europe during most of the 19th century. The Marquis de Lafayette came close to succeeding in 1830. The British creation of Palmerston's various "radical" movements, such as the "Young Italy" movement of Guiseppe Mazzini, poisoned and wrecked the republican movement of Europe in the course of development and aftermath of the 1848 revolutions. *(3)*

The victory of President Abraham Lincoln over the British in the U.S. Civil War plus the Lincoln alliance with Czar *Alexander II* created the circumstances for a great industrial development principally in three nations: the United States, Japan and Germany. It was this industrial development that brought the British to the edge of total, global defeat during the 1890s — at the hands of the alliance of France's *Hanotaux*, Germany, and Russia's *Count Witte* with Meiji Restoration factions in Japan.

Although the city-builder republican movements of the late 19th and 20th centuries have been generally philosophically puerile by comparison with their predecessors of the Golden Renaissance and the 16th and 17th centuries, the persistence of a dedication to scientific and

technological progress, even in a purblind, pragmatic form, has so far prevented civilization from plunging into another dark age — despite two world wars of this century.

The Present Danger

At this moment of writing, the world verges to the brink of thermonuclear holocaust under the combined impetus of London, Peking, and their allies in various nations' leading circles. We dare not content ourselves at this juncture with a merely pragmatic, purblind approach to the furtherance of scientific and technological progress. We dare not do less than to quickly resurrect the most advanced philosophical knowledge and methods, to apply that knowledge, those methods appropriately to the great world-building tasks before us.

Those tasks center around finally and forever bringing all humanity out of the hinterlands of oppressive barbarism. We must proceed from a conscious mastery of the universal law of progress, and with assurance that the hegemonic combination of leading powers of the world is unshakably dedicated to no other policy but that of fulfilling the requirements of a republican world order of generalized scientific and technological progress.

There must be no more Dark Ages for humanity. No factions dedicated to the oligarchical cause must be permitted to retain power in any nation. No people of any nation must be pushed into zero-growth practices and ideologies. Never again must there exist a combination of hinterlands population to threaten the human species with a new Dark Age.

A Concept of Culture

I now refer the reader to "The Theory of the European Monetary Fund", where I demonstrate two essential points.*(4)* First, I demonstrate in outline the economic theory for a general law of development. Second, I demonstrate that the conception of *negentropy*, which arises in that connection, is the proper conceptual foundation of all scientific knowledge. In other locations, my immediate collaborators and I have demonstrated the coherence of what is broadly termed "culture"—poetry-music, drama, painting, sculpture. *(5)* Here I will employ the relevant conclusions demonstrated in those locations to attack the problem of the development of African culture.

It is appropriate to emphasize that my own fundamental contributions to economic theory are most conveniently characterized as applying the implications of Riemannian physics to the problem of deterministic economic models for the condition of constant technological advancement. This involved a more profound epistemological grasp of Riemannian physics than has been generally encountered among physicists heretofore.

Usually, Riemannian physics is understood to signify the more specific accomplishments of *Riemann*, rather than the "axiomatic" conceptions and methods by which his accomplishments were effected. My own point of departure was Riemann's notion of *fundamental hypothesis*. Riemann's fundamental hypothesis and the *higher hypothesis of Plato* are equivalent notions. Riemann's accomplishments may be successfully employed without accepting or comprehending the notion of fundamental hypothesis: the derivation of Riemann's physics cannot.

It was the notion of fundamental hypothesis, aided by coherent understanding of Cantor's derivation of the notion of the transfinite, that aided men in solving the most important of the remaining problems of economic theory.

The most obvious equivalent to the Platonic conception of higher hypothesis and Riemann's notion of fundamental hypothesis occurs within the framework of the well-tempered system of contrapuntal composition in music. This immediate connection between Riemannian physics and poetry-music is perhaps the most convenient bridge for bringing into light the equivalence between certain artistic and scientific thinking. With aid of the comprehension of the three levels of knowledge of Plato, Neoplatonic Christianity, the Koran, and Dante Alighieri's "Commedia", we are aided to elaborate the needed theory of culture as a lawful conception for practical use.

However, before plunging into the elaboration of that point, we must clear away a certain amount of common-place misassumptions concerning culture.

The African weighing the problems of introducing European technology into his continent often accompanies his thoughts on this process with a cautious or even resentful attitude toward the notion of superimposing European culture generally upon African peoples. We are not thinking at this moment of those African voices that are merely echoing the cultural-

relativist doctrines of British mintage. We are expressing sympathy for the African who refuses to swallow credulously the *post hoc ergo propter hoc* argument that European technological superiority requires Africa to import, kit and caboodle, each jot and tittle of existing habits of thought and daily practice of the industrialized nations.

Africa's Cultural Challenge

African culture must be transformed, without a doubt. A culture that reflects the effects of imposed technological stagnation, in which the African mind's potentialities are deemphasized for emphasis upon the sensual appetites and impulses of the body, must be transformed. This transformation must occur along the principled lines best exemplified by *Dante's* "Commedia". The instant we pose the problem in those terms of reference, we have adopted a standard which impels us to cast aside many of the prevailing standards of artistic and other taste in European cultures themselves.

One cannot leap directly into the last, empyreal canto of Dante's "Commedia". The Dante of the inside of the "Commedia"—as distinct from the Dante writing the "Commedia"—lifted himself out of the Inferno of irrationalist sensuality. That Dante walked with Virgil through the Purgatory and through fire into Paradise. The great future art of Africa will embody and celebrate Africa's own transformation of its cultures from the colonialist heritage of brutalization of peoples into irrationalist sensuality.

No doubt existing African stories and legends, including those that embody an outlook of irrationalist sensuality and superstition, will be transformed ironically by African artists. Such Neoplatonic methods of guiding artistic audiences through the upward steps of progress outlined by Dante's "Commedia" will become the corpus of an emerging African art. It is not adequate to preach finished virtues to a people; artists are required. The artist must get inside the mind of the audience, in the manner that Dante illustrates the method, and guide the steps of African minds upward in that way from that point of intersection.

I do not propose that the greatest European art—that which is truly great rather than that which merely enjoys a favorable reputation at the moment—will not be assimilated in Africa. I propose to emphasize that it is the *method* of the Platonic dialogue, as the principle of art standing above any specifics of national culture, which is the only essential thing Africa *must* adopt from Europe. That European art that fulfills the standards of the *Platonic dialogue as method* should be valued in Africa, and will undoubtedly be honored as Africa develops. The rubbish of European culture, which now constitutes the numerically greater content of that culture, Africa will have the advantage to avoid more easily than Europe to rid itself of the same such refuse.

Scientific Culture

Once culture is defined from the vantage-point I have indicated here, a spectrum of indispensable conclusions follows. First, the culture reflected in poetry-music, painting, sculpture, architecture, drama, and so forth is as much a matter of scientific principles as is a proper mastery of modern physics. Moreover, the underlying principles of great art are the same principles that ought to inform a valid physics — the principles associated with Plato's notion of the higher hypothesis. Not only is there an agreement of this epistemological quality between great science and great art, but *the fostering of the kind of great art that fulfills those principles is indispensable for fostering scientific creativity within a population.* This means not only the fostering of great African scientific discoverers, but fostering most efficiently in the mind of the African citizen generally an enhanced capability for assimilating more advanced technological conceptions for generalized social practice.

Conversely, to the extent that Europe exports its own or an "Africanized" version of the rock counterculture to Africa, Europe will thus be impairing the capability of Africa to assimilate modern technology. Or, to the extent that Africa fails to liberate itself from primitive cultural traditions, a similar deterrence to progress will occur.

To restate the same point in the terms of reference of a preceding section, Plato's emphasis on the principles for development of the mental powers corresponds to the lessons of the dark ages. It is the lack of emphasis on technological progress among backward forms of rural-based and pastoral cultures and the tendency for mental and moral savagery among the oppressed and backward strata of otherwise advanced civilizations that makes societies vulnerable to the dark ages. All the achievements and beauties of great urbanized cultures are in imminent jeopardy until we have developed and effectively apply the conceptions needed to transform the peoples of the "hinterlands".

We must eliminate that ignorance and backwardness that have enabled the oligarchists repeatedly to transform masses of afflicted populations into social battering-rams against the institutions of civilization's generalized scientific and technological progress. Thus, although the Platonic method is the proper foundation for the development of scientific knowledge, it is equally, essentially, a concentration on the methods for elevating the mind of masses of people — including the oppressed peoples suffering the ignorance and backwardness of the "hinterlands".

The Example of Music

The great sources for the development of European polyphonic contrapuntal music are chiefly the Platonic Academy and the writings of the medieval Ismaili scientists *al-Farabi* and *Ibn Sina*. These sources insist that the well-tempered methods of music-poetry composition — in distinction to opposed methods — are a necessary experience for the fostering of the creative powers of the mind.

To make clear what I mean by opponents of this kind of music, I cite the British doctrine deployed against the great *Johann Sebastian Bach* and later deployed against *Ludwig van Beethoven*. The British insisted that music was nothing more than a pleasing melody with agreeable accompaniment and that music was chiefly a matter of exciting or otherwise pleasing sensual effects. That British view has no compatibility with what is properly regarded as music or poetry. *(6)*

From the point of al-Farabi's proof for octave-species well-tempered scales and the definition of 24 major and minor scales for European well-tempered polyphony, music has been essentially defined as follows. This definition underlies the agreement between such music and scientific thinking.

If I sing within one of the 24 scales but then augment or diminish an appropriate note of that scale, I am singing in another of those scales. If I take the third, fourth, fifth, or sixth note of a scale and treat that as if it were the first note of a scale, I am singing in a different scale than the one from which I began, in which I sing notes that are variously augmented or diminished with respect to the pitches of the original scale. By such and related means, I can move through all 24 of the major and minor scales in a lawful way.

If I choose a theme that is in one scale, and I repeat this theme in parallel vocal or instrumental voices accompanying the first, but starting at different beginning-points in time, and I follow the principles of the simple canon in so doing, wonderful possibilities unfold for me as a prospective composer of music.

These are but the most elementary features of well-tempered contrapuntal musical composition. We have chosen to emphasize such elementary features to make the relevant point to the widest audience. We now continue, showing first why the well-tempered system is so important and what is potentially wonderful in a composition treated according to well-tempered principles.

It is probably well known to all that there is a school of argument that attempts to define a "natural" physical scale of pitches according to the principles of vibrating wires, strings, tubes, and so forth. According to that misguided school, these mathematical progressions of vibrating rods are presumed to be "natural pitches" of an octave-species scale. The deviations from such "natural pitches" are then explained as permissible changes in pitch-values for the purposes of convenience. One illustration of such a convenience is the problem of tuning keyboard instruments in such a way as to permit performing in any of the major and minor keys.

That school of argument is nonsensical.

If I am to sing within a domain of 24 major and minor keys, then each note I sing is simultaneously a tone, or an augmented or diminished tone, in every other among the 23 remaining keys. Therefore, we cannot sing — except monotonously — unless the value of the tone is determined simultaneously for all 24 keys, rather than merely as a note of an octave for one key. In other words, the 24 keys are not derived rom a "natural" octave-species scale; the value of the tones of any one octave-species scale is determined by 24 keys taken as an indivisible, primary whole.

The importance of this is that the well-tempered system defines the 24 keys as a unified domain of tonal development. It is the lawful movement from one key to another within a single musical compositions that is the indispensable definition of music. The requirement of such tonal development is the primary fact of the tonal side of music; it is the *principle of development* that determines what the pitches of the tones must be. There are no "natural pitches" in

the sense one school assumes to be the case.

For reasons of convenience, I shall not review here the other formal aspect of musical development, metrical development. I merely make the observation that the metrical and tonal development of an actually well-tempered composition properly interrelate.

Musical Composition

Now let us, speaking hypothetically, proceed to compose some music. We shall employ the simplest rules of composition, those canonical principles for singing poetry in the time of *Plato*, or of *Dante, Petrarch*, or *Leonardo da Vinci*. For this purpose, no theory of harmony is needed — for reasons of proof I shall promptly identify.

In judging how to sing a line of poetry (which can be done invariably if it is genuinely poetry), we are governed by elementary musical rules.

We must observe the principles of the musical scale. The vowel-consonant connections in spoken language are musical; pitch-values are implied. (It is not necessary to go into details here on that point.) Except in languages in which specific pitches are conventional, we are merely restricted. In modern European languages, for example, there is no exact pitch associated with a syllable, but rather a tendency to prefer certain relative values of pitch with respect to other syllables in the same vicinity of speech. Our first choice in singing a line of poetry would be to decide upon one of the 24 major or minor keys. We might make a more complicated choice, but it would be a choice of some lawful significance within the elaboration of a composition in the 24-key system. It would not be an arbitrary sequence of pitches. (You can do almost anything, provided you demonstrate it to have a lawful "resolution" within the course of the completed composition.)

There is a second level of refinement to be considered. If one were a frequenter of the Academy at Athens, or an associate of *Dante, Petrarch, da Vinci*, one would probably sing the poem to the accompaniment of a stringed instrument. This accompaniment would have no resemblance to a modern popular singer producing annoying monotony with a guitar. One would add the one or two voices performed on the instrument to the singing voice; the voice or voices of the instrument would sing a canon in concert with the singing voice. This polyphony would prompt a musician to consider further refinements of choice in selecting the sequence of notes for the original design of the sung line.

I noted above that no consideration of the theory of harmony is involved in this. It is not a matter of vertical chords. It would be better for music and for understanding the performance and composition of music to throw out the doctrine of vertical harmonies altogether.

Let us focus for a moment on the point at which the second voice of a canon comes in. Let us consider, now, the note in the first voice sung immediately preceding the first note of the second voice. That note in the first voice goes in two directions. It goes to the succeeding note in its own voice; it also goes to the first note in the second voice. That latter connection is a "cross-voice" relationship. It is not vertical harmonies that actually determine consonance and dissonance in polyphonic music; it is the complexity of cross-voice relationships.

The composition of a simple canon requires that the cross-voice relationships of the polyphony be lawfully meaningful throughout. You see, no doctrine of harmony is needed; indeed, the doctrine of harmony tends to distract the student from the real issue of the matter.

By constructing the thematic statement of a canon cleverly, one causes cross-voice relationships to emergy, which one brings forth as developed voices. It is in this way that well-tempered polyphonic counterpoint introduces exciting development within musical composition.

That is only the first doorway to musical composition, but it is adequate for defining our second point.

Development of the Theme

Once the composer has found an appropriate cross-voice-linked idea of musical development, the shading of the thematic statement for the canon is determined accordingly. In other words, musical development does not begin with themes as arbitrary givens. One searches, with aid of canonical method, for a kind of development that is suitable to one's purpose and then one defines the theme accordingly.

Thus, the canonical way in which thematic material is determined for a good musical composition is analogous to the way in which the well-tempered system determines the proper pitches of the tones. One proceeds from the *concept of a whole development taken as an indivisible primary*. One then determines the particular values — such as pitches, thematic

material — which that development demands. It is the whole that is primary, and the particular that is relatively determined, relatively ephemeral.

Music has reached its highest degree of scientific development to date in the transformed notion of double-fugal counterpoint achieved in the later work of Ludwig van Beethoven. What is truly "double" in this is not the combining of two elements as in the ordinary notion of the double-fugal form. What is double is that in the development there is a development of a process of development, a development of the second order. This brings Beethoven's greatest later works into agreement with Plato's notion of the higher hypothesis.

The point, as *Plato, al-Farabi, Ibn Sina, and others emphasized, is that the well-tempered system of musical composition and performance locates music primarily in the creative processes of development embodied in the music. Music is not located in sensual effects, but in the process of lawful, creative development mediated through the domain of what might appear to some to be musical-sensual effects. It is not the sensual effects that define the intensity of "feeling" of a great musical composition; the intensity of feeling is the experience of lawful forms of creative development.*

A Physics Analogy

The split in physics between Newtonian and Leibnizian views divided European physical science into two bodies of thought and practice. The school associated with *Leibniz* was dubbed the hated school of Continental science by the British. From the time of *Francis Bacon*, and from the establishment of the British Royal Society under *John Locke's* guidance, the British have devoted the subsequent centuries to the effort to discredit and suppress Continental science. On this point, the British have been explicit.

The exemplification of the essential differences between the two schools is the opposite way in which the two opposing methods regard the phenomenon of the wave. I shall thus illustrate how the school of Leibniz, sometimes termed the hydrodynamicist school, provides a view of the universe in epistemological agreement with the well-tempered system of musical composition. It is not so astonishing, therefore, that Bach was in the factional orbit of Leibniz, or that the British efforts to isolate, defame, and destroy Bach were coordinate with British efforts against the influence of Leibniz in science.

The Wave As Primary

In the Newtonian, or reductionist (elementary-particle-centered) view of physics, the wave is a mental construct invented by the mind as a convenient way of thinking about the resultant of a complex interaction amongnumerous particles in motion. In the Leibnizian school, any wave meriting that name (for purposes of physics) is a real, primary phenomenon that directly interreacts with other waves as wave-interaction. In the Leibniz view, the behavior of the particles participating in the wave is determined by the wave, not the other way around.

The most advanced understanding of this theoretical problem to date is provided through the pioneering discoveries of *Riemann*. Although Riemann is qualitatively more advanced than other hydrodynamicist schools of physics, Riemann's work is an advancement within the continental physics of *Leibniz, Eulerbe Bernouillis*, et al. Even before 1860, Riemann developed remarkable proofs of the primacy of the wave as such — for which conclusive experimental proof was given by the fact that H-bombs work. *(7)*

The same Leibniz-Riemann approach is crucial to the main lines of progress for scientific research today.

In plasma physics, accelerators and related devices do not accelerate *individual* electrons, protons, and so forth. They accelerate plasmas. The effort to interpret scattering and other plasma reactions as particle-particle reactions is specious. The most anomalous sorts of reactions — those that defy an elementary particle sort of physics — have the characteristic feature that the collectivities of the plasmas behave as Riemannian waves.

Most dramatic among anomalies of this sort are those that involve the negentropic generation of plasma entities, such as solitons. These and related crucial evidence point in the direction of solving the problem of defining the distinctions and causal connections between the domains of inorganic and organic physics.

Energy Anomalies

The interesting sort of anomalous behavior is that in which the notion of energy as a scalar breaks down — together with the notion of electrons, protons, and so forth — as "elementary

particles". These conventional notions of scalarized energy-measure and "elementary particles" define atoms, plasmas, and so forth in terms of an ostensible energy of the system. Hence, the provocative anomalies are those that confront us with manifestations of organized reactions that depend upon causal influences in excess of what can be accounted for by the ostensible energy of the system. It appears that we have tapped something additional within the internal physics of the particles, a kind of physics that displays laws rather different from Maxwell-pivoted physics conceptions. We are obliged to think not of scalar magnitudes of energy, but of a higher form, "organized energy", an ostensible source of negentropy in certain higher organizations of atoms, plasmas, and so forth.

Biology is the most provocative vantage-point for viewing this.

Take two "organic" molecules. One is suited to be part of a living process; another of the same nominal composition is not. The difference between the two is *organization*, not atomic constituents.

This notion of organization, as key to the distinction of living tissue's constituents, is most provocative. Appropriate "soups" of such constituents reflect their characteristic organization in a manner heuristically analogous to the characteristic crystallization of inorganic substances. The term aperiodic crystal has been employed for biological processes on this account.

It has been noted that in the development of antennae, legs, and wings, on flies metamorphizing from the larval form through pupation, it is the shape of the plate from which the limb grows that determines whether it will be a leg, or wing, and so forth. It is the "wave form" generated that governs the process's constituents.

Looking backward toward the root of this business, we come to the atom. We are looking for the font of negentropy in the living tissue. Whence does the tissue secure this negentropy? Certain molecular configurations tap the negentropy of the atom; others, of the same putative building blocks, do not. Anomalous plasma behavior shows that the atom and its ostensible constituents contain such potentialities. Currently we lack definite answers; but we know which track will ultimately be the fruitful one.

Nature is ordered in a manner directly opposite to the assumptions of reductionist empiricism. Fruitful scientific investigation also proceeds directly opposite to the guidance of reductionist-empiricist assumptions. Science proceeds by conceptualizing the characteristics of a whole process of coherent development; this conception enables the scientist to generate fruitful — if not always correct — hypotheses. Through a barrage of successive, fruitful hypotheses — in which we learn important knowledge even from mistaken hypotheses so projected — we determine a specific knowledge, much as the well-tempered notion of the tonal aspect of musical development determines the pitches of tones, and as canonical method applied to a conception of musical development guides the composer in determining the proper exact values of thematic material.

The Higher Hypothesis

The key to progress is typified by those methods of development of the individual that will yield the highest incidence of leading scientific discoverers. This method, applied to the population as a whole, may not transform all of the population into leading scientists. It will be optimal in yielding the highest incidence of good engineers, technicians, and optimal results in fostering the technological aptitudes of the general population.

Therefore, if we now concentrate on the matter of optimal incidence of scientific discoverers, it should be understood that we are treating that incidence as a key parameter for all the correlated other benefits.

The epitome of the advanced scientific discoverer is the mind that has comprehended the higher hypothesis. Therefore, a directed effort to effect comprehension of Plato's notion of the higher hypothesis in the largest possible number of citizens is the method of approach that must tend to correlate with the best overall results among the population as a whole.

Even mere existing professional anthropologists, in some instances, have attempted to measure the degree of technological progress of various cultures in terms of the modal per capita throughput of energy in basic modes of production. As I demonstrate, that measure is an unavoidable step of first approximation; however, as a parameter of the process of development it is fallacious, totally misleading.

As each level of technology defines a range of man-altered conditions as primary resour-

ces, those primary resources are also defined as relatively finite. This relative finiteness may be ostensibly a matter of absolute quantities of suitable primary-resources reserves available for exploitation; the relative finiteness may emphasize a limitation of steeply rising marginal cost of exploitation. This boundary-condition cannot be overcome without an increase in the per capita "reducing-power" of the society. This per capita reducing-power depends upon inventions, upon scientific discoveries or the equivalent. Yet, these discoveries cannot be adequately realized unless the potential rate of growth of the economy is adequate; there must be a reasonably high ratio of surplus energy to total energy throughput per capita.

The result is that the per capita throughput must rise, but under the condition that the ratio of surplus also rises. (The reasons are given more fully in *The Theory of the European Monetary Fund.) This combined exponential growth in both the per capita throughput and the rate of surplus correlates with negentropy.*

This is the reference-background for presenting an adequate view of Plato's notion of the higher hypothesis.

Realization of Negentropy

The realization of negentropy, on which the sustaining and advancement of the human condition at any level depends, is mediated by that quality that distinguishes man from the beasts: the development of the creative-mental potentials of the human mind. Every beast is delimited to a range of alternative behavioral potentialities, whose thermodynamic potentialities are relatively fixed by the beast's heredity. Only man can develop himself without biological transformation of his hereditary nature; only man can develop his mind.

Not only is technological progress indispensable for successful human existence. Without technological progress man is degraded in implications of general social practice to a kind of talking cattle. Man in zero-technological-growth or devolving cultures is degraded in self-image and morality to likeness to a mere talking beast. His sensual appetites and impulses dominate his sense of what his identity is. He becomes sensualist-irrationalist-Hobbesian, beastlike man.

The beastlikeness of mankind is expressed as simple consciousness, as a set of fixed habits of conscious thought. In this mode of bestialized mental existence, the individual is enslaved to whatever impulses, prejudices, or judgments erupt into his consciousness. He knows not whence they come, nor can he prove whether they should or should not exist at all. They are simply there at the time they occur to him; he is the slave of their occurrence.

Creative development signifies changing the way one thinks. This is accomplished through what is formally represented as the method of the Platonic dialogue. One sets one aspect of one's mental processes to watch the other in the conduct of a dialogue with other persons. By watching the interplay of simple consciousness, the watching part of one's mind is able to correct the systematic errors in the process by which simple consciousness is determined.

These changes correspond to *ordinary hypothesis*. By changing the criteria of simple consciousness's generation, one becomes rational (in the ordinary usage of the term rational). This higher faculty of mind, the "watcher", the conscience, is the source of hypothesis.

There is a second level to this process. In the history of scientific knowledge, each level of such knowledge is qualitatively superseded by new general advances in knowledge. Therefore, it is demonstrated that any science, in the conventional notion of an accredited body of scientific knowledge, is intrinsically inadequate. As a level of scientific knowledge *corresponds to a level of development of the power to generate scientific hypotheses, so the* progress of scientific knowledge describes a succession of levels of quality of formulation of hypotheses.

For this condition we must assign to our mind the function of developing a "watcher" who watches the"watcher". The hypothesis that coherently and efficiently governs qualitative advancements, successively, in the quality of scientific hypotheses is the *hypothesis of the hypothesis,* or Plato's *higher hypothesis*. This is coordinate for physics as such with Riemann's *fundamental hypothesis*.

The Commedia

Perhaps the most efficient example is *Dante Alighieri's* "Commedia". The "Commedia" is apportioned into three sections: Inferno, Purgatory, Paradise. In the first section, Inferno, Dante's consciousness is simple consciousness. He is reacting only to an ordering of successively ordered experiences, governed by the principle of sensuality. In the second,

Purgatory, he hypothesizes. He questions, he is rational in the ordinary usage of rational today. In the third, Paradise, he is developing the hypothesis of the hypothesis.

The principle that orders the successive cantos in the Inferno is the principle of irrational sensual appetites and impulses. This leads to its outcome, the Pit. The Pit negates the validity of irrational sensuality. In Purgatory, Dante becomes Kantian man. He still adheres to the service of his sensual appetites, but he takes into account the chains of cause-and-effect that an action detonates in the world around him. Those actions that have undesirable consequences he suppresses (negates). He uses this negating knowledge to curb or modify his appetites and impulses. This leads him to the futility of the Earthly Paradise. Dante must give up altogether the notion that his sensual appetites and impulses are his identity. It is not adequate merely to employ rationality in seeking successful gratification. He must give up the association of his identity with such sensuality. That change is like passing though fire. Paradise is the method of developing the higher hypothesis.

Each division is composed of 33 successive cantos, ordered by a developmental principle. In the first, the Inferno, the developmental principle is sensuality, irrationality - existentialism. In the second, Purgatory, the developmental principle is Kantian: *the rational negation of counterproductive sensual impulses in order to save those that understanding hopes to satisfy from among the noncounterproductive.* In the third, Paradise, reason-for-itself is the developmental principle.

Yet, the succession of the three developmental principles also implies a developmental principle governing the entire succession of the cantos, from the first of the Inferno to the last of the Paradise. In the last canto of the Paradise, this higher, overall developmental principle is finally comprehended. The journey to the empyreal, knowledge of the content of the higher hypothesis, is now completed. That canto is the perfected knowledge of the implications of the higher hypothesis.

Universal Law

The significance of the higher hypothesis is that it correlates uniquely with the fundamental aspect of human progress in willful mastery of the lawful ordering of the universe. Scientific knowledge, in the ordinary sense, cannot be in correlation with the lawful ordering of the universe, except *inadequately*. Man could not imagine mastering the laws of the universe in any final, all-at-once moment of glory, with nothing more to learn. Man knows he is mastering the ordering of the universe only by abstracting that aspect of his creative behavior that correlates with successive advances in mastery of the universe. The epistemology of scientific knowledge's evolutionary progress, viewed from the vantage-point of the notion of the higher hypothesis, is the higher form of knowledge man can attain concerning universal law.

It is on this account that Riemann's notion of fundamental hypothesis is fundamental for physical scientific knowledge.

Conversely, to produce the highest incidence of scientific discoverers, we must have a general culture that fosters progress of developing new citizens toward comprehension of the higher hypothesis. This must be a culture in which the principles of the Platonic dialogue, as a method for reaching the higher hypothesis, dominate in all aspects of cultural development: the arts, science, law.

Self-Critical Cultures

Clearly, the most widespread obstacle to development in Africa is the attachment sections of the population have to "our ancient ways", "our special customs", or simply, "tradition". The "traditional culture" of sections of populations long enslaved to technological stagnation, especially in rural and pastoral life, is intrinsically a culture belonging somewhere in Dante's Inferno, a culture tending to the same degree of moral degeneration as the world-outlook and prejudices of Europe's fanatical environmentalists.

However, fortunately or unfortunately, that is the culture that seizes many. It cannot be simply leapt out of. The African burdened with such a culture cannot step into a European-type rationalist culture by an effort comparable to moving abruptly into another room. Like the character Dante, this African must struggle within the culture imposed upon him from the past, making his way out of the Inferno, into Purgatory, toward Paradise. It is that struggle to make his way upward that is the heart of the new African cultures to be developed.

The practical questions that confront us most prominently are, therefore, two. Most broadly,

we must set cultural progress of the sort we have outlined into motion. Concomitantly, Africa must use the lessons of the Platonic-Neoplatonic method to organize the movement.

From Tradition to Evolution

We set progress into motion by providing a climate of the benefits of technological progress. We afford the most backward peasant a credible experience of the benefits of progress. The benefits that are important to him will make the kind of thought necessary to comprehend the new practices a desirable quality of mental activity. "I have learned a new thing that increases my power over my circumstances of life." As that interest in changing his simple consciousness is established circumstantially, it is the work of the educator and the artist to employ the method of the Platonic dialogue to transform the existing cultural ingredients from a simple-conscious traditional form into the subject-matter of a new culture — a consciousness of the changing of and going away from simple-conscious traditional culture.

The moral shift that must be fostered is not one of repudiating one's ancestors pure and simple. In superseding old ways, one fulfills the existence of one's ancestors by making something better on the foundations they have provided. "Thank you for having given birth to my parents, dear ancestor. Now, through progress - through progress in change — I shall *prove that your having lived made possible something worthwhile.*" *The developing African* says, "because of the progress I bequeath to my posterity to build upon, I ensure that my ancestors have not lived for nothing".

Let us now distinguish the essence of the matter of culture.

From the standpoint of ignorant opinion on this matter, culture is a set of beliefs and so forth, as a kind of collection of objective-like artifacts. In reality, *culture is the notion of a process of development*, by which progress in knowledge and method of developing knowledge has been effected up to each point of that process of development. Cultural knowledge becomes more profound as the process is understood as a process of progress in the quality of developing new knowledge, as the process represented by that qualitative progress is abstracted from the whole experience to become the subject of reflection.

Culture in Africa will become Platonic dialogues that embody the Platonic method of superseding present-day traditional beliefs. This will be generalized, to make emerging African culture an integral part of world culture by comparing the experience of transcending traditional beliefs in Africa with equivalents in the progress-phases of European and other cultures. This critical comparison will provide the basis for the generalization of the notion of culture as *human culture*, rather than as European, African, or any other narrow definitions in this domain.

The incapacitating problem for the Europeans generally in dealing with the more stubborn social aspects of African development, will be that most Europeans today accept in their own cultures a mixture of good and rubbish. The acceptance of a rubbish-laden European culture (for example, toleration of existentialism, empiricism, and so forth) as a collection of "givens", a collection of "personal preferences", simple-conscious "given" prejudices and beliefs, means that the European so afflicted is necessarily blinded to the important features of African cultural development, to the effective comprehension of the important problems that tend to impede that development. If the European does not subject his own beliefs and habits of judgment to the rigors of the Platonic dialogue as a method, that European is a crippled person in the domain of dealing with the realities of Africa.

An Elite of Platonic Thinkers

For this purpose, Europe and Africa must produce an *elite*. This should not be an elite in the sense of a privileged stratum squatting on the shoulders of the less favored. It must be an elite of servants, an elite of the dedicated modern agents of the Platonic Academy at Athens. Each of this elite must master one or more of the relevant fields of science, engineering, medicine, poetry, music, drama, sculpture, architecture, and agronomy. That person must be developed in the Platonic method and must master his or her own field from that vantage-point. Such persons, distributed among the political, industrial-research, artistic, and other aspects of government and work in the mediating of technology transfer, serve as the radiating-points for mediating the point of view, the approach we have reviewed in outline in this presentation.

This elite must be developed with aid of new special institutions of advanced education governed by Platonic-Neoplatonic principles. These institutions catalyze the development of

the needed elite and also serve as catalysts for intoducing needed reforms into educational insitutions in both the presently industrialized and developing nations.

The process in which we are engaged is no mere economic-development program, not merely a remedy for the hazards otherwise threatening mankind in this time. We are engaged, if we see that matter rightly, in a battle to finally solve the problem of the "hinterlands". We are working to place the present and future order of this entire globe under the rule of the Grand Design.

True, we are working to uproot the preconditions of chaos, famine, and epidemic in the developing sector, and to ensure the prosperity of all nations in a half-century effort to end forever underdevelopment in any significant corner of the world. This aspect of our endeavor is necessary, but not the essence of the undertaking.

We are transforming the minds of ordinary people in both the industrialized and developing nations. The process of global economic development and technological progress provides the indispensable environment in which to foster consciousness of scientific and technological progress, especially consciousness of the development of the creative potentials of the individual mind. We are engaged in affording mankind generally a new, higher valuation of itself with aid of this new technolgical environment.

Yet to consolidate the effects of these beneficial circumstances upon the mind, the methods and implications of the Platonic dialogue must be consciously applied to science and art, to catalyze within the individual mind a rounded development. We cannot sustain progress in an environment permeated with cultural barbarism; we cannot sustain a viable artistic life among a people in technological barbarism. The principles of great art and the principles of great science are epistemologically the same principles.

"How to" education in practical technology is perhaps unavoidable. Our universities being in the lamentable condition they now represent, much of the education afforded will be poor in methodology, as stultifying of the development of creative powers as it is informative for technological practical tasks on a fixed level. We must ensure this to a certain extent, while working to supersede it, bypass it as rapidly as possible. We must infuse the process of development and grow to replace all the left-over refuse we carry into the initial phases of the present great undertaking.

It is seeing what we term *art* as properly ruled by the higher hypothesis that is key to fostering the most rapid advancement of the scientific and technological powers of labor in Africa and other zones of economic development.

Notes

(1) *Heinrich Schliemann* (1822-1892), an archaeologist and linguist, discovered the site of Troy at Hissarlik, Turkey on the basis of his hypothesis that Homeric epics were historical documents as well as artistic masterpieces. Using this and other discoveries, including major Mycenaen excavations, Schliemann opened an entire chapter to knowledge of the history of the Bronze Age, a chapter previously regarded as closed. Almost entirely self-educated (he taught himself nearly 20 ancient and modern languages fluently as an adult), Schliemann was vilified during his entire scientific career and his discoveries were ridiculed or discounted by "new dark age" proponents of the "mythical character of Homer". Schliemann published a dozen books, in French, English, Russian, and in his native German. Born in Germany, he became a citizen of Russia and later of the United States, whose rapid industrial growth Schliemann staunchly supported.

(2) The *Guelph* (Welfen) were originally a bucolic German aristocratic house, associated with the rule of Franconia, with branches in Italy. During the IIth century, through an alliance among Roman banking families centered around the Pierleoni, the oligarchical faction of the present millennium acquired the name Guelph by the marriage connection of Matilda of Tuscany's House to the Welfen house. In the course of developments following the Guelph defeat of the Hohenstaufen House (Frederick Barbarossa through Frederick II) during the events of 1266-1268, the Guelph-Ghibbelline disputes arose. In the internal struggles within Italy and elsewhere at the onset of the 14th century, the Italian branches of the Guelph aristocracy split into a "White Guelph" and a "Black Guelph" faction, the former won to the humanist policies otherwise associated with the Ghibbelline faction. Dante Alighieri was a leading thinker for the former faction. From the early 14th century, the antihumanist oligarchical faction of Europe has represented the continuity of the Black Guelph faction of Dante's time. See this author's "The Secrets Known Only to the Inner Elites", in *The Campaigner*, May-June 1978.

(3) *Lord Palmerston*, as British foreign secretary in the 1840s and later prime minister, was instrumental in founding the feudalist-romantic Young Englander movement in Britain and similar movements throughout Europe — Young Italy, Young Turkey, Young Russia, and so on. These groups, along with Palmerston's establishment of Scottish Rite freemasonry cults across the globe, served as an intelligence arm for the British.

(4) "The Theory of the European Monetary Fund" was published in Oct. 1978 as a supplement to the *Executive Intelligence Review*.

(5) See, for example, "Draft Proposal for a Heinrich Schenker Foundation for Musical Science", by Peter Wyer, *The Campaigner*, Aug. 1978; and "Think Like Beethoven", by Anno Hellenbroich, *The Campaigner*, Feb. 1978.

(6) For a discussion of the harassment campaign against Bach by the British Royal Society and the related literary association, the Kit Kat Club, see "The Secrets Known Only to the Inner Elites", *The Campaigner*, May-June 1978, pp.60-62.

(7) See "Riemann Declassified: His Method and Program for the Natural Sciences", by Uwe Parpart, *Fusion*, March-April 1979.

Abbreviations used in the book

CFR	Council on Foreign Relations
CMEA	Council for Mutual Economic Assistance
EC	European Community
EDF	European Development Fund
EEC	European Economic Community
EMF	European Monetary Fund
EMS	European Monetary System
FBR	Fast Breeder Reactor
FRG	Federal Republic of Germany
GJ	Giga Joules
GW(e)	Giga Watt (electric)
GNP	Gross national Product
ha	hectare
HTR	High Temperature Reactor
IAEA	International Atomic Energy Agency
IBEC	International Bank for Economic Cooperation
IDA	International Development Agency
IIASA	International Institute for Applied System Analysis
IISI	International Institute for Steel Industry
IMF	International Monetary Fund
KWh	Kilo watt-hours
KWU	Kraftwerk Union
LDC	Less Developed Country
LNG	Liquified Natural Gas
LWR	Light Water Reactor
mta	million tons per annum
MTPD	metric tons per day
MW(e)	mega watt (electric)
MW(th)	mega watt (thermal)
RIO	Reshaping the International Order
SDR	Special Drawing Rights
tce	tons of coal equivalent
tdw	tons dead weight
tkm	ton kilometer
tph	tons per hour
TWh	terra watt-hours
UNIDO	United Nations Industrial Development Organization
VHTR	Very High Temperature Reactor
WEC	World Energy Conference

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