

PROCEEDINGS

of the

Conference on

The Industrial Development of Southern Africa

Sponsored by the Fusion Energy Foundation

Held in Washington, D.C., May 2, 1978

\$40.00

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OPENING REMARKS

Dr. Morris Levitt

Executive Director, Fusion Energy Foundation

The Fusion Energy Foundation is a body of scientists and engineers, supported by growing numbers of industrialists and labor leaders, committed to continuing the principle of progress and development throughout the world. Our primary commitment, as our name indicates, is to the development of controlled thermonuclear fusion power by the end of this century. It's from the perspectives that are opened up through that commitment to continuously expand the world's resource base, and the capabilities of the world's population, that we have formulated programs of development involving not only regions of the United States, but a number of significant areas of the world.

The immediate predecessor to this conference was the conference on Middle East development that the Foundation held in January in New York, at which time we proposed a comprehensive high-technology development program for the Middle East region. That was shortly before the outbreak of the latest round of hostilities there. Increasingly, in the recent period and most recently in testimony before the Congress by representatives of the U.S. State Department, precisely the sort of perspectives we put forward at that time in New York — a perspective of massive capital investment for the region as the key to its stabilization and prosperity — is coming to be recognized as the only basis for dealing with those regions in the world which now immediately constitute the greatest threat to international security.

The basic principle which has motivated an extension of the work of the Foundation, from the specific area of fusion research and development to regional and global development programs, is the following: It is our conviction that if there is a policy commitment on the part of the leading nations of the world to bring into existence the most advanced forms of nuclear and related technologies and a policy commitment of massive multilateral trade and technology transfer to the developing sector, there is no region in the world whose problems are not susceptible to definitive solution.

Contrarily, without such a policy commitment there is little if any chance of solution to those problems, particularly in the sort of knotty problem regions such as southern Africa presently is.

Recently, the United States Ambassador to the United Nations, Andrew Young was speaking in Atlanta and made reference to the fact that to the extent the United States is still held in relatively high regard throughout many regions of the developing sector, the so-called Third World, that is because of the continuing visible prosperity and technological-industrial development of this nation, because of the standard of living and skill level of its population. Now that didn't happen by accident. In fact, that commitment to industrial and agricultural development, and to ensuring that the population of this nation would have access to education and skill-training appropriate to that development, is precisely what motivated the two greatest crises in the history of this nation. The Revolutionary War and the Civil War involved fighting out that question: whether or not the future of this country would be based on broad industrial-technological development, and the widest possible development of our most precious resource, the talents, skills, and intellectual capacities of our population. It was in the wake of those definitive struggles that the country underwent its greatest moments of progress.

Therefore, I think the significance of the thrust of Ambassador Young's statement over the weekend lies in this. . . . Speaking as Americans who seek to frame joint policies of development with other sister republics of the world, how could we do otherwise than advise the other nations of the world to follow exactly the path which we marked out for ourselves as the only sure one to our prospering and our security?

I find it extremely ironic that there should be any notion now that that commitment to what has come to be known as the American System is somehow outmoded; that there are now presumably objective factors which preclude extending that form of development to the rest of the world in mutual agreement with other sovereign republics.

Part of our task today in this program will be to examine such alleged, objective obstacles to continuous development, and to pose in their stead the basis for an expansion of the type of development which Ambassador Young — I think rightly — indicated, does provide an appropriate model for the future.

In other remarks that perhaps are not so well known, made during his recent trip to Tanzania, Ambassador Young stated that the key to the future of southern Africa lies in technological development, and that the United States need have no fear of any other nation playing a role in that region that would preempt an appropriate role for the United States. Only the Western sector, including the United States at this point, has the full range of resources that could be called on to develop that region.

I think that poses a focal point for discussions here. There are two problems with respect to Ambassador Young's comments: One is that as far as I know, they haven't been reported in the American press. The second is that, all too often, we find knee-jerk responses based on whether or not you like this or that personality who happens to be posing policy, rather than proceeding from the standpoint of: are we dealing here with a policy that is or is not necessary to meet the basic interests of all the parties involved in southern Africa, that entire region of the world, and indeed, the entire world population.

Therefore, it is from the policy standpoint of expanding the resources available by a commitment to the development of all forms of advanced nuclear energy by the end of the century, and a commitment to the policy which flows from locating those moments of the development of the republics of the world as the highest moments of human progress to date, that we will be putting forward for deliberation a comprehensive program for development of the southern Africa region, and a review of the scientific-technological-political-economic factors that will influence whether or not such a program can be successfully realized.

One final note on the immediate urgency that motivates this conference: Obviously southern Africa represents one of a handful of critical strategic regions in the world which, if not brought into the sphere of com-

prehensive development, can easily serve as the point for detonation of world conflict. Conversely, should the policies of development that we will indicate here be brought to bear, it can serve as one of the outstanding models for how whole populations can make the extremely exciting transition to fusion power, into the 21st century.

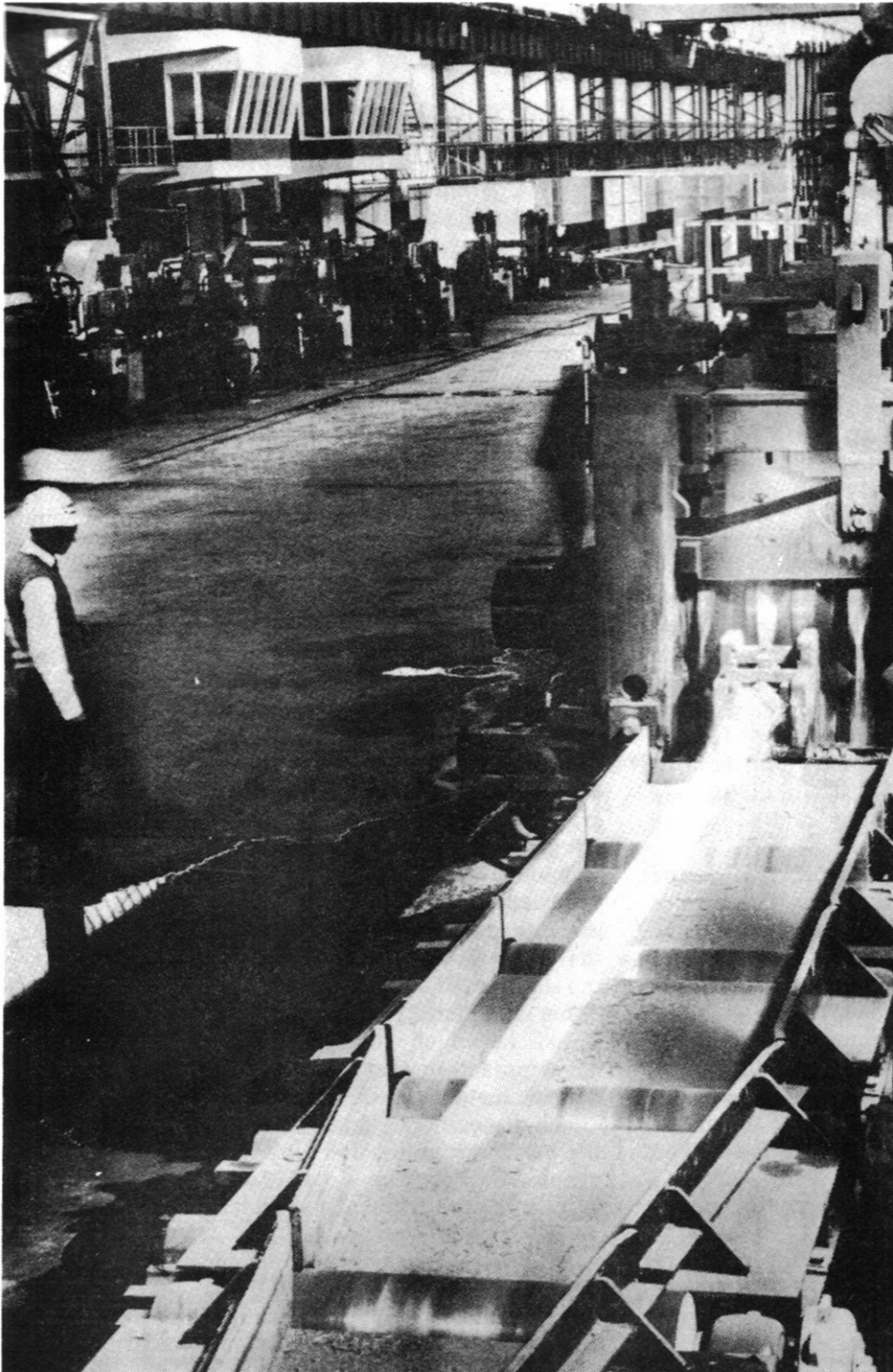
I think it poses for us the following sort of challenge: I think many of us in this room are by and large committed to principles of development. I also think that many of us would question principles or programs for zero growth, for Malthusianism, that have been put forward as the means by which we're going to somehow muddle through the immediate period ahead. The challenge to us is whether or not prodevelopment forces in the United States and the international community can act with sufficient wisdom to frame policies which expand the range of both political possibilities and the resources that will be available to all the world's population in the future. In that case, we will not fall into the trap of limited resources and possibilities that our common, zero growth adversaries would have us stumble into.

Mr. Robert Moore

Executive Secretary to the Mayor
Washington, D.C.

On behalf of the government of the District of Columbia, I would like to extend you a very warm and sincere welcome to our city. We're hopeful that during your visit, you will have an opportunity to visit and see some of the monuments and some of the highlights of our city. We further wish that you handle your conference very successfully.

The Industrial Development of Southern Africa



PANEL I

Eric Lerner is Director of Physics of the Fusion Energy Foundation. He is a graduate of Columbia University and has written extensively on global and regional economic planning and development.

Douglas DeGroot, Africa Desk, *Executive Intelligence Review* has lectured throughout the U.S. on African political economy and development, and is the co-author of the U.S. Labor Party's Campaigner Special Report, *Peace Through Development in Southern Africa*.

Peter Vanneman is Chairman of the Department of Political Science at the University of Arkansas, Fayetteville. He was visiting fellow at the George F. Kennan Institute for advanced Russian Studies at the Smithsonian Institute in Washington, and has testified before the U.S. Senate Foreign Relations Committee on Soviet policy in Africa. He spent one year as a management analyst in the office of the President of Tanzania, under the auspices of the Ford Foundation. He is currently writing a book on Soviet policy in Africa. He received his BA from Princeton University, his law degree from the University of Michigan, and his PhD from Pennsylvania State University.

David Carr has since September 1969, served with the National Foreign Trade Council as the Director of the Africa, Mideast and Pacific Asia Divisions. From 1960 to 1969, Mr. Carr served with the State Department's Foreign Service as Economic and Commercial Attachee and Counsel for Jordan, Aden, and Saudi Arabia. Mr. Carr graduated from the Woodrow Wilson School at Princeton University in 1958 and received his MA from Fletcher School of Law and Diplomacy in 1959. He will receive his PhD from New York University this summer. His doctoral thesis is scheduled to appear in a book titled *Foreign Investment and Development in the Southwest Pacific*, focusing particularly on the role of foreign investment in the development of Australia and Indonesia.

Eric Lerner

What I want to present this morning is the plan that the Fusion Energy Foundation has drawn up as the basis for a primary solution to the political and economic problems of the region of southern Africa. I want to emphasize from the very start that there can be no solution to these problems which does not take as a package both what appear to be the political aspects, the aspects of the relations between the races in southern Africa, and the economic problems. The problem of developing a region which is, taken as a whole, extremely underdeveloped, is eventually raising it to the level of the advanced sector.

That's an extremely crucial point: there can be no solution to the problem of the apartheid policy, and the other leftovers of the colonial period, without development.

As you attempt to do this as many people have proposed, all you end up with is a redistribution of the existing poverty. A redistribution amongst the races can only lead, in a very short term, to exacerbated racial conflict and exacerbated warfare. It is impossible to solve the political problems without simultaneously dealing with development. The contrary is equally true. It is impossible to further develop southern Africa or any country that is in it, including South Africa, without first simultaneously taking care of the apartheid policy and the other policies of the colonial period.

For this simple reason, the basic problem of the development of southern Africa is the development of a skilled workforce. This means the tremendous upgrading of the black population of the region and that is *impossible*, especially in southern Africa, as long as the restrictions that have been handed down as part of the apartheid policy remain — that is, restriction on development of the black population.

These two problems, problems that are generally viewed as two separate things, a political problem and a problem of development which could be solved separately, do not exist in that form. They exist as a single problem which has a single solution. *The only solution to the political problems of the area is development.* The development program that we are posing as the basis for negotiations and for discussion among the parties and states involved is the key to the solution. This must also include those nations that will

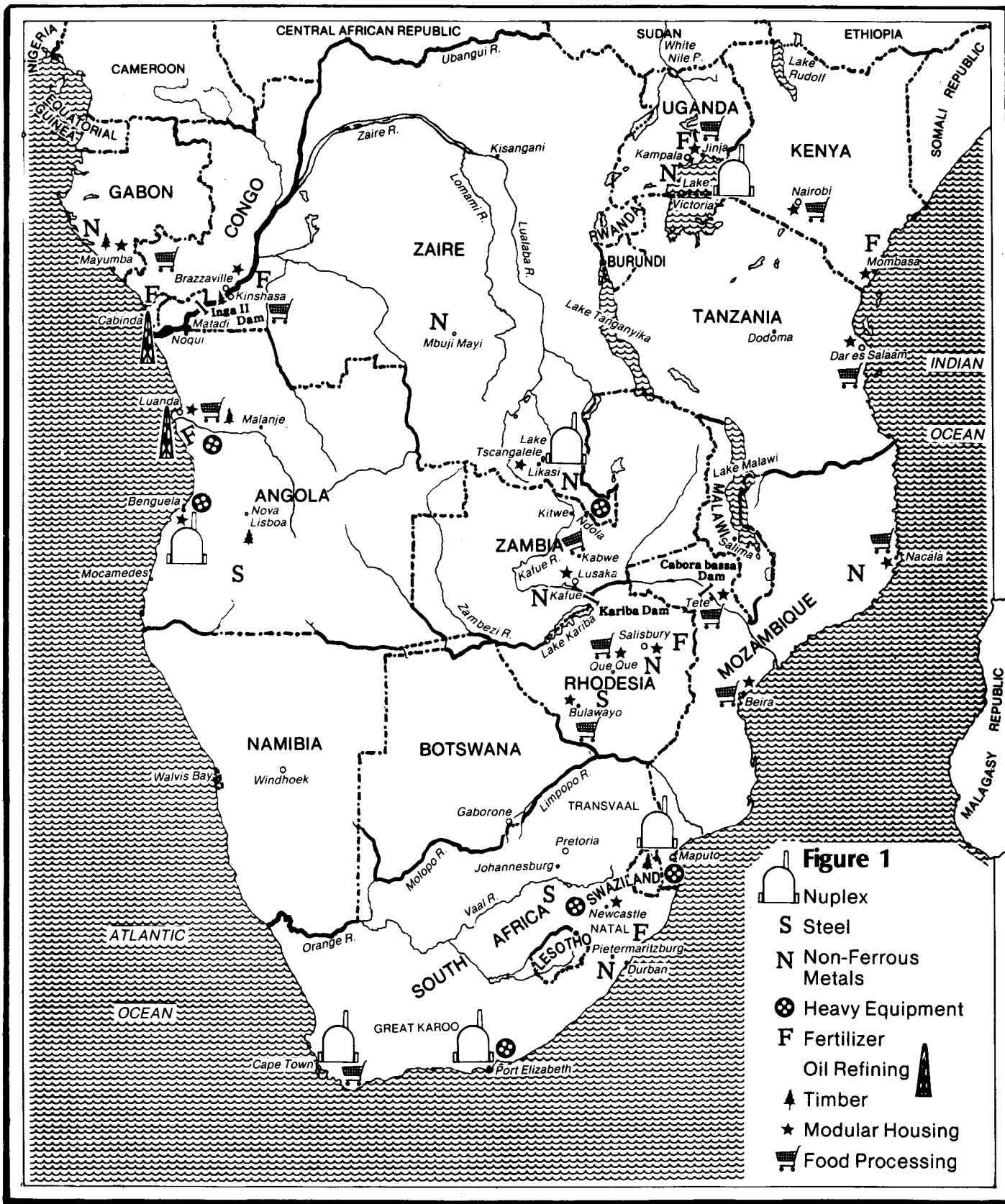
be involved in implementing such a program, which is the advanced sector nations.

There are two basic assumptions that have to be made in defining a development program. One is the context for the development of a given region, which is the extremely rapid expansion of the world economy. We cannot propose development for southern Africa if it is assumed the rest of the world's economy is going to remain stagnant as it has for the past three to four years. We're taking as the assumption, and it is not an idle assumption, that we can achieve, through the implementation of development programs like the one we are proposing, overall world growth rates of 15 to 20 percent per annum, after a gearing-up period. That sort of growth rate, somewhat slower in the advanced countries and even more rapid in the developing countries is feasible. The demonstration that this is feasible is contained in the development programs for the Middle East and for southern Africa which we have been proposing. This rapid development will be based on an energy policy leading from a combination of fossil and fission fuels to fusion over an approximate period of the next 15 to 20 years.

Secondly, within that context, the development of an underdeveloped region is primarily a question of the development of skilled labor power. That is, what is critical in any development region is to use the most advanced technologies (the most capital intensive technologies) to develop labor productivity, while simultaneously — in order to provide the qualified labor necessary for higher technologies — upgrading that labor through education and through increases in the standard of living.

This is in direct contrast, for example, to the World Bank, in which the basic policy is to attempt development in the region without simultaneously developing labor productivity.

Look at southern Africa itself: we have to say that the basic resources of southern Africa are not what people generally think them to be. Everyone thinks them to be the tremendous mineral resources of the area, which of course exist and are important; but from the standpoint of development, the most important resources of southern Africa are the extremely important pockets of skilled labor that already exist, especially in South Africa itself: skilled



white labor and numbers of pockets of skilled black labor as well. These pockets also exist elsewhere, such as in Zambia, Angola, and other areas.

What we have to do is develop these resources, use these pockets of industrialization and skilled labor power as centers for industrialization and the upgrading of the entire population of the region.

Now how do we go about doing that?

The key to the development of the region is the establishment of approximately four major industrial centers around which this process of development can be oriented. We're proposing not a series of small-scale projects, but several extremely critical large-scale projects around which foci of development can be built. There are basically four major interconnected regions of development (figure 1). The first and the most critical, the one that would act as the center of development of the entire area, is the region stretching approximately from Johannesburg in South Africa itself to Maputo on the coast of Mozambique. This region is the region that now has a concentration of development infrastructure, of energy resources, and above all, of skilled labor.

Interconnected with it, through rail-links from Rhodesia to Mozambique, is going to be the secondary center of Rhodesia.

The second major center is going to be in the so-called copper belt, the region in Zaire and Zambia that produces on the order of a quarter to a third of the world's copper.

The third major region is going to be the area of Zaire and Angola centered about the very large hydroelectric resources of the Inga II dam and the lower Congo and Zaire river.

The fourth major region is around Lake Victoria, in which a light-industry concentration is going to be developed on the basis of the extremely rich agricultural resources which can be developed in Uganda, Tanzania, and Kenya.

The first area, the area of what is now the Transvaal, is going to be a mixed concentration of industry. The principle of this entire program is that the heart of the industrial development program will be two things: one is the development of the urban infrastructure necessary for the development of the population. For example, the modular housing industry and everything associated with quality urban infrastructure.

The second leg of this development, the second principal leg, is the development of primary processing of the metals wealth of the region, that is, copper, aluminum, and steel, which is probably more important than the other two. Essentially, this region will no longer be a net exporter of raw ore to the rest of the world, but of processed metals and semi-processed metal goods.

The third aspect of the program as a whole, is a development of capital goods industries in South Africa in particular, where the nuclei of such a capital

Figure 2

MAJOR INDUSTRIAL PROJECTS

JOHANNESBURG-MAPUTO REGION

Industry	Year	Capacity	Investment \$ Billion
Modular Housing	1981	3†	
	1984	8†	20
Cement	1981	12†	
	1984	32†	3
Steel	1984	25†	
	1988	80†	40
Chemicals	1988	10†	10
Heavy Equipment	1988	2†	10

† Million Tons ‡ Million Units

goods industry, to feed into the developing centers of the rest of the region, already exists.

Let me give you an idea of the magnitude of the task we are talking about and what can be accomplished (figure 2). The program extends over a 15 to 20 year period. I am going to outline some of the necessary projects of the approximately first one half to two thirds of the period, from about now to 1990 if the program were to be immediately implemented. This gives an idea of the major industrial programs of the first region — Johannesburg-Moputo.

Starting in 1981 would be the initiation, after a two to three year gear-up time, of major urban infrastructure development — modular housing. This would involve the production of something like 3 million units per year. By a unit I mean one person, so if you want it in terms of housing units, it would be about one quarter this number. This production would gear up very rapidly after that to the middle of the decade, to nearly 8 million units per year. Cement production would rise, of course, in step.

At a later period, beginning approximately in the middle and extending to the end of the decade, we will initiate a tremendous expansion of the steel industry in the southern half — in the South Africa region itself. Current steel production in this country is about 7 million tons. We are proposing, based on extremely large reserves, the expansion of this to approximately 25 and eventually 80 million tons. This would make the region as a whole, that is, the whole of southern Africa with a population of 100 million, self-sufficient in steel.

Similarly, in the later phase of the program, increases in aluminum and chemicals and above all, as you develop the necessary skilled labor, an increase in the heavy equipment industry, the industry supplying especially tractors, construction equipment, and mining equipment will be needed.

In the second region, a similar basic program

applies, but obviously on a more modest scale in the copper belt, where the present level of development is less (figure 3). Here again after a period of development mainly aimed at upgrading the population and the urban infrastructure — by the middle of the next decade — we can be developing extremely large-scale production of copper. For example, we are proposing about 6 million tons and, later, 15 million tons, to meet the global demand we are hypothesizing: a world economy growing at about 20 percent per year. For comparison, the present world production of copper is about 6 million tons per year.

The third major region we are discussing, broadly speaking, Zaire, western Zaire plus Angola, is again fairly similar in conception; concentrating on the development of nonferrous metals and also the extremely large phosphate and other chemically-

Figure 3

MAJOR INDUSTRIAL PROJECTS			
COPPER BELT			
Industry	Year	Capacity	Investment \$ Billion
Food Processing	1981	17†	2
Modular Housing	1981	4‡	25
	1984	10‡	
Cement	1981	15†	4
	1984	40†	
Copper	1984	6†	10
	1988	15†	

† Million Tons ‡ Million Units

Figure 4

MAJOR INDUSTRIAL PROJECTS			
ZAIRE-ANGOLA			
Industry	Year	Capacity	Investment \$ Billion
Modular Housing	1981	1‡	5
	1984	2‡	
Cement	1981	3†	1
	1984	8†	
Fertilizer	1988	5†	1
Aluminum	1984	1†	3
	1988	3†	
Steel	1986	12†	15
	1990	30†	

† Million Tons ‡ Million Units

Figure 5

MAJOR INDUSTRIAL PROJECTS			
LAKE VICTORIA			
Industry	Year	Capacity	Investment \$ Billion
Food Processing	1981	30†	3
Modular Housing	1982	4‡	25
	1985	10‡	
Cement	1982	15†	4
	1985	40†	

† Million Tons ‡ Million Units

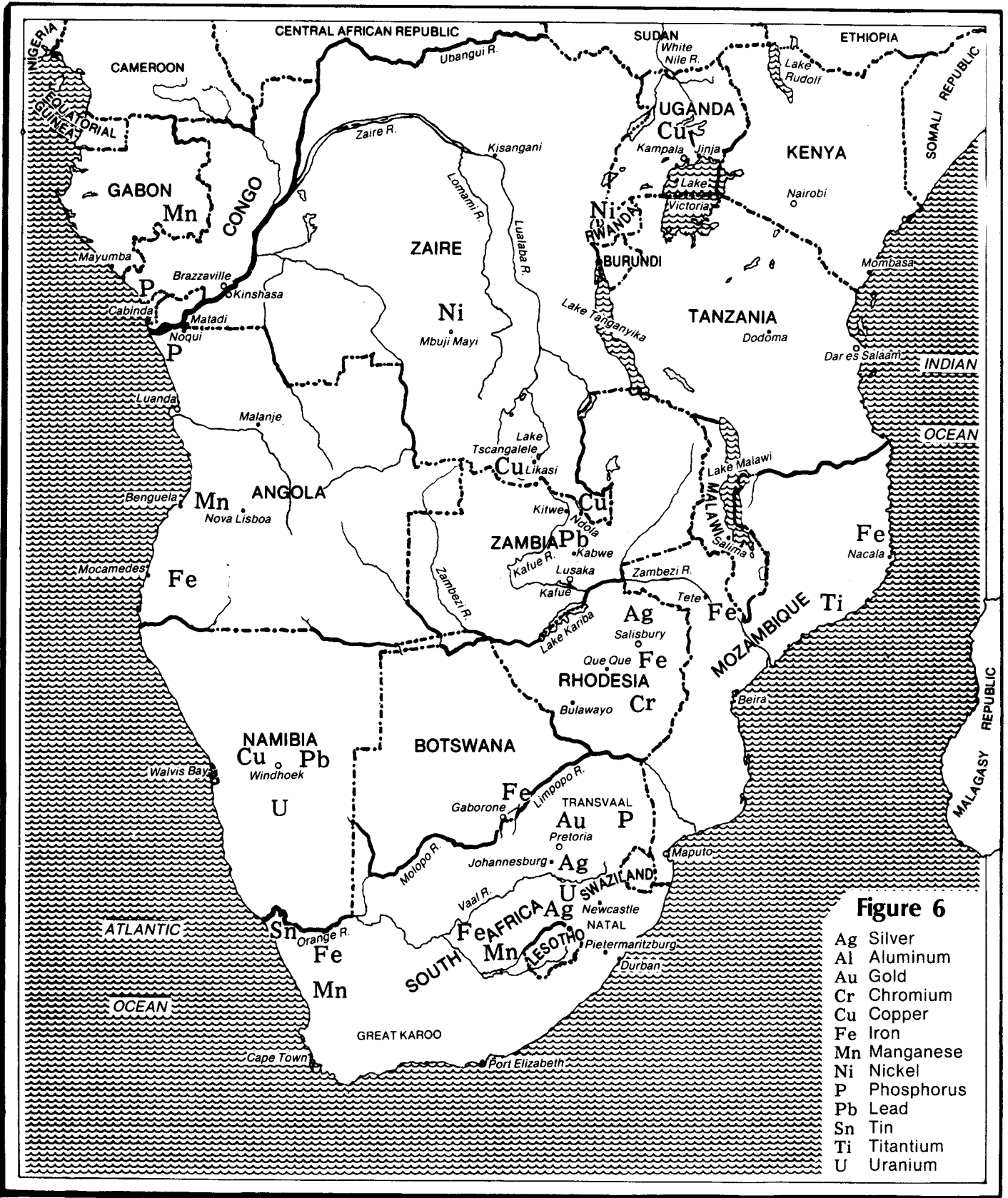
important minerals in the Angolan region (figure 4). Angola also has extremely large iron reserves, among the largest in the world. Although these reserves are approximately comparable to those in the South Africa region, a comparable steel industry could not be as rapidly developed because of the much more limited population resources.

Finally in the northern region around Lake Victoria, we're proposing, at least for the first period we're discussing, mainly the development of light industry (figure 5). We do not have here the very large core of skilled labor as in the other regions. Here are a very small number of skilled people, mainly in Uganda, and generally a low level of development. Therefore at the start we have to concentrate on less technically advanced types of industry, such as food processing, but I would emphasize that within each industry, *what must be applied is the most advanced type of technology* for that industry. The principle of maximizing productivity of labor is primary.

Obviously, such a development program presupposes a tremendous development of infrastructure. That means the development of the mining infrastructure (figure 6). It is actually the case that the mineral wealth which is so familiar to people cannot be developed without further increases in labor supply.

Prior to the current recession in the world economy, many of these countries, especially Zambia, were running into limitations in production of their mineral resources based on the shortage of skilled labor and this, to a certain extent, even continues as the condition today.

It is quite true that the region is probably the richest in mineral resources of any region in the world. South Africa itself has not only the well-known gold and silver resources, but also is extremely rich in uranium, iron, manganese, copper, and so on.



The copper belt itself extends into the central region, with iron resources and copper in the north. These would also have to be developed with extremely large-scale mining development projects.

This is approximately the order of magnitude of the investments that we are proposing (figure 7). These are simply the major schemes involved. Angola, concentrating mainly on iron development initially, at least, or later in the period, within approximately ten or twelve years, would be exporting semifinished and finished goods. Rhodesia would concentrate on chromium nickel with an entire variety of minerals and metals in the Republic of South Africa, and copper mainly in Zambia and Zaire. Taking these figures discretely, this means approximately a ten-fold increase in production in the next decade. Incredible as this may sound it is entirely possible based on the reserves which exist now. To the disappointment of people who like to talk about limited resources, zero growth and so on, any study of southern Africa is the best demonstration that the resources that are limited are not those that are below the ground, but exclusively those that are above ground, in other words, the resources of human productive labor.

The most important prerequisite to this program is the development of the energy resources of the region. At the present time, the region has almost no electric resources outside of very limited areas, outside of the neighborhood of South Africa itself, and to a certain limited extent Zaire in its development of hydroelectric resources. What we are proposing is the use primarily of nuclear energy, supplemented by coal which is found in abundance in the region, and hydroelectric power, for a tremendous level of electrification over the next ten years. The growth of electric power would exceed something like 25 percent per annum. The map broadly outlines how that is going to be done (figure 8). Each dot represents a major electric power generating facility: nuclear-based, coal, and hydroelectric. Each of these centers is going to be developed around a source of energy, primarily nuclear. We are proposing, in the period of approximately the next seven years, the development of *nuplexes*, nuclear-powered industrial complexes, centered in Moputo, smaller centers in Port Elizabeth and Capetown, and extremely large centers of above a dozen thousands of megawatts each in the region around the copper belt and in Lake Victoria.

A nuplex, or nuclear complex, is not simply the sort of familiar nuclear generating station as in the United States. It is an idea that was developed 20 years ago and has yet to be implemented on a full scale. It is the concept of using the full potentiality of nuclear energy *integrated* into on-site industrial complexes. That is, using not only electric generation, but also to a certain extent using the neutron flux, the so-called waste heat — all the energy resources in an integrated way — in the process of a very high level technology, turning raw materials into finished products. This idea would be a transition to the sort of more advanced

Figure 7

MAJOR MINING PROJECTS

Country	Mineral	Current Production*	Goal 1988*	Investments in \$ Billions
Angola	Iron	6,000	30,000	2
Rhodesia	Chromium	300	5,000	7
	Nickel	4.5	50	2
RSA	Uranium		10	2
	Iron	15,000	120,000	10
	Chromium	1,600	15,000	20
	Copper	15	1,500	2
	Manganese	3,400	30,000	15
	Coal	80,000	250,000	20
Zambia	Copper	900	10,000	20
Zaire	Copper	500	5,000	10

* 1,000 tons

conception, such as the fusion torch, which we've outlined in some of our other literature. A fusion torch based on the actual development of thermonuclear fusion power would enable this region to go to extremely low-grade ores and process them successfully at low cost into finished products, such as copper, steel, and so forth.

Over the shorter term, this nuplex process would have to be supplemented by the rather faster development of coal and hydroelectric. Coal resources in the region are enormous, far beyond anything we're proposing to utilize. In the hydroelectric area, resources, in particular in the Zaire-Angola region, are also extremely vast. As a matter of fact, it is estimated that the Zaire River is capable of producing something on the order of 100 gigawatts of electricity. That's about enough to run one-third of the United States. We're proposing to develop approximately a fifth of that potentiality, 20 gigawatts in the next decade and a half.

This briefly outlines the order of magnitude of increase that we're proposing (figure 9). As you can see, most of these countries' present capacity is abysmally low, almost non-existent outside of South Africa and to a limited extent, Rhodesia. This sort of program presupposes a tremendous transformation not only of the mode of production in the region but the general way in which the individuals live — total electrification of both rural and urban areas.

The present level of urbanization in the region is approximately 33 percent. Only one-third of the population lives in urban areas. Very conservatively, by the time the first two phases of this program are completed, by approximately 1988-1990, the early 1990s, more than half of the population — 55-60 percent — will be living in cities.

The first question, of course, is where do these people come from? How can this be done without disruption of agriculture? In fact, although

agriculture is secondary in the region to industrialization, agricultural development can go forward simultaneously with a transformation of the primarily rural to the primarily urban population.

Figure 10 gives a general idea of both the present situation and proposed changes in the agricultural production of the region. The region is actually very rich agriculturally, although the areas that can be cultivated are limited. The map notes the presently-cultivated areas for grain production, areas for plantation, tropical crops, and the areas, especially concentrated in Rhodesia, for major projects that are actually now on the drawing boards, that can be used to expand or intensify, mainly through irrigation, the agricultural productivity of the region. Rhodesia is most important, and here we're proposing essentially the carrying out of existing programs.

Probably more important than this relatively modest extension of agriculture, is the tremendous intensification of agriculture that we develop through mechanization, through a large-scale process of mechanizing the agriculture of the region and applying fertilizer. What exists is an agriculture which generally could be characterized as stone-age, not even up to the level of using the ox and so on, in general, man-powered agriculture. On the basis of transforming that through adequate use of fertilizer, even before mechanization, absolutely tremendous gains in productivity could be made. Figure 11 shows present yields-per-hectare that are obtained in various countries here, extremely low yields typical of the low productivity of the agriculture. With simple addition of the necessary levels of fertilizer, production could be raised. The sum of these figures is in the area of a 100 million tons of food per year. This is approximately 1 ton per capita, which is approximately half the level of production in the United States, or the level of domestic consumption in the U.S.

Obviously, the major problem linked to the development of the agriculture — and this gets to the core of the entire program — is not the tractors and fertilizer, but how do you take somebody who is essentially living in the stone age, is living in what has been correctly characterized as village idiocy, and transform him into a productive worker in the twentieth century?

The basic conception necessary is the conception of the concentric circle, that is, an organizing process. The developing process has to organize the population such that by stages, sections of the population are brought from essentially village life to cooperative, modern farms where they learn essential skills, and from there, move into the more skilled working divisions of the urban areas. Essentially, you have at any point in time, including the early 1990s, a population that is not stratified in a hierarchical way, but more in a dynamic way, people at different stages

of development, moving in towards key industrial centers.

It's the process of training these people that becomes the critical parameter of the entire program. I've been talking about shortage of labor. Let me show you exactly what I mean (figure 12). This is an estimate that we calculated of the new employment in industry that would be created by this program. These are the basic industries: food processing, timber, modular housing, and so on that are going to be developed in the region by this time. Also mining, construction services, transport, and so on — about 39 million new productive jobs. This is a population which by that time will be approximately 160 million people — a tremendous increase in employment. What we'll be suffering from in this region by that time is not overpopulation — that region has never been really famous for it — but tremendous underpopulation, a tremendous lack of the labor necessary to run industry.

How will we overcome that? Figure 13 gives the dimensions of the problem in education. By 1990 we are going to need approximately 20 million new, skilled workers, and approximately 20 million new, unskilled workers. The present labor force in the region — and I'm being somewhat generous here in my definition of skilled and semiskilled — is less than half that figure. The educational system at the present time — a consequence of the colonial period, and in South Africa, the apartheid policy, which does not encourage the education of the blacks of the school age population — is atrocious. There are only approximately 7 million, roughly 50 percent of the school age population, in primary school, and only 10 percent of that in secondary school. I might add this is not wholly the problem of the blacks. The white population in South Africa is only at approximately an eighth to tenth grade educational level on the average, even in the administrative layers. According to South

Figure 9

ELECTRIC ENERGY*			
Country	Present Capacity	Goal 1990	Nuclear
Angola	.3	8	8
Kenya	.1	15	10
Malawi		4	
Mozambique	.3	11	7
Rhodesia	.6	8	1
RSA	7.5	48	16
Tanzania	.1	18	12
Uganda	.1	12	8
Zaire	.8	30	5
Zambia	.7	7	5

* gigawatts

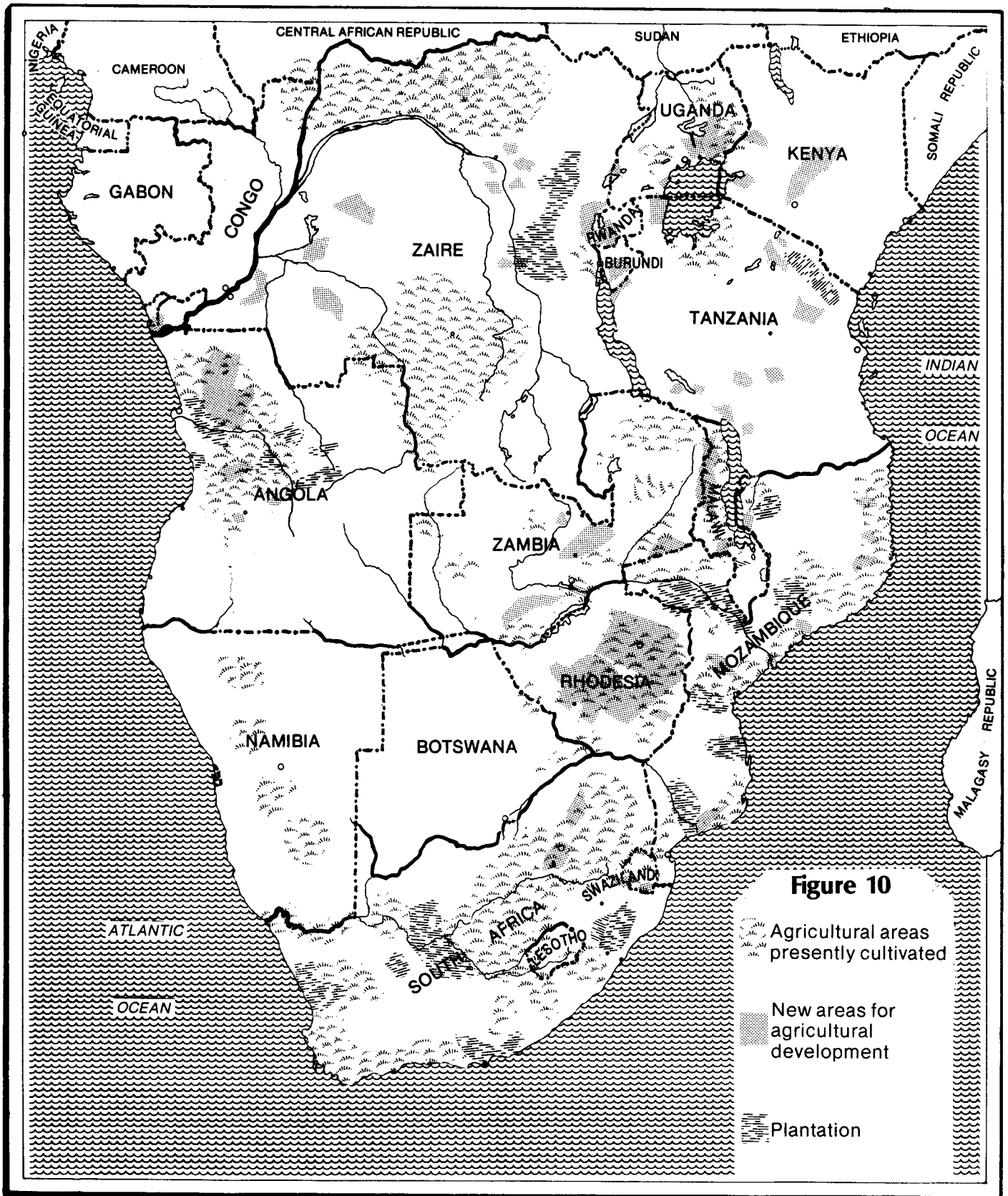


Figure 10




-  Agricultural areas presently cultivated
-  New areas for agricultural development
-  Plantation

Figure 11

SOUTH AFRICAN AGRICULTURAL YIELDS

	Total Land Area (million hectares)	Grain Area (million hectares)	1977		Projected 1980	
			Present Yield (tons per hectare)	Present Production (million metric tons)	Grain Production* (million metric tons)	Total Fertilizer Required** (million metric tons)
Kenya	58.3	1.8	1.2	2.2	17.5	1.3
Rhodesia	39.0	1.0	1.8	1.8	9.6	.7
South Africa	122.1	6.5	1.8	12.0	65.5	5.0
Tanzania	94.5	1.2	1.6	1.4	12.3	1.0
Uganda	23.6	1.8	1.2	2.1	17.7	1.4
Zambia	75.3	.6	1.3	.8	5.8	.5

*Calculated at 10 tons per hectare using double cropping and trickle-drip irrigation methods to supplement rainfall.

**Calculated at .380 tons per hectare per crop.

Africa's own statistics, most of the people who run South Africa do not have a high school education, or just barely have a high school education.

Higher education is at an extremely low level. There is a tremendous shortage of professionals of all sorts. Our program necessitates massive enlargement of secondary education; primary education, starting immediately reaching virtually full enrollment in secondary schools by 1986, the basic bottleneck would be the production of something like 200,000 people capable of teaching secondary schools. Those qualified people don't exist in South Africa or the southern African region at the moment. Obviously, the developmental aid for this would be very direct: either the recruitment of secondary school teachers, or people who can be trained as secondary school teachers from the advanced countries. . . .

In outline I've shown what can be done, what must

be done. The final question is how can this be financed? Is this a practical proposition in the hard terms of economics? The answer is, yes it is, if the terms of economics are the long-term, 20 years, 30 years. Figure 14 shows the cost benefit analysis of the program we just proposed. It's not a cheap program whose numbers are billions of dollars. We're talking about the investment of one-half of a trillion dollars in the southern African region, in increments, in the next 10 to 12 years. And that wouldn't be the end of the program either.

However, obviously what you're developing is a tremendous export capability, a capability to export primary metals in their finished form — copper, steel, aluminum, and so on — by 1995 reaching the level of at least \$35 billion a year, growing after that as it is supplemented by export of heavy equipment, and so on. Thus you will not get your returns back in a few

Figure 12

NEW EMPLOYMENT

Industry	1990 New Employment*
Food Processing	2
Timber	2
Modular Housing	2
Steel	1
Copper	1
Aluminum	1
Chemicals	1
Heavy Equipment	1
Other Manufacture	5
All Manufacture	12
Mining	2
Construction	6
Services	12
Transport	5
Energy	2
Total	39

*in millions

Figure 13

EDUCATION*

1990 Labor Force Requirements	
Skilled (8 years plus)	20
Semi-Skilled (6 years plus)	20
1978 Labor Force	
Skilled	6
Semi-Skilled	6
1978	
Primary School Enrollment	7
Secondary School Enrollment	0.7
Primary School Teachers	0.2
Secondary School Teachers	0.035
1982	
Primary School Enrollment	14
Secondary School Enrollment	4
Primary School Teachers	0.5
Secondary School Teachers	0.2
1986	
Secondary School Enrollment	10
Secondary School Teachers	0.5

* in millions

years. The money invested would return as exports only by approximately the year 2000, approximately a 22-year period. There'll be sufficient surplus for repayment of these loans in approximately 30 years.

That obviously defines to a very large extent the terms of the financing that has to be offered — long-term, low interest financing. But this is not charity on the part of the developed countries. What do they get out of it? Well, two things: immediately, this program by itself, simply implementing this program or beginning to, would create in the advanced world 2 million productive jobs in the capital goods producing sector. That's enough to take quite a wallop out of the mass unemployment of the developed sector. It would increase by approximately one-third the production of capital goods. That's enough to nearly compensate the idled capacity in the capital goods sector.

From the broader sense, this cost-benefits data really can't be totaled in terms of money, but is nevertheless real. The benefit other than the obvious — and not negligible benefits — of bringing peace to the southern African region and avoiding a great power struggle in that region, is the production of the necessary minimal infrastructure to fuel a development rate of the world on the order of 20-25 percent a year. The necessary raw materials and

Figure 14

COST-BENEFIT ANALYSIS	
	\$ Billions
Major Imports	
Electric Plants	120
Infrastructure	50
Trucks, etc.	30
Mining Capital Goods	100
Industrial Capital Goods	210
Total Imports	510
Peak Year	130
Export Earnings by 1990	35
Total by 1990	200
Total by 2000	more than 650
Total by 2010	more than 1200
Advanced Country Employment	
Peak — 2 million	
Capital Goods Production	
Increase of 33%	

semifinished materials that the world will need to undergo the greatest boom and the greatest prosperity that our planet has seen in its history. On the basis of that sort of benefit calculation, the investment of even a half trillion dollars is not excessive.

Douglas DeGroot

The first political point to be made in regard to the industrial development of Africa is that there are humanist forces there, who desperately want to see that development occur. In fact... there are humanists in Africa who have attempted to develop and implement programs, like the one we are proposing, on a more modest scale... They have faced enormous obstacles.

From the very beginning, with the establishment of the initial European settlement at Capetown by the Dutch, the interests who set up that settlement very consciously wanted to limit the number of Europeans there. The Dutch East India Company was afraid that if too many Europeans got there, and got the idea that they could develop some kind of industrial-oriented economy, they would have a problem controlling southern Africa, like the similar problem that their British allies were having with their North American colonies at the time.

The second historical fact is the counterinsurgency that has historically been conducted in the southern

African region to maintain an extremely aversive atmosphere between Africans and Europeans. Behind that is this: There had to be a separation between the blacks and the whites. They had to maintain these two groups apart from each other as much as possible in order to avoid contact between the two groups leading to modernization of the blacks. If the blacks had been allowed to freely associate, for example, with the European settlers and what they were trying to do at the time, the blacks would have very rapidly acquired skill levels that would have made the region very tough to control politically.

Immediately, the demand would have been for more development. That's precisely what the circles we're talking about were trying to avoid.

When the British moved into the Cape colonies, as southern Africa was called at that point, they immediately began counterinsurgency operations. After 1815, when the British actually took over control of the Cape colony, it began with a vengeance.

The primary vehicles for maintaining this aversive

atmosphere between the groups were the missionaries, who were politically deployed out of the London Missionary Society. These missionaries from the London Missionary Society *introduced* the pass-law into southern Africa. The missionaries from the London Missionary Society consciously pushed and implemented a policy of keeping the African population off in separate enclaves, which they were supposed to govern themselves according to what they were made to see as their "own interests," and to be maintained separate from the Europeans. If the African wanted to leave this enclave, he was required to have a pass.

Now, obviously this keeps the two groups separate and impedes the kind of necessary interaction that would have facilitated a quite rapid development of the African population. At the same time, to create a paranoid mind-set among the European populations, there were created tribal organizations which maintained a warlike kind of difference with the Europeans; there were constant uprisings called country wars, which could be . . . turned on at will by British military and administrative personnel; judiciously turning off and on these kinds of wars at crucial points helped to maintain the aversive atmosphere between the two groups.

With this kind of development, as industrial and more advanced agricultural forms of production were introduced, a modernization of the African population was prevented, and in turn, production was impeded. That's the historic meaning and significance of apartheid, and that's where the underdevelopment of even relatively advanced South Africa comes from. This is what humanist circles in the region as well as their counterparts in Europe have been fighting against from the very beginning, in order to modernize the region.

Now, despite this, these humanist forces were successful in introducing limited amounts of industry, and there was one specific period in which humanist networks in the region tried to set up a republic, explicitly oriented to industrial development, and modernization — including modernization of the African population. This is what's termed the Kruger republic.

Paul Kruger tried to build a country, an industrial country. He had a circle of various people from southern Africa, a circle so limited that in fact, he had to import many technicians and so on from Europe to help him administer the country he was trying to set up. The only reason he got as far as he did was because of close collaboration with industrial factions in Europe, if not formal relations with European countries. I'm referring especially to German industrialists, who wanted to collaborate with him as he developed what was called the Transvaal Republic.

These German industrial factions prior to Kruger's effort had wanted to develop the regions surrounding the Transvaal Republic as well, moving in skilled labor. German industrialists particularly eyed the

area just north of the Transvaal, which is known today as Rhodesia. This is precisely the reason that Cecil Rhodes formed the British South Africa Company — to grab hold of Rhodesia and establish it under the authority, then indirectly, of the British. Rhodes acted to impede anybody else from getting established in that region to develop it industrially. There are many details one could go into around the process of isolating the Transvaal. Various tribal uprisings were touched off by the "tribal advisors," of these British networks in the areas all around the Transvaal, providing a pretext for the British to move in militarily, annex these regions, and isolate Kruger.

I should very briefly mention what Kruger's policies were. Of course, he had problems, he had problems with his own people, that is, with the Boer peasants, who themselves were not highly educated. They wanted to build their farms, be left alone, and so on. The positive impulse into this group of people had been contributed largely by Huguenot refugees who came from France after the 1685 Revocation of the Edict of Nantes. With their higher cultural level, aspects of this group were very similar to the Puritans that came to the Americas. It was largely on this basis that the positive humanist tendency developed and came out during this Kruger period.

On the race question itself, even in the face of opposition from his own Boer base, Kruger ran through the assembly various laws calling explicitly for no adherence to the policies on separation by race that had been brought in by the British and the London Missionary Society. He said that you have to look at the active population and judge them on their level of attainment of civilization. Civilization is the important thing, modernization. "You can't put everyone in the same tray," is his often quoted statement. You can't treat Africans as a group. You've got to do everything possible to help modernize and raise their standard of living, and let them participate in the institutions of the state. That was his policy.

He was attacked by more backward elements in the Boer population, people connected with Cecil Rhodes, who very vigorously organized among this layer of Boers to try to malign Kruger.

Kruger's connections to European industrial factions were destroyed, one by one, by Cecil Rhodes, and by the City of London. Kruger had no major outside backing that he could rely on. Once his republic had been isolated — this wasn't enough for the people in the City of London. Krugerism — what the British called his attempts to modernize — had to be stamped out. That is the real reason the British ran the Anglo-Boer war, to stamp out Krugerism. The British moved in half a million troops, and in about three years time destroyed the Republic. And after that war, they moved in and picked up the layer of people, to a large extent, who had been critical of Kruger before. These were called, by the way, the Progressives, Cecil Rhodes' own people. They always had nice little names for their counterinsurgency

imaginative approach can rescue us from the impending prospect of a regional, if not a global, holocaust, emanating from southern Africa.

A major motivation for Soviet activities in Africa is securing some access to its resources. There is evidence to suggest that the USSR would cooperate in developing southern Africa if significant access to her mineral wealth were guaranteed. Leonid Brezhnev himself hinted at this in a conversation with the British Foreign Secretary in Moscow this past fall (1977).

Soviet African specialists have been development-oriented since the mid-sixties with the rise of Vasily Solodovnikov, who recently assumed the ambassadorship in Zambia, after heading the African Institute of the USSR Academy of Sciences. Pointing to Soviet experiences in Egypt, the Sudan, Somalia, and recent events in Angola, the USSR's African specialists argue that more Soviet-supported proxy wars could lead to a series of expensive and counterproductive Vietnam-type debacles. However, since its African policy is now a centerpiece of its overall foreign policy, decision making for that area has been transferred to the highest levels of the regime where there seems to be considerable debate.

The top Soviet policy priority today is to bolster its own sagging economy. Access to the relatively inexpensive minerals in southern Africa would temporarily mitigate the prospectively exorbitant costs of extracting Soviet minerals from the frozen Tundra of Siberia. The Soviet leadership is also engaged in a wide-ranging debate over its own emerging energy and resource shortages, and it appears that the compromise interim solution is to push ahead with its own development plans more slowly, while seeking access to less expensive resources elsewhere, especially in Africa.

The USSR is particularly interested in the uranium and coal reserves and in what mix of fuels to rely on for energy in the coming decade. It is also under increasing pressure to keep up with the mushrooming energy needs of its Eastern European empire, at a time when its own output of oil, gas, and coal are growing at a declining rate.

Going further, the Soviets are also interested in other minerals, such as chrome, which it plans to process and re-export at a profit, in order to earn the scarce foreign exchange necessary to purchase high priority technology. The USSR has developed a multiplicity of international financial institutions to facilitate the marketing of raw materials in order to acquire foreign exchange. The USSR has banks in most major money markets, except New York, and including most European capitals and Singapore and Beirut. Its joint ventures trade oil all over the world.

Many British, American, and South Africa strategic analysts argue that the primary motivation of Soviet African policy is strategic denial, threatening to restrict western access to African resources, which

would dampen if not cripple western economic growth. There is considerable evidence to support this contribution, but a closer reading of the relevant data indicates that access for their own use is an equally acceptable interpretation of Soviet intentions. The two could, of course, be concomitant goals. It should be stressed, however, that access is potentially an even more dangerous motivation than denial, since the former is defensive, and more closely related to the immediate national security interests of the Soviet Party-State.

What other indications are there that the USSR might opt for the path of development rather than the recently successful path of proxy war? To begin with, there are indications that the Soviet leadership has been deeply divided over its African policy, since the Angolan intervention, although admittedly the more militant elements seem stronger now. The Brezhnev regime has always been reluctant to indulge in adventures which would sabotage detente irretrievably. Thus Brezhnev privately assured our government that Angola represented a unique Soviet foreign policy initiative and there is evidence to suggest that he was sincere, even though duplicity has served Soviet foreign policy well in the past. In fact, the major Soviet effort in Angola occurred only after the U.S. Congress had clearly signalled that the U.S. wished to pursue a laissez-faire policy there. The apparent success of the Angolan operation, enhanced the fortunes of the more militant elements of the leadership as symbolized in the elevation of the head of the arms industry into the highest governing organ, the Politburo, at the 25th Party Congress, during the height of the Angolan conflict.

Despite this, Brezhnev moved to restrain the militants. The ouster of former President Podgorny immediately after his historic African trip last year was in part, at least, the result of Podgorny's advocacy of a more aggressive African policy. Podgorny was a longstanding rival of Brezhnev's and was seeking support for his power bid from the more militant factions in the regime, who awaited Brezhnev's demise.

Brezhnev's fragile health must certainly have sharpened the power struggle over his succession, and one might just as easily interpret his assumption of the Soviet Presidency as a step toward honorable retirement, rather than as a consolidation of his power.

Nevertheless, the continued viability of the UNITA insurgency in southern Angola, as well as the fragility of President Neto's health and his government, strengthened the hand of Soviet African experts and proponents of detente, who had counseled caution, favoring the path of development. In December 1977, Brezhnev reasserted his authority over Soviet African policy by sending his close associate, Andrei Kirilenko, a CPSU secretary, and member of the Politburo committee on National Security and Defense matters to the Angolan independence

celebration. There are indications that Kirilenko is now running the USSR on a day-to-day basis. He holds the key post of Party Secretary for Organization Affairs. Since he is older than Brezhnev, Kirilenko has often been viewed as a possible "caretaker successor," while the power struggle for the long-term succession continues.

Some may argue that this interpretation is not credible in the light of the Ethiopian situation, but I would suggest that the opposite is the case. Although, as early as June 1977, the USSR was quite aware of the possibility of a Somali attack on Ethiopia, it hesitated until November, months after the Somali attack, before initiating its massive intervention on the Horn. Here again it was encouraged by the American government's repeated declarations that it preferred a *laissez-faire* policy. The expulsion of Soviet advisers from Somalia left Brezhnev with no alternative, if he were to rescue the USSR from a major foreign policy defeat. Although the ultimate developments on the Horn clearly enhanced the fortunes of the militants, the Soviet intervention was quite carefully orchestrated, despite viability of development-oriented factors in the regime.

For example, while some might argue that the presence in Ethiopia of the second highest ranking officer in the Soviet Army, signalled commitment to a more militant policy, it might be suggested to the contrary that General Petruv's presence represented a determination by Brezhnev to carefully restrain and orchestrate the entire operation. In fact, the Soviets scrupulously avoided major incursions into Somalia despite some provocation and the fragility of General Barre's government. The repeated rumors circulated by Soviet diplomats that the USSR might not be able to resist Ethiopian pressure to invade Somalia suggest a continuing debate in Moscow over the militance of its African policy. Certainly her success there aggravates the temptations in Kenya, Saudi Arabia and southern Africa, especially in the context of the power struggle over the succession.

Turning to the recent Zaire invasion, we have known since before the first invasion in spring 1977 that the USSR, the Cubans, and the East Germans were involved with the Katangans in Angola; but then as now, the paucity of evidence, indicating that the USSR *encouraged* the invasion of Shaba Province as distinguished from merely *countenancing* it; and the halting fashion in which the invasion was executed, coupled with vehement Cuban denials of involvement suggest, at the very least, a continuing debate in the Soviet regime over its African policy, despite its euphoria over the Ogaden War success. It is, however, interesting that the Soviets reportedly bought huge quantities of cobalt, a major export of Zaire, just before the invasion.

Since the USSR possesses vast quantities of cobalt, it is probable that it intends to resell it at higher market prices resulting from the shut down of the mines in Shaba after the invasion. The Soviets turned

a similar profit with chrome from boycotted Rhodesia several years ago. Here again we see the foreign exchange motivation. While it might be argued that the huge Soviet cobalt purchases provide evidence of their involvement in the invasion of Shaba, it might also be suggested that this evidence proves only foreknowledge, not necessarily encouragement of the attack.

It would be difficult for the USSR, East Germany, and Cuba to resist the determination of the Katangan exiles (whom they clearly did train) to return to their homeland, especially when their incursion might relieve pressure on the embattled President Neto of Angola. Of course, if the fragile Mobutu regime in Zaire collapsed in the process that would be a happy windfall for the USSR. But here again *countenancing* an action must be clearly distinguished from *actively encouraging it*, if we seek an accurate picture of Soviet intentions. The whole tenor of the second Zaire invasion suggests a continuing debate in which the more militant tendencies are gradually, but not yet decisively, gaining ground.

Now returning to the subject of this conference; what has this Kremlinological exercise to do with developing southern Africa? In short, it reminds us that only a bold and imaginative policy designed to strengthen the hands of less militant factions in the Soviet leadership stands a chance of rescuing southern Africa from the jaws of an impending holocaust. In its drive to secure access to southern Africa's resources, the USSR has a policy option other than development; and that is a series of proxy wars in Rhodesia, Namibia, and South Africa, which they hope would culminate in the emergence of regimes susceptible to their influence like those in Mozambique, Angola, and Ethiopia.

Since the USSR — which is clearly a major force in southern Africa — has essentially been excluded from efforts to resolve the tensions there, the evidence, at present, suggests that this is the course the USSR is likely to pursue, unless major new initiatives, such as those which are the subject of this conference, *among others*, are forthcoming.

The new Brezhnev Constitution and the treaties with Mozambique and Angola make it quite clear that the USSR plans to play a major role in southern Africa. The Soviet Union is a global superpower capable of projecting its military might anywhere on the globe, as it has repeatedly demonstrated in the past few years, especially in Africa. The Soviets seek to portray their nation as the patron of what they call the "progressive" forces around the world, and while they are hardly programmed by revolutionary ideology anymore, it would be a serious mistake to underestimate the impact of this generalized motivation of their decision-making process.

The question then is whether the USSR will play a constructive or destructive role in the evolution of political and economic forces in southern Africa? Much depends on American policy. The USSR will not

be locked out. She must either be drawn into a peaceful process of transition by a bold and imaginative policy, encouraging the process of development and thus facilitating prosperity and enhancing concern for human rights; or she will resort to force, that could engulf the entire region in a bloody racial war; and which could escalate even further into a superpower confrontation.

In my opinion, the present power struggle over the Brezhnev succession leaves open the course of peace rather than war, but time is short. Increasingly

confident, sophisticated, and experienced in the African context; emboldened by their relative successes in Mozambique, Angola, and Ethiopia determined to secure strategic access to Africa's resources, and to project its image as the patron of progressive forces around the globe and, above all, until now completely locked out of the transition process, the USSR and its proxies may opt for violence. This conference proposes a positive alternative — the path of development.

David Carr

I would like to present three major stimulæ to comprehensive economic development that seem to have been very important in other countries that had successful growth experience; I am offering these three major economic frameworks as a backdrop to the specific development program as it has been given to you this morning.

These three major stimulæ to comprehensive economic development are increasing exports, high savings and investment rates, and structural transformation of the economy.

At this point I perhaps should offer a disclaimer that the ideas and insights I am sharing with you today are my own and do not necessarily reflect the viewpoints of the National Foreign Trade Council.

The first major stimulus to comprehensive economic development, at least in economic history, has been expanded exports, and this should remain true and be very important for southern Africa as well. I do wish to downplay this particular aspect a little bit. It is true that if you look at Japanese economic development, exports are very important in the 1950s and in the 1960s in fueling their rapid rate of economic expansion. Similarly, in Korea during the 1960s and 1970s, export expansion again has been very important for fueling their economic growth and you probably can point to many other examples, such as Egypt in the late 19th century. There is an old theory in economics called comparative advantage which does seem to say that countries should stick with producing what they are good at producing and what their resource endowments entitle them to. Of course, you do have the infant industry argument. There is also the idea that comparative advantage should not be statically conceived but should be dynamically conceived — that is, that countries should move on and

produce commodities stage by stage as they acquire additional skills and as world market changes require.

The basic idea here is that countries are not interested in just physical exportation. They are interested in receiving revenues therefrom, and you have quite a few examples in recent economic history in which countries suffer severe losses in that kind of trade as they had to pay much more for imports than they were getting from their exports. Egypt was a successful example in the late 19th century, but in the early 20th century, say 1910 to 1938, they lost about 25 percent of their per capita income because of adverse developments in the terms of trade for their cotton. Looking at the last few years, you have Zaire, where gross domestic product fell by 6 percent in 1975 and 1 percent in 1976 because of sharply falling copper prices. Zambia is probably an exemplary case history of a very sharp fall in national income.

As a personal aside, I did leave Aden during the 1967 collapse. There they also suffered a very sharp loss in their income (not because I left the country); it did in the succeeding two years. Zambia lost 40 percent of their gross domestic product between 1973 and 1975 and really lost all the development momentum they had achieved during the entire 1960s. This was a twofold result of the very sharp drop in copper prices, and secondly, because almost all or a very large proportion of their national income was due to copper production.

So, the basic point I am making is export-led development is an important consideration and will be important for southern Africa in the future but is not by any means the only important element. These countries should concentrate on their export development program. They should carry out market research to see which commodities would sell best in

overseas markets and they should also look to see — as Eric Lerner pointed out — which of their products that are now exported in raw material form would be better exported in processed form, whereby they could receive more value added on the local scene.

The second major stimulus to economic growth in other successfully developing countries is high savings and investment rates. Under Rostow's theory of stages in economic growth, a country comes into the take-off area when it achieves savings and investment rates of an excess of 10 percent annually. Japan reached this in 1878 and then during the 1940s, 1950s, and 1960s went up to 25 percent and finally to 35 percent in terms of their gross national product. Korea had a savings ratio of something like 13 percent during the 1950s and early 1960s and then in 1966, it shot up to 22 percent and thereby fueled tremendous economic expansion during the late 1960s and early 1970s.

In South Africa — as you may know that is a fairly advanced country — they had a savings ratio of something like 24.5 percent from 1970 to 1976, and during 1977 it went up to 27 percent for that one year.

There are three basic methods with which a country can achieve high savings and investment rates:

First, if you are dealing with a lot of state enterprises, a country should ensure that for the state enterprises as a whole, there are adequate profits received in excess of ordinary expenditures. Now, Eric Lerner did give an example of the ISCOR plant, which is deliberately run at a loss, but that may be all right for say, one or two state enterprises, but if the country is going to marshal its own funds for comprehensive economic development, it should ensure that the state enterprises as a whole generate sufficient profits for raising local capital.

The second way of achieving high savings and investment rates — and one might accuse this of being the system, at least in the past, in the Republic of South Africa — is to skew the income distribution in such a way that the poor are squeezed a bit and the wealthy get much higher income so that, under economic theory, the market propensity say of wealthier groups is higher, and thereby you could raise very substantial investment funds.

Now, the third and I think the most promising way of raising substantial local investment funds, as has been achieved in Korea and in many other successfully growing countries, is to have a spirit of cooperative nationalism. Now this, again, is where economics runs into politics, but if you have a spirit of *division* within regions of the country or between classes in the same country, it's very difficult to get people to save their money and to mobilize firms to expand their investments. What is more likely to happen if there is a spirit of animosity prevailing in the society is that people will invest in land, will speculate in commodities, and remit their funds to Swiss bank accounts.

What the Japanese have learned, and I think the

Koreans have learned also, is that they have massive savings schemes at the post-savings department level and then are able to get business, labor, and the government together, to agree upon the desirable goals in a common development program. Then everybody appears to be moving to the same objective; they are willing to save substantial elements of their income and have them transferred to companies for their investment programs. They do not speculate anti-socially.

This is difficult to achieve because many of these countries, of course, are in a decolonization experience currently, and many animosities are being created as a result. But I think it is important for a spirit of cooperative nationalism to develop in these countries so that substantial savings and investment funds can be raised on the local scene.

The reason why I'm emphasizing local savings and investment is that if you look at countries that have achieved substantial development in the past, it may be true in the initial stages that substantial funds do have to come from overseas and that of course will be true with the program as it has been presented today. But if you are planning over a 20-year period, and you have large amounts of funds coming in from overseas in the initial period, the plan is not likely to be successful unless substantial local funds are raised which can ensure that the development program sustains a tremendous momentum on the local scene, and local investors and local labor, businessmen, and government officials all take part in trying to mobilize local funds so that the program can take root.

Now, the third and last, but by no means least important stimulus to economic development is structural transformation. There are three basic reasons why a country should be interested in changing the structure of its economy. One I already implied — when I was commenting on the danger of relying on increased exports of your raw materials or the things you have been producing all along — is to diversify risk. If you are producing a lot of things in diversified fashion, you are less likely to suffer if the terms of trade turn adverse with respect to one or two or three commodities.

The second and probably most important reason why a country should be interested in a structural transformation of its economy is that if you are dealing with agriculture or you are dealing within existing mineral finds, it's very difficult to push for more than 5 or 7 percent increase per year in the output of these commodities. But when you go over to industry, it is quite within the realm of possibility to have growth rates of 10 percent per year — and even light industrial products, textiles, food processing — and when you get over to sophisticated industrial products, growth rates of 20 percent per year are not out of the realm of the imagination. If you look at the Japanese or Korean growth experience, you can point to quite a few examples over a five- or ten-year period where 20 to 25 percent growth rate in such items as

transistors, automobiles, electronic appliances has been obtained.

The third reason why a country would be interested in structural transformation is that many of these industries that will be created have dynamic linkages, spill-over effects, and external economies with other industries. Thus, you are not just concentrating on the immediate industries which you are interested in, but there will be supplier firms, that will be contracting to that particular industry, and there will be many other ancillary enterprises that will be stimulated into being as a result.

Now, I will only spend a little bit of time in my concluding remarks on how these three ideas can be fused in terms of making a development program that was introduced this morning a practical proposition. Eric Lerner did place heavy emphasis on the aspect of training and education in order to ensure that the development program that you have in mind can take hold, that there will be sufficient labor and sufficient skills to implement that particular program.

I might give you one example from my experience when I was in Oman in which a deliberate antidevelopment-type project was put into place. That was the pipeline from interior Oman to the coast. Said-Ben-Tamur, the former sultan, insisted that the American oil company building that pipeline would have to change its labor force as the pipeline moved from one tribal area to another; so every 10 miles, the pipeline kept being extended — the workers might be working say five or six months — they would be laid off and the oil company would take on new laborers and of course, have to be involved in the expenses of retraining. And this was done deliberately so that people would not have permanent skills — and maybe acquire dangerous political ideas at the same time.

Now, on the South African scene, you have had the example in the past of certain mines being established and the labor coming in from Mozambique or certain

tribal areas, coming in for very short periods of time. . . each man as a bachelor. Their families are left in the hinterlands. The families are self-sufficient and the laborers were paid rather a low wage. The idea was, they stay for maybe two years, then go back to their place of origin and new people would come in to take their place. Of course, it's not good for overall development because you don't have the permanent acquisition of skills. These skills are lost as the people were turned back; you do not have subsidiary industrial enterprises created by some of these people who have acquired special skills.

There are many examples in other countries, where a successful development has taken place — not because Shell has created a certain oil refinery or certain mines have been established, but because the labor pool has been trained as a result of the establishment of these companies, so that when the work force is reduced with an ongoing enterprise, these laborers move on with their skills and set up other enterprises. And I think the key role to be played in any successful development program is to build up your skills and have them transferred to other enterprises, and then the development program can be successful.

So when I look on the development plan that we had this morning, I look on it primarily as poles of development to create certain major industries in certain areas. The plan is most likely to be successful if you have an ongoing training program, there are local innovators, and enthusiasm to put the program across, and if there are vigorous reactions from the local scene to overcome the many obstacles that will come about in implementing the program and in pushing ahead with the new program, with the needed reforms and changes to establish the needed auxiliary industries and supplier firms and to change certain of the institutions.

QUESTIONS

Why didn't Mr. Lerner mention the potential of hydroelectric power in Africa?

Mr. Lerner

In the program that will be circulating here later in the day, we do mention the sources of hydroelectric power. Let me just comment generally. In the region, as I said, there are three different sources of power. Apart from a certain, relatively small, amount of oil, which is in Cabinda, and is used mainly for foreign export purposes, you have tremendous amounts of coal, you have tremendous amounts of hydroelectric power, and you have uranium, for nuclear power.

There is no question that in most cases the cheapest source of electricity today is hydroelectric power, where it is available; because of the extremely high and concentrated rainfall in the southern African region, it is available there. We are absolutely in favor of its high-level exploitation. It can be developed with moderate rapidity, which is to say, it is intermediate between nuclear power which currently takes about seven years to develop, and coal, which takes three to five years under most conditions.

Our general approach is that of pushing hydroelectric development ahead to essentially maximum potential, basically as a transition into a period in which nuclear power would become more and more the main source. You cannot rely predominantly on nuclear energy until you reach the stage of fusion power development. So these are not contradictory options, but complementary options in energy development.

You have suggested very large-scale aluminum production. Where do you plan to get the raw materials?

Mr. Lerner

The region is not at the present time explored. There are many parts of the region including southwest Africa and Namibia which are not completely explored. Every year, and often every month, you have major new developments of mineral resources. I believe it was last year that there was a first major estimate of the bauxite resource of Gabon. They are now estimated in excess of 100-200 million tons in content. If you exploit those over a 30-year period, once you reach full potential, then very large quantities, I believe of the order of several millions of tons of aluminum, do not become excessive. The

resources already identified, now considered proved resources, are alone sufficient to supply them.

Beyond those, the resources in south Africa itself, though not as large, are also extremely extensive. There are additional bauxite reserves scattered through the region. If you take the reserves as a whole, then you have sufficient ore production for at least something in the order of 20 to 30 years on the scale we're talking about.

Beyond that, I don't think we're going to run out because aluminum happens to be the third most common element on the surface of the earth. And once energy is available more cheaply than now, through the development of advanced fusion power systems, in the early part of the next century, much more inadequate resources, much lower concentration of aluminum in ores could be exploited. Therefore not only this level but an even higher level of manufacturing of aluminum could be achieved. For the short term, I think the primary resources will be from Gabon.

Could Ian Smith's 'Internal Solution' in Rhodesia work, and what would be the consequences for the region's development?

Mr. DeGroot

The best solution for development will be the solution that involves all the parties. That immediately excludes the so-called "Internal Solution."

The Patriotic Front force and their allies in the front-line states have to play a very important role in the form of government that eventually is established in Rhodesia, so that we can avoid a "Thirty Years War" scenario . . . Their involvement in government has to be very significant. The Internal Solution therefore would be a continuation of the kind of system that has historically prevented a coalescence of the forces that we're targeting to get development off the ground. The Internal Solution puts into power a number of people who have no real political base, whose base is provided by . . . the Church and other parts of the state apparatus, or by tribal organizations. They have no political base. It's a continuation of the kind of relationship between the races, between the industrialized and non-industrialized, that has to be ended if this plan is to have a chance of working.

The Third World Into The 21st Century

PANEL II

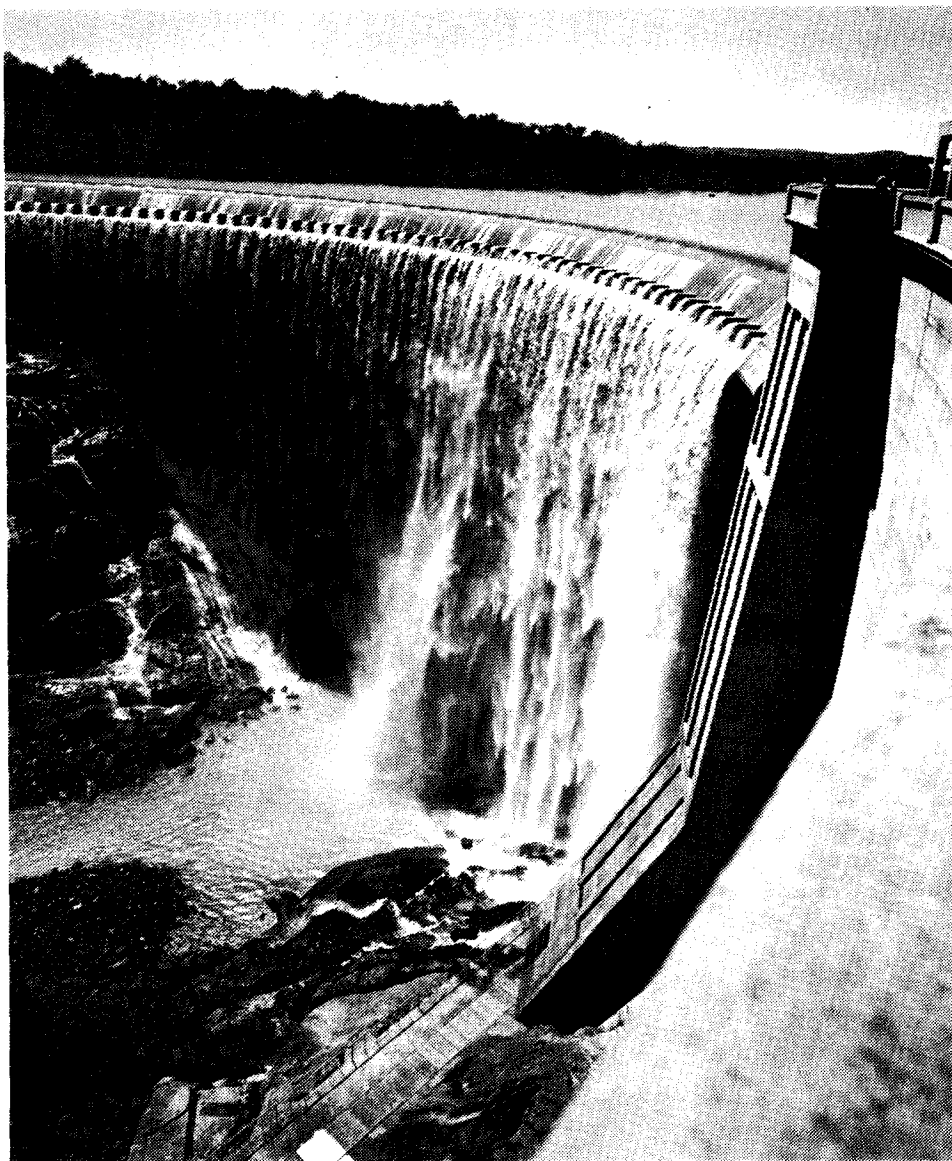
Dr. Stan Krause of the Department of Agriculture International Development staff is currently on assignment with the Technical Assistance Office of the Africa Bureau of the U.S. Agency for International Development. He is currently involved in the program design and implementation of AID technical assistance projects. He has been employed by the Department of Agriculture since 1952, and served two years in Ghana and two years in Brazil as Economic Advisor to the Ministry of Agriculture. Dr. Krause received his PhD in agricultural economics from the University of Minnesota.

Uwe Parpart is the Fusion Energy Foundation's Director of Research. Mr. Parpart is a graduate of the West German Naval Academy and has taught and written on basic questions in mathematical physics and strategic planning. He is the author of *The Concept of the Transfinite*, an important evaluation of the work of Bernhard Riemann and Georg Cantor.

Dr. William van Rensburg is Chairman of the Geoscience Department at West Texas State University, Canyon, Texas. He was formerly the British Petroleum Professor of Energy Economics, and Director of the Institute for Energy Studies at Rand Afrikaans University in South Africa. He was also the Technical Director of the South African Minerals Bureau. He is the senior author of *South Africa's Strategic Minerals — Pieces on a Continental Chessboard*. He is also the co-author of the soon-to-be-released *The Economics of the World's Mineral Industries*. He received BSc honors and MSc from the University of Pretoria, and received his PhD from the University of Wisconsin.

Dr. Morris Levitt is Executive Director of the Fusion Energy Foundation, and also editor of its publications, *Fusion* magazine and the *International Journal of Fusion Energy*. He has testified before numerous congressional committees and state legislatures on energy policy.

Dr. William Ellis joined the Energy Research and Development Administration in February 1976 as the Chief of the Advanced Fusion Systems Branch of the Confinement Systems Program of the Fusion Energy Division of Energy Technology. He is now responsible for the management and planning of the non-Tokamak confinement experiments in fusion research for the Department of Energy. From 1970 to 1975 he was the associate group leader of the SCYLLAC project at the Los Alamos Scientific Laboratories. Prior to that appointment, he worked for three years at Culham Labs in England doing research on High Beta Toroidal Pinch Discharges. Dr. Ellis received his PhD in plasma physics from Princeton University in 1967.



Dr. Stan Krause

I endeavored to design and limit my comments to southern Africa. I should point out that I also feel constrained to speak on my individual responsibility this afternoon. In other words, my comments have not been officially cleared by either the Department of Agriculture or by the Agency for International Development where I have been detailed for most of the last year by the Department of Agriculture.

The session this morning mentioned that agriculture is the most underdeveloped segment of the economies of southern Africa. That's very true. Passing reference was made to the dominance of agriculture in terms of numbers of people who gain their livelihood. That is emphatically true. The central question in the perspective on this session was, can this part of the Third World absorb modern technology?

...On the political side of it, I would say that my political assumption is that there will be no major national or civil wars, but that national pride and tribal rivalries, etc., will continue perhaps somewhat as they have in the past 10 or 20 years. This of course, will impede the rate of development. This international aspect certainly would impede the development of integrated systems among countries in that area. If the outcome is more optimistic, great, obviously.

I consider these assumptions moderately optimistic for all that, in view of the present obstacles to majority rule in South Africa, Zimbabwe, Namibia, etc. I will use, where I refer to these countries, the expected names under majority rule, Zimbabwe and Namibia. . . .

We are focusing on nine countries that are definitely less developed, and South Africa which is considered developed by most groupings. The nine countries have something on the order of 35 million people. The Republic of South Africa, about 25 million. Indicators of development are low. Agriculture is the leading single economic sector in six countries, Malawi, Mozambique, Angola, Lesotho, Swaziland, and Botswana; over 80 percent of the economically active population is engaged in agriculture in four of these countries and over half in all of them. As these facts already indicate, the dominant form of agriculture is subsistence agriculture. The level of living is very low, much lower than it is in other sectors. You can find frequent statements and statistical comparisons indi-

cating that the level of living among the rural dwellers in these countries is on the order of a third or a fourth of the national average for those same countries. Translate that in terms of how that compares with your civil servant or your industrial worker. The comparison would be unfavorable, indeed.

You have heard the term stone-age agriculture used this morning. That does dramatize — I'm not sure that it's quite stone age, but rather probably more in the norm of 18th century agriculture in western Europe. . . .

Now, these countries do have, most of them, a limited number of larger, much more commercialized farms. I found estimates of 6,000 such in Zimbabwe, 800 in Swaziland, 450 in Zambia, 3,000 in Mozambique, etc. That adds up to perhaps 20,000 plus or minus. The numbers of such are lower than they were a few years ago, mainly because some of the Europeans who formerly owned and operated them have departed. Nearly all of them were managed by Europeans. These, a few years ago and even today, produce a very large share of crops which were commercialized—20, 25, 30 percent or more.

So with the decline of that kind of farming, you have an increasing problem with respect to agriculture as a source of export earnings, and indeed, with respect to agriculture supplying the townspeople. This means that you have sizeable agricultural imports at present in some of those countries.

This division between subsistence agriculture and commercial agriculture often is referred to by development people as economic dualism. You have other forms of dualism, of course, in these economies, but it is fairly striking in agriculture. . . .

I found one source which summarized national goals for the region as 1) more broadly based participation in economic development, 2) greater equity in the distribution of economic benefits, 3) economic growth. Now that may be surprising to some of us with our middle-class Western orientation. Why are participation and equity rated equally with growth? In fact, in this case, they are listed ahead of growth. I don't have all the answers. I can't even demonstrate that this really reflects the view of the majority of people of these countries, but I submit that this may be an accurate statement.

These people have seen a lot of the fruits of the

dualistic system that I have indicated. They have observed the results of rapid growth by a few of their people, but they have observed that there have been few benefits, indeed, for the majority. They have come to doubt, therefore that growth alone, without careful attention to participation and equity will benefit many of the people. Development strategy, they may believe, is based on rapid, but narrowly based modernization, and the hypothesis that the benefits will trickle down to the majority is doubtful. That hypothesis is today in considerable disrepute.

There is a rapid rate of population growth on the order of 2.5 to 3 percent per annum in virtually all of these countries. Agricultural growth is lagging behind other sectors, so the production of food is barely ahead, sometimes not ahead, of the rate of population increase.

We should note that these countries are engaged in rapid Africanization of their managerial, executive, and technical positions. Sometimes they are forced to do this because the Europeans simply have left. In other cases, the leaders honestly desire to get these positions Africanized as rapidly as possible. But often, they bring in managers with minimum training, very minimal managerial experience. There is no doubt that some sacrifice in efficiency and loss of the rate of growth results, at least temporarily.

There has been very little agricultural research in these countries over the last decade, except that directed toward exportable crops.

You will think at this point that I have painted a very dismal picture. Certainly some of the other presentations were vastly more optimistic. I do believe that the outlook is hopeful, but at a rather moderate rate of growth.

Let me review very quickly the kind of assistance these countries are receiving at present. Then we will look at the kind of technology there may be.

Most of the economic assistance for these countries has come from Europe, specifically from the former colonial powers. Rather recently, Russia has come to provide quite a bit of assistance, particularly in Angola; and one very large project which has been financed by the People's Republic of China is a railroad in Zambia. The United States has arrived on the scene with respect to economic assistance very recently.

I tried to make an estimate, a calculation of the actual expenditures by the Agency for International Development which, of course, is the U.S. government's arm for bilateral assistance in agricultural projects. This is on the order of \$12 million this year. That's in agriculture alone. . . . Most of the agricultural assistance currently is going to three rather small countries, namely, Botswana and Swaziland and Musutu. Most of the U.S. bilateral assistance is emphasizing training and institution building, for two reasons: first, these, in the view of practically all of us, have very high priority and secondly, these are

opportunities to get started rather rapidly. Other donors also are investing rather heavily in education and in specialized training. We are trying to get cranked up for more directly impact programs; for example, the Department of Agriculture provided the manpower last year for the design of a soil conservation resource-improving program in Swaziland and another team to design a program in marketing for Botswana.

Opportunities: there is little doubt that southern Africa has the basic resources to more than feed its people for many years...fertile land, water, both for production and for energy, that in turn will provide many of the needs. There is quite a lot of that, and there are trainable people. Sometimes these resources aren't exactly distributed where the people are. Most observers believe that the greatest potential exists in Zambia, Mozambique, and Zimbabwe. For example, in Mozambique, it's estimated that two-thirds of the land may be cultivateable while only 6 percent now is cultivated.

To quickly enumerate the principal constraints: education, managerial expertise...capital. You had some very impressive numbers thrown at you by some of the panelists with respect to what may be required to raise the technology in industry and provide jobs there. Numbers for agriculture might not be quite all that large, but would be very large nevertheless. Here is one illustration. If you were to try to provide some direct help to 5 million farmers, two hectares each, at a \$1,000 improvement for development cost per hectare, that's \$10 billion, and that isn't a whole lot.

I mentioned the lack of research into technology. I have mentioned the population growth. Another factor is the variability of weather: the weather statistics of many of these places look a great deal more like West Texas than Iowa or Illinois. That is a problem.

In the political sphere, I think it's fair to ask how are you going to contain the high expectations of the masses of people? Many people probably expected virtual miracles in their state of well-being after independence. It isn't necessary to explore how that might have occurred. It happened. That is, the expectations happened, but the miracles haven't happened.

What are the possible strategies? What strategies are available? The first strategy I would term incremental growth. This is the only one which I give much of a chance, considering the various conditions, trends, and constraints. This will not please those who may visualize the technology of Iowa or Taiwan or Israel to predominate in southern Africa, let's say in the year 2000. The opposing strategy is one concentrated on smaller pockets of very high technology. That would be attractive in many ways, and particularly would have a chance of attracting foreign investment that would bring along trained manpower. Other parts of the world, Iran, Saudi Arabia, Sudan, may very well follow that course. It may be technically logical for

parts of southern Africa. I will allow you to judge whether the people and the leaders of those countries will really accept that model for long.

There are several institutional models: small farm units which may be individually owned or which may continue at least for a while under the traditional forms of tenure, or where the land really is controlled by the tribal authorities. Larger units may be communal. They may be cooperative or commercial or they may be state enterprises. Many of you know that cooperative and communal models are very popular in Africa though very little land really is handled that way today.

The point in mentioning this is that development will require not only technology but a design for the diffusion of institutional forms, and my own orientation is such that I believe that the latter may be at least as difficult, if not more difficult than the technology itself.

The strategy of the U.S. government in this situation now heavily emphasizes the needs of the poor majority. Growth is secondary in the program goals of the U.S. government. This is not just a whim of a few people. This is the result of a congressional mandate. I personally believe that there is some more flexibility under the congressional mandate to concentrate on growth than currently is the case, but be that as it may. I would point out that there is legislation before the Congress called the Humphrey-Case Bill which would considerably amend our foreign assistance structure and that includes a restatement of purpose of our bilateral programs. I think the restatement of purpose would be an improvement in some regards. . . .

Americans, individuals and institutions, have two remarkable skills to offer in this situation, I believe. One is to help out greatly in the training and the other is our skill in applied research. We understand the role of training in our U.S. agriculture. Now, granted, it may have to be amended in moving it from Iowa to Angola to Mozambique, but I think we can do that too if we really put our minds to it. We also have learned a lot about applied research. We wrote the book about applied research in agriculture. The last 100 years we have really done exceedingly well in that.

But the book we have written is a little bit in contrast with some of the things we thought we discovered a few years ago about the "Green Revolution." There came along this green revolution and we thought, oh, boy, we are going to design perfection and move it out and everybody is going to have plenty of food. We have learned some hard lessons about the great limitations of that green revolution. Now we are having to go back and commit ourselves to a vastly larger and more difficult task of applied research — that is localized — than the earlier images of the green revolution.

I believe that the route to development in most cases involves limited packages of new technology rather than an image of a quantum leap to perfection as the

green revolution implies. I recognize that I am speaking rather differently from some of the images this morning. I don't know whether the designers of this session expected that they would get a divergent view but I hope that that is constructive. My image, my strategy is of a path of agricultural development which is rather different from that for industry which was presented by Mr. Lerner.

Your prospectus mentioned a possibility termed modular growth. I doubt that this is economically and socially feasible. Agricultural production, input-supply and marketing must be fairly well integrated and consistent.

I should point out that a new assessment of the agricultural sector in southern Africa today is underway. We should expect a much improved understanding and statement of possibilities out of this assessment within a few months. The U.S. Department of Agriculture and a consortium of southeastern U.S. universities is undertaking this task as part of a broader study planned and financed by the Agency for International Development.

What are the technological implications? Can southern Africa absorb high technology in its agricultural sector? You will perceive that my answer is yes. However, my image of the rate of change may be more gradual than yours. Attempts at crash programs, I believe, are unlikely to succeed.

History also supports my view. I looked at an earlier analysis of the agricultural development process in 54 countries from 1950 to 1968. This showed that very few of these sustained rapid growth per capita. Only Israel exceeded a 4 percent rate of output growth per capita. Bulgaria, Greece, Yugoslavia, and Cyprus exceeded 3 percent per year. The rate of growth in total production exceeded 5 percent in only six countries, five of those in Latin America.

So, we better be pretty sure that we have lots better models and lots better implementation than has occurred in the last 30 years before we commit ourselves to models that are vastly more ambitious than this. Specific applications of new technology are likely to be identified and to succeed if 1) there is lots of training; 2) there is lots of applied research; 3) there is relatively high political stability, and 4) appropriate institutional forms are developed and established. I can visualize large increases in use of energy for production of fertilizer, herbicides and pesticides; irrigation; transportation and processing; cultivation, initially, tilling the soil in preparation of a better seed bed, and relieving temporary labor shortages; and finally, threshing and drying — both do relieve, again, temporary labor shortages and reduce post-harvest losses.

Most of this energy is likely to come from fossil fuels for another decade or two. Hydroelectric power, presumably and hopefully, will become more important. . . .

Uwe Parpart

The Fusion Energy Foundation held its first conference on development geared toward the Third World sector about two years ago in Chicago. In my mind, the most remarkable thing about these conferences is not so much the conferences themselves and what has been presented. Rather, in the actual study we have undertaken of these conceptions of Third World development which tend to diverge from the conceptions we have put forward, we find that the two most remarkable models of development in our own century and in the modern era generally, the development of the United States and of the Soviet Union, are either never or, if at all, only mentioned in passing, and then, as inapplicable to the kind of development which we should actually be looking forward to in the rest of the world.

What I would like to propose to you is that, rather than looking at models of failure, rather than taking statistical averages of failures of development that have occurred for a variety of reasons in various parts of the world, what would behoove us, and perhaps the most important, is to take a close look at the American model of development; at the Soviet model of development, and to try to identify why, in contrast to what occurred in the rest of the world, these models actually succeeded. Then perhaps, after we gain an understanding of what the principal elements of such development have been, we might find ways and means of looking at the remainder of the world economy, and ask ourselves, what is necessary there? What elements of these successful models would be applicable in those sectors, and to what extent can we look forward, under those conditions and on the basis of rising expectations rather than lower expectations, to actually determining a course of economic, industrial and social evolution which not only parallels but, could even begin to exceed the kind of development that we have seen with regard to what are today's two major superpowers?

This is what I want to talk to you about. I want to talk to you about the American model of development specifically, with a certain look over our shoulder at the development of the Soviet Union, especially the most ambitious development project which is underway in the world today, namely, the development of the vast semicontinent of Siberia.

I think if we look at it that way, and try to abstract and get a grasp on what occurred and what was essential to successful efforts, then we will find ways and means of breaking out of certain habits we have formed and that have been formed for us in terms of thinking about the Third World sector, which will be a very useful and positive thing indeed.

There are certain preconditions; there are certain things we have to be clear about if we want to derive certain things from what I like to call the American Model of development, from what was once an underdeveloped and in fact an undiscovered continent; the principal elements of this have been mentioned in various ways in FEF conferences.

The first point I want to make is that no successful effort at development anywhere in the world can conceivably succeed if it is based on short term expectations. That is to say, any effort to try and design a development program, or simply think about one coherently, which proceeds from a time-frame of only two, three, five years of financing could conceivably come up with anything other than necessary failure. There is a necessary correlation between financing and the actual input and focus that is chosen for development in a certain period — a necessary correlation between to what extent we expect to develop in-depth the infrastructure of a certain country, and the financing mechanisms that work hand in hand with that. Any kind of short-term financing necessarily entails attention to a labor-intensive approach, and to the existing and already partially or fully developed resources that the sector under consideration actually exhibits.

This is to say that if you actually want to look at southern Africa from the standpoint of short-term financing, you will necessarily conclude that you should do a little bit more of what we are already doing at this point, and in that way slowly develop in that mode. Under those circumstances you should not and would not expect any dramatic changes, which is implied in the very premises of that argument, and therefore not a very surprising conclusion.

On the other hand, if you focus on the idea of development as a matter of "bringing the Third World into the 21st century" it becomes clear that, indeed, the effort must be made not so much to continue

present trends of failure but in fact to do the opposite, to innovatively look for methods of reversing precisely those efforts and causes for failure with which we are at this point familiar.

In that case, we will not concentrate on labor-intensive methods and on the exploitation of raw materials which have already been developed to a certain extent, and which can be further developed through simple application of labor at a minimal skill level; we will, on the contrary, concentrate our efforts on the development of labor-power itself, and on a capital-intensive approach which is going to be successful precisely to the extent that simultaneously this attention to the labor-power problem is successful.

These are the two alternative conceptions that I think we must look at in general terms. I will also point out to you that, on the one hand, a labor-intensive approach geared toward the immediate and low-cost extraction of raw materials, has always been an element of Third World development policy, or nondevelopment policy as may be the case; and on the other hand, there has always been a policy of concentrating on what at any given point in time was the most advanced level of technological development and the finest and best type of labor-power available and educable in a given period of time.

This brings me back to what I said earlier, the question of the American Model. This country was established as a fight over which of these two models was going to be adopted. There's no question in my mind, and I think the same thing can be said with certain variations for the Soviet Union, that the actual fight of the American Revolution was over a very specific point: whether or not this country was going to be an attachment — based upon the application of cheap labor and certain extractive industries on the model of the Hudson Bay Company — an attachment to the English homeland, to the United Kingdom, or whether this country was going to make use of the very skilled labor power, the most advanced industries that had been developed in the Old World. Was this country going to apply the most advanced technologies so as to develop here a continent and a population which could carry on the very best efforts that had been made in the Old World, or was it going to be a mere attachment to what the European "homeland" or "homelands" demanded. That fight was explicit. Much of the legislation the British Parliament imposed upon the colonies of North America and others had as its principal contents this question...

As a result of the success of the American Revolution, we had, by the beginning of the 19th century and increasingly by the middle of the century, a situation which in fact is very much like what we have in most Third World sectors today — not if we look at them country by country, but if we look at them region by region. In southern Africa today, both in terms of the industrial elite in South Africa itself as

well as to a more moderate extent, but nevertheless significant from our standpoint, in the black African countries in southern Africa — there are certain elites, managerial elites, political elites and so forth, who are capable of providing leadership to an overall development effort, and who parallel, in a sense, precisely the kind of role that was played in the development of the United States by a relatively unskilled, relatively backward European labor — peasant labor in many cases. If you actually survey the U.S. situation, say in the 1830s and the 1840s, you would find that there was a tremendous influx of relatively backward peasant populations from Ireland, from Germany, from Eastern Europe and so on, and the problem that existed was how was the elite that created the American Revolution going to begin a process of assimilation of these backward masses of the population into an overall framework of development. They did it, as we know, and it showed tremendous success as the century went on, especially the second part of the 19th century, which made the United States very rapidly into one of the leading industrial nations.

That process of assimilation of a population, in precisely the kind of concentric circle fashion that the Fusion Energy Foundation's Eric Lerner has discussed in detail, and the simultaneous introduction and reliance upon the most advanced technologies that existed at any given point in time — that was the process that built this country. This is also the process the builds "rising expectations," and correctly so. This is the process that made this country unique in the sense of social mobility, in the sense of expectation of social mobility...

So the American Model is what? It is a very, very simple model indeed. It is a model of relying upon the most educated strata, the most skilled labor force, to absorb the most highly developed elements of industry and further develop that process of industrialization, while simultaneously bringing in, successively, in waves, in concentric circles fashion, a population that has the expectation precisely of moving in that fashion.

To the extent that you create and sustain that progress, precisely to that extent you have the kind of model which I think is indeed applicable everywhere in the world. I don't see any reason whatsoever why this model should be any less applicable in Africa than it is on the North American continent. I see absolutely no reason why this model should not be as applicable in Asia. In Northeast Asia it is working, why should it not be applicable in Southeast Asia? I see no reason why this model should not be applicable in the Middle East, or why it should not be applicable in South America.

That is the point that we have to uniquely concentrate on to overcome the present problems which all of the development policies that have been designed for the Third World sectors over the past 20 years have run into. If we do not make such an explicit commitment, I, in fact, see not slow growth as the

alternative at all, but I see precisely the kind of chaos at the very verge of which are now tottering, not just in southern Africa but as well, in the Middle East, as well in Southeast Asia, and so forth.

The so-called slow growth alternative for the Third World, the alternative of say, 2 percent, 5 percent growth in industrial output, in agricultural output, in energy development and so on, is to my mind no alternative at all. If we had proceeded from the standpoint of that kind of outlook in 19th century America, we would never be where we are today. In fact, we would not be anywhere near it.

The fundamental assumption has to be: We have to go as fast as we can, without building into our program any deliberate ways of retarding that process, which happens only too often.

There is one notion, one concept, which to me signifies more than anything else the wrong way of looking at the development of the Third World. This is the notion of what is called "appropriate technology." That is the notion of a technology which is "appropriate" to the *backwardness* of the population under consideration. This idea is that the way in which you have to deal with a situation is to zero in on a given level of backwardness and then design a program of essentially keeping it that way, or, if not keeping it that way, very, very slowly, on the basis of a certain "appropriate technology," getting out of that situation. That model is not workable, and has been proved time and again to be not workable.

If you look at the Soviet Union's development...you will see that the overall population structure in the Soviet Union in the 1920s certainly was not any better than the overall population structure in most Third World countries at this point in time. This is true from the standpoint of education, from the standpoint of tribalism, from the standpoint of backwardness, from the standpoint of superstition, from the standpoint of anything you can find in the Third World sector today. While we may not endorse the specific methods that were used, while we may not endorse the political content and environment in which that development occurred in every detail, one thing is absolutely clear: there was a very strong and important commitment in the Soviet Union to industrial development as the only way of bringing that most backward of European countries into the 20th century.

This is our collective task today. It is the collective task of the United States, of Western Europe, and of the Soviet Union to make an effort which is modeled not on processes which could not possibly have created these superpowers in the first place, but which has to be modeled precisely on what the positive contents of their own development were. That is what we have to transmit. That idea is what we have to give to the Third World sectors in order to make possible that we ourselves in fact have in significant measure already achieved. We are not committed to keeping our advancement in order to preserve against the Third World's onslaught — this is the wild image of

people like the existentialist Jean-Paul Sartre — the siege of the city by the countryside. This paranoid idea of what we are and what we can do, how we can look at the world, I want to reject and I want to reject it thoroughly. I want to pose in its stead a model, an idea, and a task which is based on the model of the development which we ourselves represent.

It should be understood that what I've said, in a sense, represents two different outlooks on "colonial policy." It is unfortunate that in our day and age, the term colonial policy has acquired such a bad name. The reason for that is largely because people tend to forget to prefix "British" to the term "colonial policy." If that were done, the air would clear, and we could distinguish between the idea of a colonial policy that can in fact succeed, and British colonial policy that is designed to keep entire populations in enforced backwardness.

In any case the idea I want to raise is the idea of what we for ourselves would appropriately pose by thinking about our own development. What was our situation in the 16th and 17th centuries? What were the most advanced technologies that existed and how were they applied?

When the exploration of this continent was undertaken, it was based on the most advanced technologies, in navigation, in shipbuilding, in agriculture and other things, and what those Europeans who engaged in this exploration did was to apply those technologies to found the North American colonies...

If we were going to pose a problem to ourselves today which is in line with that history, we would say, well, what is the level of technology from the standpoint of which we could conceive colonization on a similar scale? We would be talking not about the development of southern Africa, however necessary that is; we would not be talking about the development of Southeast Asia, however necessary that is. We would be talking today about the development of the solar system. We would be talking today about designing the colonization of the planet Mars. We would be talking today about designing projects that carry us into the middle of the next century, in the very same way that our not altogether crazy forefathers designed such policies and ideas in the 16th and 17th centuries.

The idea of going across the Atlantic Ocean, at that point in time, on the basis of the kind of vessels that they had, on the basis of the kind of navigation instruments that existed, on the basis of the kind of technologies that were had, I would in fact judge to be a much more risky undertaking by any stretch of the imagination than a well-designed plan on the basis of our most advanced technologies today for the future exploration and colonization of the solar system.

The reason I mention this is not in order to pose it as an alternative to the development of southern Africa. I pose this to you in order to get us out of the situation in which we look at the world from the standpoint of the apparently ever narrower confines into which we have

been squeezed, in order to look forward to a situation in which we see the development of fusion energy, the development of nuclear energy, the development of vast raw material resources on the basis of the application of these technologies. All of this should really direct our view toward what we're going to have to accomplish in the 21st century, in the way in which

our own forefathers accomplished what we are today. And from that standpoint, I think we can take another look at southern Africa, at Southeast Asia or at any other backwards place in the world and say, for heavens sake, let's get on with the business of at least bringing that situation into the kind of shape that we ourselves are in today.

Dr. William van Rensburg

Southern Africa has been cursed with the world's most complex racial problems, and blessed with vast mineral riches. South Africa has the world's largest reserves of gold, platinum, gem diamonds, manganese, chrome, fluorspar, and antimony. She also has large reserves of a number of other minerals of critical strategic and economic importance to the West.

Let me say that when I talk about reserves, I am talking about those minerals which are technically and economically exploitable now. Last year minerals to the value of nearly \$7 billion were produced in South Africa alone. Well over 50 percent of this production was exported mainly to western industrial nations. A substantial portion of the rest was processed into a variety of alloys and semi-manufactures for export. . . .

The vast mineral industry is backed by an impressive physical infrastructure, not by American standards but by Third World standards, including major railway lines and major and minor ports: For instance, it is possible with this network for Zaire to export copper to the port of East London. . . .

The railway infrastructure, the most important transport infrastructure, is much more highly developed in South Africa than in the rest of the region. Two very important new developments in this respect are the Saldanha Bay line and the Richards Bay Line up to the Johannesburg area. Two major new export channels were created in this way.

Similarly, South Africa is now building some of the largest single power stations in the world. The country has developed an integrated international power group which allows the transport of power from one part of the country to the other.

The mineral reserves: South Africa's percentages of world reserves of a number of important industrial minerals are indicated by platinum, 86 percent; chrome ore, 83 percent (I may add that if you add Rhodesia's chrome the share is 99 percent and the rest

of the world, about 1 percent, about which perhaps half is Russia); vanadium, 64 percent; gold, 49 percent.

The production percentage . . . is much higher. Unlike many other developing countries, South Africa has a highly diversified mineral industry. In fact, she produces some 52 different minerals, an enormous share of western world reserves for a number of minerals: in gold, a very large proportion; platinum, 99 percent; industrial diamonds, significant; chrome ore, 84 percent (and the rest being in Rhodesia, virtually all of it); and manganese, a very large proportion too. A few other minerals, vanadium and platinum and uranium show up pretty significant. If we look at the world situation, for South Africa and the Soviet Union, again the combined percentages are quite astonishing.

Now it is interesting to note that five countries, the USA, Canada, the USSR, Australia, and South Africa have between them more than 50 percent, at least more than 25 percent of world reserves of 16 of the 20 most important industrial minerals and more than 75 percent of 12 of those 20 most important industrial minerals. I might add that this figure was . . . based on data up to 1972. As a result of more recent discoveries, it is probably understated for a number of minerals.

So in the context of the world, then, South Africa is one of the big five, particularly as far as non-oil mineral reserves are concerned. . . .

Now, let's look at production. Again, I have used the 1975 production. South Africa's production was a large percentage of the western world production . . . it is quite significant for a number of important industrial and strategic commodities, vanadium being outstanding. Asbestos does not appear to be so large, but we should remember that South Africa is the only producer of two very important varieties of asbestos, namely, chrysotile and amosite.

Now if we look at the position of the United States,

by contrast, you have . . . at one stage, the world's largest exporter of minerals, now becoming a very important mineral importer. In fact, in 1976, the U.S. mineral balance of payments deficit amounted to \$32 billion. In other words, the United States is becoming increasingly and dangerously dependent on imported sources of minerals and it is becoming increasingly difficult to obtain reliable sources of supply of those minerals.

South Africa's rank as a world producer of some of the most important minerals is fairly high In fact, in 1977 the value of South Africa's total mineral output, despite a world recession, grew by over 23 percent.

Considering the distribution of South Africa's mineral trade in 1975, there is an interesting phenomenon If you look at the geographical location of South Africa and pretty much the same is true of the rest of the subcontinent, you will find that unlike Canada, one of the other giants, which is very close to the United States and therefore, overly dependent on the American market as a source of imports, and Australia which is overly dependent on Japan, South Africa's mineral trade is more balanced with no single area getting more than about 20 percent, that being Western Europe. What is surprising is the very small amount that the U.S. at the moment obtains from southern Africa. This, I think, will have to change in time.

Now, there is a popular misconception that the South African mineral deposits all constitute bonanzas which are there for the taking. This is utter nonsense. The deposits in southern Africa are characterized by the following features. First of all, they tend to occur in remote areas. Secondly, they tend to be large, but very low grade and highly complex minerologically, and therefore, require very complex metallurgical treatment.

So, the South African mineral industry is backed by impressive research and development facilities which have been applied not only to that particular country but to the whole region and in fact, some of these facilities have been exported worldwide.

To give you a few examples of this, in the wake of recent increases in the gold price, South Africa has now developed a technology to take out literally the last pin head out of a ton of gold ore. They are in fact, taking out of the leach liquors which contain .13 grams per ton. They are managing to recover 93 percent of that gold, at the cost one-tenth of the value. There are similar examples in the case of uranium and even in sulfide beneficiation, which means that in several instances, South Africa is today able to exploit mineral deposits in order of magnitude lower than that in any other country.

Now, the South African mineral industry also provides employment to tens of thousands of workers from South Africa and from a number of other countries on the subcontinent. Until 1976 some 78 percent of the black workers in South African mines

came from outside the country. As a result of the recent political disruptions in the subcontinent, this percentage has now dropped to 50 percent. In view of the lack of employment opportunities in most other south African countries, it is a great pity that this should have happened.

While one may argue about the morality of the system of migrant workers on the South African mines, we should not forget that a great deal has been done in recent years to improve the wages and living and working conditions of these men. It is not always appreciated, too, but the mines provide these workers with certain basic skills and offer them, in some instances, their first contact with western civilization.

It should be clear from what I have told you that southern Africa is an indispensable source of industrial and strategic minerals to a Western world that is rapidly depleting its own resources. The loss of southern Africa's minerals to the West will lead to critical shortages of some of these minerals and will affect a marked change in the balance of power. The facts speak for themselves and few resource analysts dispute this contention.

Under these circumstances common sense and self-interest should dictate a policy by the West to do everything in their power to promote the development of southern Africa's mineral resources. The benefits of such a policy will include security of supplies of a large variety of minerals, greater price stability, and improved material well-being of all the inhabitants of the subcontinent.

Certainly, such a policy should be combined with an insistence upon improved social conditions for black workers and the right for them to progress to skilled and professional jobs. Most whites in the area now accept the need for such changes and in an atmosphere of encouragement and heavy investment in the mineral industry, such changes should come about.

However, the converse is also true. In an atmosphere of threats of sanctions and even invasions as I have heard, there will be a hardening of attitudes and I'm afraid social and economic progress will fall by the wayside. Now, we might ask when confronted by such a policy that calls for an embargo on investment in and trade with South Africa, does it improve the standards of living of the blacks? Does it improve the security of the West? Does it promote improved political dispensations in South Africa? Of course not!

Mr. Chairman, I'm not a politician; however, I'm convinced that the best atmosphere for solving the human and political problems of southern Africa is one of greater affluence. The logical way to create wealth in this region is to develop its great natural resources and in so doing, creating jobs for people and providing raw materials and processed products to the west.

In the accelerated development of the mineral industries of southern Africa, our first concern should

be to provide jobs for people. This does not mean that the mineral industry should be primitive or completely labor intensive. Many of these industries are highly sophisticated already. Advanced technology should be applied whenever this is the most profitable manner of doing the job.

In a world where adequate supplies of energy is a problem at the moment, every conceivable source of energy should be tapped. The political leaders of the west should take a long hard look at southern Africa and at their own interests in the area. If they do so honestly, they will find that the only rational policy is a commitment to develop with the emphasis on the natural resources of the area.

Finally, I would like to show you a picture that kind

of frightens me considering the flow of oil in 1965 and the . . . flow of oil that is shipped by sea in 1975, something that is not commonly appreciated is the fact that the southern tip of Africa represents a defacto strait. The tankers have to hug the shoreline because if they go as far south as Cape Agulhas, they reach the "roaring forties" in which no tanker can survive. So you can see that apart from the mineral resources of the area, it is of critical strategic importance to the West . . . to secure that Cape searoute.

Now, there is a counter argument today which says that of course, we could open the Suez Canal and there is the Sumed pipeline. I would think that all those are equally vulnerable in times of conflict.

Dr. Morris Levitt

What is often swept under the rug in discussions of energy are two things. One will be addressed, I think in the next panel. I will only touch on it. It's absolutely idiotic to talk about energy policy for the United States as if all you have to take into account is our own domestic needs — as if you can pile up the right number of BTU's of any type, without considering such questions as our export capabilities, especially in the nuclear area, or how much we are devoting to research and development for more advanced resources.

The far larger general question, however, is something implicit in what Professor Van Rensberg just indicated. We are increasingly having to access lower and lower grade ores. The total amount of material that will be required to launch us into a situation where we will have an essentially unlimited resource base available to us, as we move beyond the earth, is going to require tremendous amounts of energy.

Therefore, the critical question involved in both energy policy and in dealing with the proposals that have been made here, is how do we ensure that we have the total mix of resources of old and new types that will be required to continue this process of development?

It's at that point that you immediately encounter the question of the unique quantitative and qualitative features of fusion energy

The criteria, a very simple criteria for energy appropriate to meeting the needs of all humanity . . . was spelled out on one occasion by the

leading Soviet physicist, Peter Kapitsa, and we have developed it in a number of more elaborated contexts. The simplest rule of thumb is what is the density and rate of energy through-put that you can produce through any energy source. How much per unit time, per unit area? If you don't have the developing energy technology which generally tends in the direction of increasing flux density, you are automatically, sooner or later, locking yourself into a fixed resource base and all the horrors that has always meant for humanity.

Fusion power, contrarily, involves not only expansion of the total energy supply in amounts equivalent to millions of years worth of use at thousands of times the present rate of use, but more importantly — and this is a factor that's usually not sufficiently stressed — it can mean an increase by factors of thousands . . . in the density and intensity of the energy output. This means that all of the resources just indicated and those we have not yet explored, with more advanced technologies for locating mineral deposits, can be accessed successfully so that the earth then becomes not only a flourishing garden in its own right, but a tremendous launching pad for humanity

That's why the Fusion Energy Foundation is holding this conference. That's why the Fusion Energy Foundation now presents as one of the key focal points of our program today, a report on the concepts, status, and prospects in the future for fusion power. Dr. Krause's presence here reminds me that we generally must have a good hard-core agriculturist in every

program because no matter what they say, they are for development down to their toes.

Let me say one or two more things about some things we have recently learned about the status of the fusion program, and how you can grab hold of certain handles on the world's strategic situation. It's useful to keep in mind that something like 99 percent of the resources in military R & D go into nuclear and aerospace-related areas, which means that the United States and the Soviet Union have extraordinary capabilities in precisely those areas that have marked bones of technological and strategic contention. One can only imagine what sort of situation we would be moving into if those capabilities were *coupled*, in a fashion geared to make possible the sort of development program we have looked at today. In fact, we have proposed this in a policy paper issued by the Foundation, entitled "From Detente to Entente."

There is a concrete expression of that . . . Within the last few weeks the leader of the Soviet fusion program, Dr. Velikhov, who is also one of the leading directors of Soviet science, put forward a proposal through private channels in the U.S. on his recent visit, that the United States and the Soviet Union as they move into the last stage of development of prototype fusion reactors, do this jointly in a third country. This is the quintessence of the motivation of the earlier Eisenhower "Atoms for Peace" Program which electrified the world in the mid-1950's, and unfortunately, only realized a small fraction of its potential.

That's one critical dimension to keep in mind. The second is that we are advised that the outside board of review of the fusion program, the Fusion Review Committee, headed by John Foster, who was the Vice President for Energy Systems of TRW, Inc., the former head of research and engineering for the Pentagon, is about to issue a review of the fusion program in this country which will indicate that by any criterion, the investment and full support of the fusion effort is justified in the sense that we can guarantee that we will be able to produce commercial fusion reactors in this century. This, unfortunately, stands in contrast to the present budget levels under Secretary of Energy Schlesinger, which by the only benchmarks provided by the Department of Energy indicate that we are roughly in a regime called Logic I, in which you perhaps never reach commercial fusion power.

So, I would have you keep in mind, within the constellation of factors for the criterion for energy — future world energy needs — the fact that without a commitment now, bringing fusion on-line roundabout the end of this century, you cannot talk about rationally allocating existing resources. Bear in mind the strategic interface with the Soviets and the potentialities for a breakthrough well beyond the prophylactic measures of the SALT talks. Bear in mind the prospects indicated by every independent scientific body that has reviewed fusion and the present sorry state of its funding.

Dr. William Ellis

This is a serious matter — fusion energy development. I used to live in England, and one of my favorite people there was Christopher Wren, who as you may know, designed and built St. Paul's Cathedral in London. There's a very beautiful memorial inscribed above his tomb in that church, and it says, "If you seek His monument, look about you." And in a way, fusion is like that

Fusion power, as I think everyone here knows, is the energy which runs the universe Look about you. Walk outside. You have the sunlight on you; or, if you like, walk outside on a clear night and view the billions of fusion reactors that are in the sky.

Mankind began its search for fusion power about 26 years ago, in 1952. We have come a long way since then. For the first six years of the research program, the United States, the United Kingdom, and the Soviet Union all conducted more or less simultaneous programs in secret. In 1958, it was realized that the fusion energy problem was extremely difficult and had at the most, only very peripheral connections with weapons technology. As a result, at the Geneva Conference in 1958, the program was declassified and that began essentially an era of international research and cooperation in fusion which I would like to try to summarize for you today.

Our goal in the program is the production of useful fusion power at the earliest possible time Literally, we believe that fusion could provide all the world's electrical power needs, essentially without limit. We believe that this will be the first application of fusion energy. It has been extensively analyzed . . . and we believe that it survives competitive costing.

There are other things that one can imagine doing with fusion energy. For example, one can use the waste heat as process heat for industrial applications. One can use the neutrons from a fusion source to initiate essentially neutron chemistry and generate synthetic fuels which could replace fossil fuels, such as gasoline, which we use in our cars. The fusion reactor core would be a very useful thing to have as fissile fuel to be used in a fission economy

What is fusion? Fusion is a nuclear reaction which occurs between, in principle, any two nuclei (figure 1). We have focussed our consideration on light isotopes of hydrogen, mainly deuterium and tritium. These

nuclei, if brought close enough together to overcome the electrostatic repulsive force, fuse; the reaction products are helium or an alpha particle, and an energetic neutron which carries a great deal of energy outside of the reacting volume. When you add up the pieces which are the reaction products, namely, the helium and the neutron, and compare them with the fuel, you find that the reaction products weigh less than what you started with, according to the famous Einstein relation. That energy is available in principle for conversion to useful output.

What is plasma physics? Plasma is a collection of electrically charged particles, ions and electrons, which are generated by heating a gas to very high temperatures so that the electrons are stripped from the nuclei of the ions by collisions (figure 2). The result is basically an electrically conducting gas.

This has good parts and bad parts. The bad part is that the particle energies are so high for fusion — on the order of 10 to 100 million degrees and the particle velocities are very high. Imagine a heat and particle velocity that measures the same thing and therefore, the time required for an assembly of plasma particles to be disassembled, left to themselves, is very, very short. In fact, it's too short to be useful. Therefore, the gas must be confined.

The good thing about plasma is that it's electrically conducting and therefore, in principle, you can exert a magnetic force on it just like you can on any electrical conductor. A familiar example is the rotary electric motor whereby the correct choice of magnetic fields, the correct choice of currents can make a thing spin around. You do the same sort of thing to . . . plasma. You can take a magnetic bottle and hold the plasma.

There are many magnetic bottles and . . . magnetic confinement geometries that are used; I'll refer briefly to some of these approaches. You can do several things with a magnetic field. You can twist it around into a circle, a donut or a torus. The leading machine for this is a so-called Tokamak

The Tokamak machine . . . is a donut-shaped machine. There a number of variants in the world. The Russians invented one of them. It's also the leading geometry in use in the United States. The basic idea is that the magnetic field lines go around like lines on the inside of a donut (figure 3). The

plasma particles have a difficult time moving across this magnetic field

The basic idea is to make the magnetic field strong with two ends of a cylinder, so the plasma particles spiraling along field lines seem to bounce back and forth between the high field regions. It works fairly well and is probably the second largest area of emphasis in the world. It certainly is in this country.

There are a number of fast pinch devices which are superficially similar to Tokamaks (figure 4) There is a separately administered program in the Department of Energy called inertial fusion or laser fusion. This type also attempts to have the fusion event take place *so fast* that the particles cannot fly apart due to their own thermal motion. They don't use magnetic fields very much and the schematic (figure 4) shows a laser shining on and blowing up a small fuel pellet.

How do you get energy out of a fusion reactor? You make a core of plasma, and heat it up to an appropriate temperature which is between 10 and 100

million degrees (figure 5). You surround the core with a vacuum and in the vacuum you have a magnetic field to keep the plasma from bombarding the walls, which would not do the walls any good, and would cool the plasma down. On the outside, a moderating medium is required which means something that slows neutrons down by collisions so they stop combining which occurs in the vacuum blanket; they give up their energy in the form of heat; in the end, you are going to cool them, to make hot water or steam and steamroom generators as shown (figure 6) This figure shows a heat exchanger system that takes the heat outwards. This requires a turbine to run a generator, and the generator makes electrical power. The right side of the figure looks much like the output part of a conventional fossil fuel power plant. What fusion must do is generate a fusion reactor core, which requires producing sufficiently high densities of plasma, sufficiently high levels of particles per unit volume, with a sufficient temperature in a suitable fuel for a long enough time, that when those reactions

Figure 1

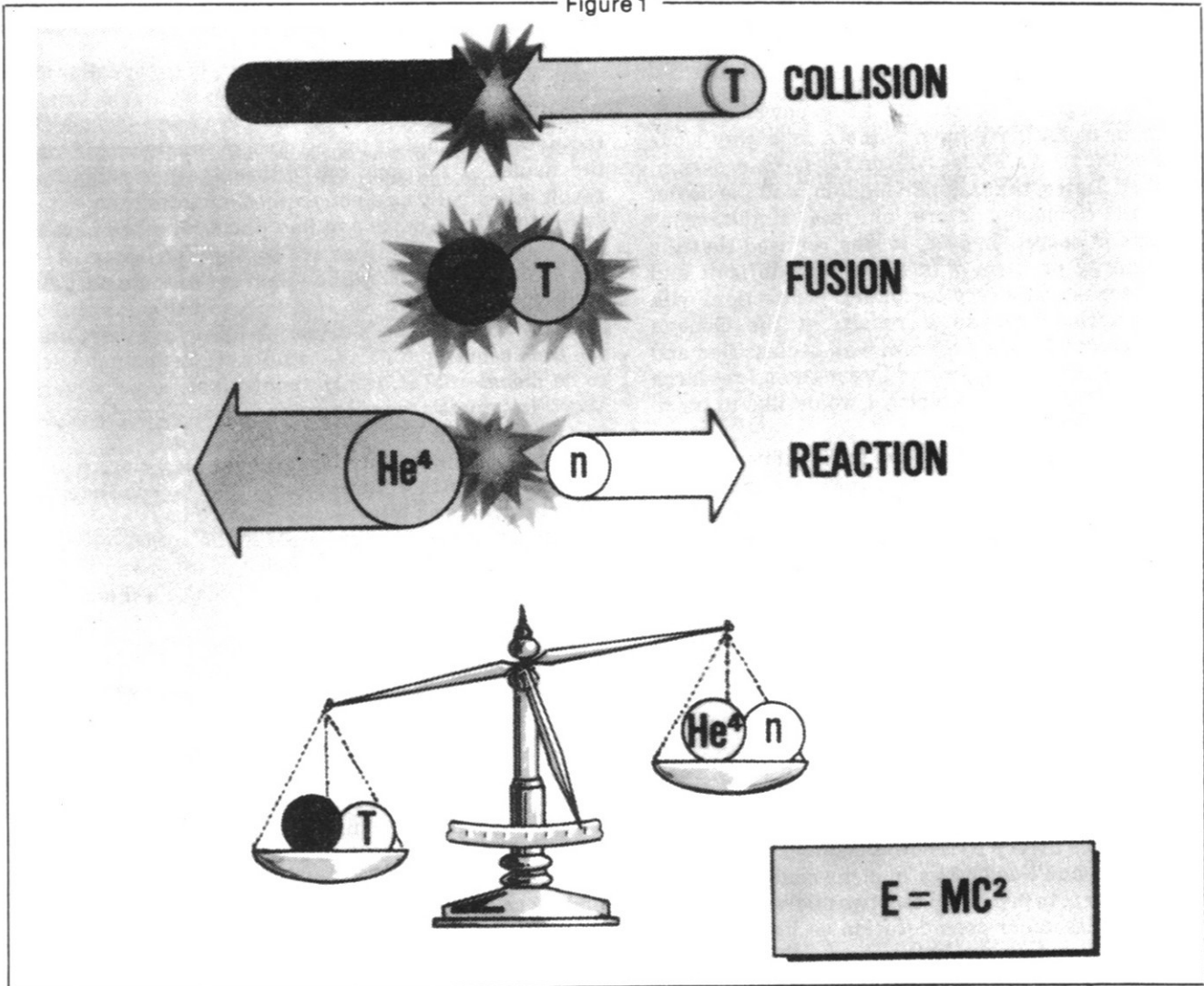
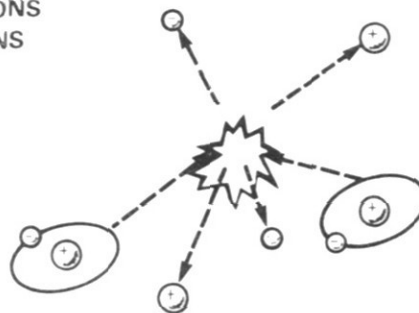


Figure 2

WHAT IS PLASMA?

III Fundamentals of Fusion

● WHEN A GAS IS VERY HOT COLLISIONS BETWEEN ATOMS TEAR OFF ELECTRONS

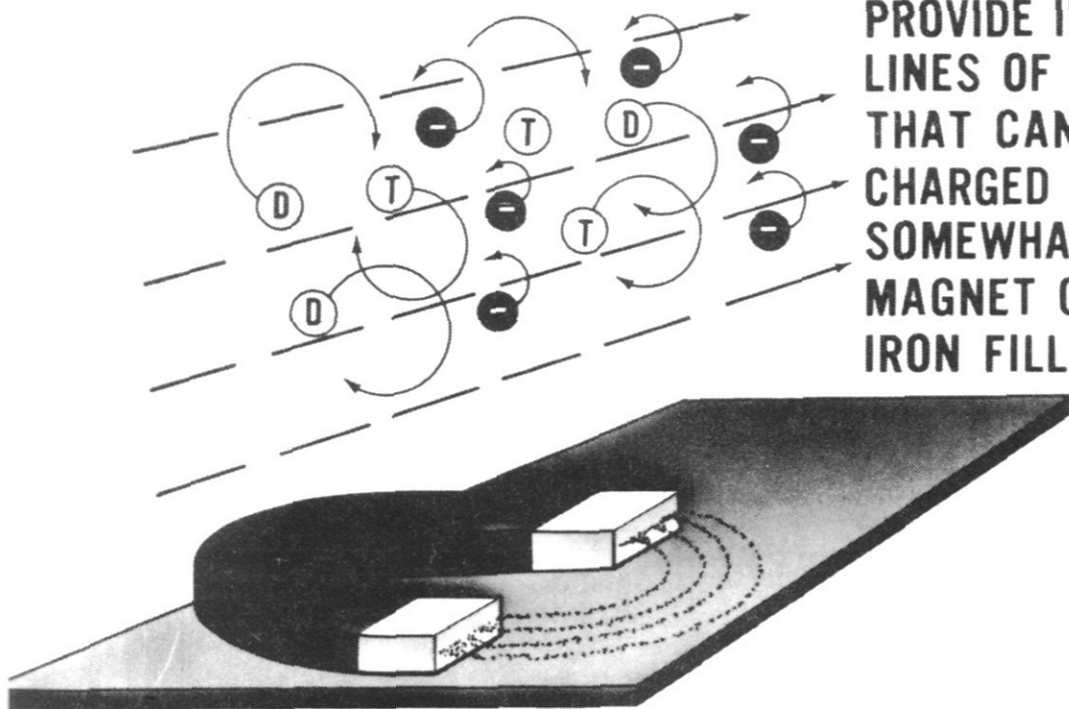


● THE RESULT IS A PLASMA, A GAS-LIKE MIXTURE OF IONS AND ELECTRONS

● A PLASMA TENDS TO EXPAND LIKE ANY GAS. IF ALLOWED TO TOUCH A WALL, IT WILL COOL QUICKLY AND REVERT BACK TO A GAS

Figure 3

MAGNETIC FIELDS PROVIDE INVISIBLE LINES OF FORCE THAT CAN HOLD CHARGED PARTICLES SOMEWHAT LIKE A MAGNET CAN HOLD IRON FILLINGS



occur you get more power out than you put in. At the moment, we are very close to achieving such a net energy gain in these systems.

What are the advantages of fusion? First, there's no shortage of the fuel required. EPA reactors would run basically off deuterium which is available chiefly through water, and lithium, which is used in the blanket to absorb the neutron energy to produce tritium, so that the fusion reactor is then a "breeder" — which creates its own fuel. Fuel is thus easily obtained and is widely available. It's available to all countries. There is no combustion waste because there is no combustion in the usual sense.

There are also reduced radioactivity problems compared to certain versions of fission reactors. There is a reduced accident potential in the sense that a fusion reactor is incapable of "running away" in the usual sense of the word. There is no inherent fissile material production, although it can be arranged for, if it is a desired commodity. These advantages of a technical nature allow one to site fusion reactors in places where you might be able to use the product, for

example, under cities. Finally, it is claimed that there are reduced mining, milling and transportation costs for fusion compared to some other competitive system.

There are some disadvantages. It is a difficult long-term research and development program, and an expensive program. There are still significant radiological problems, although the problems, in our view, are orders of magnitude lower than those of most fission fuel cycles. The economic viability is a matter still under discussion, although I believe it is viable or I wouldn't be working on it.

The four major fusion programs may be thought of in terms of blocs — the U.S., Western Europe, the Soviet Union and Japan. The Japanese program has substantially grown and is now, believe it or not, becoming competitive with the U.S. in terms of manpower. They have been revving up their program for some time, and it is growing by leaps and bounds.

The USSR cooperative program was formally established about four years ago via the Nixon-Brezhnev accords. We have an active exchange

Figure 4

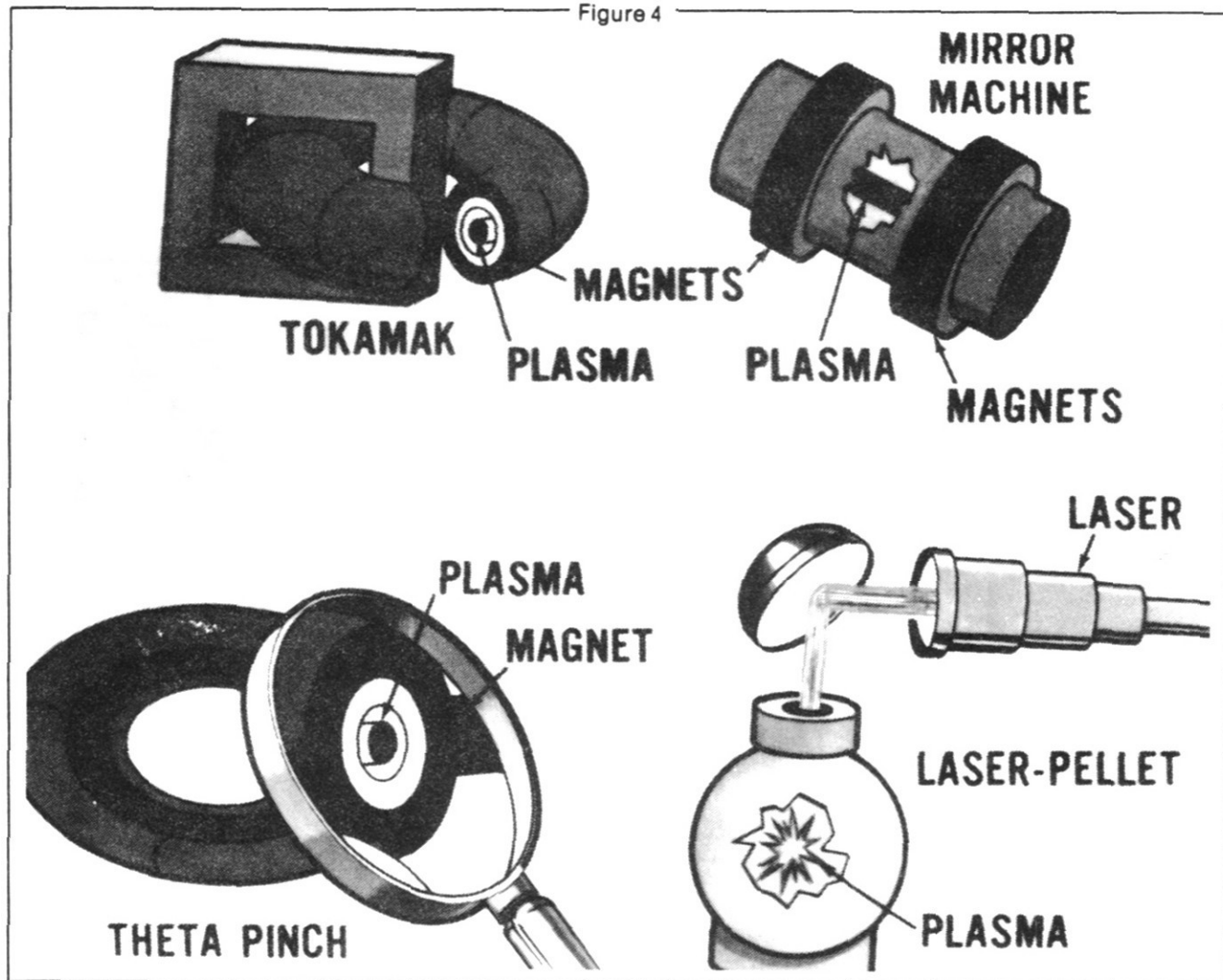
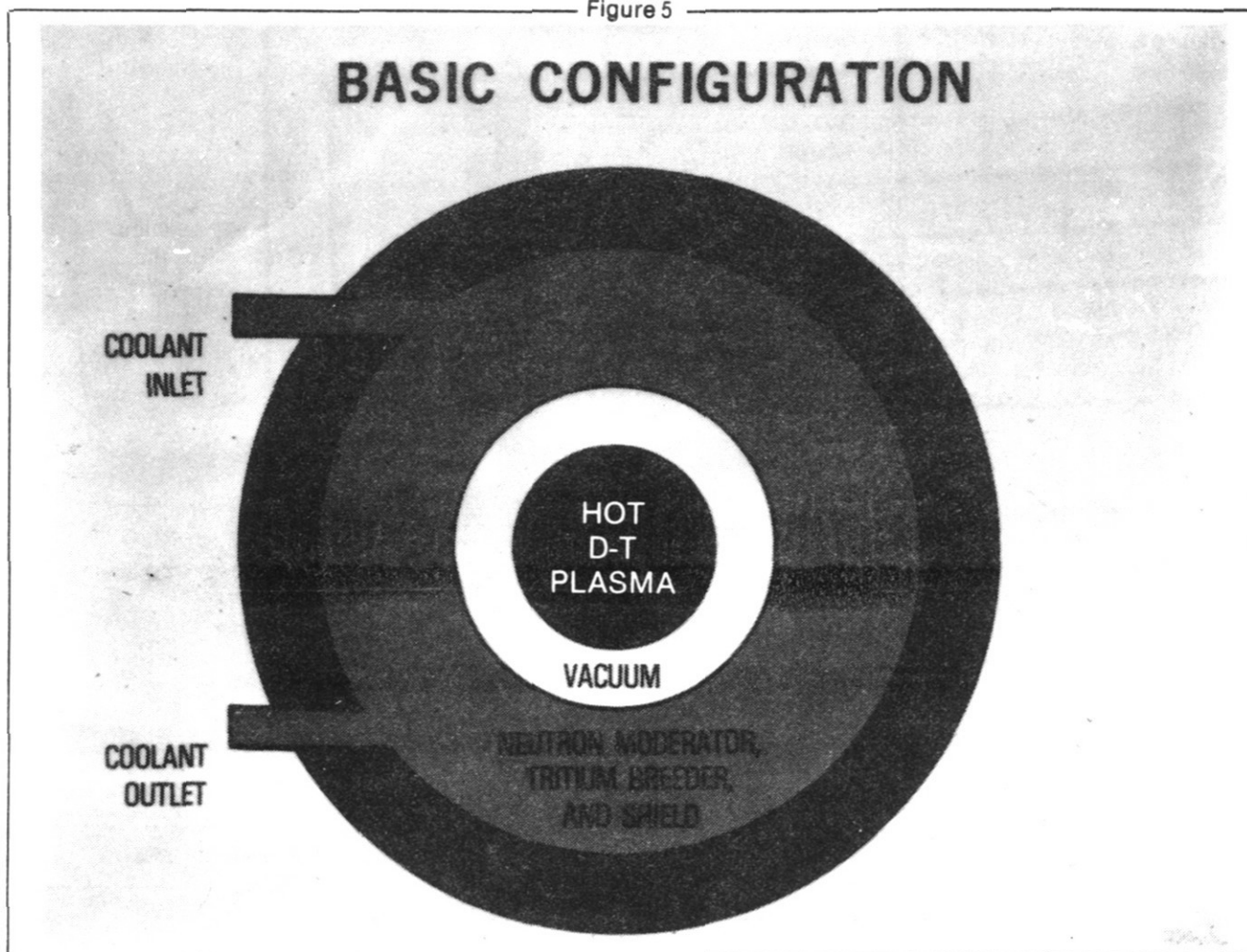


Figure 5



program; I myself am slated to go back to the Soviet Union for a week's visit this September. The last time I was there was three years ago. A number of U.S. scientists and managers go back and forth, so we get to know each other, we get to pick one another's brains, and to get complementary research efforts going, we hope.

The major fusion contractors in the U.S. are the Oak Ridge National Laboratory, Los Alamos Scientific Laboratory, the Lawrence Livermore Laboratory, and the Princeton Plasma-Physics Laboratory.

We also involve a considerable number of universities in our programs, for two important reasons. One is that there is a type of research which is better carried out at universities than it is at the large national research centers — small investigations which cut much more deeply than is sometimes possible in the mission-oriented national laboratory programs. A key point, that we use the universities for, is their source of trained manpower. Attending the Plasma-Physics Division meetings at the American Physics Society every November, you will see thousands of papers given; most of these people have grown up in university fusion programs. . . .

The U.S. program turns out about 200 Ph.D.'s a year in the field of plasma-physics. The internal logic of the magnetic feeding program as we manage it is basically the following: To develop the scientific knowledge needed for the creation and control of plasma on a basis sufficiently broad to obtain fusion power. The primary avenue to do this is the Toroidal Confinement Systems in which the dominant geometry is Tokamaks. A secondary avenue is the open confinement systems, the largest effort there being in the magnetic mirror machines. The second main point is to bring along technological development at a sufficient level that the fusion machines will have the technology they need to operate — so that we can get proper direction for the physics efforts while seeing the end goal and what a fusion reactor will look like. . . .

There are several things needed. One is an ion temperature between 10 and 100 million degrees. . . . The point that we have now reached is somewhere over a kilo-volt, about 10 million degrees. The Doublet III machine and the TFTR, or Tokamak Fusion Test Reactor at Princeton, are both machines aimed at achieving reactor-level ion temperatures in the next

that they have obtained. The dark points shown for fusion devices represent points we have obtained in the magnetic fusion area. The dotted lines and error bars represent our guesses as to where the next generation of machines is going. You will notice that TFTR, the Tokamak Fusion Test Reactor, is up at energy break-even and the Mirror Fusion Test Facility, which is the second largest fusion machine in this country, has got an energy gain of about 10 percent.

The TFTR at Princeton is a machine which is going to cost roughly \$250 million. It is the first machine in the world designed to burn deuterium and tritium, rather than do the experiments in deuterium alone, and try to extrapolate results to tritium. We really don't like to use tritium, first of all because it's very expensive, but more importantly, it's radioactive. It's not particularly a biological hazard but if you have ever worked at a national laboratory, as soon as you start carrying tritium around in bottles, the safety engineers descend on the experiments to the point where work ceases. The Princeton facility is considered to be a break-through in a number of ways. . . .

The so-called toroidal field coils around the outside. A neutral beam injector, which is basically a charged particle accelerator which accelerates fuel ions up to very high energies, neutralizes them and roars them down in a vacuated tube to impact on the plasma. The neutral particles can cross the magnetic field without hindrance whereas the charged particles can't. It runs into the plasma, the neutral beam dissociated it therefore replenishes or refuels the machine and it also provides a heat-in click to keep the temperature up, facing the problem of radiation losses and transferal losses from the plasma. This is the biggest Tokamak being built and as I mentioned, the first that will actually burn D-T. It's goal is to demonstrate D-T burning and also to demonstrate energy break-even.

A word about magnetic mirrors: magnetic mirrors can be thought of as a tube of magnetic flux with a high field at each end which looks like a pinched-in place. Real magnetic mirrors are a little bit more complicated than that, although the principle is exactly the same. In the minimum beam mirror of the type they developed at Livermore, the magnetic field coil that sets up the magnetic field, looks like the seam

Figure 8

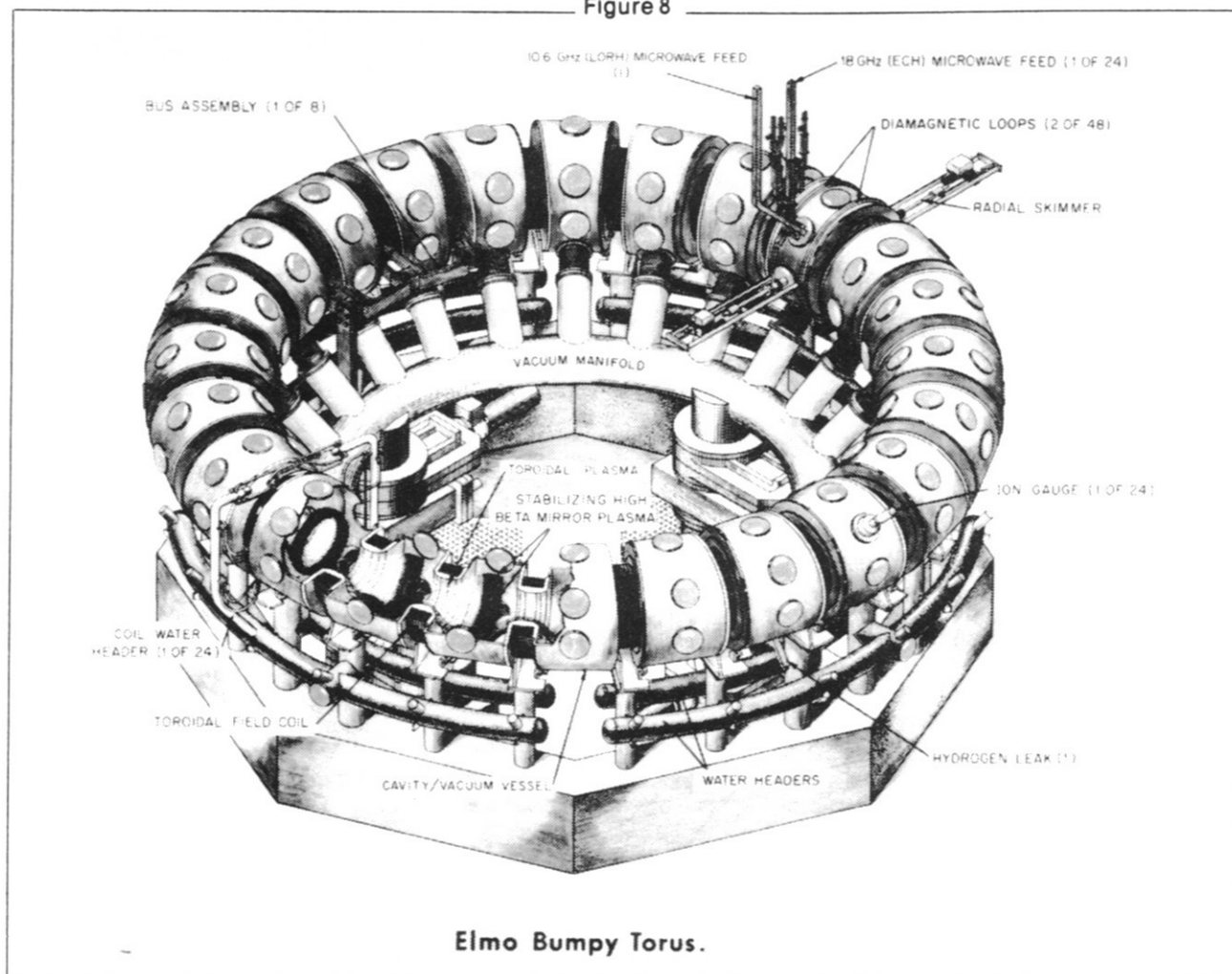
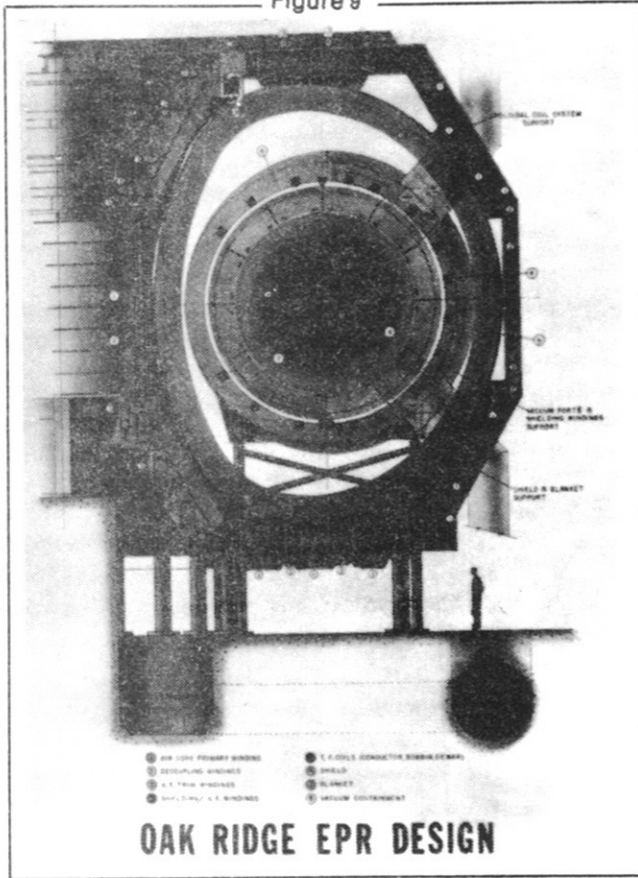


Figure 9



OAK RIDGE EPR DESIGN

on a baseball, and so it's called the baseball coil. The plasma that's inside is a funny-looking twisted bow-tie shape which has the interesting property that the magnetic field curves away from the plasma surface in every direction; and that is good for making possible stable plasma confinement. These machines come closer to what is called classical confinement of plasma than any machines yet in the world.

These instruments can be quite big. In the MFTF device, which is the largest of these machines we are building, the distance from floor to throat in this machine is about 10 feet, so that's a pretty good size hunk of hot plasma It will run at a very high temperature and in this case well over 100 million degrees. The projected results are that we will establish the limits of confinement time for the beam system. It will help us prove scaling laws which are functions of size of machine and will provide a data base for comparison to tokamaks — which should tell which machine would extrapolate best to a reactor. We hope to begin operation of this machine in 1981, just about the same time the TFTR will come on line. This machine will not burn tritium.

Figure 8 is an interesting device called the Elmo Bumpy Torus. It is operated at Oak Ridge. It's an interesting hybrid between Mirrors and Tokamaks. It is in a circle so that it doesn't have the problems of open-ended machines, but it is a series of mirror cells all connected together. Since the mirrors have trouble

with energy beams because particles and images are lost out of the unit, the idea here is to put a whole series of mirror cells together so that each one of them squirts its particle into the next cell, so that nothing ever gets lost.

We have a program called the Large Coil Project which has been done with international participation, specifically with Western Europe to deliver some coils. This is also done at Oak Ridge. The idea is to cast a six-coil, super-conducting toroidal magnet system — that is, a Tokamak without any plasma. It's slated to begin operation in 1982.

Another technology program is the Tritium System Test Assembly — TSTA. This is located at Los Alamos. It may be regarded as a Tokamak reactor without the Tokamak. It has the fuel processing facility, tritium separation, tritium storage, tritium injection, etc., but there's no Tokamak there to squirt into. The idea is that technology on magnets and fuel-handling would be developed separately, and then you marry it to the machine so as not to overcomplicate the research program. The objectives are to demonstrate an integrated steady state tritium processing and containment facility in the near term.

Going a little further than the present experiments to the realm of reactor design, we don't know precisely at this time how to go out and build a fusion reactor although we think we could take a pretty good cut at it. Still, there are a lot of things to be learned. However, this is how Oak Ridge thinks that an experimental power reactor would look (figure 9). There is the standard man. You can see that the plasma is several times his dimension. The magnet coil is the oblong thing This is a Tokamak, and it's donut shaped.

Figure 10 is a tandem mirror reactor design. The tandem mirror is considered to be a very efficient candidate for a fusion reactor. It has a standard minimum B cell at each end of a long solenoid, and it turns out that the plasma has a devil of a time getting passed through those mirrors located at the ends and therefore tends to stay bottled up in the center section which is the simplest of all possible geometries. It's uniform, it's straight. It's low-field strength. The high technology is at the ends where you have high energy beams and high field magnets. But it's all down at the end and it's figured that one can, in fact, keep tritium out of that part of the system probably so that the neutron radiation is minimized. Basically, it's a long, straight system with a pair of mirror plumbing at the ends. It would be about the size of any other power plant. I used to live a few hundred miles from the Four Corners Power Plant in New Mexico. It's very, very big. This is the size of a tractor-trailer truck, for example.

I would just like to touch a few of the issues which tend to dominate our thinking and program and this will have to be less than an in-depth discussion, but the issues I would like to bring to your attention are the pace of the program by which I mean, how fast should

it be funded? What is pacing it at the moment? What is the cost of developing fusion power? What is the proper balance between the various approaches to fusion; between the 1950s program versus the technology program; between Tokomaks versus mirrors; between those leading candidates, versus the smaller things; the national labs versus the universities; the U.S. effort versus foriegn, etc; the number of balancing acts that have to be performed in maintaining this program?

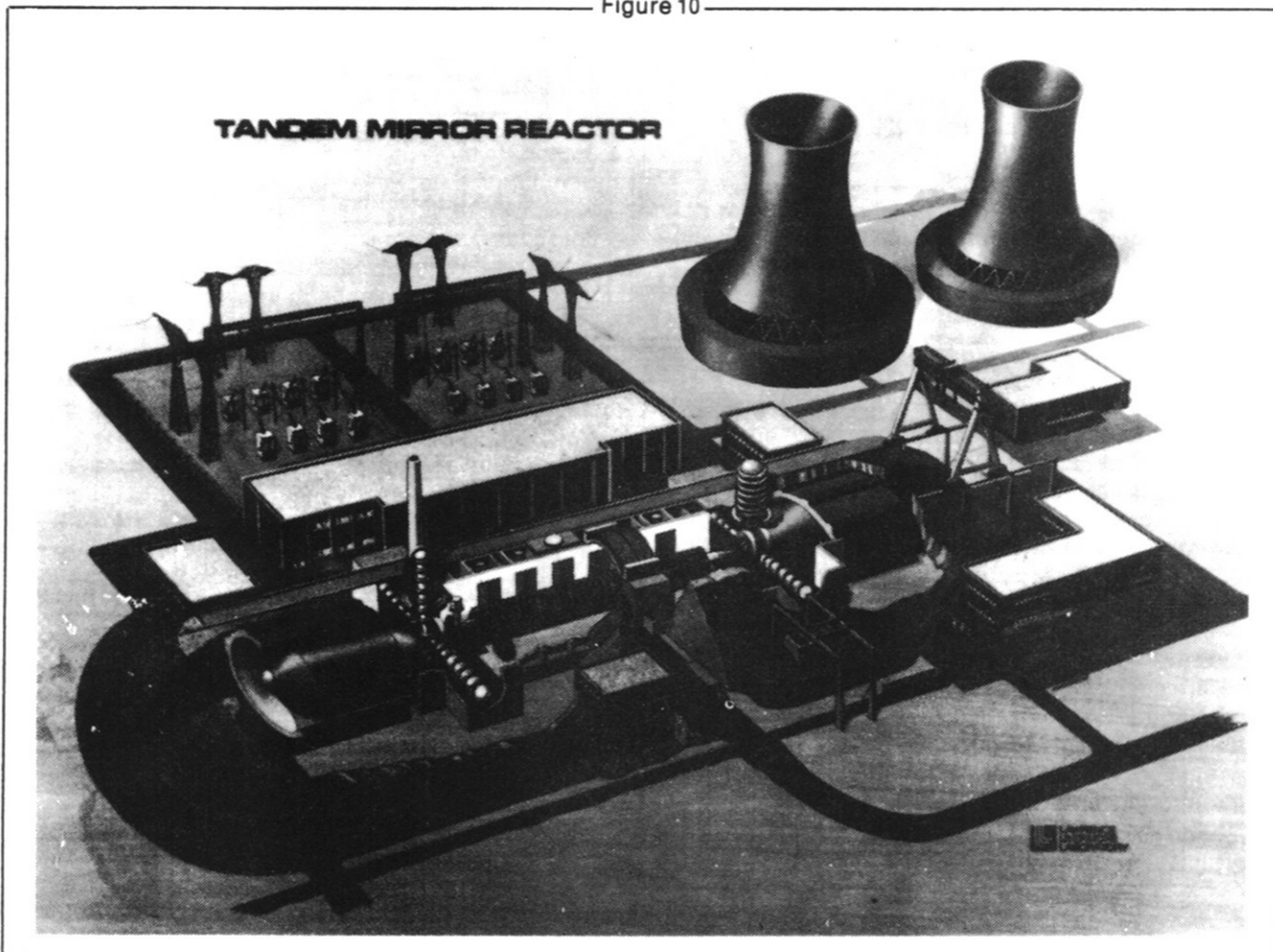
There are, first of all, problems of obtaining adequate support. Three things have been listed here: 1) Fusion is perceived as an expensive program, a long-term, high technology, high-risk program by the people responsible for city, national energy policy. 2) National policy has recently increasingly emphasized shorter-term energy solutions and a word we have heard before — “appropriate” technologies. 3) Fusion is in a position of having no powerful motivating factors of an institutional nature. We lack a patron. National defense cannot be invoked. The glamour of landing a man on the moon cannot be invoked. Industry does not regard fusion as a high profit area to move into at the moment. The scientific community, I think, regards fusion as an interesting physics

problem. So far, the scientific community as a whole across this country does not mobilize behind fuison in the way which I think the program could use. So those are some of the problems in obtaining what one could regard as adequate support — that is, not funding as it is now, but funding to go as fast as we can.

Program costs: We don't know exactly what fusion power will cost to develop but our guess is that it will cost in the \$ billion range. This number might be compared to the annual cost of energy in this country. When one adds up the charges for electricity, gasoline, for coal, etc, the number is in the hundreds of billions of dollars annually. We believe that this estimate is reasonably accurate. We have foreseen several steps in the program to reach a demonstration reactor and these have been incorporated into this estimate. This estimate does not seem to be irrational in view of the comparable costs for space, or for fission energy or other things one can think of — military assistance, being one.

It will become apparent that the rate of increase is not linear. Program has been held at basically less than the cost of living increase for the last couple of years. This is a matter which lies at the core of the question of what the pace of the program should be.

Figure 10



Should it be limited by technical factors? The program should go as fast as technology will permit. Although we don't kid ourselves that there are serious technical problems to be overcome, we think they are certainly solvable. Or should it be limited by other considerations of a political or other nature?

This brings us to a discussion of what the program pace should be. What is the need for an inexhaustible new base energy resource? Is the energy crisis real or is it not real? Without going into answers, the question ought to be considered, is there an identifiable need for an inexhaustible energy resource? Second, what is the potential of fusion to satisfy the need for such an inexhaustible source? The technology of the program seeks heavily into that consideration. Third, what progress has been made in fusion since its beginning? Have we run across anything that we would regard as a fatal flaw? What can you learn from the past that might help you extrapolating into the future? Do we have the management teams and the skilled individuals and the techniques in place to speed up the

program or what would be the limit to how fast we could speed it up? What are the international implications of success or failure?

We don't know whether fusion is going to work, absolutely. Certainly, I believe that it will, but even more importantly, it's my belief that it's important that the world know whether or not fusion is going to be available to it. The need for a sound technical basis for energy policy decisions basically addresses the point that no action is a decision, or, to put it another way, energy policy decisions are made all the time. They are made every time allocations of funds are made in the agency. The question is are decisions on whether to promote fusion or to slow it down going to be made on the basis of a technical information data base or are they going to be made on other grounds. The decisions will be made and they are being made today. If the program were funded to allow it to go at its — what you might call its natural pace, as fast as it can go — we believe that a demonstration reactor could be operated in the 1990s.

A QUESTION

I realize that your talk had to be of a general nature, but when you said you still weren't sure it was going to work . . . I tried to get a handle on that and the one that comes to my mind is that you are still not sure whether the energy requirements for creating plasma would be greater than the power output. Is that the general problem?

Dr. Ellis

I don't want to leave you with the wrong impression. I personally believe it's going to work. What I said is that I am unable to stand up and guarantee to this audience or to any audience that fusion power is absolutely going to be a reality by this, that or any other year. There are still uncertainties . . . Now, I believe that basically fusion has put the scientific data base in place over the last 25 years and that we are sort of an epsilon away now from achieving a demonstration of scientific breakeven. I believe this could be done with the FDR device, it could be done with other fusion machines, Soviet machines, European machines, and Japanese machines.

The question of economic feasibility is something else again because that requires not only a net energy

output from the plant, but that it must be attractive economically for people to buy it. A lot of people spend time making estimates as to what fusion would cost. Now, our own thinking at the moment is that the main cost of the fusion plant will be the capitalization costs. The fuel costs will not be the dominant factor. If that's the case then our present estimates in present dollars of a few thousand dollars per kilowatt are correct. At the present time, they are a few times higher than fossil fuels are and one has to use some judgment as to whether that would be a viable system 10 years from now or 20 years from now when the fossil costs are almost certain to be higher.

In that sense, it's a little uncertain as to whether fusion is a panacea for energy problems. I think you have to develop these systems to understand what the technical problems are and then run a demonstration plant, see what it costs, and then you look at it and see if you want to buy it.

This is my own view of what ought to be done with the breeder reactor, too. I think that there are two entirely different concepts of filling the world with breeder reactors and building a breeder reactor so you find out what the problems are and what it would cost.

Financing Development

PANEL III

David Shapiro is a delegate representing the 42nd Legislative District in Baltimore, Md. Mr. Shapiro serves on the Economic Matters Committee in the Maryland House of Delegates. Recently he co-sponsored a Maryland memorial bill (HJR 95) calling for the re-chartering of the United States Export Import Bank with an increased funding base. The bill passed the Maryland Legislature in April and is expected to be signed by Maryland Governor Blair and forwarded to President Carter.

Warren Hamerman, National Executive Committee of the U.S. Labor Party, is widely recognized as a leading authority on U.S. economic policy, and has addressed leading U.S. politicians, industrialists, and banking interests, outlining programs for high-technology industrial development. He is most recently the author of *Report to the Congress on U.S. Export Policy: A Proposal to Expand the Export-Import Bank*.

Lic. Carlos Romero Barrera, General Office of Technical Affairs of the Mexican Ministry of Foreign Relations. Lic. Barrera is a specialist in international law and holds a professorship at the Ibero-american University in Mexico City.

Dr. Hany Makhlof, who addressed the conference on behalf of the League of Arab States, is an associate of Business and International Management at the University of the District of Columbia's School of Business. After receiving his Bachelor's degree at the American University in Cairo, Dr. Makhlof came to the U.S. in 1964 where he received his Doctoral degree in International Business at the American University in Washington, D.C. Dr. Makhlof also taught at George Washington University and was a research associate in the Foreign Area Studies division at the American University, where he co-authored the *Area Handbook for Morocco* published in 1972.



David Shapiro

... The question comes as to what we need to do as responsible individuals in making policy decisions. Obviously, there is no one solution to conquer all the woes of a severely ailing economy. It was my hope that in this session in the Maryland legislature, we would be able to reaffirm the state's commitment and responsiveness to this problem by introducing House Joint Resolution 95.

House Joint Resolution 95 deals with technology production, energy growth and trade in the state of Maryland. It requests the Congress of the United States to enact a comprehensive and balanced energy program. Whether or not President Carter has of yet realized the implications of a necessary energy program, in the next nine months, it's my belief, this is the prime problem facing our country and needs to be addressed immediately.

The resolution calls for Congress to act in a timely fashion: to recharter the Export-Import Bank of the United States, realizing of course, the bank's ability to play a major role in American trade policy. The resolution requests that Congress also expand the funding base of the Export-Import Bank and begin the sponsorship of high technology trade for the purpose of creating jobs.

Placed in this resolution are hopes that conventional means of energy will be realized and especially (and I sort of shudder, seeing that we are on the eve of "Sun Day") that nuclear energy is realized as a viable source of energy.

Obviously, no one source will be the answer to our problems. It's important to realize a moderate mix of solar, geothermal, nuclear, oil shale All need to be addressed and that's the Foundation's problem. In the short run, perhaps solar energy needs to be addressed in its development with research and development, but obviously, this development will not occur within the next 30 to 40 to 50 years.

In this short term, I believe nuclear energy, with the safeguards, being put into its proper perspective, will be the answer to alleviating our short-term problem. Again, nuclear energy must be addressed with regard to the hopefully increased production that our country needs to develop in stabilizing our economy. With a \$45 billion trade deficit, it's apparent that the market will bear it no longer. Hopefully, with conferences such as these, with panels and discussion of the nuts and bolts of what makes a country strong, the economy will reach this goal in the not-too-distant future.

Warren Hamerman

Throughout the course of today's conference, I was part of discussions with many people from different nations and from the U.S. government that raised a number of reactions to the presentations presented, all of which would tend to fall under the topic: feasibility. And, there were a wide range of categories of feasibility which were addressed in numerous discussions. Financial feasibility was of the utmost. Strategic feasibility, with raised eyebrows, was discussed. Political feasibility was raised, and so forth.

I would argue that essentially, underneath all of the different feasibility questions, there is a central unifying theme. The essential unifying theme is, is there an alternative to the current economic and financial situation in the world economy as a whole? Is there an alternative to, essentially, extension of loans and credits to Third World nations or to advanced sector nations or project contracts of a general two to five year character which make it impossible to think about the sorts of development programs which are outlined in today's program? And yes, there is. There is a very straightforward alternative which would allow us to make the *financing* of developing sector industrialization, such as we have outlined in terms of southern Africa, commensurate with the actual task of achieving developing sector industrialization.

That's a very important point because normally, the question of financing questions; we then have to develop economic arrangements and treaties which fall within the limitations of those financial arrangements.

I would argue quite the reverse. That we set our goal for the industrial development of southern Africa, or as we did three months ago, in a compatible program for the industrial development of the Middle Eastern region, first, address those questions of manpower development, infrastructure and so forth which are necessary, and then determine the most appropriate, feasible, practical arrangements for seeing that such a program is implemented. That's the role of financing in terms of development.

I indicated at the outset that twenty year or eighteen to twenty year low interest credit for the developing sector, allowing for the type of comprehensive regional development program which we have outlined here, is a straightforward matter. In fact, at

numerous times, increasingly in the past year, there have been various proposals advanced, and certain limited deals and arrangements done, albeit at insufficient volume, to achieve just that.

The current head of the Export-Import Bank, John Moore, recently testified at the U.S. Congress, and he advanced the proposition that, really what we need is long-term, twenty year credits for the developing sector at very low interest, to revive our markets for gearing up American exports. That would be an appropriate target orientation.

Nelson Rockefeller, recently in New York City, announced an idea for pulling together a private, non-governmental corporation utilizing Arab surplus funds geared toward energy development and agricultural development through the extension of loans on a long-term basis at low interest.

The Soviet Union recently—and this is a very interesting point, because it's often overlooked that approximately fifteen percent of the Soviet Union's exports go to the developing sector—has been experimenting with some very interesting financing arrangements. This includes extension of recent credit to Morocco, a twenty year credit for the construction of a phosphate plant and a port, at 2.5 percent interest.

Others are discussing the concept, but really the paradigm, the paradigm model for thinking in terms of a financing arrangement, a straightforward financing arrangement which serves the interest of industrialization in the developing sector, began to surface slightly less than one year ago in terms of the policy conception of Jürgen Ponto, the former head of Dresdner Bank in West Germany. What Ponto was conceptualizing, attempting to think through, directly addresses the topics of the conferences today, and was based on the fact that in the advanced sector, in western Europe, in particular, and in the United States, there is a great need for industrial economic growth through export activity. In the southern African region there is a fantastic need for a long-term program for industrial development; similarly, in the Middle East. Therefore, what one must do is simply match up, in workable fashion, an economic development program which utilizes the grossly underutilized advanced sector production capacity in a large-scale comprehensive economic development deal in the

Third World, and in this case, in particular, in the southern Africa region.

The Ponto plan was basically as follows: that what was needed was an alternative market, a market which specialized, as it were, in nuclear energy development and Third World development projects, that cut across existing political boundaries. Such a market ought to be pulled together in Luxembourg which utilized industrial groupings from throughout Western Europe and so forth. In the notion of the plan, a gold-backed monetary system was an essential element for stabilization; Middle Eastern economic development; technology transfer; a capital-intensive mode of development in the developing sector.

Because as soon as you are thinking about reversing the so-called risk question, you immediately have a different orientation to the type of economic programs you are involved in. The risk question is a vicious fallacy. You can go to New York or London at this point and present to the banking community, or go to government agencies, and present our program for a half-trillion, twenty year economic development package for southern Africa and get the following response: Even if such a thing politically could be put together, who would take the risk on those investments? I would argue that... we turn the tables, ... we view the situation as one in which one cannot risk not taking such a program, because it will lead to strategic confrontation, it will lead to regional hot spots and wars in situations lacking economic development, a conception of "into the 21st Century." That the world cannot take the risk of not having a large-scale technology transfer, a capital-intensive approach, comprehensive regional development programs in the developing sector.

Now if we are going to take that as our fundamental axiom, then the questions of exactly how does one put together such a financing package must be looked at in some detail. And they can only proceed, like an economic development program in real economic terms, from looking at the world economy as a totality. That's what I propose to do....

Let me first point out to you what the existing situation is. If one looks at 1977 or right at the present point, each of the three major sectors of the world economy are in a very bad economic situation. The advanced sector nations, Western Europe, Japan and the United States, unless they can come up with a joint package similar to what I have outlined, will be forced to conduct competitive trade wars amongst one another. I would point out the greatest concentration of technology, productive planning, equipment, skilled workforce ever assembled in human history, exists in the advanced sector nations. Unless we can utilize that capacity at full tilt for developing sector industrialization, transfer technology to the developing sector, or if we restrict our fundamental assumption to no economic growth, or moderate economic growth as was suggested earlier, then those advanced sector nations are going to be fighting amongst one another.

The trade situations which result from that I think are fairly well known: the United States \$27 billion trade imbalance last year and so forth. The U.S.-Soviet or East-West, West European-Soviet sector trade at this point is grossly inadequate in terms of real capital good flows and so forth. It's somewhat ironic that in 1977 while our nation suffered a \$27 billion imbalance, the foreign trade ministry of the Soviet Union, with estimates corroborated by American government officials, pointed out that if there were no political restrictions to East-West trade, there were \$13 billion of orders ready to go through, and would have gone through last year.

In fact, the situation is very similar between the advanced sector nations and the developing sector nations. The political restrictions on economic trading activity with the Middle East are well known. The political restrictions on economic trading activities with South Africa at this point are also well known. What we are going to outline is a proposal for reversing those restrictions in the context of an expanding global trade economy.

Basically, the strategy is quite straightforward. We have as our centerpiece nuclear energy development, development in the Third World similar to the large-scale programs outlined earlier. To these are matched manpower development and skilled labor force development in the developing sector, particularly.

The strategy works like this. If we gear up the export base, both of the advanced sector nations and the East bloc nations simultaneously for Third World development, and essentially set our parameters that both the East and the West are going to be involved in expanding their own internal economies through transfer of capital goods to the developing sector, there we have the political basis — the political feasibility for making a comprehensive Middle Eastern economic development package and a comprehensive southern Africa economic development package — one which completely leaves aside the alternative of East bloc and advanced sector nations essentially developing discrete client states or attempting to compete against one another, in client state fashion, in particular developing sector regions.

That's inadequate for two reasons. The most important reason it's inadequate, besides the dangerous conflicts which ensue, is that it's incompetent. It's repetitious. It won't work economically. We will never have the developing sector nations undergo true industrialization. We will never have a skilled workforce, a true high technology economy shifting into the 21st century in the developing sector... if the advanced sector nations and the East bloc take the discrete client state approach, or the situation evolves essentially into that. More and more of the aid is going to take the form of strictly militarily-determined realities, rather than the 20-year, real economic development perspective.

So here's how the flows work. The advanced sector

and the socialist sector are exporting nuclear energy infrastructure, development infrastructure, capital goods, into the developing sector. To do this, particularly in the socialist sector side, would necessitate a gearing up of the export base of the East bloc economies, and particularly the Siberian development projects and the nuclear energy capacity in embryo, Soviet mass production of nuclear energy plants. So we need greatly enhanced advanced sector exports of capital goods to the East bloc, technology transfers around nuclear energy and state programs going both ways, and energy and primary-product exports from the East bloc to the advanced sector.

Then, from the developing sector nations — although there are large distinctions among different developing sector nations — in general, in the short term, we want to gear up and further develop export of primary products to both the socialist sector and the advanced sector nations.

I have specifically used the word primary products here as distinguished from raw materials, because primary products is a broader term which in my view would encompass, yes, the increased flows of raw materials, but it will also allow for the transformation of those raw materials in the developing sector into other primary product forms.

Consumer goods, and students, to both the East and the West, engineering, scientific skills and so forth, is not to be distinguished from the building of educational infrastructure in the developing sector, which is a primary goal. But the advantages of having students from the developing sector in already existing facilities will allow us to gain much greater momentum in the short term on this whole program.

For the advanced sector and for the United States in particular, such a conception — a broad conception like this — means a complete reversal of the trade imbalance. We are talking here of an immediate gear-up to approximately \$200 billion to \$300 billion in exports annually, from the current \$110 billion or so in capital goods exports. For the East Bloc economies, this program means, immediately, a gearing up of internal economic stability. For the developing sector, most importantly, this is the only feasible economic and political route for achieving real industrial infrastructure, as a joint effort of all the elements of the world's economy as a whole.

This perspective is one which cannot be gone at in piecemeal terms. There are many proposals, as I indicated earlier. Most recently, something of great import is the Mexican proposal for a \$15 billion fund for technology transfer to the developing sector, in addition to the various plans which I mentioned earlier.

The practical considerations, and financing arrangements, follow in a very straightforward fashion, as long as four fundamentals in the current world economy are addressed. The four fundamentals are these: There is no way in which this program could work — there is no way in which Third World

development can occur, there is no way in which the U.S. economy can be utilized at full skill capacity and we have revitalized our urban areas unless the question is addressed of debt obligations to the IMF-World Bank of the developing sector nations, particularly the least developed countries, the so-called LDCs, which reaches \$40 billion annually just in debt service. One can talk about development in the Third World, getting momentum going on existing projects and so forth, but if we walk around the question of Third World debt obligations, and in particular, to the IMF and the World Bank at this point, we will achieve nothing. Since all existing short-term loans and financing are going back to the IMF and World Bank in debt service, there is no infrastructure which is going on through those programs, by and large.

What must be done is to freeze debt obligations for the IMF and World Bank, then to reorganize developing sector economies along the financial model which correlates with the policies of our first Secretary of the Treasury, Alexander Hamilton. That is, a freeze on debt obligations to the IMF and World Bank, and a reorganization of Third World economies in a Hamiltonian fashion.

What is Hamiltonian economics? Essentially, it's a commitment to the development of a skilled labor force through the industrialization of agriculture and the enhancement of manufacture, and using credits to achieve that purpose; therefore, credit extensions to productive investment through technology inputs to enhance productivity, to increase manufacture for home improvements, for infrastructure are favored at long-term low interest, and on the other side, credits extended for speculation or real estate price speculation, non-productive labor-intensive forms of economic activity, are penalized through high interest and other means. That's the essence of the Hamiltonian economic approach.

It has just recently been adopted in policy features in public pronouncements by the Mexican government, and also some months ago was discussed in terms of Venezuela.

The need is to utilize financing to achieve development infrastructure and to specifically ensure that that's what financing goes to and not to debt service. One does not have to look as far away as southern Africa or Asia to see what the problem with a short-term financing at high interest rates approach means. All one has to do is look, for example, at New York City, which is operated and been under such an approach for the last years. No long-term 15 to 20 year development perspective for gearing up the port, industrial activity, and so forth, but instead, short-term financing, which is paid for by, increasingly, dismantling what's left that has some value to it. Each year, the financing becomes shorter and shorter term

The Hamiltonian approach is just the obverse.

After a freeze on IMF and World Bank debt

obligations and a reorganization in Hamiltonian terms, what is required is gold backing for currency trading relations. I mention gold backing not in terms of the fetish about gold, but in terms of a workable stable arrangement that can go into effect immediately so that we can proceed on this perspective over the next 20 years.

The final fundamental is that the loans extended for such projects, 18 to 20 years, must be at extremely low interest so that the project's development is not strangled by the financing, but is allowed to develop and flourish so that real credits can be generated to allow greater economic activity in the future.

Those four fundamentals are in essence all one needs in terms of the financing. Any number of existing combinations in private-government consortium arrangements can be placed together. Really what one wishes is the most practical and straightforward approach.

What I want to address in my closing remarks, however, is to pick up on an observation, which I thought was most acute and timely, which appears at the end of the speech by our representative from the Department of Energy. In the last chart he had on the screen — I wrote down the exact words — he said that the greatest question and impediment at the moment to achieving fusion power is that "there is no powerful motivation. There is inadequate support from industry, scientific layers, banking layers," one could add labor and agriculture I'm sure, "to achieve this program"; that there exists not enough support for an economic development, scientific advancement program. This support doesn't even exist for what may be, admittedly with certain scientific reservations, but nonetheless excitingly presented to everyone in this room today, a potential for an unlimited energy source, commercially feasible in scientific judgment, before the end of the 20th century.

Man could have a virtually unlimited energy source to do what he wishes, economically, politically, and so forth, in the 21st century. And there exists not the political support for that.

I recall three months ago, when we had our convention on Mideast economic development, the essential underlying theme of that convention — which took place at much more hopeful times than the Mideast has since experienced — was that even though the Begin-Sadat talks had occurred, that unless a concrete economic development package was introduced as a new element into that situation, unless we were able to outflank existing political obstacles and introduce a 20-year comprehensive economic development package in the Mideast, which would be the content of any Geneva-type agreement, that situation politically would necessarily devolve — and it did. That element was not introduced in a public, visible way.

We now face a similar situation in southern Africa. We have two alternatives — either the East and the West, with their existing scientific and productive capacities, jointly collaborate on a comprehensive economic development strategy for southern Africa, or the situation will devolve into wars.

Those are the alternatives. The challenge, I think, to everyone at this conference, is to ensure that there does come into existence very rapidly in the United States, in particular, where it's most necessary, a political counterpole, as it were, of visible adequate support for a 20-year program based on global world development, a 20-year program for industrial development in the developing sector, which assumes great prosperity, great economic growth, and that makes further development necessary and further economic expansion necessary in the advanced sector, in the developing sector as a whole, and in the socialist sector economies. Those are the alternatives.

Lic. Carlos Romero Barrera

The topic I will deal with this afternoon could be discussed and analyzed in a research project of various volumes or in two or three semester-long courses on a post-graduate level. To try to deal today with this complex matter in a broad and complete way would be impossible, given the time limitations.

The first step to avoid ambiguity is to define the term "development": Hereafter I will understand development to mean not only the simple growth and expansion of a country's productive apparatus. Rather it must be a growth and expansion which results in an increase in national and per capita income, as well as in a rise in the level of employment of both human and natural resources of a given country.

Regarding financing, it is known that it can be internal and external. Internal financing can occur through the use of financial resources that come from exports and the channeling of public and private savings into investment for development. External financing, on the other hand, occurs in three modes: (1) economic aid; (2) direct foreign investment; and (3) credits, from private, public and inter-governmental institutions.

Regarding financing through economic aid, we know that so far it has been minimal relative to the real needs of the developing countries and that it has been used more as a political instrument of the industrialized nations to guarantee their hegemony or security as they see it — rather than as a vigorous effort in international cooperation. We know that often this aid is conditioned to satisfy the commercial interests of the donor country, and that other times it has been channeled into military expenditures which, in terms of development as we understand it here, represent nothing.

On the other hand, we know that the current trend is towards less aid, partly because in these moments of world economic crisis the industrialized countries are very occupied in resolving their grave problems of inflation, unemployment and balance of payments imbalance. There is a strong current of opposition to foreign aid in the legislative bodies of the great powers, above all because this aid is not always granted to the most needy nations, but rather is often for supporting governments which are neither very democratic nor very liberal.

It is worth noting that aid in itself is insufficient to make a significant contribution to development, when it is not made part of a systematic program but is used instead as an occasional palliative for the grave problems of chronic indebtedness and the other effects of the economic and technological backwardness of the developing countries that receive it.

Aid can, on the other hand, be an instrument of real development when it is not channeled into unproductive social expenses, into mere servicing of the debt, or into the military strengthening of the recipient nation, but when instead it is rationally invested in the expansion and differentiation of the productive apparatus — with resulting effects on the levels of employment and income.

Now, with regard to financing through direct foreign investment, we can affirm that it can be an effective instrument of development when the national economic profit is greater than that obtained by the investor, that is, when the investment is translated into an increase in the productivity of the factors of production. This implies a greater return to the labor force, lower prices, and greater fiscal contributions. Foreign investment will also aid development if the profits remitted abroad are less than the total increase in local production that results from the investment. When foreign capital invested in a developing country complements the development efforts of that nation rather than replaces them, and when it does not result in the importation of patterns of luxury consumption corresponding to another level of development, when it creates a demand for national goods and services; when it increases the technology available to the country and the volume and composition of exports — it will be contributing effectively to financing the development of the country in question.

Foreign investment will not be an effective instrument of development, on the other hand, if it creates balance of payments imbalances, through excessive remissions of profits and of patent and trademark royalties, or through the excessive importation of foreign inputs and services.

The third form that foreign financing can take is the issuance of credit by international private banks, multilateral financial institutions, or national governments. This form of providing resources to the

developing nations has in many instances been only a means to repay earlier debts or as an instrument of trade policy of the creditor nations, who tie their aid to purchases of goods and services in their own countries.

The impact of indebtedness depends on the form it takes. The least dangerous form seems to be the receipt of funds by the national bank through the sale of financial bonds and paper to foreign holders, since in this case the indebtedness does not involve the ceding of certain decision-making rights over the economy to foreigners. Rather, it permits the inclusion of these resources into investment plans contemplated in the national development program.

Debt in general can be a viable instrument for financing development, when it results in rates of productivity high enough to repay the loans and still maintain a positive balance. To achieve this objective, it is imperative that the borrowing country negotiate loans on non-onerous terms, on the one hand, and on the other that it make use of these resources where they can produce the greatest results in terms of development.

On the other hand, debt is very dangerous when it is used as an instrument of economic policy to substitute for internal reforms which are necessary so that the costs of the growth and differentiation of the

productive apparatus can be absorbed by national resources.

Having theoretically analyzed the forms of financing and their relationship to development, I would now like to refer briefly to some policy direction which the Mexican government has laid out with regard to financing development.

Mexico now plans to finance its own development on the basis of the exploitation of its sizeable petroleum resources. Recent statements of President José Lopez Portillo and of José Andres de Oteyza, the Minister of National Patrimony and Industrial Development, have clearly defined the objective of carrying out industrialization, now in the capital goods sector, and also of developing new sources of energy such as nuclear energy.

Regarding the problem of massive financing of the development of the developing sector, last April 27 the Mexican government made a proposal before the International Monetary Fund to create a \$15 billion fund, that would be used for the acquisition of capital goods and for the financing of long term development programs in the developing countries. It would be a means of transferring funds from countries with a surplus to the most needy nations, in order to implement development and not solely to cover the repayment of their foreign debt.

Dr. Hany Makhoul

The Arab states, being in the developing state themselves, appreciate the difficulties faced by the Third World countries in securing the capital needed for financing their economic and social development. Like other developing nations, the Arab states have to mobilize their resources and efforts to build a diversified economic base and improve the quality of life for their peoples. They are also permitted to assist in the transfer of development capital to the less-developed countries of Asia, Africa, and Latin America.

As a result of the increase in the income from oil exports in 1973-74, the Arab oil producing states joined the club of major aid givers. Between 1973 and 1977, we have provided about \$19 billion in soft loans and grants to other developing countries and to international financial institutions. As a percentage of their GNP, the Arab aid givers are probably the leaders as far as foreign aid is concerned.

According to a recent report by the Chase Manhattan Bank, the United Arab Emirates, for example, has provided an average of 18.1 percent of its GNP since 1973. Kuwait has provided aid to an average of about 5.3 percent since 1973. Saudi Arabia's aid amounted to about 5.2 percent of the GNP, again since 1973. The annual report of the World Bank further indicates that there are other Arab states that have provided more than many of the developed nations and these include Qatar, Iraq and Libya, whose aid averages from 5.4 percent to 1.3 percent of their GNP.

By contrast, the World Bank report indicates that United States aid in 1976 for example, constituted about 0.26 of the GNP. Germany's aid was about 0.3 percent of their GNP, and Japan's aid was about 0.2 percent of the Japanese GNP. Only two Western countries have been able to meet the United Nations' goal of 0.7 percent of GNP. These are the Netherlands

and Sweden. The record of the socialists and the Soviet bloc countries has not really been that much better than the Western countries.

Some critics of the pattern of distribution of our aid have charged that a good part of those billions that they have disbursed has gone to other Arab countries; they charge that Arab aid is not disbursed or distributed evenly among all needy countries. All I can say is that foreign aid, regardless of the source, has never been distributed evenly or equitably. It is only natural that the Arab oil producers give priority to other Arab states who need development capital; and I would like to name a few of these — Egypt, Sudan, Yemen, Somalia. These states have very low per capita income and definitely, they need aid from their colleagues in the Arab League.

A look at the pattern of distribution of Arab aid, however, from 1973 through 1977, indicates that more and more Arab aid is going to non-Arab states. In 1975, for example, 40 percent of Arab aid went to non-Arab states. In 1977, about 59.6 percent of Arab aid went to non-Arab states.

At the present time there are seven institutions . . . that channel the Arab financial assistance to other countries. These are the Arab Bank for Economic Development in Africa, the Kuwait Fund for Arab Economic Development, the Saudi Fund for Development, the Abu Dhabi Fund for Arab Economic Development, the Iraqi Fund for External Development, the Islamic Development Bank, and the Arab Fund for Economic and Social Development.

The Arab Bank for Economic Development in Africa was established in 1975 and it was established as a multilateral institution. Eighteen Arab states have contributed to the capital of this Bank, which has increased from about \$231 million to about \$706 million and this is the present capital of the bank. However, it has the ability to borrow additional capital when needed. The countries that have received aid from this bank in 1975 are about 26 in number. I think most of the African countries have received some grants or some soft loans from this institution.

The bank's loans are usually tied to specific projects. They are mainly infrastructural projects and agricultural projects. They carry interest rates or service charges, if you like, ranging from 1 to 6 percent, but most of the loans granted so far carry an interest rate of 1 to 3 percent. These loans are repayable in periods ranging from 15 to 25 years, and some of them have very liberal grace periods as well.

The interest rates or service charges that the bank includes in its agreements are based on the economic conditions of the recipient countries rather than on a pre-set formula or a pre-set rate. The bank prefers, however, to co-finance projects rather than sponsor a project completely by itself.

The Arabs prefer the co-financing for a number of reasons, one of which is that they would like to involve the industrial countries and their institutions in the effort to develop the African nations. The Arabs like to stress that more Arab aid should not mean less European or American or Japanese aid. On the contrary, the Arabs emphasize that any increase in Arab aid should be matched by a similar increase in the aid given by the industrial countries.

To make this point as clear as possible, the Arab oil producers indicated, in the negotiations that led to the establishment of the International Fund for Agriculture Development about two years ago, that the OPEC members' contributions to the fund would only match those pledged by the industrial countries. Each group of nations thus ended up paying about \$450 million of the capital of this particular fund.

In addition to the financial assistance provided by the Arab Bank for Economic Development in Africa, many African countries have applied for and obtained soft loans from other funds established for development by Kuwait, Saudi Arabia, the United Arab Emirates, and Iraq. The Arabs have also established a special fund for technical assistance, aiming at assisting the African countries in the preparation of feasibility studies, solving technical and managerial problems faced by African nations, and developing technical skills in Africa. At the Afro-Arab Summit Conference of March 1977, the Arab states pledged \$1.4 billion in new aid to Africa. This aid is to be channeled through the Arab Bank for Economic Development in Africa, as well as through the African Development Bank. A joint committee composed of a number of African nations and a number of other countries was established to ensure that those funds are used in the best interests of the African nations.

No one can claim, however, that Arab aid or Arab funds can solve African economic problems. The process of development is very complex, as you know. It requires worldwide commitment. It requires global and regional planning and long-term perspective. It requires global partnership, in which those who can help and those who need help are equally committed.

SUMMARY

Dr. Morris Levitt

In the course of the day, we have heard the presentation of a comprehensive development program for the southern African region. The motivation and conceptual basis for that program is grounded not especially in any idiosyncrasies of the region, although we have seen the historical elements that can be drawn on there, but primarily, in the historical thread of the development of the United States itself. We have had a look at what the possible future can be, particularly in terms of the unlimited and qualitatively advanced forms of energy that fusion portends. And now we have considered the criteria and the mechanisms for adequate financing of that policy, with clear expressions from significant sectors of the international community, who have played a leading role in the recent period, that this outlook is directly compatible with policies that they have been engaged in drafting.

The question therefore now is whether we will continue to have the situation that one speaker today referred to earlier as the *laissez faire* approach, the approach of Adam Smith, and what has been referred to I think by Ambassador Andrew Young as the policy vacuum that the United States permitted itself to create in the southern African situation. The flip side of the *laissez faire* vacuum approach is to create all sorts of bogeymen running around the region. I think we have had adequate presentation of what the factual and conceptual basis is for formulating an analysis of the Soviet role in the region and joint U.S.-Soviet efforts.

We could either have the bogeymen or we can proceed, on the basis of the extraordinary proceedings here in like events, to construct the necessary political counterpole in the United States, so that we are able to present to the nations of the world — and especially those that have already strongly indicated that this is exactly what they are waiting for — a commitment to our own and world development.

The United States draws on its resources and strengths which, when all is said and done, still represent the greatest cumulative resource and totality of assets that are available anywhere in the world, because they are embodied in our population, in its organic commitment to progress, in its realization in industry and agriculture. As Dr. Krause said, we wrote the book on applied research in agriculture. That's because of the cultural tradition that we have, a deeply ingrained, even though badly battered, commitment to progress. We must draw on that, in conjunction with the efforts that have been referenced here: the unfinished project of Jürgen Ponto; the expressions that we have witnessed here from the representative of the Mexican Foreign Ministry which has played a leading role in Third World development; an expression from the Arab League of the sort of policies toward which we are converging after the October U.S.-Soviet statement on the Mideast and the call for a new Geneva Conference.

The United States can offer the world a deal it can't refuse, as well as restore the soul, the vitality, of the American System. Thank you.