Space medicine to rescue the Earth's biosphere

by Warren J. Hamerman

How can mankind, in the context of initiating a challenging Moon-Mars colonization mission, reverse the full-scale threat to the Earth's biosphere caused by the draconian and incompetent global policies of the International Monetary Fund (IMF) and World Bank?

If we can transform the Martian desert into arable and inhabitable land, then reversing the galloping desertification on Earth is a relatively straightforward task. Already in the four Skylab missions of NASA, between May 1973 and February 1974, *Potential Agricultural Zones* (*PAZs*), were targeted in to-be-rehabilitated desert areas of Africa (Sahara, Sub-Sahara, Namib and Kalahari) and elsewhere. As the examples of California's Imperial Valley, Egypt's "New Cities Program" and Israel's Negev and Sinai projects have demonstrated, currently existing deserts are all *PAZs*.

With the technology to actually create "livable" atmospheres and optimal weather patterns on foreign planets, then the work of modifying and controlling weather and atmospheric phenomena on Earth can be readily accomplished. If we can provide the *life-support systems* for sustaining astronauts in space flight and eventually creating the life-support systems for long-term missions such as space stations and the inevitable colonizations, then space-age medicine and exobiology can be applied to providing the maximum life support for every man, woman, and child on the Earth.

The space program approaches the question of health in a totally centralized, top-down fashion, precisely the method which we must employ to rehabilitate the world's population and the biosphere from the IMF wreckage. In 1961 NASA announced that it would construct, on-site near Houston, Texas, a $60 million Research and Command Center (RCC) for the Project Apollo Program. From the foundation up, so to speak, a Life Sciences Team was set up, with the responsibility of ensuring that the astronauts remained in good health and physically fit to perform their assignments in space, land on the moon, and return safely to Earth before the end of the 1960s. This mission was successfully achieved in July of 1969 when Apollo 11 brilliantly executed the first lunar landing and return to Earth.

How fragile is the Earth's biosphere? The entire biological envelope around the Earth is rather small in width but incredibly well-designed. The highest point above the Earth's surface where biology can be naturally found—spore-forming bacteria and fungi—is approximately 20 kilometers, while the lowest depth under the ocean for "life" is approximately 11 kilometers. The total width, in other words, of about 31 kilometers or 15 miles can be walked in about four hours at a normal pace. (**Figure 1**) Actually, the situation is even more compact. Within the zone of a few hundred feet above and below the surface, the vast majority of all biomass conversion occurs.

Our atmosphere functions as a wondrously-designed laser to tune and focus certain optimal wavelengths from the electromagnetic spectrum, while filtering out unwanted bands. The atmosphere of Biosphere I (Earth) functions, along with the magnetic field, as a filter or blanket to protect living things from most of the radiation types which could be damaging. NASA scientists have established, that in the electromagnetic system, there are only two principal "windows" for the sun's radiation to penetrate to the Earth's surface. One window encompasses visible light and part of the ultraviolet and infrared frequencies; the other window includes radio frequencies of about 10^9 Herz. Other radiation is effectively blocked. (Source: *Post-Viking Biological Investigations of Mars,* Committee on Planetary Biology and Chemical Evolution, 1977, Washington, D.C.)

The thermodynamics of the process as a whole operates in such a way as to keep the temperature band in the zone of biomass conversion within the tolerances for living systems, which at the extremes function between $-12°$ and $+80°$ centigrade. The biosphere as a whole also operates with tolerance bands with respect to pressure, pH (acidity or alkalinity), ionization and radiation, and water accessibility. In all, only about 20 key elements are combined in certain definite proportions to comprise the "structures" of living things. The composition of the Earth's atmosphere is measured as: 20.9% oxygen; 78.0% nitrogen; 0.04% carbon dioxide; and trace amounts of other gases.

Also significant, is the overall ratio of the biologically important water-soluble electrolytes. These water-soluble electrolytes play an essential role in enzymatic and physiologic function. (The most significant of these ions include Na, K, Mg, Ca, Cl, S, and P.)

Man is a relative "latecomer" on Biosphere I. The age of the Earth is generally given as 4.5 billion years, with the oceans having formed 3.5 billion years ago. The oldest known primitive organisms appeared 3 billion years ago, while the oldest known photosynthetic and nitrogen-fixing organisms appeared 2 billion years ago. The Earth's oxydizing atmosphere is 1.5 billion years old and the oldest plant is 400-500 million years old. Man's primate predecessors appeared only 1.5 to 2.0 million years ago. The human species itself can be traced to, at best, activities beginning well under 100,000 years ago.

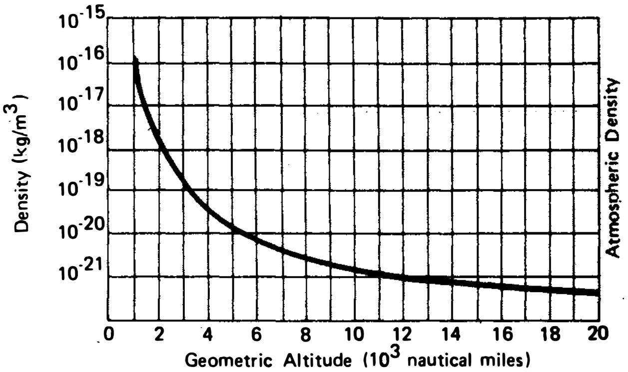
The history of the biosphere demonstrates that the universe does not tend to a statistical thermodynamic equilibrium. The totally unique feature of the biosphere on Earth is that as human civilization has developed, it is the human economy's enormous technological capability which now plays the qualitatively determining feature for good or bad in terms of large-scale biospheric events—desertification, droughts, deforestation, weather patterns, and atmospheric phenomena.

This fact was dramatically stated by one of the astronauts in the Skylab program:

From space "it is easier to see man's influence on the Earth, on the vegetation, than it is to find natural vegetation differences."

FIGURE 1

Atmospheric density as a function of altitude



The rapid decrease is correlated with a decrease in both atmospheric pressure and partial pressure of oxygen. (Source: Arnauld E. Nicogossian and James F. Parker, Space Physiology and Medicine, *Washington, D.C.: NASA, 1982.)*

Astronauts on Earth

Already through the combined technologies and experience of Space Medicine and Exobiology in designing and managing Life Support Systems for the astronauts in the Mercury (six manned missions from May 1961 to May 1963), Gemini (ten manned missions including the first U.S. extravehicular activity), Apollo (11 missions from September 1968 to December 1972 including the transport of 29 astronauts and successful landing of 12 on the lunar surface), Skylab (four missions from May 14, 1973 through February 1974) and the Space Shuttle or "Space Transportation System" (STS) Projects (ongoing missions beginning April 12, 1981), the United States has developed the capacity for maximizing the health of man. The Soviets have accumulated parallel capabilities in their successive programs of Sputnik, Vostok, Voskhod, Soyuz, and Salyut.

While not all of the considerations involved in human life support in space are directly applicable to Earth, the vast bulk of the experience and knowledge are immediately transferable and relevant to improving human society on Earth. Furthermore, the basic principles underlying the astronauts' health and life-support systems are of vital importance for implementation on Earth. **(Figure 2)**

The basic concept involved in maximizing the health of each individual astronaut was that since each astronaut was a "precious national asset" who was "irreplaceable," then every step must be taken to maximize his health in dealing with known and unknown dangers.

To replace the global biological holocaust created by the IMF and World Bank, we propose that the space-age approach of maximized life support is what must be applied to every man, woman, and child on Earth. In other words, our program mission in the post-IMF era will be to treat the children of Africa, Asia, and Ibero-America as "irreplaceable" astronauts.

In short, economic policy can be usefully viewed as "life-support" policy, in which the basic medical engineering principles proceed from several considerations: 1) a generous margin of safety; 2) redundant systems; and 3) optimizing nutritional and immunological programs.

Space medical engineering

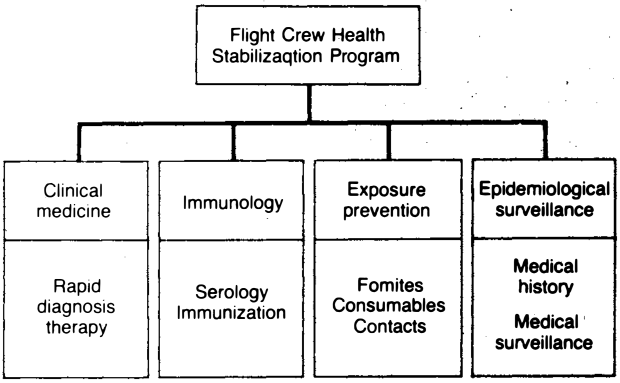
The general requirements of a life-support system include: a) supplying the nutrient substances involved in metabolism; b) maintaining a breathable atmosphere, tolerable temperature, pressure, pH and so forth; c) providing a sanitation system for the removal of waste products; and d) protecting the individual against known and unknown diseases. **Figure 3** and **Table 1** show some aspects of the system.

Among the fruits of space medicine exists a wonderful model for the optimum immunological and nutritional programs appropriate for transfer immediately to all ~~people on~~ Earth, were we to seriously embark on a post-IMF global program to eliminate the *biological holocaust* conditions currently devastating Africa, Asia, and Ibero-America and threatening the rest of the biosphere as well. (**Table 2**)

The nutritional program for the astronauts was based upon the straightforward fact that man requires approximately 40 separate organic compounds and minerals in his daily diet. (**Table 3**) Human metabolism derives its energy through the release of energy through chemical oxidation of foodstuffs. The total energy requirements are not constant but

FIGURE 2

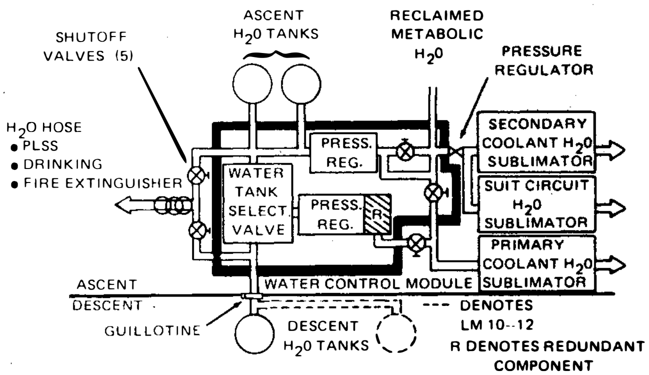
Elements of the Apollo Flight Crew Health Stabilization Program



This plan was designed to minimize or entirely eliminate the possibility of adverse alterations in the health of flight crews during the immediate preflight, flight, and postflight periods. (Source: National Aeronautics and Space Administration, Biomedical Results of Apollo, *Washington, D.C., 1975.)*

FIGURE 3

Water Management Section of Apollo Lunar Module Environmental Control System



(Source: *Biomedical Results of Apollo.*)

Table 1

Preflight procedures for Apollo mission

1. The discovery of latent illnesses during the process of selection of astronauts and the preparation for missions.
2. The implementation of the health stabilization program and other *preventive* measures.
3. Determination of individual drug sensitivity to the contents of the Apollo medical kits.
4. Providing baseline data against which to compare postflight data for determination of space flight effects.
5. Prevention of any situations which might delay or otherwise interfere with operational aspects of the missions.

Source: *Biomedical Results of Apollo*

Table 2

Apollo program immunization requirements

Disease	Required immunization of astronaut	Required immuniz. of family members of astronaut
Diptheria	Yes	Yes
Pertussis	No	Yes
Tetanus	Yes	Yes
Typhoid	Yes	No
Influenza	Yes	Yes
Mumps	Yes	Yes
Poliomyelitis	Yes	Yes
Rubella	Yes	Yes
Rubeola	Yes	Yes
Smallpox	Yes	Yes
Yellow Fever	Yes	Yes
Other	(*)	(*)

* Only as indicated for travel to endemic areas.

Source: *Biomedical Results of Apollo.*

depend upon the total energy to be expended in work (physical and mental). (**Table 4**) Nonetheless, both the U.S. astronaut program and the Soviet cosmonaut program independently converged upon providing diets in the range of 2,500 to 3,000 kcal/day. (**Figure 4**) Of the total energy input, approximately 11-18% of the energy was desirable in the form of protein. (**Table 5**) The human diet must contain the basis for the 20 different amino acids necessary for the functioning of the human biological "systems" (immunological, digestive, neurological, etc.). In addition to the supply of whole protein, the astronauts are supplied with a full spectrum of vitamins, minerals, and micro-nutrients.

Through the experiences of manned space programs, particularly as longer-term missions occurred, the total energy content of the diet in both the astronaut and cosmonaut programs has steadily increased. For example, the first Soviet flights had daily caloric intake of 2,600 kcal; the Soyuz program began at the level of 2,800 kcal; by Salyut 6 the diet was 3,150 kcal. The American program's energy content in space has been somewhat lower, on average—about 2,500 kcal—except in the Apollo lunar landing missions where it was 2,800 to 3,000 kcal. The Space Shuttle mission crews have eaten diets in the range of 3,000 kcal per crewman. (Source: *Space Physiology and Medicine*.) Thus, the astronaut and cosmonaut nutritional intake lies in the overall range of 2,500 to 3,000 kcal.

It is this quality and quantity of diet which must become the norm among all people on Earth, under the theme to "Make Every Child As Healthy As An Astronaut." As a complement to the nutritional and immunological programs, an entire array of advanced technologies for use in medicine have already been developed as a byproduct of research on lasers, x-ray microscopy and holography, nuclear magnetic resonance (NMR), etc. (See "Advanced Technologies Can Conquer Disease," *Fusion*, March-April, 1985.)

For instance, the gravity-free conditions of space have proven ideal for developing the process of *continuous flow electrophoresis* (CFE) for separation of proteins, enzymes, and hormones. Electrophoresis on Earth is of critical medical and pharmaceutical-producing importance because, through electrical stimulation of a biological substance, the constituents of a mixture are separated so that they can be analyzed. Without gravity, under space conditions, the process is 450 times more productive.

Furthermore, the collapsed sanitation systems of human communities on Earth have much to learn in concepts of design, materials, and construction from the NASA spacecraft sanitation systems. For example, the Apollo project's

Table 3

Typical composition and caloric content of Apollo daily meal

Food composition of daily meal

Meal A	Meal B	Meal C
Fruit cocktail	Chicken salad	Beef stew
Bacon squares	Beef with vegetables	Potato salad
Strawberry cubes	Butterscotch pudding	Sweet pastry cubes
Cocoa	Fruitcake	Grapefruit drink
Orange drink	Pineapple-grapefruit drink	

Food values

Constituents	Meal A	Meal B	Meal C	TOTAL
Energy (kcal)	759.0	1123.0	911.0	2793.0
Protein (g)	28.5	45.2	28.7	102.4
Fat (g)	25.4	42.0	32.4	99.8
Carbohydr. (g)	106.4	140.0	125.7	372.1
Ash (g)	7.0	6.8	7.3	21.1
Ca (mg)	176.0	505.0	486.0	1168.0
P (mg)	342.0	712.0	592.0	1646.0
Fe (mg)	3.3	4.8	4.9	13.0
Na (mg)	1659.0	1526.0	1916.0	5101.0
K (mg)	818.0	863.0	1047.0	2728.0
Mg (mg)	64.3	89.5	95.3	249.1
Cl as NaCl (g)	4.30	3.05	3.94	11.29

Source: *Space physiology and medicine.*

Table 4

Metabolic rates during Skylab extravehicular activity (EVA)

Mission		Duration (hours)	Metabolic rate (kcal/hr) CDR*	PLT*	SPT*
Skylab 2	EVA-1 (Gas cooling only)	0.55		330	260
	EVA-2	3.38	315		265
	EVA-3	1.56	280		
Skylab 3	EVA-1	6.51		265	240
	EVA-2	4.51		310	250
	EVA-3 (Gas cooling only)	2.68	225		180
Skylab 4	EVA-1	6.56		230	250
	EVA-2	6.90	155	205	
	EVA-3	3.46	145		220
	EVA-4	5.31	220		185
Total time		83.6			

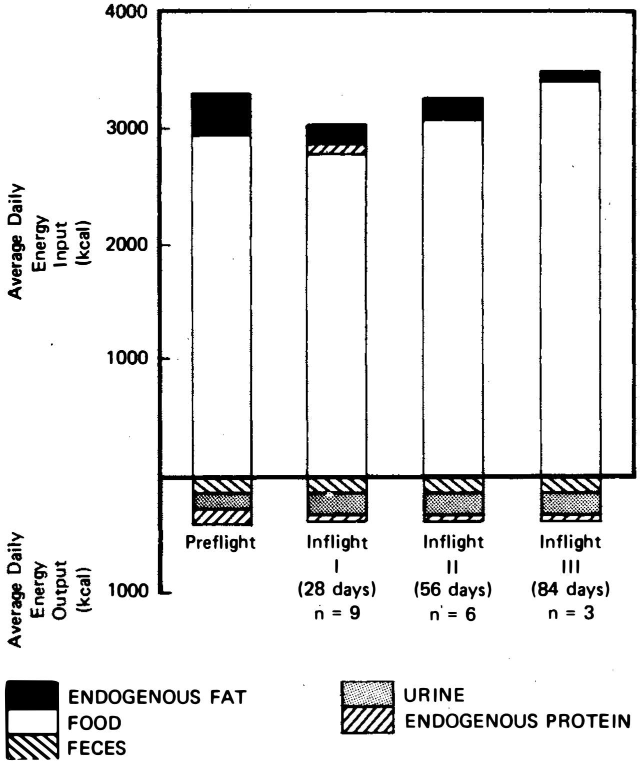
$\overline{X}$: 230 kcal/hr

* Respectively, Commander, Pilot, Second Pilot.

Source: *Space Physiology and Medicine.*

FIGURE 4

Components of average daily energy balance, for preflight period and 3 inflight periods (Skylab).



Energy input includes calories from food intake and from utilization of endogenous fat and protein stores. Energy output includes loss of calories through feces and urine, measured by bomb calorimetry; protein accretion through the addition of muscle mass; and fat disposition. This figure demonstrates that fat was utilized in the preflight period, and also during each of the inflight periods. Protein accretion occurred during the preflight period and later inflight as well, but endogenous protein was broken down during the first 28 days inflight. Food intake was markedly reduced during the first inflight period, but increased thereafter. (Source: Space Physiology and Medicine.)

Table 5

Nutritional composition of typical Apollo diet

Nutrient	Percent of dry weight
Protein	18.0%
Fat	17.0%
Total carbohydrate	61.0%
Fiber	1.0%
Minerals	3.0%

Source: *Biomedical Results of Apollo.*

Personal Hygiene Station (PHS) interfaced with a Waste Management System (WMS) is useful for study. Further advances in technology beyond the WMS-PHS concept have been incorporated in the Space Shuttle's Waste Collection System (WCS). The WCS is a multi-functional system designed to collect and process biowastes from the crew members.

Additionally, the approach of NASA in giving each astronaut an overview of preventative health measures through basic biomedical training, at least in approximation, ought to be among the standard fare of schooling for secondary school students on Earth.

Rescuing Biosphere I

Were we to successfully complete our Moon-Mars mission, the planet Earth (Biosphere I) would only be the first *biosphere,* or life-supporting sphere, in space as we proceed to consciously create the conditions of atmosphere, temperature, necessary elements, and even gravity through human technology, to sustain colonies on the Moon, Mars, and elsewhere. From this standpoint, the task of applying such thinking to a crash program to "rehabilitate" the Earth from the IMF's policies does not seem like such an unmanageable task, despite the already manifest disastrous consequences of the IMF's policies—massive outbreaks of human disease, as well as unusual intensities of flora and fauna epidemics, and breakdowns in the Earth's weather patterns resulting in anomalous instances and perturbations in drought, flooding, and other weather events. Elsewhere, the case has been exhaustively documented that these large-scale events are the direct result of consciously designed IMF and World Bank policies and not the aberrant after-effects of "irrational Mother Nature."

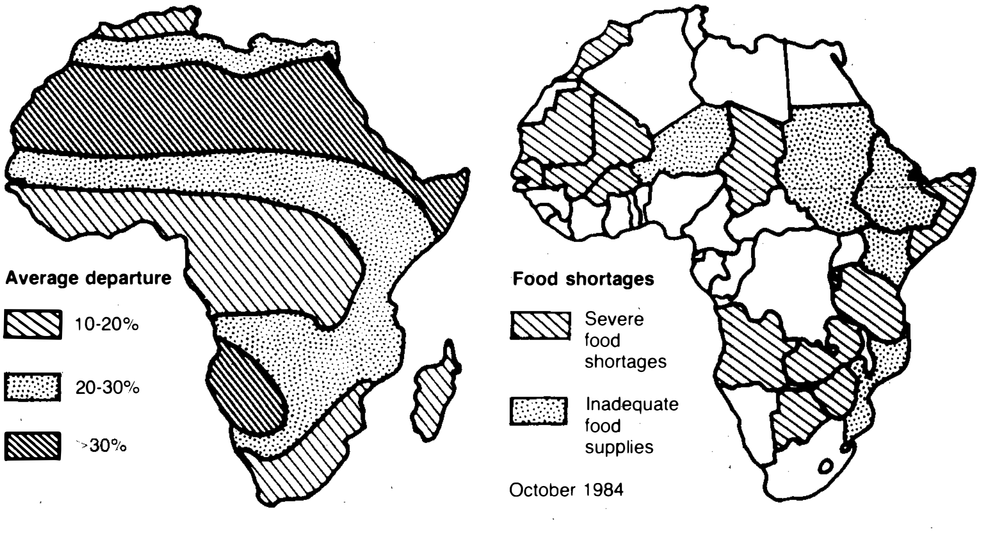
Through the destruction of the productivity of the human economy as a whole, more primitive organisms have come to the fore. The process for the biosphere as a totality can be thought of as a large-scale "cancer." In a human cancer the highly differentiated "species" function of cells break down. Associated with the loss of differentiated function or "skill level" of various cells, tissues, and organs, is a loss of polarity and structure. In short, the cancerous growth takes over, consuming the energy throughput of the system, to reproduce an unspecialized mass, or blob—a totally parasitic, nonfunctional growth which only reproduces itself. As the center of the cancer or tumor rots, the cells clump, can't diffuse oxygen and nutrients in the blood, and cannibalize the very individual which is feeding their growth.

No free energy is added to the individual's system as a whole, and he or she loses all redundancy of living function and reserve capacity. The immunological system tends to break down. In time, the individual dies from infections and malnutrition caused by the parasitic diversion of energy to "support" the tumor. The IMF's policies upon the human economy have had the effect of setting a "cancerous process" in motion for the biosphere as a whole.

FIGURE 5

Rainfall variability and food disasters in Africa

The map on the left shows the distribution of the average departure of rainfall in Africa from the long-term mean, expressed as a percentage. On the right is the Food and Agricultural Organization's (highly underestimated) survey of those African countries affected by severe food shortages and inadequate food supplies in October 1984. Those areas with the highest long-term variability are hit first by any regression in the biosphere's energy potential. (Source: The Global Climate System, *World Meterological Organization, 1985.)*



The causal relationship between the IMF's policies of brutal economic austerity regimes and the outbreak of "cancerous" breakdown for the biosphere as a whole is discussed in the *EIR* Special Report issued July 1, 1985, entitled *Economic Breakdown and the Threat of Global Pandemics* (see especially LaRouche's "The Role of Economic Science in Projecting Pandemics as a Feature of Economic Breakdown.")

The economic breakdown of the world economy has been the direct outcome of the conscious takedown of the *energy intensity* and *capital intensity* of the human economy. Human economies function according to the same thermodynamic principles as living processes. Under conditions of increasing throughputs of energy-intensity and capital-intensity, associated with periods of technological progress and sustained generation of "free energy," the society *grows* and is what we call a healthy economy. It is through improvements in land and the productivity of labor with technology that man has been capable of increasing the *potential relative population density* of his species. Historically this process has been characterized by the increase of human population nearly 500-fold, from primitive man's population of 10 million to the currently-approaching 5 billion.

Conversely, human economies, like living organisms, can also be starved of energy, capital, and nutrient throughput as the IMF "conditionalities" program has implemented. Such societies eventually cannibalize themselves and die, favoring the reproduction of lower parasitic species over man. Moreover, the human economy has uniquely developed to the point where it is the total qualitative and increasingly quantitative singularity in the biosphere, for better or worse. Thus, under conditions of human progress man improves nature through large-scale capital-intensive infrastructure projects—such as rehabilitating deserts, weather modification, rerouting waterways, and so forth. Equally, under IMF regimes which order the destruction of photosynthetically-dense human agricultural zones as well as the laterization of jungle and forest areas, the collapse of energy throughtput, the looting of natural resources without replacement, and so forth, large-scale biospheric processes are disrupted. **(Figure 5)**

The sensor and camera capabilities of Landsat, Seasat, meteorological, and other advanced satellite systems have given man the capacity to monitor the changing conditions on the Earth's surface and in the atmosphere. Through the evaluation of light and heat wave radiation, the distinct "signature" of the entire Earth's land and sea cover has been mapped and stored in Biosphere Data Banks which give precise readings on different types of vegetation and even whether a body of water is clear or polluted. Already, as a "spinoff" from the space program, man has developed the technological capability to "manage" the processes in the biosphere.

Mankind clearly stands at a monumental crossroads, with the full capability to create new biospheres through the colonization of other planets and moons while exploring the frontiers of our solar system and probing outward into interstellar space. In the post-IMF era, the human population will grow rapidly to tens of billions, as we begin our historic mission to "improve" the universe. To accomplish these goals, of course, we will need many, many astronauts. Therefore, we can think of no greater necessity than beginning to treat every African, Asian, and Ibero-American child as a potential astronaut, with the full nutritional, immunological and medical program that implies.

To replace the IMF we need a NASA-style mission control coordinating center to not only guide our course along this exhilarating pathway, but also to translate these capabilities into an immediate upgrading of the "health" of the world's population and our biosphere on Earth.