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INEQUALITY, LIMITS AND GROWTH FROM A BIOECONOMIC VIEWPOINT

By NICHOLAS GEORGESCU-ROEGEN*

1.

Differences between individuals or between groups of individuals are not only normal but also unavoidable phenomena in the biological world. But only within the human species do we find, from the dawn of history on, inequalities of a different nature—social inequalities which have little, if anything, to do with the biological differences. As the earliest social philosophers, Plato and Aristotle, observed, these differences are the source of social upheavals, a point confirmed with perfect regularity by history. Social conflicts of all times have hinged on the economic inequality between social classes, yes, even when the battle cry contained no overtly economic slogans. Other species—the termites, the ants and the bees, as common instances —live in society, but, curiously, are free from any social conflict.

In this paper I propose to explain the fundamental reason for this difference, which singles out the human species, and to use that result for bringing to light the real difficulties that have beset all economic programs aimed at removing economic inequalities between social strata or between nations. I also submit that the solution of tensions of all sorts that exist now in the world and those of a still graver nature that await us in the near future require an entirely different approach than that of standard economics, which insists on relying on the price mechanism and financial transfers exclusively. The new approach, as I have proposed to call it, is *bioeconomics*. [Georgescu-Roegen, 1976] The term is intended to make us bear in mind continuously the biological origin of the economic process and thus spotlight the problem of mankind's existence with a limited store of *accessible* resources, unevenly located and unequally appropriated.

I say "accessible" because, although our spaceship floats on a cosmic sea of energy and matter convertible into life necessities, we can use only a speck of that energy and matter. The "escape" plans which we hear now and then seem to ignore the fact that we can

* Distinguished Professor of Economics, Emeritus, Vanderbilt University, Visiting Benedum Professor of Energy Economics, Regional Research Institute, West Virginia University, and Professeur Associé, Université Louis Pasteur, Strasbourg.

escape only to a planet of climatic conditions identical to ours. Such a planet can exist only in a solar system like ours. The nearest such system is at a distance of about ten light-years away. To travel there by present rockets it would take one hundred years (one way). But, since planets from other solar systems cannot be seen from the earth, we cannot know whether that system has any planets at all. Besides, if it has planets, it is quasi-certain that none would be capable of sustaining the terrestrial form of life. Where is a planet like ours and how many light-years are separating us from it? Who knows and who will ever know? And if we could after all reach a planet capable of sustaining terrestrial life, it is highly probable that life there would be facing the same problems of resource scarcity as those from which we would like to escape. We must not doubt that our destiny is bound to our existence as a biological species on this planet. For in the ultimate analysis, this is what we are: a biological species.

2.

The fact that all biological creatures depend for their life, directly or indirectly, on the *available* form of energy reaching the earth as solar radiation is a relatively old idea which goes back to Hermann Helmholtz. As a result of the recent ecological reverses, the idea has become a commonplace. The complete story, however, is that life also needs a particular form of matter, called (by symmetry) available matter. It is matter available in a structure sufficiently ordered to be used for our own particular purposes. It is, for example, copper ore, as opposed to the copper molecules scattered to the four corners of the world. Through various geological and biological transformations, the available matter necessary for life is now provided by topsoil on land and, in bodies of water, by sediments and by substances in solution.

All species, including the human, go about maintaining, reproducing, and defending themselves with the organs with which each individual is biologically endowed by birth. Following the biologist Alfred Lotka, we may refer to these organs as *endosomatic*. All species, including the human, have also become better adapted to life through advantageous biological mutations. But these mutations occur sporadically and, moreover, the improvement they bring about is fantastically slow relative to the human sense of the flow of time. It took not less than forty-five million years for the *Eohippus*—an animal which in the Eocene epoch was just the size of a beagle—to become

the powerful animal that we now know as the horse. The uniqueness of the human species resides in the fact that mankind transcended this slow endosomatic improvement of its mode of existence—an evolutionary step that fundamentally changed man's fate.

Apart from a few cases of marginal significance, the human species alone began to use and, later, produce *exosomatic* organs, i.e., detachable limbs such as clubs, hammers, knives, boats and, more recently, guns, automobiles, jet planes, etc. As best as we can judge, it all started some twenty million years ago when one of our primeval ancestors, the *Proconsul*, happened to pick up a club from the woods and felt (in a way that we can justifiably surmise) that its arm became thereby longer and more powerful. The result was that the *Proconsul* became thereafter a club-carrying animal. To be sure, this unique phenomenon would not by itself have been of great consequence had it not been sustained by a biological evolution—the improvement of the human brain and the parallel development of the Veblenian instincts of workmanship and idle curiosity. But once the human species reached the turning point at which it could produce exosomatic organs, the subsequent progress in this particular direction was spectacular—exponential, as some like to describe it now.

Unfortunately, the exosomatic evolution that has gradually brought part of humanity to live in the comfort attained by the Western World has not been an unadulterated blessing. It confronted mankind with three predicaments.

3.

The first predicament is mankind's addiction, not only to the comfort (legitimate to a certain extent) offered by the exosomatic organs, but also to the "pleasure" derived from extravagant gadgetry and mammoth contraptions, such as two-garage cars (no typographical error) and absurd implements such as the motorized golfcart. The addiction, which is completely analogous to that of the first fishes which evolved into air-breathing reptiles and thus became irrevocably addicted to air, now constitutes a predicament because the production of exosomatic organs became from a certain moment on dependent on the use of available energy and available matter stored in the bowels of the earth.

And the rub is that the stock of terrestrial available energy and matter accessible to mankind is necessarily finite. Moreover, thermo-

dynamics, backed by as irrefutable evidence as any provided by history, teaches us not only that matter-energy can be neither created nor destroyed, but also that available matter-energy is continuously and irrevocably degraded into "waste," a useless form as far as human interest is concerned. It is in these laws of thermodynamics that lies the root of economic scarcity. In fact, thermodynamics is the physics of economic value, as Sadi Carnot set it going through his famous memoir of 1824. For in a world where the thermodynamic laws would not apply, the same energy could be used over and over again and no material object would ever wear out. Of course, life as we know it also could not exist in such a world. [G-R, 1971, 1976]

The conclusion is clear and inescapable. The industrial activity in which a very large part of mankind is now engaged speeds up more and ever more the depletion of terrestrial resources. It must, therefore, come to a crisis. Sooner or later "growth," that great obsession of both standard and Marxist economists, must come to an end. The only question is "When?" Clear symptoms of the environmental limit have become plainly manifest over the past ten years or so. Pollution is spreading practically everywhere. The United States, once the biggest oil producing nation, is no longer able to increase its production of crude oil in accordance with its current needs.

What has been obvious all the time, but entirely ignored by standard economics, is that natural resources constitute a prime factor in the movement of nations. Natural resources have been the cause for the movement of people over the continents, as during the Great Migration, or, in the past two hundred years, from the Old to the New World. Control over mineral resources has always moved nations to wage war against each other. Nowadays this aspect of the problem is more strikingly manifest than ever. The inequalities of distribution of natural resources relative to the size of the corresponding population is upsetting the old inequality in some cases, and accentuating it in others. In addition to setting the stage for possible fateful international complications, this trend complicates the problem of helping the world of the hungry and the sick, to which I shall presently return.

4.

The second predicament brought about by the exosomatic evolution is the social conflict. [G-R, 1966, 1970, 1971, 1796]

A bird, for example, flies with its own wings and catches insects with its own bill, i.e., with its endosomatic organs. Since endosomatic organs are the natural property of the individual, *they cannot be the object of any "normal" conflict*. The only salient exception is, again, constituted by man. There is, first, the institution of slavery, which has allowed one human to use the endosomatic organs of another human. Second, similar shift has been achieved by the use of personal servants of all sorts as well as by that of domesticated animals. Some people catch fish with the bill of the cormorant and many run with the legs of a horse. These possibilities have naturally led to conflict, but not necessarily to a social conflict. Nor did exosomatic instruments lead to such a conflict as long as their production and use were confined to the circle of one family or of one familial clan. The era when each family, or each familial clan, lived by what its own bow and arrow could kill or its own fishing net could catch was the era of "primitive communism," as Marx called it. Because of the close ties among all members of these small communities, the formula "from each according to his abilities, and to each according to his needs" could work fairly well. Individual conflicts there were—remember Cain and Abel. But no social conflicts existed; there were as yet no social classes, other than those constituted perhaps according to age.

However, the production of exosomatic instruments soon began to call for more hands than were available in a familial clan. At that moment, production had to be organized on a multi-clan level, in other words, to become a social instead of a clannish activity. The clans themselves had to become aggregated, even fused into a higher type of existence, into what we usually mean by "society." At the same time, as an indissoluble requirement of socially organized production, labor became divided, not according to the various types of skills, a division which already existed even within a single family, but according to the roles within the organization. The division, as has been known since Adam Smith and even earlier, is between productive and unproductive labor. A more comprehensive terminology to fit the general picture is to speak of "governees" and "governors."

Concomitantly, a second factor came into play. Exosomatic instruments requiring the cooperation of a large number of people (such as a flour mill, a large boat, or a jet plane) may ordinarily serve a large number of people, yet hardly all members of the society. Even some staple commodities could not always be produced in sufficient quantities for all. This fact raised an entirely new issue: which members are to benefit from the use of the exosomatic instruments? The an-

swer is neither simple nor direct. By their nature, exosomatic instruments are not the natural property of any particular individual. *Prima facie* the issue of who shall use a given exosomatic instrument (or its products) seems to give rise only to an individual conflict. However, the conflict over the distribution of exosomatic instruments and their products has always settled along the division established by the needs of organized production.

Briefly, the exosomatic evolution by creating a social division engendered a first type of conflict, namely, the conflict over who shall go down the shaft of a coal mine and who shall direct the mine's operation, ordinarily from a desk in an office. The second conflict, over who shall use most of the mined coal, established itself along the same social division, that between governors and governees.

At this juncture we should not fail to consider the crucial question broached in the opening section. Species other than ours live in societies based on organized production and yet are not afflicted by any form of social conflict. The answer to this apparent puzzle is that those species came to live in society through endosomatic evolution, which means that each member's role in production is established at birth through its soma. For example, the ant doorkeeper is born with a flat head and, moreover, its instincts are such that it likes nothing better than to block the entrance to the ant colony with its head. In such a society there can be no conflict between one "social class" and another. When the worker bees kill most of the drones as winter approaches, it is not a civil war; it is a normal biological event for that species.

The social conflict of human societies exists only because the human species came to live in society as the result of exosomatic, not endosomatic, evolution. Nothing in the soma of a newborn human determines his future role. Later he may become a ricksha man just as well as a mandarin. And the rub is that, in contrast with the ant doorkeeper, a ricksha man would like to be a mandarin and, as a part of his ordinary efforts, would struggle to exchange roles.[1]

[1] That different occupational roles may lead to a social conflict is evidenced by the latent, but wholly valid, opposition between peasants (the countryside) and townees (the cities). The importance of this conflict for the social economy was recognized even by Karl Marx, who noted, only in passing, that "the whole economic history of society is summed up in the movement of this antithesis." [*Capital*, I, p. 387]

5.

No doubt, a mind from another world would have great difficulties in understanding many aspects of our economic process. Above all, it would find it hard to see why the unproductive labor has always been the economically privileged class. For it is those who provide unproductive labor of all sorts that should be at a disadvantage in their bid for a share of the national income. Manual workers can ordinarily show *how many* bricks they have laid, *how many* shoes they have made, *how much* earth they have moved, and so on. By contrast, governors (be they senators, judges, writers, or statisticians) cannot show in any palpable manner how much or how hard they have worked. The secret of their success resides precisely in this very fact —that no objective measure exists for their work. Naturally, one can keep on exaggerating only what cannot be measured objectively. That is why the social elite of all times, from the high priests of Ancient Egypt to the contemporary technocrats, have asserted their superiority by asking the same question: "Where would you, the governed, be if it were not for us to help you survive?" And the fact is that this question has during all historical periods contained a substantial amount of truth. The high priests of Ancient Egypt did inform the farmers when the time for preparing their fields was ripe; the capitalists did create new jobs through their ventures; and the technocrats do answer a legitimate need of a highly complex mode of existence. But equally true is the fact that a social mythology has always been erected on each of these legitimate roles so as to justify the abusive growth of special privileges. [G-R, 1971]

We have turned around and around and around the mathematical model by which Walras claimed to explain how certain market conditions would guarantee the optimal distribution of national income. But we have missed the essential part, namely, that the Walrasian equilibrium presupposes the existence of an initial income distribution and that this distribution is determined by the division into social classes. [G-R, 1966, 1971][2]

As is clear from the above analysis, the social conflict will, unfortunately, remain part of the human lot as long as our mode of life

[2] The condition (which is systematically ignored) for the existence of Walrasian equilibrium is in fact far stricter. Every member of the community must be endowed *ab initio* with a perpetual income sufficient to maintain him alive according to the prevalent historical standards. [G-R 1966, 1971]

depends on the production of large-scale exosomatic instruments. Contrary to the Marxist fundamental faith, socialization of the means of production cannot bring the social conflict to an end. Where there are now directors and presidents, there will be (as we know only too well by now) commissars and secretaries—a new class with the same old privileges.

Economic models of taxation, subsidies and income transfers are not the means to ensure against the possible severity of social inequality—for which history of old and modern times offers enough illustrations. Economists must become convinced of the crucial truth that social inequality is deep-rooted in our exosomatic mode of existence. Hence, the only means to prevent its aggravation are political and aimed at maintaining the freedom of criticism and the right to vote in, and out, the governors and their appointees. Admittedly, the pressure of an increasing population on a finite and tight-fisted environment is apt to upset this applecart. All the stronger is the reason for economists to turn away from the ill-fitting positivism of the past hundred years and to start looking at the economic process from a physiological and evolutionary viewpoint in a dialectical manner. [G-R, 1966, 1971]

We must also get rid of the myth that increased industrialization will cure any evil. If anything, extreme industrialization sharpens the social conflict. That the well-being brought about by industrialization is not without its social price is a point perceived by both Plato and Aristotle. The former insisted that in his model republic change must be fought off; the latter recommended that in a good society only the vital material needs ought to be satisfied. [G-R, 1977] The same thought has formed the leitmotiv of agrarians of all tints and is now revived in the light of the crises that plague mankind with increasing distress. What is at issue is in fact growth for growth's sake, the psychosis of bigger and still bigger cars, refrigerators, super jets, and even louder loudspeakers. [G-R, 1966, 1971, 1976]

Growth has nevertheless one legitimate role, especially in the present situation in which still another kind of inequality calls for immediate action. This inequality is the third predicament brought upon mankind by the exosomatic evolution.

6.

The biological world is divided into numberless species, the result of the ubiquitous and perennial evolution through biological mutations. Because of its exosomatic evolution, mankind has found itself divided also into different *exosomatic species*. The emphasized expression is meant in all earnestness.

Mankind has been, and still is, divided into races, which means that any two such divisions could coalesce with each other with no biological obstacle. But the exosomatic story has been entirely different at all times. While the Egyptians were building pyramids which even nowadays arouse our admiration, people in Central Europe were living in a Cro-Magnon type of economy. Such differences still exist and in some cases are even greater. Compare the mode of life of North Americans with that of the bushmen of the Kalahari. Exosomatically, even *Homo indicus* is an entirely different individual from *Homo americanus*. *Homo indicus* travels mainly on foot or, at best, in a small cart puled by a donkey, and cooks in a primitive hibachi by burning dried dung. *Homo americanus* travels in an automobile, when not flying in an aircraft, and cooks electrically in a self-starting, self-stopping, and self-cleaning stove. The separation is even deeper and more resistant than that between two biological species of the same genus—say, between a tiger and a lion. For an intellect from another world, which would probably see no reason for distinguishing between the knife and the hand that holds it, *Homo indicus* and *Homo americanus* may appear not as two distinct exosomatic species, but as two distinct genera, if not even families.

Over the past quarter of a century massive financial aid was directed, especially by the United States, toward the economic improvement of numerous countries. In some cases—Western Europe and Japan—the aim was quickly and fully achieved. In most others, especially in the cases of the neediest countries, the effect was next to nil in spite of the greater aiding effort. The puzzling contrast is easily explained in the light of the foregoing observations. Western Europe and Japan belonged to the same exosomatic species as the United States, the ultimate supplier of the needed equipment for recovery. The most underdeveloped countries belonged, and still belong, to a different exosomatic species. The equipment supplied from abroad —from the United States and later from Western Europe—could not possibly fit the exosomatic structure of the underdeveloped nations, any more than a feather taken from a bird could become a better fin for a fish.

Here, again, our parochial (and perforce superficial) understand-

ing of the economic process in its intimate structure led us astray. A *Homo indicus* called for help after his donkey fell into a ditch and broke one of its legs. On the advice of his economic authorities, *Homo americanus* hurried along with one steel radial tire to remedy the trouble of the "vehicle." This is not said in a facetious vein. The R & D in Western countries is interested only in improving the exosomatic instruments already used by them—to design a shaving machine that shaves quicker, or a microwave oven with more self-controls, or a quieter air conditioner, and so forth. All these achievements can be of no help to the people of South Asia or tropical Africa, for the simple reason that these people are a different exosomatic species, that is, they use entirely different exosomatic instruments. To put an electric stove, a refrigerator and a color television set in every household in Bangladesh is a beautiful dream. The fault lies with those who have believed that it can be actually realized over a short period by a few development plans.

7.

The underdeveloped can be helped only if the R & D of the developed countries turns its attention to how to improve the exosomatic level of the underdeveloped. It is a great pity that the organization of the Peace Corps—a great idea—has almost faded away. The Corps ought to have been expanded into a Peace Army (as I suggested in 1965 at the Honolulu Seminar held by the Agricultural Development Council) and composed of local and foreign "soldiers" working in close cooperation.

In the advanced nations, growth simply engenders growth. But the underdeveloped nations can grow only if they are helped. And the most difficult problem of a program for the development-of-the-underdeveloped is that the developed nations must accept a lower level of well-being. Under the stringency of the now emerging conditions, only in this way can the underdeveloped nations be freed from famine and misery. The reasons for this statement are simple.

First, the world population has reached an astounding size; it has just gone over the four billion mark. At the present rate, each year a population of eighty million—equal to that of East and West Germany combined—is added to our already crowded spaceship. It should also be noted that only a small proportion of this eighty million pertains to the newborn; most of the increase comes from the

difference between the old and the new age groups. This is how a population generally grows. The additional eighty million—which soon may become one hundred million or even more—must be fed, clad, educated, sheltered and kept healthy, requirements that impose an increasing burden on an already overburdened population.

Second, national populations are not evenly distributed on the globe and most of the time are not evenly endowed with natural resources. For a picture nearer to his own home a Westerner should try to imagine (if he could) a United States as thickly populated as Bangladesh, in which case it would have not less than five billion people, twenty-five percent more than the population of the whole world! It is hard to believe that even an economy as technically advanced as that of the United States could feed such a large population. If it could, there ought to be no starvation anywhere in the world right now.

Third, scarcities, which have been veiled by the mineralogical bonanza of the past one hundred years, have recently come to the surface. The oil embargo only helped us to become aware of the situation one moment earlier. And when things become scarce, the loser is inevitably he who is economically powerless. Developed countries, because of their immense industrial capacity, also enjoy a great purchasing power. On the oil market, for example, they can simply dominate it, to the practical exclusion of the underdeveloped countries. And the sad fact is that oil is needed far more urgently by these other countries, be it only for supporting their agricultural production through mechanization and high-yield varieties, whereas a large part of oil consumption by the advanced countries satisfies flimsy needs of the kind mentioned earlier. Given the monopsonistic power of the advanced nations on the markets of natural resources, it stands to reason that the gap between the underdeveloped countries poorly endowed in natural resources and the advanced nations will become increasingly wider. This would be true even if the latter nations would just remain at the old level of economic well-being.

A person in the advanced countries may consume on the average hundreds of times more resources than an inhabitant of some nations in West Africa. The United States, which represents only five percent of the world population, consumes about thirty percent of the world annual consumption of natural resources. To maintain a constant well-being for their increasing populations, the advanced nations will have to corner the poor ones on any market in which the

supply is highly inelastic because of real scarcity.

What is needed for even a mediocre solution of the malignant inequalities of a world that seems to have reached its ecological limits is, therefore, not a program based on the mechanics of supply and demand in a dehumanized market, but a change of values in both the developed and the underdeveloped countries. The former must renounce everything that makes life hollow behind a cascade of futile gadgets; the latter must recognize the illusion of growthmania and bring down the size of their populations even more than their developed neighbors.

8.

Growthmania is still very much alive, at least among standard economists and self-styled technocrats. All continue to proclaim that technology is going to grow and grow, exponentially, as they like to say. "Come what may, technology will find us a way." Those who share this faith choose to ignore the most elementary principle of nature. They praise, for example, the "breeder reactor" as an almost unlimited source of energy, claiming against all principles of thermodynamics that that reactor produces more energy than it consumes. And they never ask whether the effort involved in effectively building and feeding the breeder will pay for itself in terms of energy *and* matter. The paper-and-pencil equations suffice to feed their faith.

Nor do they stop to consider the simple fact that natural resources present a certain hierarchy in regard to mankind's exosomatic needs and also in regard to their availability. One still hears the victory cry over the technological feat of producing protein food from crude oil. [G-R, 1975] The cry "Eureka!" rightly belongs, on the contrary, to a process by which automotive fuel would be conveniently produced from "oats" or wood (as was done in many countries during World War II).

Lastly, the same writers ignore that, more often than not, technological progress has represented a move against the grain of economy of resources. One may cite, for example, the automatic drive, the super-duper carburetor, and (not to forget it) the golfcart mentioned earlier.

But the most striking case in this respect is the mechanized agriculture along with the high-yield varieties. Both represent a substitution of the scarcest kind of resource—terrestrial energy—for practically free solar radiation. This is not to mention the additional depletion

of material resources caused by the use of tractors as well as chemical pesticides and fertilizers. [G-R, 1970, 1971, 1976] Yet intensive agriculture must continue, not because it is profitable given the prevailing prices in advanced countries, but because a high yield is necessary to feed the still increasing population of the world.

The point leads to another immediate bioeconomic commandment: the population of the globe must decrease to the level of the natural carrying capacity of the glope, i.e., to the level at which it can be fed by organic agriculture alone. Naturally, that level is rather small since in organic agriculture man must share his farming soil with his beasts of burden. There must be both food and fodder. "The horse eats people" is the way in which the imagination of the Romanian peasant crystallized his hard-to-bear conflict.

9.

I hope to have proved in the foregoing analysis that the multiple crises that confront mankind at the end of this century call rather for stopping growth, nay, for reversing the growth of both population and material conveniences. Growth should be a target only for the underdeveloped nations and only up to the modest level that must ultimately become the rule for all. But for a long time the most urgent problem will be that of food for the hungry nations. Yet the program should be based on the slogan, "Factories, not food, for the hungry," factories that would enable them to support a mechanized agriculture until the pressure of population on land has faded away. The position that calls for a redistribution of the industrial power, as understood in this context, is as valid as that which calls for a decrease in population. It is sad that this truth has been obscured by ideological sterile controversies over the basic bioeconomic problem.

The necessary resources for the above program of helping the underdeveloped may come from many directions. They may come from a renunciation of futile exosomatic instruments, of the razor which is wholly tossed away when the blades get dull, of electronically operated flag poles, of Concordes, of the mimeographing machines for which millions of trees are felled to remain "unread," and, above all, from totally discontinuing the production of armaments. It implies, above all, the undevelopment of the developed.

A word of caution seems in order in closing. We should not be

lulled into thinking that, just because we found growth to be a hard nut to crack when needed most, undevelopment must be a simple matter. Accumulation may constitute the main headache of all planners; decumulation, however, is a far more complicated process. [G-R, 1971, 1976] To take just one example: if population decreases too fast, the old persons become exceedingly numerous relative to the groups that keep the economic process going. The conflict that would necessarily ensue could become so harsh as to disturb the social order by a biological, instead of a social, war waged between generations through institutionalized euthanasia.

Growth, as understood by standard theory where it is always depicted by exponential curves, is certainly falling out of fashion, like many other famous preoccupations of the economic profession in the past. If my intuition is correct, we should soon witness the emergence of a new guild, that of undevelopment experts.

Be this as it may, I hope that economists will ultimately come to see that the problem of natural resources is mainly an ecological one and that economics, as practiced until now, cannot substitute for bioeconomics. Numberless economists—Milton Friedman, for one[3]—believe in a strange alchemy by which the price mechanism could create energy and matter. The price mechanism cannot prevent bioeconomic catastrophes from happening. Nor can it help the distribution of natural resources in a fairly satisfactory way among successive generations, not even among contemporaneous ones.

All this boils down to the need for a change in our values. In the past we went from "Thou shalt not kill" to "Thou shalt love thy neighbor as thyself." The times call for a new commandment:

"Thou shalt love thy species as thyself."

This means nothing more than that each current generation must take into account the demand (i.e., the needs) of future generations, for these generations cannot yet be present to bid for their share of mankind's dowry of available matter-energy. It is the task of bio-

[3] According to press reports, Friedman claimed that "The problem in energy is the extent to which government has interferred with the market, and Mr. Carter's solution to act on demand by bringing it down to a diminishing supply is to interfere still further and will make energy less available." [*The Houston Post*, April 22, 1977, page 9A] Friedman seems to believe that even at this hour we should make energy more available, so as to spend it on all kinds of extravagant contraptions in which the most fortunate usually indulge. Indeed, according to his well-known position, the *right* prices are those that are determined by the free play of the extant income distribution.

economics, broadly outlined in this paper, to set up a logical framework for this issue and a workable system for implementing the new commandment.

It is too early to predict in some detail how this program will develop. But two pillars of standard economics must in any case be abandoned and replaced with entirely different—nay, opposite—principles. First of all, we must discard the principle of discounting the future, which has served as the basis for Harold Hotelling's famous study of the economics of irreplaceable resources [Vide Hotelling] and continues to do so. Mankind, as a quasi-immortal entity, cannot discount the future; only a mortal may do so. Second, instead of the traditional principle of rational behavior—that of maximizing "utility" (whatever that may mean!)—our policy toward natural resources in relation to future generations must seek to *minimize regrets*. From what it seems, it is precisely because we have always maximized utility that we are going soon to greatly regret our past policy.[4]

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[4] A reduced version of this paper was read at the DFG—Symposium on *Limits to Redistribution in Stagnating and in Growing Economies*, Augsburg, June 30-July 3, 1976. The present version was prepared while the author held an Earhart Foundation Fellowship.

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