ownership of these exosomatic instruments is the object of a struggle between rich and poor, human beings and countries, that will be there under any regime as long as there is a human society.

For Georgescu-Roegen the GNP (Gross National Product) would be better called "Gross National Cost" and, like the concepts of efficiency, profit and other narrowly defined economic notions, it must be replaced by thermodynamic priorities in evaluating economic activities and technologies within a broad ecological context.

His paradigm is more useful and fruitful than standard economics, because it is concerned with the dramatic consequences, confronting mankind as a result of the reversal of patterns in the relations between population, energy and resources. The next generation of economists will speak only the language of Georgescu-Roegen. Or, as the Nobel Laureate Paul Samuelson described him, Georgescu-Roegen is "a scholar's scholar, an economist's economist," a man whose ideas will interest minds when today's skycrapers have crumbled back to sand.

Looking Back

Nicholas Georgescu-Roegen

Most of you are far from even getting near to my age. When I defended my dissertation at the Sorbonne in 1930 hardly anyone of you was born. So I hope that you will not have to wait until you reach my own age in order to realize how I feel now, after a long, long effort shattered by this century's catastrophes, to receive this lift-spirits accolade from you. Although it should go without saying, I want to say it.

My gratitude goes first to our President, Professor Joseph Constantine Dragan, without whose visionary support the *European Association for Bioeconomic Studies* could not get off the ground. I also wish to thank the Vice-Presidents, Professors M.C. Demetrescu, Romano Molesti, and Eberhard Seifert, who by their initiative, dedication, and elbow-grease have organized the E.A.B.S. and made it possible for us to set forth our contributions to the solution of mankind's entropic predicament. Last, but not least in any way, I am greatly thankful to Korinna Müller and Traian Filip who have worked hard *in camera* to bring this event to its assured success.

I should not fail to salute you as the first generation of bioeconomists either. Actually, to salute you is the main reason for my intervention at this event, one of the worthiest in my life. Together with a host of other students of the ecological problems of mankind you are on the tail of a tidal wave, so to speak, that jolted almost everyone, but mainly writers and publishers. There was surely a writing on the wall by the oil embargo of 1973-1974, although everyone, especially in the advanced economics, could read it in his or her own language at all gasoline stations: PUMPS CLOSED.

The idea that the exhaustibility of mineral resources, finite in amounts, must be a major concern of ours had been only rarely entertained. Masterly frontal attacks were accomplished first - incredibly today - by two economists, in France by M. Messance during the eighteenth century and in England by W. Stanley Jevons during the nineteenth. Only by the middle of this century there appeared some perceptible interest at first for the problems of pollution, simply because being a surface phenomenon, pollution had already reached the level at which it inconvenienced its perpetrators. But as hardly anyone could see the growing caves left after the mining of the underground resources (as we could see later the immense hollows of several miles in diameter created by the modern open-pit mines) consideration of the scarcity of these resources advanced rather slowly. The Paley Report, *Resources for Freedom* (1952) was a remarkable impetus for that unfolding as evidenced by the founding of the anagram institution, *Resources for the Future*, which, incredibly again, was to study only the scarcity of materials, not of energy (of which there was plenty at that time in the United States).

Although before the oil embargo several remarkable contributions had already dealt with some of the important issues of scarcity of natural resources, the field now known as environmental science or energy analysis was virtually a no-man's land. People from all walks of life, notably those without a definite professional tie, irrupted into it then and ever since. And because of the silly constraint, "Publish or perish," those green energetists have resorted to any flight of fancy. Any artifice or skill from some past training was forced to work, as in a labour camp, on anything, except on what was meaningful. Science *à la mode*, as Richard Rothman would say, was in full swing, which meant that only what was on paper should count. I need recall only the enormous blunder - that on whatever you may spend one dollar (the author of it was American) on caviar or on potatoes, you will get exactly the same amount of embodied energy in either case. It was proved correctly *on paper*, by the does-all input-output analysis, and published in *Science*.

In spite of such hitches, to be an environmentalist has become a fashionable and easily accessible, nay, an exceptionally lucrative profession. Global associations that keep mushrooming are nonetheless all superaboundantly founded. Given the extreme disarray of the environmental perspective this situation calls for a confident explanation, to which I shall now turn.

The associations that claim to offer solutions to the menacing energy crisis cannot be lesser than global so that we should acknowledge their plan, also global, to safeguard the earth. The success of these associations is due to several factors, the most important being that they speculate a general human weakness. This is to delight in listening to any lullaby, and what those global associations sing in mass is just a lullaby. In that typical manner they sell what I think to be a shrewd and highly dangerous snake oil. Indeed, take "Sustainable Development", the most advertised snake oil for ecological salvation: it is surely the most charming lullaby. It is a new logo which outmoded "Steady State" only after the members of that ilk got to think at long last that their prescription would provoke the century's scientific scandal if proposed to the people of Bangladesh or of any country of want. For such countries "Steady State" would have meant a verdict for eternal misery. But do we care about what happens in reality as long as we are applauded by global conventions?

Now, to be a lullaby what it says must be somewhat of a dupery, and the lullaby "Sustainable Development" is no exception. If nonetheless it has had a remarkable success, it was because of a few additional favourable circumstances. A particular favourable catalytic factor which must have presided over the choice of "Sustainable Development" is that for this logo the subliminal suggestion is the expression "Sustainable Growth" made famous by W.W. Rostow during the days of growthmania. Search as search can through the entire economic literature no one could find a single paragraph in which the meaning of "development" is disassociated from that of "growth;" on the contrary, constantly "development" is used interchangeably with "growth" - except in the writings of Joseph A. Schumpeter, but who should care a bit about the most inspired philosopher of what the economic process *is*. Why should then anyone listening to its propounders think that the miraculous development can happen without any growth? No,

anyone will believe what they want him or her to believe, namely, that the snake oil will foster growth, GROWTH as that propagated by Sir Roy Harrod and W.W. Rostow.

Conditions inside the environmental science grew quite scandalous as economists hastened to make known their reaction to the oil embargo. Almost certainly, in defense of their past positions which, Marx's included, never allowed for the important role of natural resources in the economic process. It could not be otherwise as modern economists reduce everything to the vapid terms, input = to what is put "in", output = what is put "out". Thus, when pollution hits everyone in the face, economists must have wondered where it came from, it was not in their standard production function. Does an energy crisis loom large at the horizon? We need not worry. The economists' canon has been for long that ever since the time of Father Noah we have ascertained that "come what may, we shall find a way".

The situation was further aggravated as many natural scientists also entered the arena to express their negative opinion about the entropic devastation. For example, Peter Auer, a physicist trusted with many signal jobs, wrote a special essay to explain why the Entropy Law cannot limit in the least economic growth. And Glenn Seaborg, the greatest among the great Nobelists in physics, preached that science will enable us to put everything exactly back from where we took it, so that the Earth will remain eternally a perfect environment.

As science has been extolled as never before for its assumed unlimited power to fix anything we want, it was natural for some sprightful environmentalists to buttress the "do not worry" canon by a new guarantee, the guarantee that several alternative technologies are waiting just around the corner wherefrom they may come out any time now, in about a few weeks some specialists in energy convertors have assured us not very long ago. Some has constructed a clock that runs "on air", and hopes that soon we will be able to run everything on air would not be unjustified. But it was an authority such as John von Neumann who assured us that soon energy will be as free as the unmetered air. The ecological salvation must then also be just around the corner.

The most advertized of the alternative technologies is certainly that based on the direct harnessing of solar energy. Authors who ordinarily hasten to write something, anything, dealt sumptuously albeit repeatedly with that problem although they did not even dream that no technology can be viable unless it is sustained by a totally uncommon recipe, a Promethean recipe as I proposed to call a recipe that, like fire, can make more *available* energy *accessible* to us by using substantially less of it. To wit:

With the small flame of a match we can set on fire a whole forest, nay, all the forests of this planet and have access to all that immense heat energy.

And still more important for our exosomatic life, with just a handful of coal put under the boiler of a steam engine, we can make accessible to us more coal to mine, still more coal and other mineral resources with which to make more steam engines and other machinery. In the words of my great master, Joseph A. Schumpeter, "we make machines to make machines... to make machines". This algorithmic process is imperative for the survival of an advanced *exosomatic* species such as ours.

After hearing about this marvellous technique, one may find hard to believe how

many rigorous restrictions characterize technological arena. I am considering the extraordinary lesson from *Solarex*, very likely the most qualified organization in the field of silicon cells, which shattered the widespread hope that a viable solar technology also lies around the corner. By a well-conceived and quite costly experiment they proved with the complete respect for experimental protocol that the amount of solar energy harnessed by a large assay of silicon cells does not suffice to reproduce the cells used up by the process, even if all the necessary material ingredients are provided gratis.

Curiously, this news, old of some twenty years, has not come to the ears of any ecological, technological, or energy expert. Nonetheless, we kept insisting that "solar technology is here [not around the corner!], we can use it now", and thought that we ought to have a Sun Day. It is true that the basis for some solar technology has been here since the emergence of the chlorophyl plants. We have been using it for millennia, first of all to get clubs and sticks, and now in a massive way, but not in the measure that could sustain a development of the vital sectors of an exosomatic living to which we are addicted in the full meaning of that word.

That it is impossible to rely now only on that technology has been proved beyond doubt by the fuel crisis that extended during the reign of Elisabeth I over all Atlantic countries of Europe, as I shall explain now.

Sustainable Development, as presented by almost all its advocates, is in essence an economy fueled by the solar energy harnessed by the green plants. This necessarily means that tractors, trucks, and other agricultural machinery should be replaced by beasts of burden. And this is the hitch that has bothered (so it seems) no advocate of that economic prescription. *The beasts of burden are no perpetual motions of the first kind.* To live and pull loads they must be supplied with energy, viz. fodder. Fodder, in turn, needs some land on which to grow. The final conclusion of this simple concatenation is that all humans must divide the agricultural land between the production of food and that of fodder (a point confirmed by the wisdom of the Romanian peasants who used to say "the horse eats people", flabbergasting the uncongenial town-dwellers). Since there is some necessary minimum of daily food intake for the average human, the humans' number in the world must be reduced drastically not only for a sustainable development but even for a stationary economy. But as we know by now no community would accept such a demographic programme, save if forced at the gun point, as it was, perhaps it still is, the practice in China. However, the issue of overpopulation has not been viewed yet in its dismaying dimension. Think of it, if United States were populated as thickly as Bangladesh, it would have a population as large as that of the whole world now. If it could support itself in that condition, it should be able to support now the world population - which, of course, is an absurd speculation.

By a careful unraveling it will be seen that the actual target of Sustainable Development is "Conservation" which must not be even whispered because it has no alluring power for a lullaby, nor can it suggest to be the product of a sophisticated analysis. That conservation in its basic meaning is the only valid ecological programme is what I have tried for years to bring it home. But I also showed that a sine qua non of conservation is a *negative population growth.* For surprising though it may seem, Malthus was not

Malthusian enough. His solution for the food scarcity was a steady population, the same as the earliest of the current lullabies. For the good of their own species, humans will eventually accept a steadily decreasing population.

Sustainable development could not be an exception. What factual conditions are cowered under that alluring title is the return to our previous technology, the wood technology, which may be fraught with even more severe snags in the long run than the current one. Forests cannot be turned into everlasting suppliers of appreciable amounts of wood. Deforestration has gone on continuously. Only since the beginning of this century ninety percent of forests have been lost. This included mainly rain forests, but with the savage deforestration in Western Europe to support the economic development of the wood technology (when even cannons were made of wood) by the end of the seventeenth century a crisis sounded the end of the sustainable wood. Fuel, that meant wood, was no longer easily available. A crisis menaced economic activities in exactly the same way as the present insinuating crisis of mineral fuels affects us today. That wood crisis had a fortunate end. It was reduced by the invention of the steam engine - a fabulous albeit sorely disregarded exosomatic organ - the gift of Prometheus II - personalized by two mortals, Thomas Savery and Thomas Newcomen. The object lesson of that remarkable history can hardly be overemphasized. It bears out what I have said earlier about viable technologies. What can save us now is only a third Promethean gift. Now, although the advent of Prometheus III is totally unpredictable - neither Galileo, nor Huygens, who were the predicted Prometheus II, corresponded to the hopes placed in them - he or she may happen any time.

Recently, but not with the same global fanfare, a new solution for the ecological salvation has found its way in print. The Entropy Law can be and will be soon refuted. Have not most of natural laws - remember the Almagest or the phlogiston - been refuted by the march of history? I am not impressed at all by this sophisticated affirmation. Established brute facts have hardly been thrown out of existence, only their interpretations have been modified now and then. To cite an apropos case, statistical mechanics did not refute the *fact* that when two bodies are in termal contact the warm body becomes colder and the cold colder. It only sought to provide it with a different interpretation, close to the beloved classical mechanics.

Be this as it may, in the case of the Entropy Law history is on the opposite side of the aforementioned contention:

Absolutely every time when the bare hand of a human touched some embers that human reported that his hand, not the embers, got schorched

thus confirming what the famous thermodynamicist, Rudolf Clausius, said it in a splendid transparent way for anyone who is not satisfied without systems of non-linear differential equations (as is now *à la mode*):

Heat always passes by itself from a body to a colder body, but it never passes by itself from a body to a warmer body.

With the ongoing glorification of science to fix anything - science can do any, many things but not everything - and with the endless expatiations on the various interpretations of the Entropy Law we came to believe in earnest that that law can be effectively refuted

so that we could live in a paradisiac anentropic world. There can, I think, be no more inept desire. Should an anentropic world exist,

I would certainly not accept to live in it since there I would not take a bath for fear that my neck would be scorched while my toes would be frostbitten.

I would not accept to live in an anentropic world also because without friction (a major producer of bad entropy) I could not go where I wanted, nor write with pencil on paper. Astonishing though it may be, the following point deserves to be emphatically marked:

Biotic life may exist only in a world in which the Entropy Law is at work.

Anyone ready to start digging for the anentropic world should bear this in mind all along with Albert Einstein's overlooked opinion (from his *Autobiographisches*):

[Because a] theory is the more impressive the greater the simplicity of its premises is, the more different kinds of things it relates, and the more extensive is its area of applicability [it explains] the deep impression which classical thermodynamics made upon me. It is the only physical theory of universal content concerning which I am convinced that, within the framework of the applicability of its basic concepts, it will never be overthrown.

I have recalled earlier that the initial task of the *Resources for the Future* was to study the scarcity of mineral resources, now called non-renewable in opposition to the renewable flows that come from natural sources - a deceptive term because none of these flows is truly *renewable.*

Hard to explain why in spite of all that, by now ecologists of any status maintain that it is preposterous to worry about the scarcity of matter; the whole Earth is made of matter, as two writers on ecology demonstrated in *Science.* They should have been flagged down for two reasons: first, because they ignored that not all matter is available matter, and second, because we should not worry about energy, the whole planet is made of energy (unqualified).

The same idea has been frequently propped by many dominant writers who believe that whatever they scribble on paper is what reality displays. This category comprises many standard economists, highly respected, who just point to the hoary Wicksteedian production function based on total substitutability and rewritten, for the occasion as

$$O = F(L, K, R,),$$

(where notations are customary) and instruct us that there is no reason to worry about any natural resources - matter or energy - being depleted, O may be kept constant or even its development sustained because if R (the natural resources) must be decreased, we can always compensate for that by simply increasing the other factors of production, more labour, L, and more capital, K. That is absolutely perfect as an elementary exercise in advanced calculus, but it is an utterly fatuous proposal to actuality:

In actuality more capital and in the end also more labour cannot be obtained without more resources, increasingly more (according to the solid economic principles).

It is especially in connection with the scarcity of matter that I found myself at the

opposite end of those writers and, as I can say in good faith, of the actual servants of thermodynamics. Coming into the field as a green worker, I was able to see - as Schumpeter used to say about the young Stanley Jevons - what the veterans had not seen and be disturbed by what they were taken for granted. But my fortune, as I explained in detail in one autobiography "Georgescu-Roegen about Himself", had been wrought by marking events: as a student of the great Emile Borel I read his *Mécanique Statistique*, and as a curious student I was impressed by the working of the Entropy Law in my own country.

So, as I turned to learning thermodynamics from the usual textbooks I was struck from the very beginning by the fact that the discipline concerned with the material transformations in the world studies what happens to the energy in *the bulk*, but completely ignores what happens to matter in *the bulk*. The only time matter indirectly mentioned even now in classical thermodynamics is in connection with friction as a robber of available energy. I felt that such a perspective was lame. Like everyone else I knew that the soles of our shoes must be replaced, not reassembled from their original molecules dissipated all over the place, and that the same was true of many other objects of matter in bulk. Judging that matter in the bulk, just like any available energy in the bulk, dissipates irrevocably, I cast my vision into a proposition involving only authentic terms of thermodynamics:

Perpetual motion of the third kind is impossible.

As I have defined it, the motion of the third kind is a *closed* system (not to be confused with the *isolated* one) that can exchange only energy with its environment (as the Earth is for all practical purposes) and performs mechanical work forever at a finite rate. The above postulate asserts that such a system is impossible, just like the older perpetual motions, of the first and the second kind, are.

This contribution has received a *fin de non recevoir*, as my distinguished supporter Stefano Zamagni said pinpointedly, from both the professionals of thermodynamics and from the self-induced activists in and around that discipline. No qualified student seemed to want to cross intellectual swords with me over my postulate. But I have been informed that on the side only some have opined that the postulate and the implied Fourth Law of Thermodynamics I have also enunciated are not true. Economists did not want to miss the occasion to aver the coming of new Jerusalem. Too many had gotten sparkling laurels for devising all kinds of growth recipes.

A couple of experts at vociferation have simply called out that my postulate does not deserve any consideration because *it has not been proved.* This is another sad proof of how utterly demanding science is. Those particular denouncers ignored that no other perpetual motion had been effectively proved. They did not know that the impossibility of a factual assertion cannot be proved in the same way as a logical impossibility is formally proved. Think of the way you would prove that it is impossible for the number of the real roots of a polynominal of uneven degree to be even.

My proof had followed the procedure used for the other perpetual motions, which was to show that the blueprints set forth to show the possibility of each of the perpetual motions were flawed. What I proved was that the famous Van't Hoff box, purported to

show how the interdiffusion of different gases may be *completely* separated, could not do that. One snag of that box, as I see it, seems to affect also the now fashionable separation by laser. It is the impossibility of calibrating perfectly the semi-permeable of the box or the wave of the laser to the composition to be separated.

Some critics have imagined another experiment to prove that dissipated matter can be completely reassembled. They proposed to use a magnet to reassemble the filings from an iron bar. The argument places those critics in the excellent company of Galileo. We may recall that Galileo did not believe that the arrow gets hot also from the friction against the air. He argued, if it were so he could measure it. Indeed, no instrument was then so refined. But do we have now a perfect instrument with which to determine exactly how much filings might be on that floor before the experiment begins. This is a demand of logic for the exactitude of the proposed experiment.

In this connection it may be well to see how smallness works its way through a material process. No matter how small k, the rate of matter loss is through each operation, after n operations the coefficient of the matter in bulk remaining is $(1-k)^n$, and this approaches zero rapidly. Incredibly, however, in the *Bulletin of the American Physical Society* (1976) we find a "Policy of Permanent Self-Sufficiency in the Use of Non-Renewable Resources", which claimed that any resource can last forever if each year the same proportion K of the remaining reserves is depleted. Of course, what is involved is the size of the function of time, e^{-t}, which indeed is never zero, but in time will be smaller than the diameter of an electron.

It was on such a searching and querying furrow that I realized that since matter irrevocably degrades we must recycle it whenever it is possible, but what we can recycle is only available matter that, although available, is no longer in some useful shape - broken glass, old newspapers, worn out motors, and so on down the line. We cannot recycle the unavailable matter, the small, microscopic, ultra-microscopic bits of matter dissipated from automobile tyres on the pavement or from our wedding rings in the places we frequent. To be sure, if we allow the time of operation to be infinite, then anything becomes possible, even the perpetual motion of the first kind, for then we can move with an infinitesimally slow speed.

I should not bypass the facile objection addressed to many bearers of some novelty, illustriously to Stanley Jevons. At a round table discussion of my views, some charged my postulate to be false, while the next speakers insisted that it was already well-known. Here again the poor information of the last critics, some very respected academics, rendered their argument barren ab initio. What they had in mind was the thermodynamics of the open systems, the splendid achievement of Ilya Prigogine and his Brussels School. While it is true that the new thermodynamics considers also the open systems - veritable progress from the classical thermodynamics which had in view only the closed systems - it still does not consider the irrevocable entropic degradation of matter or the completely irreversible interdiffusion of gases. The way I have shown this fact is surprisingly simple. The fundamental law of classical thermodynamics is the familiar equivalence in *energy units*

$$\Delta U = O + W,$$

where ΔU is the quantitative change of the energy within the system, O is the flow of heat transported in and out *only by thermal contact*, and W, the amount of work performed on or by the system. In his celebrated volume of 1947, in the English translation *Introduction to Thermodynamics of Irreversible Processes*, Prigogine's novelty was the replacement of that equivalence by another equivalence

$$\Delta U = \phi + W,$$

also in *energy units*. O is replaced by ϕ which is also an energy element - it could not be otherwise if the other two terms still represented energy. ϕ includes as well any energy carried inside or taken out of the system by some matter. That matter is to be viewed as an entropically indestructible element serving as a carrier of energy. For example, it might be a piece of hot iron or the hot air from a furnace introduced into an open system.

I propose now to project my concluding observations against a famous story about Mohammed, the Prophet, famous but not from the official Koran. The story is that Mohammed once preached that because the mountain does not come to Mohammed, Mohammed must go to the mountain. However, with the growth of our power to the point where we can cut Suez and Panama canals, and by the nuclear power even move mountains, it seems that Mohammed was wrong as concerns us, the overindustrialized humans. Today we can bring the mountain to Mohammed who need not make any move.

This is, I maintain, the idea that presides heavily over the current ecological outlook which, at bottom, means to sing to the Mohammeds a lullaby about the alternative salvations ready to come forward any time now from where they are waiting.

That is certainly the most expedient charge for those who profess a wholehearted concern for mankind's continuous ecological fortitude. To persuade people to change their views on life and their habits is without doubt a very difficult task.

The right choice is to follow The Prophet's counsel, to convince the people that *they* should move towards the mountain of a life longer and saner than that which would prevail otherwise. This is the idea that guided me in setting forth a bioeconomic programme in my first manifesto (December 1969). That programme, I admit, is unpalatable, especially so to the upper crust of our species where ever it may find itself. Hard to believe in retrospect, the main opponents to the essence of that programme have thought that the ecological problem we are now facing can be solved by calling me and the few others of the same persuasion "pessimistic doomsayers". Philip Abelson, the editor of *Science* and the main fighter against that creed, could arm his editorials for his plank. In one editorial he cried "Enough of Pessimism". I wonder whether I was an irrational pessimist when in an interview for *The New York Times Magazine* in December 1979 I said that if production, distribution, and consumption of mineral fuels are not covered by a world-wide policy, in a not too distant future warheads may fly for the possession of the last drop of Arabian oil. It is not for bragging but for obtaining the absolution for my pessimism that I mention now the Gulf War (which certainly was not in response to the annexation).

Further, my programme has been accused of wanting us to return to the cave, if not to the tree. In the main, that programme only invited us all to cure ourselves of the morbid

craving for extravagant, mammoth gadgetry, often self-contradictory, as well as of our attachment to fashion - which, as Oscar Wilde quipped, must be a terribly bad thing since we get rid of it every six months. You might have read the advertising of an automobile which blasted that driving it along *Strada del Sole* is the nearest thing to pure pleasure. One particular sin, however, should not be overlooked, especially in advanced economies it is a widespread practice. It is the sin of ignoring the original meaning of economizing as found in Aristotle's (probably spurious) *Oeconomica.* According to that meaning, we should economize by ceasing to overheat, overcool, overspeed, and many other such overdose.

No environmental policy should possibly ignore an ethical issue that pertains to the fate of the future human generations. Cynicism seems now being in great favour with many literati, some of whom keep uttering the remonstration "What has posterity done for me?". But I would like to ask them "What has posterity done to you so that you should deprive them of plowshares and shovels by wasting scarce metals in order that you should enjoy luxury after luxury, two-garage cars, pleasure motorboats and yachts, or even the incriminatory golf-carts?". Further, if I may, "What has posterity done to you so that you should pass on to them a planet full of murderous pollution and a public budget full of debt pollution".

A few minds only have struggled to expose the sellers of the snake oils and the applause seeking cynics, but I know from my own experience that their task is a terribly harsh one. Their voices have been stifled by the deafening rallying cries of those assembled in global (nothing lesser than that would be befitting) conventions of which I spoke earlier where many untutored minds can air their drivels. To concoct some ecological prescription does not demand any excellence. Look up, if you wish, some of the recent issues at random of *Ecological Economics* and *Journal of Environmental Economics and Management.* How all this anomalous condition came about has been admirably explained by a perceptive young economist who in a document of the time asked "What does Professor Georgescu-Roegen expect us, young fellows, to do, to write some solid stuff like Marshall, Hayek, Frank Knight, or other greats? Not to perish, we must resort to the easiest course, to cranck the mathematical machine". And given the current brouhaha in the environmental orientation such scrabbles find their way in print in preference to everything else. There are publishers who also know that people delight in hearing a lullaby, and hence publishing lullabies brings subscribers even to a submediocre periodical. Garrett Hardin is a writer who, among other great talents, has always come up with *le mot juste* for a strange situation. That is particularly true for his last volume *Filters against Folly,* with the piercing subtitle *How to Survive Despite Economists, Ecologists, and the Merely Eloquent.*

Among the great scholars opposing the cornucopian view of mankind's entropic predicament I should mention only those with whom I happened to work closely and from whom I got much inspiration. Preston Cloud, a superlative biopaleontologist, is the author of many outstanding monographs, especially *Man and Natural Resources* published in 1969, *before* the oil embargo. William Miernyk, who has accepted to serve as the United States representative to this Association, also did not wait for that embargo to stir his

interest in the problem of the scarcity of mineral resources; he had already published several documented volumes on that issue.

We have tried insistently to imagine how our abode might look after a nuclear holocaust, and found it horrid indeed. However, that need not be a part of mankind's future if *homo sapiens sapiens* could be wise, too. Much more menacing is a natural phenomenon over which we do not have much control. It is the steady worming of the Earth. Thermodynamics, which is *à la page* today to be disparaged, teaches us that there is no technique, not even among those around the corner, to cool a heated planet. And the outcome of that warming may be even ghastlier than that of the post-nuclear landscape. In the expert opinion of Jacques-Yves Cousteau, it will be a completely flooded planet but without any rain.

The future for our species does not look felicitous in the least. Yet there is much that we can do to improve it for a longer span. It all depends on us, more so on young humans like yourselves. On this thought and on all I have dared (yes, dared) to say in this address, I wish you, members and friends of this Association, a successful bioeconomic activity for your glory and the good of mankind. Or do you know another species that deserves a greater attention from us?