

A MIND AHEAD OF ITS TIME

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Prologue

Readers familiar with Nicholas Georgescu-Roegen's recent work, especially his long introduction to the English translation of Gossen's Entwicklung, might suspect a similarity between this essay and that introduction [Georgescu-Roegen, 1983].¹ Following the caveat of writers of fiction, let me stress that any such similarity will be purely coincidental.

Gossen was a German bureaucrat who wrote a single book published in 1854 (translated into English in 1983). He was, in his time, an economist manqué. In his History of Economic Analysis, a volume which Georgescu considers "magisterial," Joseph A. Schumpeter wrote that Gossen was one of a few early economists who "wrote above their time." Georgescu disagrees:

No one, I have submitted, can write above one's time. Gossen was no exception. The Entwicklung was not above the understanding of Gossen's contemporary literati. The bureaucrats who read his examination papers, which contained most of his novel ideas although not always to best

advantage, were able to understand what Gossen said. Gossen did not write above his time. He only happened to write in the wrong country [GR, 1983, lviii].

Gossen's work was ignored by his contemporaries, as well as by later economists, until it was "discovered" by Jevons and Walras about two decades afterwards. Objection to the Entwickelung was not because of what it said, but to Gossen's use of what would today be considered rudimentary mathematics.²

Georgescu's critique of the concept of "thinking above one's time" appears to be based solely on the criterion of comprehension. And given the elementary nature of Gossen's mathematical presentation he is surely correct. As Georgescu himself noted, however, at the time Gossen wrote German economics was dominated by the Cameralist and historical schools, and the use of mathematics -- or any analysis in a broader sense -- was anathema to them [GR, 1983, op. cit.]. It seems, then, that Gossen's work was ignored in Germany not only because of what he wrote, but because he chose to elucidate his concepts by the use of equations and graphs.

It would be grossly unfair to suggest a parallel between the careers of Gossen and Georgescu-Roegen. When Gossen realized that the Entwickelung was a failure he asked his publisher to withdraw unsold volumes from the market, and that evidently was all but a small number of the original printing. His

disappointment was exacerbated by a severe attack of typhoid fever, and he died in 1958 at the age of 47.

Georgescu-Roegen, by contrast, is internationally-renowned. His work has been translated into several foreign languages, and he has been given virtually every honor that an economist can receive.³ Still, Georgescu's work can be classified into two clearly defined "boxes." One contains his significant contributions to traditional Neoclassical theory [see e.g. Samuelson, 1965], and to inter-industry economics [GR, 1966, 316-337].⁴ Georgescu's "principle of perseverance of nonpreference directions," for example, foreshadowed a well-known concept in Neoclassical economics which Samuelson later was to dub "revealed preference." Contributions such as these guarantee Georgescu a place in the Pantheon Great Economists.

The other "box" contains his seminal contributions to economic methodology (in the correct use of that word), and an entirely new paradigm called "bioeconomics." The latter, in the eyes of Georgescu's followers, are his most important contributions. They are, however, ignored by virtually all "traditional" economists. Among those in this camp who are willing to acknowledge the existence of Georgescu's novel ideas, most greet them with skepticism. It is because of this reaction to the most original ideas in economics advanced during the past half-century that some of Georgescu-Roegen's followers, including the present author, believe that his thinking is ahead of its time.

One final comment is needed before ending this prologue. Most economists, of whatever persuasion, do not wander outside the narrow boundaries of their discipline. Even a partial review of Georgescu-Roegen's literary and scientific output reveals a breadth and depth of knowledge without parallel in the profession. His writing includes references to biology, chemistry, ecology, thermodynamics, mathematics, philosophy, information theory and, of course, economics.⁵ He was trained in mathematics, spent two years as a post-doctoral student of the great Karl Pearson, and was led into economics by another of the great minds in this field, Joseph A. Schumpeter. What Gottfried von Haberler said of Schumpeter, however, also can be said in paraphrase of Nicholas Georgescu-Roegen: "He is nobody's pupil" [Spiegel, 1952, 742].

Methodology

Throughout his career, Georgescu has had a keen interest in epistemology and the scientific method. Discussions of methodology are found in many of his papers. His views are presented concisely and cogently in an article in the Journal of Economic Issues, together with a comment by Salim Rashid, and Georgescu's rejoinder to that comment [GR 1979b].

Georgescu knows there is a legitimate role for mathematics in economic analysis. What concerns him is the abuse of mathematics which has trivialized much of contemporary

economics.⁶ He is critical of ". . . endeavors that now pass for the most desirable kind of economic contributions although they are just plain mathematical exercises, not only without any economic substance but also without mathematical value [GR, 1979b, 317]." Georgescu recognizes, however, that there are useful applications of mathematics in engineering economics, and cites linear programming as a specific example [*Ibid.*, 320].

Georgescu broadened his methodological criticism of traditional economics to what he has frequently referred to as its "mechanistic dogma." This idea, which had its origins in the physical sciences, was adopted by the early Neoclassical economists and has remained an essential part of their intellectual baggage. According to this economic belief: "Everything is reversible exactly as in mechanics . . . [*Ibid.*, 321, italics in the original]. In actuality, the economic system is continuously changing -- irreversibly and qualitatively. "The most important aspect of the economic process is precisely the continuous emergence of novelty [*Ibid.*]" . And this novelty always represents a qualitative change. Such changes cannot be handled by analytical models which consider quantitative variation alone.

The only methods by which we can hope to understand the world around us are analysis and dialectics, and there is an unbridgeable gap between them. Analysis can deal with actual phenomena only by using arithmomorphic concepts; that is, numbers. Dialectical concepts are distinct, but they are not discretely distinct; they may "overlap with their opposites

[Ibid., 322]." An arithmomorphic concept is separated from its opposite by a null set, but a dialectical concept is separated from its opposite by a "substantial penumbra." Within that penumbra, both A and non-A are true. "What the prevailing arithmomania ignores is that . . . [it] . . . cannot even get started without using dialectical concepts [Ibid., 323]." The reason for this has been already stated; that is, the world around us constantly changes qualitatively.

Georgescu's pellucid distinction between arithmomorphism and dialectical reasoning elicited a "comment" from Salim Rashid, then an assistant professor at Dartmouth. Much of Rashid's comment is irrelevant to the present discussion, but he challenged a statement by Georgescu that "even an infinite space can accommodate at most a denumerable infinity of three-dimensional objects . . . [GR, 1979b, 318]." He went on, however, to quote the salient points in Georgescu's initial discussion of arithmomorphism and dialectics, and concluded that: "Not only have these arguments received no satisfactory answers as yet, but also they appear to be unanswerable. Nor can it be said that the issues raised are so subtle or intricate that the average economist cannot appreciate them [Ibid., 186]." His final point was that: "One of the inimitable merits of mathematics is that it mechanizes the process of grinding out articles [Ibid., 187]." And the virtue of this, Rashid continued, is that in an institutional milieu of "publish or perish" this is the only way for a young economist to hope to advance in the profession.

In his "rejoinder" Georgescu gently chided his critic for failing to familiarize himself with Cantor's theorem, and demolished Rashid's brief mathematical criticism. He pointed out, however, that:

The last part of Rashid's comment. . .constitutes an extremely valuable document of the times. It is a frank admission of the corrupt conditions of the economics profession, at least in this country . . . Since publish or perish applies to all academe, why is it that economists alone can subsist by automatically grinding out empty exercises from the mathematical mechanism? The answer is that the American economics profession is dominated by a powerful and well-entrenched establishment determined to defend at all cost the type of economics by which virtually all its members climbed to the summit [op. cit., 191].

It is worth noting that while a decade has passed since Georgescu's methodological critique, and his trenchant criticism of the American economics profession, no economist has been willing to publicly challenge his views. Evidently there is a new apothegm in conventional economics: "If there is no way to challenge a critical argument on logical grounds, ignore it!"

Bioeconomics

If Nicholas Georgescu-Roegen had remained within the confines of Neoclassical theory his prestige within the American economics establishment would have been enhanced. By 1969, however, when he was invited to give the Richard T. Ely Lecture [GR, 1976, 61-69] -- one of the highest honors that can be awarded by the American Economic Association -- it was evident that his disillusionment with conventional economics had already set in. In the opening paragraph of that lecture he said that for two decades he had been arguing that not every element of the economic process could be represented by an arithmomorphic model. And at this time his path-breaking work, The Entropy Law and the Economic Process, [GR, 1971], was in press. It's clear that, unlike the revelation that came to Saul on the road to Tarsus, Georgescu's revolutionary ideas about methodology, and the nature of the economic process, had a long and slow gestation.

When The Entropy Law and the Economic Process was published, it did not create an immediate stir. A review by F. M. Adleman, in the June, 1972 Journal of Economic Literature, was abstruse, patronizing, and far from laudatory. There were strongly positive reviews by Kenneth Boulding, Will Meyer, and the Library Journal [GR, 1976, endpage]. The latter said that: "Henceforth economists must take [Georgescu's] conclusions into account lest their analyses and scholarship be found wanting." Few judgements as prescient as this will be found in book reviews.

Unfortunately, since almost all traditional economists ignored that conclusion their "scholarship" has been wanting indeed.

Dragan and Demetrescu sub-titled their book, Entropy and Bioeconomics [1986], "The New Paradigm of Nicholas Georgescu-Roegen." This is an apposite designation. Kuhn defined a "paradigm" as a new research field which shares two common characteristics: (1) it is "sufficiently unprecedented to attract an enduring group of adherents from competing modes of scientific activity," and (2) it is "sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve [Kuhn, 1970, 10]." The number of American bioeconomists might be relatively small, but judging by the burgeoning literature that number has become significant on a global basis. And those attracted to the study of bioeconomics stick to the subject; they become true "adherents."

Essentially, bioeconomics is an amalgam of evolutionary biology, economics and thermodynamics. Drawing on the pioneering work of the biologist Alfred Lotka, Georgescu postulated that the economic process is an extension of biological evolution. The body (or soma) of every creature is endowed with inherent organs. These were described by Lotka as endosomatic organs. And those organs, or at least some of them, changed very slowly (for better or worse) as every living thing adapted to changes in its environment.

The human species is unique among creatures (a word which includes both humans and the lower animals) in its ability to develop tools and other implements which can be regarded as

"detachable organs." All such extensions of the human body can be described as exosomatic organs. This, in nuce, is the biological component of bioeconomics.⁷

How have conventional economists reacted to what can be called the First Postulate of bioeconomics? Basically, their reaction has been one of indifference. Carrying Adam Smith's dictum about the advantages of the division of labor to an absurd extreme they have said, in effect, that biologists should "do" biology while economists should remain within the artificial boundaries that have been erected around the discipline. But there is more to it than that.

Evolutionary changes, including exosomatic changes, are qualitative. Thus they cannot be handled by the arithmomorphic models of conventional econometrics. Shifts among occupations, differential changes in productivity, variations in patterns of international trade, and other structural changes in the world's industrialized economies, have accelerated during the past decade or so. And while macroeconomic models have become increasingly large and complex, their performance in forecasting even major aggregates, such as Gross National Product, or Gross Domestic Product, has not improved. It is likely that qualitative changes have had much to do with the stagnation of progress in this branch of conventional economics.

The Second Postulate of bioeconomics makes an even sharper break with traditional economics. The basic model of conventional economics is the self-sustaining "circular flow" diagram which shows "production" moving in one direction and

"consumption" in the other.⁸ But the economic process is not self-sustaining. Economic activity alters the environment in a cumulative way while changes in the environment, in turn, alter the economic process [GR, 1975a, 4].

The failure of conventional economics to recognize the fact of cumulative (and irreversible) change is due to its reliance on the "mechanistic dogma." But the Second Postulate of bioeconomics states that the economic process is not a mechanical one at all; it is entropic. All economic activity requires the use of energy. And energy can be divided into: (1) available or free energy, which can be transformed into work, and (2) unavailable or bound energy which cannot be used again because it is dissipated as heat [GR, Ibid, 7]. The Second Postulate of bioeconomics is that there is an unalterable "opposition between mechanics and thermodynamics [which] stems from . . . the Entropy Law [GR, Ibid]." Also, "the entropy of a closed system continuously and (and irrevocably) increases toward a maximum; that is, the available energy is continuously transformed into unavailable energy until it disappears completely [GR, Ibid., 7-9].

Finally, there is a Third Postulate, an original idea of Georgescu's which he has labeled the Fourth Law of Thermodynamics. It states that matter is subject to the same degradation as energy. Examples are rubber that is irretrievably lost because of friction between automobile tires and highways, and the copper, silver, and other metals lost as the weight of coins is diminished through continuous use.

The inescapable conclusion derived from these postulates is that the global economic system follows a life-cycle similar to that of any living organism. And it is this conclusion which conventional economists find most irritating. In Georgescu's words: "[There is an] economic myth . . . that man will forever succeed in finding new sources of energy and new ways of harnessing them. . . The idea is that if the individual man is mortal, at least the human species is immortal. Apparently it is below man's dignity to accept the verdict of a biological authority such as J.B.S. Haldane that the most certain fate of mankind is the same as that of any other species, namely, extinction [GR, Ibid, 5]."

Models, Paradigms and Public Policy

Conventional economics has been altered by accretion from the fragments in the writings of Plato to the most recent fad of modern mathematical economics. In 1776, Adam Smith codified what had been written about economic matters until then, and added his original observations in The Wealth of Nations. Since that time, new developments have been incorporated regularly into traditional economics. Some were absorbed smoothly into the evolving body of doctrine; others only after considerable debate.

It would be wrong to leave the impression that there is at present a monolithic body of conventional economics. There are several sects which tend to reflect their members' political

beliefs. Economists are a notably contentious lot, and are more than willing to air differences of opinion publicly.

Bioeconomics is the one paradigm which cannot be absorbed into "mainstream" economics. Its basic postulates are completely at variance with the mechanistic assumptions of traditional economics. Thus Georgescu-Roegen and his followers are "outsiders" as far as conventional economics is concerned.

In spite of wide differences about many theoretical and policy matters among the different sects of traditional economics, there is one concept that is shared by all: "The overwhelming majority of citizens, and almost all those at the helm of policy, are deeply imbued with the concept of sustained, if not accelerating, economic growth, generally regarding it as a self-evident economic imperative" [Mishan, 1990, 35. See also, Beckerman, 1971]. The notion that economic growth is the summum bonum of economic policy has the support of almost every member of the traditional economics fraternity. A notable exception is Edward T. Mishan who challenged this idea on ecological grounds while remaining within the framework of conventional economics [Mishan, 1967]. The physicist Albert Bartlett also has challenged the notion of continuous growth in a widely reprinted article relating exponential growth to increasing energy scarcity [Bartlett, 1978].

If economic growth is to be sustained, it must be supported by an adequate supply of resources and cheap energy. In the earlier (and some of us believe more sensible) days of classical economics, the central focus of economic analysis was on the

scarcity of resources. Modern economists have found a new principle, however, which they believe negates the problem of scarcity. It is called "the principle of unlimited substitutability."⁹

The ability to substitute resources, factors of production, and technology, is an essential part of any successful economic process. But adding the word "unlimited" completely changes the meaning of substitution. As Georgescu has pointed out this has led traditional economists to the absurd conclusion that capital can be substituted for resources, as the latter are depleted, and --through the use of fusion and solar energy -- there need be no concern about a scarcity of power in the future [GR, 1982, passim, other sources cited therein, and GR, 1979c, 97-99]. Thus the conventional view is that even with an increasing population there will be a steadily-improving global standard of living. Political economy, as it was then known, had been labeled "the gloomy science" during the Victorian era. Today's conventional economists, however, have an unwavering faith that technical progress, and the price system, will solve the world's economic as well as its ecological problems. This will be done, essentially, through continuing recycling and technical changes which will produce steady gains in "net energy." Not even the most naive conventional economist would argue that technological progress will solve all the problems of the less-developed countries (LDCs). They are, however, expected to share in the bounty of the new age of abundance. The beauty of this argument -- however specious it might be -- is that residents of

industrialized nations can continue to enjoy the alleged blessings of consumerism with clear consciences.

Georgescu had noted that because of the Fourth Law of Thermodynamics, the most efficient recycling system conceivable could not prevent the gradual depletion of resources. And the concept of net energy has not been rigorously defined [GR, 1982, 13, 18]. Georgescu's dialectics have demonstrated rigorously that the technological optimism of conventional economists is completely without foundation. His conclusions, however, have failed to elicit a successful response.

What are the policy alternatives of conventional and bioeconomics? Conventional economists urge those at the helms of the public and private sectors to do everything in their power to stimulate economic growth. Monetary and fiscal measures should be used to encourage saving and stimulate investment. More money should be poured into research, development and education. Consumerism is considered to be a positive good; it is the end and purpose of economic activity. In the "developed" nations of the world such policies are praised by a majority of the population. When economists are criticized it is only because of their failure to develop new policy options to achieve those hedonistic goals. If his work were more widely-known, Herman Heinrich Gossen would be the patron saint of today's conventional economists since he believed that the search for pleasure was mankind's highest goal [GR, 1983, passim].

The policy objectives of bioeconomics are diametrically opposed to those of conventional economics. First, it is

essential that all of us recognize that the earth has a limited dowry of energy and resources, and that dowry is not the property of any single generation. Thus it is imperative that we practice serious rather than cosmetic conservation. The focus of public policy should be on the elimination of waste. Excesses of consumerism should be discouraged. At the 1972 United Nations assembly, held in Stockholm, to deal with problems of the environment, Georgescu proposed that all natural resources be "worldized." He also proposed the abrogation of all passports to permit the world's people to move freely in search of better opportunities.¹⁰ Needless to say, both proposals were tabled with alacrity.

Whether we like it or not, there is already evidence that the bioeconomic view will prevail in the long-run. Growth rates in most of the industrialized economies have been declining. In the United States, for example, real Gross National Product per employed worker, increased at a rate of 2.34 percent, compounded annually, between 1947 and 1969. From 1969 through 1988, this rate had dropped to 0.63 percent. During the earlier period the standard of living of employed workers doubled in about 30 years. At the rate in effect since 1969 doubling time would increase to 111 years. But it is likely that the rate of increase in this important economic indicator will continue to decline. Even (West) Germany and Japan, known for their economic growth "miracles" in the past, are experiencing declining growth rates.¹¹

One of the basic hypotheses of conventional economics is that producers and consumers behave rationally. Collectively, however, we behave anything but rationally. As I have shown elsewhere [Miernyk, 1986, 349-30], policies based on bioeconomics involve no risk. The entropic process of bioeconomics is irreversible. But policies based on this body of thought could be reversed if a future generation found that strict conservation of energy and resources were not needed. The policies we follow today, however, are irreversible. If we continue to pursue them the day will inevitably come when resources and energy will be exhausted. By then, however, there will be nothing left to conserve.

Georgescu is not optimistic about the likelihood that mankind will behave rationally when it comes to the intergenerational allocation of resources: "Will mankind listen to a program that implies a constriction of its addiction to exosomatic comfort? Perhaps, the destiny of man is have a short, but fiery, exciting and extravagant life rather than a long, uneventful and vegetative existence. Let other species -- the amoebas, for example -- which have no spiritual ambitions inherit the earth still bathed in plenty of sunshine [GR, 1975a, 35]." Georgescu's reference to amoebas calls to mind a humorous rhyme, with somber overtones, by Alfred Priori.¹² It seems an appropriate way to end this essay honoring one of the great minds of the twentieth century.

SURVIVORS

Cockroaches have lived, with elan and esprit,
since about -- we've been told -- three-million B C.
Their birth rate is high -- even higher than rabbits.
There are no restraints on their foul eating habits.

If one lacks fresh viands, it will ingest instead,
another cockroach -- recently dead.
Indiscriminate tastes have made these small besties
the oldest, by far, of all extant species.

Humankind can survive, if it changes its ways,
for several millenia -- give or take a few days.
But eventually the earth will no longer, they'll find,
be a habitat for those who won't eat their own kind.

Then the roaches will gloat; they'll be our sole heirs.
Once more, when we're gone, the world will be theirs.

Morgantown, West Virginia
July, 1990.

NOTES

1. Since Georgescu's work will be mentioned frequently in this essay future references will be abbreviated as GR.
2. Cf. Spiegel (1952) for essays about Gossen by Jevons and Walras mentioned in the text.
3. For a partial list see Dragan and Demetrescu (1986), p. 6. By 1986, 40 books or articles about Georgescu had been published in the U.S. and 10 other countries [op. cit., 211-213]. That number is surely larger today, and it will continue to increase.
4. See also, Tang, et al. (1976). Georgescu showed, inter alia, that "Samuelson's formulation of the Substitutability Theorem is inexact and his proof is not quite rigorous (GR, 1966 p. 321)." Also, Georgescu's Theorem 7, in Analytical Economics provides a more direct, and computationally-simpler, version of what is still referred to as the Hawkins-Simon theorem (or condition) in the input-output literature (GR, 326-330 and 336-337).
5. See, for example, the scientific virtuosity displayed in [GR 1975b.]
6. In this he has been joined by other economists with impeccable mathematical credentials, notably Wssily Leontief and William Baumol.
7. For elaboration see [GR (1971)], and [GR 1976, Ch. 1].
8. This diagram is typically the first "analytical device" to which the beginning student of economics is introduced. A perceptive one would quickly recognize that, while it has no time dimension, it is a "model" of perpetual motion!

9. For the genesis of this "principle," as well as the assumptions underlying it, see Miernyk (1986), 335-336, and (1982), 107.
10. The last two proposals are mentioned in the draft of a manuscript by Georgescu-Roegen entitled "My Life Philosophy."
11. The U.S. growth rates were calculated by the author from data in GPO (1990), 296 and 330.
12. This rhyme is published here for the first time with the permission of its author.

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