Government of the planet

Steven M. Stanley

The Ages of Gaia: A Biography of Our Living Earth. By James Lovelock. W.W. Norton/Oxford University Press: 1988. Pp. 252. \$16.95, £13.50.

JAMES Lovelock publicized his stimulating Gaia hypothesis during the 1970s, in part through collaboration with Lynn Margulis, an eminent cell biologist. The hypothesis asserts that life on Earth sustains habitable conditions for itself by actively regulating its environment on a global scale. In this world view, feedback from the abiotic environment stabilizes the global ecosystem.

Gaia was the Earth goddess of Greek antiquity. The Gaia hypothesis does not represent quite the apotheosis of our planet that its name, taken literally, would imply, but it does assert that the Earth, together with its life, is a kind of super-organism that maintains itself through a homeostasis akin to that of simpler forms of life. This elevated status does not go down well with many Earth scientists, who see organisms as modifying but not fully regulating their environment.

In this new portrayal of Gaia, Lovelock counters earlier criticisms that the Earth's interior is inorganic and beyond biological control by comparing it to the inner wood of a giant redwood. The simile is imperfect, however, in that the living tree synthesized its wood, whereas the mantle, core and much of the crust pre-date life on Earth. Furthermore, most definitions of life include not only the capacity for self-regulation and growth, but also for self-replication. Judgement of the Gaia hypothesis in these terms quickly degenerates into semantics, however, and life has never been amenable to proper definition in any case. Far more important is the veracity of the fundamental tenet of Gaia — that life, since shortly after its appearance, has in various ways sustained and improved its physico-chemical environment so as to flourish.

Although he makes his living as an inventor, James Lovelock was trained as a medical researcher. Thus, it was apt that he should coin the term 'geophysiology' for the discipline predicated upon Gaia. Here Lovelock notes an interesting historical parallel. James Hutton, the father of modern geology, was the first Western thinker to view the Earth's dynamism as constituting a kind of physiology, and Hutton, too, was trained as a physician. The overt attempt to establish a large new field of science almost singlehandedly is a rarity in the modern age, the other obvious example

being E. O. Wilson's launching of sociobiology — a field that, despite much controversy, has clearly taken hold. Lovelock's proposal for the legitimacy of geophysiology remains less substantial, which is not to say that none of his specific ideas will prove to have merit. His book should be read.

The Ages of Gaia takes its name from Lovelock's attempt to show how life has maintained a habitable Earth while evolving in the course of more than three billion years. In his view, Gaia awakened in Archaean time and then episodically shifted her homeostatic balances to new equilibria during biotic transformations. In this book, as in his earlier writings,

tive photosynthesizers to oxygen toxicity.

Lovelock offers no biotic reason for the build-up of oxygen to approximately its modern level by 600 million years ago, when animal life was diversifying rapidly, and his suggestions for biotic control beyond that point will seem far fetched to many readers. He adopts the conventional view that the oxygen flux into the atmosphere is governed by the rate of carbon burial — buried carbon being unable to recombine with oxygen — and that the oxygen flux from the atmosphere is governed largely by the rate of exposure of reduced material. He goes on to propose more unorthodox ideas about oxygen homeostasis, among them one in which

James Lovelock — the geophysiolgist with questions still to answer.

Lovelock concentrates on atmospheric chemistry and global climate. His initial formulation of the Gaia concept stemmed from his conclusion that life is responsible for maintaining a chemical disequilibrium in the Earth's atmosphere that is anomalous with respect to conditions on lifeless planets. Methane, for example, reacts with oxygen in sunlight and is sustained in the Earth's atmosphere only through ceaseless organic decay.

One of Lovelock's more imaginative sub-hypotheses is that, during the part of Precambrian time when oxygen sinks prevented photosynthetically produced oxygen from building up in the atmosphere, methane from bacterial decomposition rose to a relatively high atmospheric concentration. It then broke down in the upper atmosphere under the influence of ultraviolet radiation to form a smog of complex organic chemicals that strengthened the greenhouse effect, warming the Earth's surface. When oxygen finally began to build up in the atmosphere, it reacted with methane, lowering the concentration of this greenhouse gas and cooling the Earth. Lovelock suggests that this episode produced the ice age that is recorded in rocks about 2.3 billion years old. He suggests that the atmosphere then re-equilibrated within perhaps 200 million years, with oxygen remaining at a level well below that of the present day, the hypothetical limiting factor being the weak resistance of primi-

forest fires regulate the system, with intervals of heavy global burning accelerating carbon burial and causing atmospheric oxygen to increase. At such times, he argues, forests become even more flammable. The ensuing devastation results in a decline in carbon production and burial, which reduces the flux of oxygen to the atmosphere and thus reverses the trend.

Criticisms of Gaia have taken two forms: some people argue that the proposed regulatory mechanisms cannot or do not work, others that evolution could never have produced Gaia. The great complexity of the global ecosystem is at the heart of both classes of criticism. How can global regulation be attributed to a narrow set of controls, such as some of the effects of forest fires? How could life possibly control the salinity of the oceans? In addressing the other issue, how Gaia could develop in the first place, Lovelock emphasizes that success in natural selection is not simply a matter of flourishing within the environment, but of changing that environment to one's own advantage. This idea is applicable to individual populations, but how can it apply to a global ecosystem containing vast numbers of distinctive populations, each facing a unique set of selection pressures, with none able to benefit from its own minuscule contribution to such variables as global temperature or the level of atmospheric oxygen? ▶

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And what of the great mass extinctions? If, as some experts estimate, 95 per cent of all species died out in the Permian mass extinction, would not a gaian system have died with them? Global biotic crises have generally occurred every 20 or 30 million years. If Gaia existed before each crisis, she failed during it, in the sense that abiotic causes of heavy extinction overrode her homeostatic mechanisms. The massive extinctions that ensued would

have damaged Gaia further, leading to still more extinctions, and so on. How could Gaia have survived such downward spirals? This present volume is imaginative and delightfully written, but full of unanswered questions. Perhaps Lovelock will address them in his next book. □

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The thin green line

Norman Myers

Public Policy and the Misuse of Forest Resources. Edited by Robert Repetto and Malcolm Gillis. *Cambridge University Press*: 1988. Pp. 432. Hbk \$69.50; pbk \$27.95. To be published in Britain in December, hbk £45; pbk £19.50.

DEFORESTATION of the tropics has been proceeding at an increasing rate since about 1970, yet virtually all analyses of the issue have failed to tackle the core factors at work. They have responded to the symptoms rather than the problems themselves. Still less have they addressed the sources of the problems, to be found in macro-level processes of policy making and planning.

Hence the value of this book — it is the first to engage in methodical assessment of the covert causes of deforestation, concentrating on “the impacts that governments, most of which are committed in principle to conservation and wise resource use, are themselves having on the forests under their stewardship through policies that inadvertently or intentionally aggravate [forest] losses”. Such policies range from those that deal specifically with forestry matters (like timber royalties and logging regulations) to those bearing on tax and trade regimes, industrial incentives, land-tenure laws, settlement programmes, agriculture, population, indeed development overall. The policies concerned were mainly instituted for worthy objectives, including industrial or agricultural growth, regional development and poverty alleviation. But all too often they “have resulted in economic and financial losses while contributing to the depletion of forest resources”. At the end of the book, those policies that can be altered to reduce forest loss without foregoing economic advancement are identified.

The overall argument is presented through case-study examples from Indonesia, Malaysia, the Philippines, China, Brazil and West Africa (also, for comparative purposes, the United States, where certain irrational policies still hold sway). In Indonesia, where timber exports have been earning gross income of

\$2 billion per year, inefficient economic policies in forestry industries (in the form of exceptional subsidies, tax exemptions and heavily subsidized credits among other types of protection) have not only fostered unsustainable logging; they have caused a loss of potential harvesting payments plus other revenues worth \$4.4 billion during the period 1979–1982 alone. In Brazil one of the main causes of deforestation has been cattle ranching: strongly promoted by all manner of incentives worth \$2.5 billion, it has proved to be a highly successful commercial activity for individual entrepreneurs, while imposing a net drain on the national economy. During forest clearance, ranchers have burned marketable timber worth \$5 billion, ostensibly on the grounds that they could make easier profits through government subsidies. Fortunately, in both Indonesia and Brazil, things have recently improved somewhat through direct intervention on the part of the countries' presidents.

The contributors of the 12 case studies amply document the ways in which forestry policies have frequently generated ‘timber booms’ and other scrambles for short-term profits. Yet the greater part of deforestation is attributable to non-forestry policies. Among them are excessive clearing of land for plantation crops such as rubber, palm oil and cacao, and for mining and roads, dams and other large infrastructure projects. Overall, the

principal form of policy-induced deforestation is through measures that impoverish households living close to the margin of subsistence, especially in rural areas: “These include pricing policies and investment priorities biased against the agricultural sector, development strategies that depress the demand for unskilled labor, and agricultural policies that favor large farms over smallholders. Such policies retard the demographic transition, make rural populations more dependent on natural forests for subsistence needs, and increase the concentration of agricultural landholdings”. It is primarily as a result of them that there has been a mass migration of small-scale cultivators into Brazilian Amazonia, culminating in the burning of some 80,000 square kilometres of forest during the 1987 dry season.

On top of all these mis-directed and mis-applied policies of the governments of the nations directly concerned, external factors have contributed to the general abuse of forest resources. For instance, trade barriers protect wood-processing industries in the developed world, thus usurping many of the benefits from forest-based industrialization that could accrue to developing countries. Much of the excessive logging has been carried out by multinational timber corporations based in the developed world.

Public Policy and the Misuse of Forest Resources is a pioneering appraisal of the entire policy context within which deforestation is progressively promoted. The editors are to be congratulated on their analytical acumen: the argument is pursued with detailed documentation throughout, and is rounded out with first-rate summary chapters which introduce and close the book. □

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“Protect the forest from fire” — on a billboard in Jagdalpur, India, a man is seen setting fire to a forest in this life and as a consequence is roasted over a fire in hell. From *The Hour of the Fox: Tropical Forests, the World Bank, and Indigenous People in Central India*, by R.S. Anderson and W. Huber. Publisher is University of Washington Press, price \$25.