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Energy and Economic Myths, Part 2
Indian Health and Disease • The Case for Water Transport

AN EXPENDABLE PEOPLE

by
Alice
Anderson

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A STATESMAN OF WORLD IMPORTANCE

Jayaprakash Narayan has been jailed along with other leaders of the Gandhian Movement and those of the Opposition parties which have recently allied themselves with it. Mrs. Indira Gandhi has thus played into the hands of her opponents, just as did the Viceregal Government each time that it arrested Mahatma Gandhi, for experience has shown that there is no better way to alienate public sympathy than by arresting selfless patriots, and no more effective way to mobilize it than by contriving to be arrested. Indeed we are living a historic moment, for what Mrs. Gandhi has actually achieved is to set in motion a new Satyagraha (non-violent resistence) campaign – this time against herself and what she stands for.

There is a certain logic in these developments. First of all Jayaprakash Narayan, or JP as he is affectionately known in India, along with Vinoba Bhave (now 80 years old) is the heir to Mahatma Gandhi. The latter is now the spiritual leader of the Gandhian or Sarvodaya Movement, the former its political leader. Though JP founded the Socialist Party of India, he never sought political power for himself and when Nehru invited him to join his Government he refused.

The Gandhian Social Philosophy is very profound and very beautiful, and provides a complete blueprint for life in a decentralised rural society living in harmony with its environment. Unfortunately it was never applied, for when Nehru came to power he repudiated it, and pursued instead the policies of westernisation and industrialisation initiated by the British Raj. This he did with a degree of zeal which no Colonial Government would have dared display, and his daughter Indira Gandhi has still further accelerated their implementation.

IT FOLLOWS THAT THE NEW SATYAGRAHA CAMPAIGN IS BEING FOUGHT BY THE SAME MOVEMENT AS THE LAST AND AGAINST THE SAME MISGUIDED POLICIES.

Why are they so misguided? This should be evident from but two considerations. Ninety per cent of India's population of 600,000,000 people lives in the villages – some 540,000,000 of them – in which the only visible benefits of modern technology are the odd bicycle and Singer sewing-machine.

Only twenty per cent live in the cities. As Gandhi pointed out it is considerably more expensive in terms of resources and hence of money to keep people in cities than in villages. Indeed India cannot begin to afford to provide its present relatively small urban population with more than an insignificant fraction of the amenities required for urban living: homes, schools, roads, sewage works and jobs. Yet to industrialise India means urbanizing it. It means encouraging the majority of the Indian people, who, at the current rate of population growth, will number more than a billion by the end of the century, to move to the cities, of which at least three will by then have populations of over thirty million – veritable human anthills – where misery and degradation would reach undreamed-of heights.

Where would the resources come from for building and maintaining these massive cities? They can only come from the countryside, which must thereby be systematically pillaged on an even greater scale than is the case today, to obtain the land, building materials, lumber, food and water required for so gigantic an enterprise.

It is not generally appreciated that the great famines which occurred during the British Raj were not due so much to crop failures (there had been many of these before and provision for them was made by the stores maintained by the farmers themselves at the village level) as to the fact that crop failures caused prices to rise thereby making it inaccessible to the impoverished farmers. *They starved, in fact, because the food had been diverted to the cities.*

Today food is being sold abroad. At least thirty-five per cent of India's exports are made up from agricultural produce, twenty-five per cent of which is food. For a country with a chronic food shortage to sell food abroad to finance the building of motorways and office blocks, not to mention the manufacture of atom bombs, must surely be the most irresponsible not to say callous policy which a government has yet drawn up.

Clearly a responsible and humane policy would tend in a very different direction. It would abandon the outdated ideals of our Western urban society, which is itself on the verge of collapse, and would opt for a rural solution to the great problems it faces.

This is the basis of the Gandhian Social Philosophy, and in this sense JP's movement is a revolt of the countryside against the cities. Why is it classed as a "right-wing" movement by Indira Gandhi and her Soviet allies? It is indeed "right-wing" if this means that it does not aim at putting the proletariat in power, but the peasants who out-number them ten to one. Indeed if JP's policies were adopted there would be no urban-proletariat – India would become instead the association of village republics which Gandhi dreamed of – the foundations of which Vinoba and JP have struggled for thirty years to lay down.

It is indeed "right-wing" if this means that it stands for the maintenance of Indian cultural traditions in the face of disruptive urban influences – which for too long now have been associated with "progress". It is certainly not "right-wing" however, if by this is meant advocating unfettered large-scale enterprise, still less a monolithic centralised militarist state, in which the dominant ethnic group ruthlessly persecutes its minorities and engages in wars of conquest with its neighbours.

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- **Fighter** for the Independence of India
- **Leader** of the the non-violent campaign against corruption
- **Unjustly** imprisoned by the Indian Government on 26th June, 1975
- **Reported** to be seriously ill in prison

The Campaign is working for the release of Jayaprakash Narayan and all the political prisoners held without trial. We are breaking the total censorship imposed by Indira Gandhi by producing a Digest of News published in the World Press – **SWARAJ** – which is being sent into India by independent means.

More information on Jayaprakash Narayan, his work and what he stands for, is available in our booklet, price 35p, as shown below.

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This perfectly describes the Fascist State. Sadly India, under Indira Gandhi is also coming to answer this description. Diametrically opposed to it is JP's movement which stands for an association of village republics (Panchayat Raj), for non-violence towards men and nature (Ahimsa) for non-violent resistance (Satyagraha) and for the welfare of all (Sarvodaya) not just the greatest number.

In the current sense of the terms JP's movement is neither "right-wing" nor "left-wing". Its principles transcend these crude classifications. If anything it can be related to the anarchist tradition of Kropotkin, Bakunin, Proudhon and Tolstoy, (Gandhi, an admirer of Tolstoy, described himself as a philosophical anarchist) as well as to the new Ecology Movement, represented in Britain by the Ecology party (formerly the People party)* "Ecologie et Survie" in Alsace and the Values party in New Zealand. The need for a new ideology is apparent since we are living in an ideological vacuum. Western Liberal Democracy has nothing to offer, and is unlikely to survive the next decade in any major country. Nor has Russian Communism which provides but an alternative pattern for living in an industrial society – and has little relevance to a world trying desperately to negotiate the transition to the post industrial age. Maoism is more attractive. The Chinese have undoubtedly solved many of the practical problems of decentralised living, but their social philosophy is rudimentary. Man is still regarded by them, in economic terms, as an animal whose main functions are to produce and to consume. The goals of the Chinese State are basically those of our present Industrial world. It is the means of achieving those ends that are different – and admittedly more realistic.

Gandhiism is both more philosophical and more radical. It offers a new set of goals – not just a new way of achieving the old ones. The decentralised way of life is not desirable for economic reasons only, but because it is that which best satisfies man's biological, social and spiritual needs – needs whose very existence have been forgotten in the general stampede for material benefits into which the world has been irresistibly drawn.

However the reaction against materialism has already begun, and it is likely to be overwhelming; its implications are inestimable, and the signs are that Gandhiism may well be its vehicle. Indira, though she does not know it, may indeed be struggling to suppress what is destined to become the social philosophy of the post industrial age.

Fifty years ago her illustrious namesake fought valiantly to oppose the tide of westernisation and industrialisation which was then beginning to sweep the world. Although he was certainly the greatest man in India's history, probably in world history, and was supported by the vast majority of the Indian people, he was unable to reverse the trend. The tide, however, has now turned. It is Indira Gandhi who is swimming against it, and with the vast mass of the Indian people against her she must inevitably be overcome by it.

In the meantime everything must be done to bring about the release of JP. He is both too admirable and too important to be allowed to languish in prison. He is the one man capable of mobilising a major nation in to adopting the policies which all nations will have to adopt if mankind is to have a future.

Edward Goldsmith

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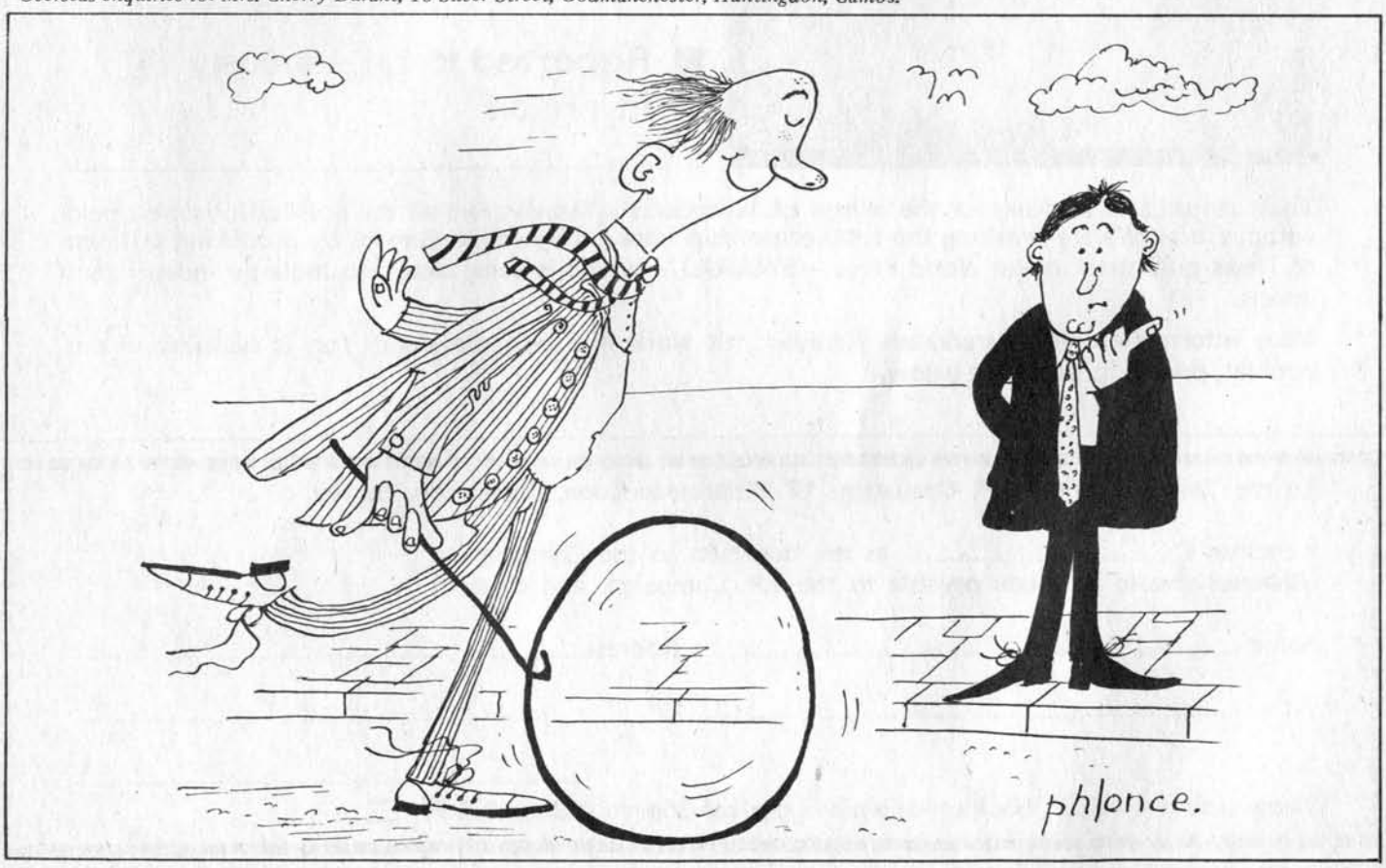


AN EXPENDABLE PEOPLE

Power and Water in the American South West

by

Alison Anderson

Strip-mining, large scale water abstraction and pollution from massive power plants will render uninhabitable a fascinating area of southwestern U.S.A.: The Black Mesa is the home of some of the least acculturated among remaining Indian tribes.

In compensation for the loss of their land and their cultural identity, they will get money – to be transformed in to shoddy consumer products in the supermarkets of Los Angeles.

The pattern has not changed.

History and Background of the Four Corners Project

The "Four Corners Region" (see map) is an area of southwestern United States comprising parts of seven states, Wyoming, Colorado, Utah, New Mexico, Arizona, California, and Nevada. (The name refers to the fact that four of the states meet at a point.) The region extends south and west from the southern Rocky Mountains, to the Pacific coast and to Mexico. The area is mostly mountainous and desert; the soil is fertile but dry and subject to erosion. The scenery is spectacular; within the region are more than thirty national parks and monuments, including the Grand Canyon, as well as more highly developed recreation areas. In most spots the air is sparkling clean and clear, attracting both tourists and permanent residents.

The region also includes 38 Indian reservations; some of the tribal groups are among the few which have managed to maintain some semblance of their traditional cultures. They practise subsistence farming and gardening, and in some areas raise animals.

The Colorado River and its tributaries make up the major river system for the region, and almost its only source of water, though ground water is available from deep wells in some areas. Several growing cities of California and Arizona, and the lush agricultural lands of southern California, depend on the Colorado. There are plans as well for agricultural development in Arizona. Mexico by treaty has some claims to the river water, and recent court rulings have upheld Indian rights.

The cities are also hungry for electric power. The Colorado and its tributaries flow through many canyons, of which the Grand Canyon is only the most famous. Dam sites for hydroelectric power are numerous.

The Colorado River Compact, signed by the seven states in 1922, specifies the quantities of river water to which each state is entitled, based on an average river flow. Unfortunately, this average was calculated over what have turned out to be the five wettest years of the century. The water is thus over-allocated, sometimes by a significant amount. Proposals for dealing with this problem have ranged as far as a suggestion to divert water into the Colorado system from the Columbia River in the state of Washington, several hundred miles away across the Rocky Mountains.

In the meantime, each state has come under pressure to develop uses for its "own" portion of the Colorado water before the others do, in order to ensure its share of the attractive but clearly finite pie. The last few decades have seen a steady stream of plans and projects, and arguments, political manoeuvres and lawsuits, among the states, private groups, and public agencies. California built Hoover Dam in 1928. Other dams have followed, over steadily mounting environmentalist opposition. The apparent culmination of this process was a proposal to build five dams in the Grand Canyon itself, to provide power both for city use and to pump water to a vast agricultural project in Arizona, the Central Arizona Project.

This last dam proposal has apparently been defeated. Power for the irrigation project is now to be provided from one of six huge thermoelectric plants. These in turn are to be fueled by the soft coal which is found in plenty in the Four Corners region, particularly on the central area called Black Mesa. River water is needed both for cooling, and for coal transport. The proposed locations for the plants are shown on the map. Two, *Four Corners* and *Mohave,* are now in operation; others are under construction. The six plants are often referred to collectively as the Four Corners project

The Four Corners Project and the Southwest

What the six soft coal power plants are doing to the American southwest can be stated succinctly: destroying land, water, and air.

Two of the plants are to obtain coal from deep mines, the other four from strip mines located primarily on Black Mesa. The effects of modern strip mining on soil and land even under the best circumstances are well known. The dry mesas of the southwest are erosion-prone, and the mine areas are so isolated that longer access roads are necessary. Also, much of the initial work was done quickly and out of the public eye, with predictable results.

Water quality is threatened from three sources. The mining operations disturb surface flow patterns, in an area where the small, seasonal streams are especially vulnerable. Mine runoff also adds heavy metals, salts, and acidity to the streams and thence to the Colorado. Peabody Coal Company on Black Mesa also draws 2,000 gallons per minute from deep wells to carry its coal 273 miles by slurry line; what is left of this water by the time it reaches the Colorado downstream is unfit for any likely use. The quantities involved deplete the small store of ground water, and risk polluting the rest. Finally, the power plants themselves use great quantities of water for cooling. Much of this is lost by evaporation; the remainder is both hotter and more salty when it returns to the river.

Finally, the power plants as designed have no special provisions for controlling the air pollution arising from burning soft coal, though this issue is currently in the courts. In 1966, the smoke plume from the Four Corners plant, the first to go into operation, was the only man-made sign visible in North America by day to passing astronauts.

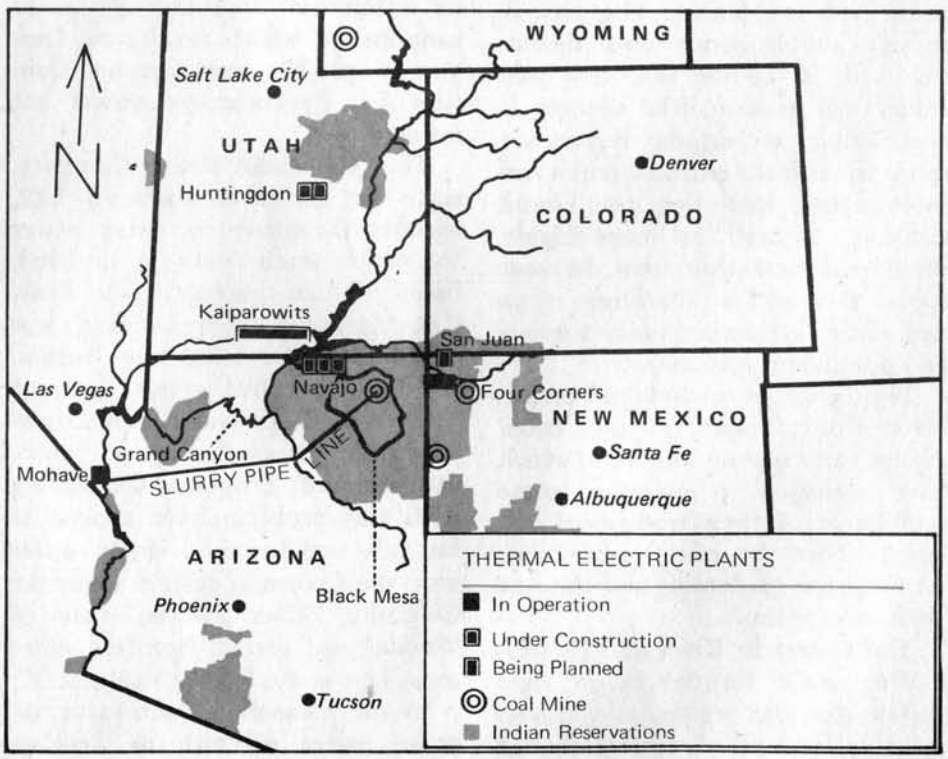
The Four Corners Project and the Indians

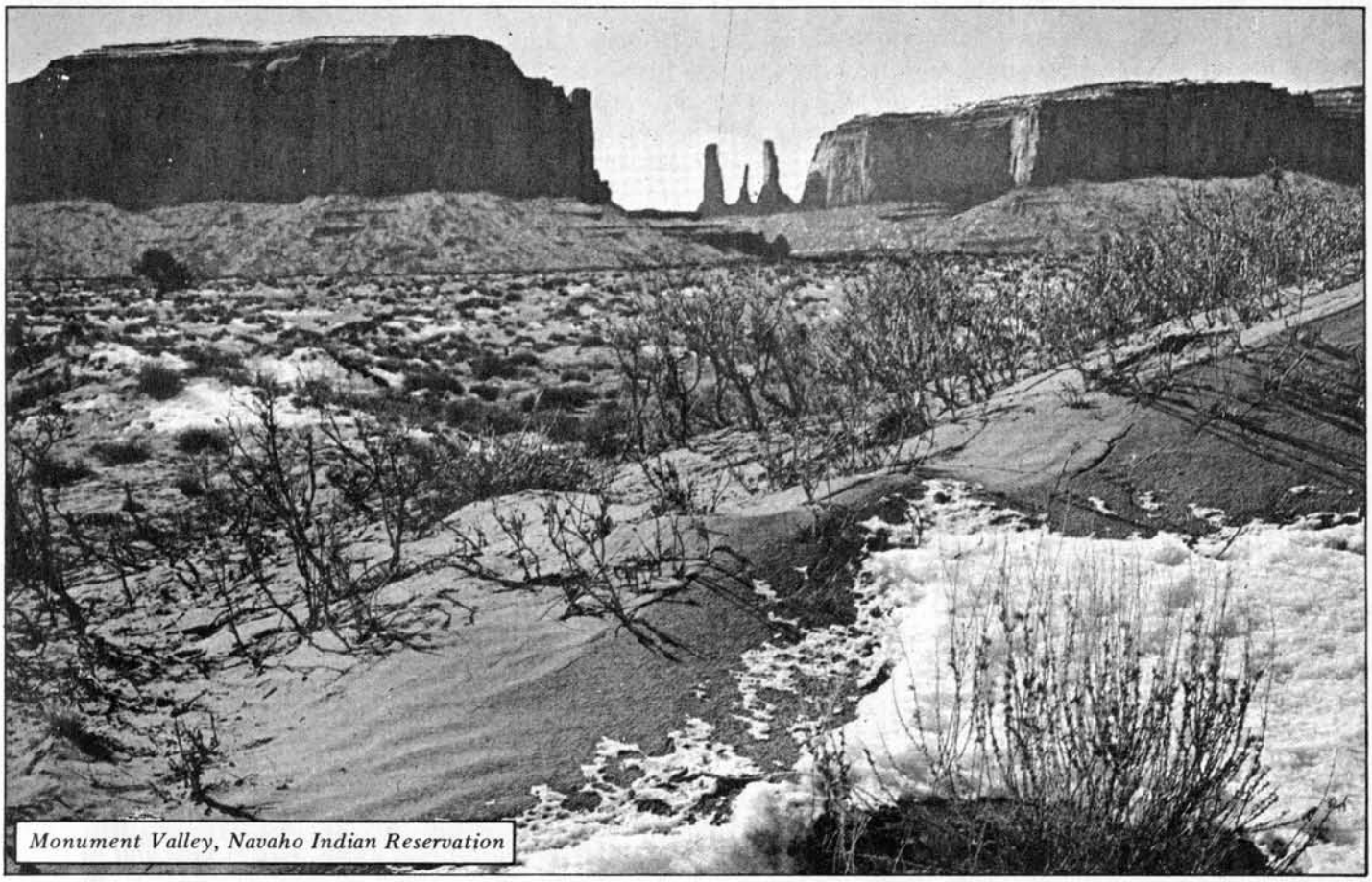
The Four Corners project is clearly a crime against the environment, on an unprecedented and massive scale. It is not yet even clear that they make "economic" sense, though the answer to that question depends in part on the overall energy crisis. Now what about the Indians? What is happening to the Indian groups in the Four Corners region, and why and how did it come about?

We will concentrate on the Navaho and Hopi cultures on and around Black Mesa; they are not the only groups involved, however. Dams in conjunction with the Central Arizona Project will flood at least one reservation downstream. Groups from several tribes have joined the Sierra Club, citizens' groups, private landowners, and even state officials in some of the many lawsuits that have been filed against various aspects of the project. It has been stated that half of all U.S. reservation Indians will be affected by the increasing air pollution.

120,000 Navaho and 5,000 Hopi Indians share Black Mesa and its immediate vicinity. In the northern area live several thousand Navaho, dwelling in isolated hogans, growing vegetables in gardens carefully located near water sources, and grazing some sheep and cattle. Traditional people, they are mostly illiterate and many do not speak English. They have lived successfully on this barren-looking land for hundreds of years, although the introduction of sheep has led to some problems of overgrazing. In the centre of the mesa are Navaho-Hopi joint grazing areas; further south are Hopi villages and Hopi and Navaho farmlands. The Hopi have also maintained a traditional way of life. Both tribes obtain water from wells sunk into the mesa; in spring the dry washes carry water from snowmelt and some rain.

What to "do with" the Indians and their reservations has presented the U.S. government with an awkward situation for many years, especially at times when reservation land becomes valuable in white men's eyes, or when the poverty-stricken state of the Indians becomes embarrassing. Policy in the southwest for several years was to "terminate" reservations by giving individual Indians one-way bus tickets to the cities of southern California. The Indian lands thus "abandoned" could then be managed by developers. It was later proposed that entrepreneurs be forced to share the profits of development with the tribes, for instance by locating industries on reservations so that the Indians could have jobs. Presumably, then, within a generation the tribes would be fully absorbed into the American (white man's) Way, and there would be no more need for the expense of running reservations.





Monument Valley, Navaho Indian Reservation

Legislation to implement this proposal was never passed, but for many planners the concept provided the ideal context for the development associated with the Four Corners project. After all, the mines would be mostly on Indian lands, and provide jobs; the power plants themselves could also provide employment. The project has been presented in this way to the Indian groups involved.

Peabody Coal Company leases 40,000 acres of Navaho and 25,000 acres of Navaho-Hopi joint land, all in the northern part of Black Mesa. The area contains an estimated 337 million tons of bituminous coal. Peabody will receive from a consortium of power companies $750 million over the thirty-five year lease, which it expects to be able to renew if desired. Peabody will pay the Hopi $14.5 million and the Navaho $58.5 million. For the water drawn from the water table, the Hopi received $5.75 and the Navaho $15.30 per million gallons. In 1972, eighty Indians were employed at the mine and eighty more at the Four Corners plant. Peabody also promises $125,000 over five years to the Navaho Community College.

These and similar leases were signed between the coal companies and the Navaho and Hopi Tribal Councils. The Tribal Council form of organization was imposed on the Indians of the American West in 1934 by the Bureau of Indian Affairs in Washington. The councils are supposed to be composed of members elected by the separate villages or other tribal units, and to be the official representatives of their people in dealing with white men. The councils, made up primarily of "progressives", have only imperfectly represented their people. In particular, the Hopi have never accepted this alien imposition on their own structures of government. Thus, in many cases, the councils have entered into agreements with private companies, agreements held valid and binding by the courts, even though most of the people concerned were unaware of the existence of such negotiations. The Hopi contract with Peabody Coal is an example: less than a quorum of the non-representative Tribal Council were present when the lease was signed. Many traditional Hopi became aware of Peabody Coal only when the bulldozers arrived.

Tribal Councils have also signed agreements regarding tribal rights to water. The courts have tended to rule that Indians have "first rights" to water bordering their reservations. In particular the Navaho of Black Mesa have been awarded first claim to the Colorado, on the ground that the land is arid, the water is essential to Indian life, the Indians are officially expected to live there, and therefore they are entitled to the water.

In 1968 the Navaho Tribal Council were offered and accepted the jobs and other "benefits" to accrue from the presence of power plants and strip mines. In return they waived most of their claim to the water of the Colorado, and agreed to *give* the remainder to the irrigation projects downstream. These agreements were separate from those whereby Peabody Coal buys well water from Black Mesa.

The 65,000 acres of coal land on Black Mesa are rapidly becoming uninhabitable. Based on past American experience in Appalachia, twice this area can be expected to be devastated due to access roads, erosion, and "general wear and tear." The Navaho who live here can do so no longer. There is no other place for them on Black Mesa; all habit-

able sites are already occupied. They will be "relocated," in the words of the planners. No one seems to have worried about how this is to be done, or where they are to live afterwards. Nor has anyone considered the non-economic question of maintenance of their customs, the way of life that makes them Navaho.

The mining area is upstream of the Hopi and the remainder of the Navaho land. The flow of surface water across this remaining land has been completely altered. Some artificial channels have been dug, but with little effect. Some of the water passes through the channels, some seeps into the ground, in each case carrying great quantities of mine wastes. We do now know whether the ground water here will be contaminated in this way, but it has happened elsewhere. We do know that the southern parts of Black Mesa suffer from the effects of the changes in surface water. And the 2,000 gallons per minute Peabody Coal draws from its wells leaves Black Mesa entirely.

The traditional Navaho and Hopi cannot long survive on Black Mesa, because of demands for electric power in Los Angeles and for subsidized agriculture in Arizona. This may be simply the latest turn of a wheel that has been rolling for over a century, regrettable but unavoidable – just as progress is unavoidable. It is true that some of the Indians on the Tribal Councils were in favour of the development, at least as it was presented. It is true also that many of the younger Navaho and Hopi are willing to take the jobs available, to leave the old ways as ways that can no longer be lived. It may be that the cultures of Black Mesa cannot now be preserved. If so, then it has to be said that a people are expendable. □

Bibliography

Primary sources and most of the specific data were obtained from *Problems of Electrical Production in the Southwest,* hearings before the Committee on Interior and Insular Affairs, U.S. Senate, 92nd Congress, 1st session, 1971.

Articles containing summaries and comments on some of this material can be found in

Clear Creek 13.

The Mother Earth News, 8, March, 1971.

Not Man Apart and the *Sierra Club Bulletin,* various issues from 1970 to the present.

The Phosphate Connection

by David Laing

In *Man in the Living Environment,* Frederick Smith and others from the Institute of Ecology underscored several salient facts regarding the functioning of phosphorus in natural and human ecosystems. Some of those facts, listed below, served as the stimulus for the present study of phosphate reserve exhaustion time, of which the initial version was completed late in 1971. In that first analysis, I concluded that exhaustion of US phosphate reserves would occur between the years 2031 AD (for identified reserves) and 2083 AD (if hypothetical reserves are found). More recent data on use trends and reserves, and more rigorous analytical techniques have been applied in this revised version, which advances exhaustion dates to 2011 AD (identified reserves) and 2026 AD (identified plus hypothetical reserves), assuming a continuation of present trends.

Phosphate in the Living Environment

Phosphorus is an absolute *sine qua non* for all forms of life, due to its energy transferring function via adenosine di- and tri-phosphate (ADP, ATP).

Phosphorus is usually the life-limiting element in natural ecosystems due to its low availability, which, in turn, is due to the prevalence in Nature of cations such as calcium, aluminium, and iron; these bind phosphorus in the immobile form of highly insoluble salts. Where unbound phosphate is made artificially available, protoplasm production (typically in the form of algal blooms) increases proportionately, as in eutrophic lakes and streams.

Natural processes of phosphate concentration are geologically unusual and slow-acting, while the artificial reclamation and reconcentration of phosphate is difficult and inefficient (and hence money- and energy-consumptive), owing to its propensity for insoluble salt formation. Therefore, the only practical source of phosphate is in natural concentrates, principally phosphate rock.

The world's population is now to a large degree dependent – and is becoming more so as it grows – upon crops grown on land which is naturally infertile but can be made productive under heavy phosphate-nitrate fertilization. But owing to inefficient uptake by plants and to cation immobilization, phosphate must be applied at a rate 2.7 times faster than the desired rate of increase in crop yield.

Without recourse to this combination of phosphate-poor land and phosphate fertilizer, the Earth is estimated to be capable of supporting a human population of no greater than one to two billion people.

The Data

Figures for annual marketable production of phosphate rock for the US and of annual production of phosphate rock for the world were taken from the US Bureau of Mines *Minerals Yearbook* series and from Brobst and Pratt's *United States Mineral Resources* (US Geological Survey, 1973). Figures for US and world identified and hypothetical reserves are from Brobst and Pratt. "Identified resources" are defined by Brobst and Pratt as "specific, identified mineral deposits that may or may not be profitably recoverable with existing technology and economic conditions."

"Hypothetical resources" they define as "undiscovered mineral deposits, whether of recoverable or subeconomic grade, are geologically predictable as existing in known districts."

Table 1: US and world phosphate reserves, as metric tons of phosphorus (Brobst & Pratt, p. 521). Figures in billions.

	Identified	Hypothetical	Totals
US	1.4	2.7	4.1
World	6.0	9.0	15.0

Methods of Analysis

For the purposes of this analysis, I advanced the hypothesis that phosphate production in the US is increasing exponentially with respect to time. To test this assumption, I transformed the data for production to logarithms to the base 10, and plotted these values on a graph. While a straight line plot was not obtained for the entire span, relatively straight segments emerged for the periods 1880-1910 and 1940-1971.

A similar plot of time against logs of annual production for world phosphate in the 1940-71 span shows an analogous, but slower, exponential increase from 1940 to 1966, followed by a much slower, but probably also exponential, increase from 1966 to 1971. I did not attempt regression analysis for this heterogeneous curve, but the change to a lower-increase trend in world phosphate production since 1966 is noteworthy. With world population still very much on the increase, it seems doubtful that a leveling-off trend has set in upon the phosphate curve. More likely, the low-increase trend is a temporary abnormality, but it bears scrutiny in future years.

Table 2: US marketable phosphate production and world phosphate production, as metric tons of phosphorus (*Minerals Yearbook* and Brobst & Pratt, p.517).

Year	US	World
1971	6,200,000	15,300,000
1970	6,100,000	14,900,000
1969	5,950,000	14,300,000
1968	6,550,000	14,600,000
1960	3,110,000	7,300,000
1950	1,820,000	
1900	264,000	
1890	90,000	
1880	34,000	
1870	11,000	

Conclusions

The above analysis shows that: 1) since 1940, US marketable phosphate production has increased exponentially with time; 2) if the present trend continues, exhaustion of identified US phosphate reserves will occur by about 2011 AD, and of total (identified plus hypothetical) reserves by about 2060 AD.

World trends in phosphate production are too unclear to apply this sort of predictive analysis, but it does seem clear that a slow exponential growth is occurring in this case as well. Division of world phosphate reserves by present use rates suggests maxima of 393 (identified) and 983 (identified plus hypothetical) years, assuming no increase in production over present levels. The equivalent calculation for the US gives 226 and 661 years, respectively, again assuming no increase, If world production continues to increase more slowly than US production, it seems likely that the US will become dependent upon phosphate imports shortly after the turn of the century. Seventy-one per cent of the world's reserves are in Africa and Asia, according to Brobst and Pratt. This prediction hardly seems relevant, however, in view of the fact that eventual depletion of concentrated phosphate reserves, coupled with the prohibitive expenditure of money and energy necessary to reconcentrate this resource, will necessitate a reduction of world population to the one to two billion level which the Earth can reportedly support without the use of phosphate fertilizer on submarginal cropland. It could well be, too, that wholesale eutrophication of inland waters attendant upon the increasing use of such fertilizers may precipitate its own population-limiting crisis long before we run out of phosphate. □

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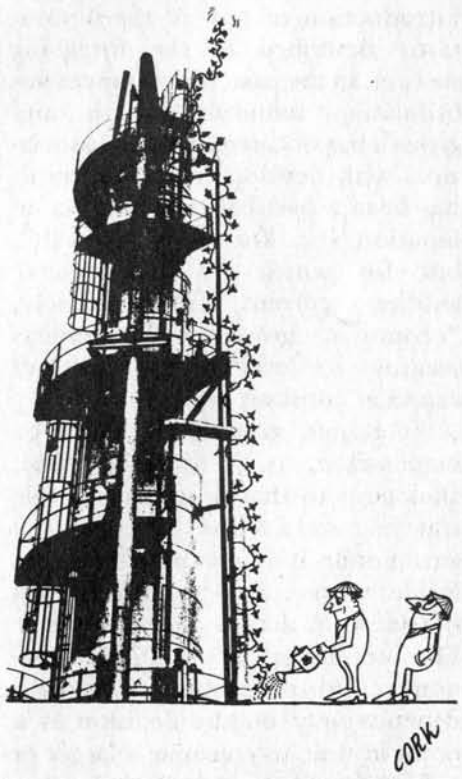

ENERGY AND ECONOMIC

by Nicholas Georgescu–Roegen

The thesis that economic growth is rapidly nearing its end is now generally accepted by all save the demented and those who simply don't want to know.
However, in the second part of this important paper Georgescu-Roegen shows that, in terms of theoretical principles rarely taken into account by economists, even a stationary economy is not sustainable. To avoid disaster, it is a *declining* economy which we must plan for and adapt to.

VII. Growth: Myths, Polemics, and Fallacies

A great deal of confusion stains the heated arguments about "growth" simply because the term is used in multiple senses. One confusion, against which Joseph Schumpeter insistently admonished economists, is that between *growth* and *development*. There is growth when only the production per capita of current types of commodities increases, which naturally implies a growing depletion of equally accessible resources. Development means the introduction of any of the innovations described in the foregoing section. In the past, development has ordinarily induced growth and growth has occurred only in association with development. The result has been a peculiar dialectical combination also known as "growth", but for which we may reserve another current label, namely, "economic growth." Economists measure its level by the GNP per capita at constant prices.

Economic growth, it must be emphasized, is a dynamic state, analogous to that of an automobile traveling on a curve. For such an automobile it is not possible to be inside a curve at one moment and outside it at the very next moment. The teachings of standard economics that economic growth depends only on the decision at a point in time to consume a larger or a smaller proportion of production [9, 27] are largely off base. In spite of the superb mathematical models with which Arrow-Debreu-Hahn have delighted the profession and of the pragmatically oriented Leontief models, not all production factors (including goods in process) can serve *directly* as consumer goods. Only in a primitive agricultural society, employing no capital equipment, would it be true that the decision to save more corn from the current harvest will increase the next year's average crop. Other economies are growing now because they grew yesterday and will grow tomorrow because they are growing today.

The roots of economic growth lie deep in human nature. It is because of man's Veblenian instincts of workmanship and idle curiosity that one innovation fosters another – which constitutes development. Given, also, man's craving for comfort and gadgets, every innovation leads to growth. To be sure, development is not an inevitable aspect of history; it depends on many factors as well as on accidents, which explains why mankind's past consists mainly of long stretches of quasi stationary states and why the present effervescent era is just a very small exception.*

On purely logical grounds, however, there is no necessary association between development and growth; conceivably, there could be development without growth. Because of the failure to observe the preceding distinctions systematically, it was possible for environmentalists to be accused of being against development.** Actually, the true environmentalist position must focus on *the total rate* of resource depletion (and the rate of the ensuing pollution). It is only because in the past economic growth has resulted not only in a higher rate of depletion but even in an increase of per capita consumption of resources that the argument drifted so as to turn around the economist's guidepost – the GNP per capita. As a result, the real issue came to be buried under the sort of sophistries mentioned in the preceding section. For even though on purely logical grounds economic growth might occur even with a decrease in the rate of resource depletion, pure growth cannot exceed a certain, albeit unknowable, limit without an increase in that rate – unless there is a substantial decrease in population.

It was natural for economists – who unflinchingly have hung on to their mechanistic framework – to remain completely indifferent when, at various times, the Conservation Movement or some isolated literati, such as Fairfield Osborn and Rachel Carson, called attention to the ecological harm of growth and the necessity of slowing down. But a few years ago the environmentalist movement gained momentum

**Some who do not understand how exceptional, perhaps even abnormal, the present interlude is, ignore the facts that coal mining began eight hundred years ago and that, incredible though it may seem, half of the total quantity ever mined has been extracted in the last thirty years.*

***Solow also claims that to be against pollution is to be against economic growth. However, harmful pollution can be kept very low if appropriate measures are taken and* pure *growth is slowed down.*

MYTHS - PART 2

The first part of this paper appeared in our June 1975 issue

around the problem of population – *The Population Bomb,* as Paul Ehrlich epitomized it. Also, a few unorthodox economists shifted to a physiocratic position, albeit in greatly modified forms, or made a try at blending ecology into economics [e.g., 10, 11, 25, 43, 49]. Some became concerned with good, instead of affluent life [25, 48]. Moreover, a long series of incidents proved to everybody's satisfaction that pollution is not a plaything of ecologists. Although depletion of resources has also been going on with increased intensity at all times, it ordinarily is a volume phenomenon below the earth's surface, where no one can see it truly. Pollution, on the other hand, is a surface phenomenon, the existence of which cannot possibly be ignored, much less denied. Those economists who have reacted to these events have generally tried to harden further the position that economic rationality and the right kind of price mechanism can take care of all ecological problems.

But, curiously, the recent publication of *The Limits to Growth* [32], a report for the Club of Rome, caused an unusual commotion within the economics profession. In fact, criticism of the report has come mainly from economists. A manifesto of similar tenor, "A Blueprint for Survival" [33], has been rather spared this glory, apparently not because it was endorsed by a numerous group of highly respected scholars. The reason for the difference is that the *The Limits to Growth* employed analytical models of the kind used in econometrics and simulation works. From all one can judge, it was this fact that irked economists to the point of resorting to direct or veiled insults in their attack against the Trojan Horse. Even *The Economist* [37] disregarded proverbial British good form and in the editorial "Limits to Misconception" branded the report as "the highwater mark of old-fashioned nonsense." Beckerman even ignored the solemnity of an inaugural lecture and assailed the study as "a brazen, impudent piece of nonsense [by] a team of whizz-kids from MIT" [9].

Let us begin by recalling, first, that economists, especially during the last thirty years, have preached right and left that only mathematical models can serve the highest aims of their science. With the advent of the computer, the use of econometric models and simulation became a widespread routine. The fallacy of relying on arithmomorphic models to predict the march of history has been denounced occasionally with technical arguments. But all was in vain. Now, however, economists fault *The Limits to Growth* for that very sin and for seeking "an aura of scientific authority" through the use of the computer; some have gone so far as to impugn the use of mathematics [9, 17, 22, 28, 44]. Let us observe, secondly, that aggregation has always been regarded as a mutilating yet inevitable procedure in macroeconomics, which thus greatly ignores structure. Nevertheless, economists now denounce the report for using an aggregative model [9, 22, 44]. Thirdly, one common article of economic faith, known as the acceleration principle, is that output is proportional to capital stock. Yet some economists again have indicted the authors of *The Limits* for assuming (implicitly) that the same proportionality prevails for pollution – which is an output, too! [9, 22, 44]. Fourthly, the price complex has not prevented economists from developing and using models whose blueprints contain no prices explicitly – the static and dynamic Leontief models, the Harrod-Domar model, the Solow model, to cite some of the most famous ones. In spite of this, some critics (including Solow himself) have decried the value of *The Limits* on the sole ground that its model does not involve prices [9, 17, 22, 27].

The final and most important point concerns the indisputable fact that, except for some isolated voices in the last few years, economists have always suffered from growthmania [48, Ch.1]. Economic systems as well as economic plans have always been evaluated only in relation to their ability to sustain a great rate of economic growth. Economic plans, without a single exception, have been aimed at the highest possible rate of economic growth. The very theory of economic development is anchored solidly in exponential growth models. But when the authors of *The Limits* also used the assumption of exponential growth, the chorus of economists cried "foul!" [9, 17, 22, 27, 28, 44]. This is all the more curious since some of the same critics concomitantly maintained that technology grows exponentially (Section VI). Some, while admitting at long last that economic growth cannot continue forever at the present rate, suggested, however, that it could go on at some lower rates [27].

Going through this peculiar criticism, one gets the impression that the critics from the economics profession proceeded according to the Latin adage – *quod licet Jovi non licet bovi* – what is permitted to Zeus is not permitted to a bovine. Be this as it may, standard economics

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will recover only with difficulty from the exposure of its own weaknesses by these efforts at self-defense.

Outside these circles, the report has been received with sufficient appreciation, certainly not with vituperation.* The most apt verdict is that despite its imperfections, "it is not frivolous."** True, the presentation is rather half-baked, betraying the rush for early publicity [50]. But even some economists have recognized its merit in drawing attention to the ramified consequences of pollution [22]. The study has also brought to the fore the importance of duration in the actual course of events [32] – a point often emphasized by natural scientists [20, 51] but generally overlooked by economists. We need a time lead not only to reach a higher level of economic growth but also to descend to a lower one.

But the much publicized conclusion – that at most one hundred years separate mankind from an ecological catastrophe [32] – lacks a scientifically solid basis.

There is hardly any room for quarreling about the general pattern of relations assumed in the various simulations covered by the report. However, the *quantitative* forms of these relations have not been submitted to any factual verification. Besides, by their very rigid nature, the arithmomorphic models used are incapable of predicting the evolutionary changes these relations may suffer over time. The prediction, which sounds like the famous scare that the world would come to an end in A.D. 1000, is at odds with everything we know about biological evolution. The human species, of all species, is not likely to go suddenly into a short coma. Its end is not even in distant sight; and when it comes it will be after a very long series of surreptitious, protracted crises. Yet, as Silk pointed out [52], it would be madness to ignore the study's general warnings about population growth, pollution, and resource depletion. Indeed, any of these factors may cause the world's economy to experience some shortness of breath.

Some critics have further belittled *The Limits* for merely using an analytical armamentarium in order to emphasize an uninteresting tautology, namely, that continuous exponential growth is impossible in a finite environment [9, 17, 22, 27]. The indictment is right, but only on the surface, for this was one of those occasions when the obvious had to be emphasized because it had been long ignored. However, the greatest sin of the authors of *The Limits* is that they have concealed the most important part of the obvious by focusing their attention exclusively on exponential growth, as Malthus and almost every other environmentalist has done.

VIII. The Steady State: A Topical Mirage

Malthus, as we know, was criticized primarily because he assumed that population and resources grow according to some simple mathematical laws. But this criticism did not touch the real error of Malthus (which has apparently remained unnoticed). This error is the implicit assumption that population may grow beyond any limit both in number and time *provided that it does not grow too rapidly.** An essentially similar error has been committed by the authors of *The Limits,* by the authors of the nonmathematical yet more articulate "Blueprint for Survival", as well as by several earlier writers. Because, like Malthus, they were set exclusively on proving the impossibility of growth, they were easily deluded by a simple, now widespread, but false syllogism: since exponential growth in a finite world leads to disasters of all kinds, ecological salvation lies in the stationary state [32, 33, 46, 53].* H. Daly even claims that "the stationary state economy is, therefore, a necessity" [66].

This vision of a blissful world in which both population and capital stock remain constant, once expounded with his usual skill by John Stuart Mill [54, Bk. 4, Ch. 6], was until recently in oblivion. Because of the spectacular revival of this myth of ecological salvation, it is well to point out its various logical and factual snags. The crucial error consists in not seeing that not only growth, but also a zero-growth state, nay, even a declining state which does not converge toward annihilation, cannot exist forever in a finite environment. The error perhaps stems from some confusion between finite stock and finite flow rate, as the incongruous dimensionalities of several graphs suggest [32, 33]. And contrary to what some advocates of the stationary state claim [66], this state does not occupy a privileged position vis-a-vis physical laws.

To get to the core of the problem, let S denote the actual amount of accessible resources in the crust of the earth. Let P_i and s_i be the population and the amount of depleted resources per person in the year i. Let the "amount of total life," measured in years of life, be defined by $L = \Sigma P_i$, from $i = 0$ to $i = \infty$. S sets an upper limit for L through the obvious constraint $\Sigma P_i s_i \leqslant S$. For although s_i is a historical variable, it cannot be zero or even negligible (unless mankind reverts sometime to a berry-picking economy). There-

A notable exception is Maddox [39]. His berating review of "A Blueprint for Survival" ("The Case Against Hysteria," Nature, 14 January 1972, pp. 63-65) drew numerous protests: Nature, 21 January 1972, p.179, 18 February 1972, pp. 405f. But given the position of economists in the controversy, it is understandable that Beckerman cannot conceive why natural scientists have not assailed the report and why they seem even to accept its thesis.

**Financial Times, 3 March 1972, quoted in [9]. Denis Gabor, a Nobelite, judged that "whatever the details, the main conclusions are incontrovertible".

*Joseph J. Spengler, a recognized authority in this broad domain, tells me that indeed he knows of no one who may have made the observation.

The substance of the argument of The Limits *beyond that of Mill's is borrowed from Boulding and Daly.*

fore, $P_i = 0$ for i greater than some finite n, and $P_i > 0$ otherwise. That value of n is the maximum duration of the human species [5,11].

The earth also has a so-called carrying capacity, which depends on a complex of factors, including the size of s_i. This capacity sets a limit on any single P_i. But this limit does not render the other limits, of L and n, superfluous. It is therefore inexact to argue – as the Meadows group seems to do – that the stationary state can go on forever as long as P_i does not exceed that capacity. The proponents of salvation through the stationary state must admit that such a state can have only a finite duration – unless they are willing to join the "No Limit" Club by maintaining that S is inexhaustible or almost so – as the Meadows group does in fact [32]. Alternatively, they must explain the puzzle of how a whole economy, stationary for a long era, all of a sudden comes to an end.

Apparently, the advocates of the stationary state equate it with an open *thermodynamic* steady state. This state consists of an *open* macrosystem which maintains its entropic structure constant through material exchanges with its "environment." As one would immediately guess, the concept constitutes a highly useful tool for the study of biological organisms. We must, however, observe that the concept rests on some special conditions introduced by L. Onsager [55]. These conditions are so delicate (they are called the principle of *detailed* balance) that in actuality they can hold only "within a deviation of a few percent" [55]. For this reason, a steady state may exist in fact only in an approximated manner and over a finite duration. This impossibility of a macrosystem not in a state of chaos to be perpetually durable may one day be explicitly recognized by a new thermodynamic law just as the impossibility of perpetual motion once was. Specialists recognize that the present thermodynamic laws do not suffice to explain all nonreversible phenomena, including especially life processes.

Independently of these snags there are simple reasons against believing that mankind can live in a perpetual stationary state. The structure of such a state remains the same throughout; it does not contain in itself the seed of the inexorable death of all open macrosystems. On the other hand, a world with a stationary population would, on the contrary, be continually forced to change its technology as well as its mode of life in response to the inevitable decrease of resource accessibility. Even if we beg the issue of how capital may change qualitatively and still remain constant, we would have to assume that the unpredictable decrease in accessibility will be miraculously compensated by the right innovations at the right time. A stationary world may for a while be interlocked with the changing environment through a system of balancing feedbacks analogous to those of a living organism during one phase of its life. But as Bormann reminded us [34], the miracle cannot last forever; sooner or later the balancing system will collapse. At that time, the stationary state will enter a crisis, which will defeat its alleged purpose and nature.

One must be cautioned against another logical pitfall, that of invoking the Prigogine principle in support of the stationary state. This principle states that the minimum of the entropy produced by an Onsager type of open thermodynamic system is reached when the system becomes steady [55, ch. xvi]. It says nothing about how this last entropy compares with that produced by other open systems.

The usual arguments adduced in favor of the stationary state are, however, of a different, more direct nature. It is, for example, argued that in such a state there is more time for pollution to be reduced by natural processes and for technology to adapt itself to the decrease of resource accessibility [32]. It is plainly true that we could use much more efficiently today the coal we have burned in the past. The rub is that we might not have mastered the present efficient techniques if we had not burned all that coal "inefficiently." The point that in a stationary state people will not have to work additionally to accumulate capital (which in view of what I have said in the last paragraphs is not quite accurate) is related to Mill's claim that people could devote more time to intellectual activities. "The trampling, crushing, elbowing, and treading on each other's heel" will cease [54]. History, however, offers multiple examples – the Middle Ages, for one – of quasi stationary societies where arts and sciences were practically stagnant. In a stationary state, too, people may be busy in the fields and shops all day long. Whatever the state, free time for intellectual progress depends on the intensity of the pressure of population on resources. Therein lies the main weakness of Mill's vision. Witness the fact that – as Daly explicitly admits [66] – its writ offers no basis for determining even in principle the optimum levels of population and capital. This brings to light the important, yet unnoticed point, that *the necessary conclusion of the arguments in favor of that vision is that the most desirable state is not a stationary, but a declining one.*

Undoubtedly, the current growth must cease, nay, be reversed. But anyone who believes that he can draw a blueprint for the ecological salvation of the human species does not understand the nature of evolution, or even of history – which is that of a permanent struggle in continuously novel forms, not that of a predictable, controllable physicochemical process, such as boiling an egg or launching a rocket to the moon.

IX. Some Basic Bioeconomics*

Apart from a few insignificant exceptions, all species other than man use only *endosomatic* instruments – as Alfred Lotka proposed to call those instruments (legs, claws, wings, etc.) which belong to the individual organism *by birth.* Man alone, came, in time to use a club, which does not belong to him by birth, but which extended his endosomatic arm and increased its power. At that point in time, man's evolution transcended the biological limits to include also (and primarily)

**I saw this term used for the first time in a letter from Jiri Zeman.*

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the evolution of *exosomatic* instruments, i.e., of instruments produced by man but not belonging to his body. That is why man can now fly in the sky or swim under water even though his body has no wings, no fins, and no gills.

The exosomatic evolution brought down upon the human species two fundamental and irrevocable changes. The first is the irreducible social conflict which characterizes the human species [10, 11]. Indeed, there are other species which also live in society, but which are free from such conflict. The reason is that their "social classes" correspond to some clear-cut biological divisions. The periodic killing of a great part of the drones is a natural, biological action, not a civil war.

The second change is man's addiction to exosomatic instruments – a phenomenon analogous to that of the flying fish which became addicted to the atmosphere and mutated into birds forever. It is because of this addiction that mankind's survival presents a problem entirely different from that of all other species [5, 11]. It is neither only biological nor only economic. It is bioeconomic. Its broad contours depend on the multiple asymmetries existing among the three sources of low entropy which together constitute mankind's dowry – the free energy received from the sun, on the one hand, and the free energy and the ordered material structures stored in the bowels of the earth, on the other.

The *first* asymmetry concerns the fact that the terrestrial component is a *stock*, whereas the solar one is a *flow*. The difference needs to be well understood [11]. Coal *in situ* is a stock because we are free to use it all today (conceivably) or over centuries. But at no time can we use any part of a future flow of solar radiation. Moreover, the flow rate of this radiation is wholly beyond our control; it is completely determined by cosmological conditions, including the size of our globe.* One generation, whatever it may do, cannot alter the share of solar radiation of any future generation. Because of the priority of the present over the future and the irrevocability of entropic degradation, the opposite is true for the terrestrial shares. These shares are affected by how much of the terrestrial dowry the past generations have consumed.

Second, since no practical procedure is available at human scale for transforming energy into matter (Section IV), accessible material low entropy is by far the most critical element from the bioeconomic viewpoint. True, a piece of coal burned by our forefathers is gone forever, just as is part of the silver or iron, for instance, mined by them. Yet future generations will still have their inalienable share of solar energy (which, as we shall see next, is enormous). Hence, they will be able, at least, to use each year an amount of wood equivalent to the annual vegetable growth. For the silver and iron dissipated by the earlier generations there is no similar compensation. This is why in bioeconomics we must emphasize that every Cadillac or every Zim – let alone any instrument of war – means fewer plowshares for some future generations, and implicitly, fewer future human beings, too [5, 11].

Third, there is an astronomical difference between the amount of the flow of solar energy and the size of the stock of terrestrial free energy. At the cost of a decrease in mass of 131 x 10^{12} tons, the sun radiates annually 10^{14}Q – one single Q being equal to 10^{18} BTU! Of this fantastic flow, only some 5,300 Q are intercepted at the limits of the earth's atmosphere, with roughly one half of that amount being reflected back into outer space. At our own scale, however, even this amount is fantastic; for the total world consumption of energy currently amounts to no more than 0.2 Q annually. From the solar energy that reaches the ground level, photosynthesis absorbs only 1.2 Q. From waterfalls we could obtain at most 0.08 Q, but we are now using only one tenth of that potential. Think also of the additional fact that the sun will continue to shine with practically the same intensity for another five billion years (before becoming a red giant which will raise the earth's temperature to 1,000°F). Undoubtedly, the human species will not survive to benefit from all this abundance.

Passing to the terrestrial dowry, we find that, according to the best estimates, the initial dowry of fossil fuel amounted to only 215 Q. The outstanding recoverable reserves (known and probable) amount to about 200 Q. These reserves, therefore, could produce only two weeks of sunlight on the globe.* If their depletion continues to increase at the current pace, these reserves may support man's industrial activity for just a few more decades. Even the reserves of uranium-235 will not last for a longer period if used in the ordinary reactors. Hopes are now set on the breeder reactor, which, with the aid of uranium-235, may "extract" the energy of the fertile but not fissionable elements, uranium-238 and thorium-232. Some experts claim that this source of energy is "essentially inexhaustible" [19]. In the United States alone, it is believed, there are large areas covered with black shale and granite which contain 60 grams of natural uranium or thorium per metric ton [30]. On this basis, Weinberg and Hammond [19] have come out with a grand plan. By strip-mining and crushing all these rocks, we could obtain enough nuclear fuel for some 32,000 breeder

**A fact greatly misunderstood: Ricardian land has economic value for the same reason as a fisherman's net. Ricardina land catches the most valuable energy, roughly in proportion to its total size.*

**The figures used in this section have been calculated from the data of Daniels [62] and Hubbert [30]. Such data, especially those about reserves, vary from author to author but not to the extent that really matters. However, the assertion that "the cast oil shales which are to be found all over the world [would last] for no less than 40,000 years" [39] is sheer fantasy.*

reactors distributed in 4,000 offshore parks and capable of supplying a population of twenty billion for millions of years with twice as much energy per capita as the current consumption rate in the USA. The grand plan is a typical example of linear thinking, according to which all that is needed for the existence of a population, even "considerably larger than twenty billion," is to increase all supplies proportionally. Not that the authors deny that there also are non-technical issues; only, they play them down with noticeable zeal. The most important issue, of whether a social organization compatible with the density of population and the nuclear manipulation at the grand level can be achieved, is brushed aside by Weinberg as "transscientific" [56]. Technicians are prone to forget that due to their own successes, nowadays it may be easier to move the mountain to Mohammed than to induce Mohammed to go to the mountain. For the time being, the snag is far more palpable. As responsible forums openly admit, even one breeder still presents substantial risks of nuclear catastrophes, and the problem of safe transportation of nuclear fuels and especially that of safe storage of the radioactive garbage still await a solution even for a moderate scale of operations [57, 58, 59, 60].

There remains the physicist's greatest dream, controlled thermonuclear reaction. To constitute a real breakthrough, it must be the deuterium-deuterium reaction, the only one that could open up a formidable source of terrestrial energy for a long era. However, because of the difficulties alluded to earlier (Section IV), even the experts working at it do not find reasons for being too hopeful.

For completion, we should also mention the tidal and geothermal energies, which, although not negligible (in all 0.1 Q per year), can be harnessed only in very limited situations.

The general picture is now clear. The terrestrial energies on which we can rely effectively exist in very small amounts, whereas the use of those which exist in ampler amounts is surrounded by great risks and formidable technical obstacles. On the other hand, there is the immense energy from the sun which reaches us without fail. Its direct use is not yet practised on a significant scale, the main reason being that the alternative industries are now much more efficient economically. But promising results are coming from various directions [61, 47]. What counts from the bioeconomic viewpoint is that the feasibility of using the sun's energy directly is not surrounded by risks or big question marks; it is a proven fact.

The conclusion is that mankind's entropic dowry presents another important differential scarcity. From the viewpoint of the extreme long-run, the terrestrial free energy is far scarcer than that received from the sun. The point exposes the foolishness of the victory cry that we can finally obtain protein from fossil fuels! Sane reason tells us to move in the opposite direction, to convert vegetable stuff into hydrocarbon fuel — an obviously natural line already pursued by several researchers [62].*

Fourth, from the viewpoint of industrial utilization, solar energy has an immense drawback in comparison with energy of terrestrial origin. The latter is available in a concentrated form, in some cases, in a too concentrated form. As a result, it enables us to obtain almost instantaneously enormous amounts of work, most of which could not even be obtained otherwise. By great contrast, the flow of solar energy comes to us with an extremely low intensity, like a very fine rain, almost a microscopic mist. The important difference from true rain is that this radiation rain is not collected naturally into streamlets, then into creeks and rivers, and finally into lakes from where we could use it in a concentrated form, as is the case with waterfalls. Imagine the difficulty one would face if one tried to use *directly* the kinetic energy of some microscopic rain drops as they fall. The same difficulty presents itself in using solar energy directly (i.e., not through the chemical energy of green plants, or the kinetic energy of the wind and waterfalls). But as was emphasized a while ago, the difficulty does not amount to impossibility.

Fifth, solar energy, on the other hand, has a unique and incommensurable advantage. The use of any terrestrial energy produces some noxious pollution, which, moreover, is irreducible and hence cumulative, be it in the form of thermal pollution alone. By contrast, any use of solar energy is *pollution-free.* For, whether this energy is used or not, its ultimate fate is the same, namely, to become the dissipated heat that maintains the thermodynamic equilibrium between the globe and outer space at a propitious temperature.*

The *sixth* asymmetry involves the elementary fact that the survival of every species on earth depends, directly or indirectly, on solar radiation (in addition to some elements of a superficial environmental layer). Man alone, because of his exosomatic addiction, depends on mineral resources as well. For the use of these resources man competes with no other species; yet his use of them usually endangers many forms of life, including his own. Some species have in fact been brought to the brink of extinction merely because of man's exosomatic needs or his craving for the extravagant. But nothing in nature compares in fierceness with man's competition for solar energy (in its primary or its by-product forms). Man has not deviated one bit from the law of the jungle; if anything, he has made it even more merciless by his sophisticated exosomatic instruments. Man has openly sought to exterminate any species that robs him of his food or feeds on him — wolves, rabbits, weeds, insects, microbes, etc.

But this struggle of man with other species for food (in ultimate analysis, for solar energy) has some unobtrusive aspects as well. And, curiously, it is one of these aspects

**It should be of interest to know that during World War II in Sweden, for one, automobiles were driven with the poor gas obtained by heating charcoal with kindlings in a container serving as a tank!*

**One necessary qualification: even the use of solar energy may disturb the climate if the energy is released in another place than where collected. The same is true for a difference in time, but this case is unlikely to have any practical importance.*

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that has some far-reaching consequences in addition to supplying a most instructive refutation of the common belief that every technological innovation constitutes a move in the right direction as concerns the economy of resources. The case pertains to the economy of modern agricultural techniques.

X. Modern Agriculture: An Energy Squanderer

Given the extant spectrum of green plants and their geographical distribution at any one time, the biological carrying capacity of the earth is determined, even though we could compute it only with difficulty and only approximately. It is within this capacity that man struggles with other life-bearing structures for food. But man is unique among all species in that he can influence, within limits, not only his share of food but also the efficiency of the transformation of solar energy into food. With time, man learned to plow deeper, to rotate the use of land, to fertilize the soil with manure, and so on. In his farming activity, man also came to derive an immense benefit from the use of domesticated draft animals.

Two evolutionary factors have influenced farming technology over the years. The oldest one is the continuous pressure of population on the extant land under cultivation. Village swarming, at first, and later migration, were able to relieve the pressure. Means of increasing the yield of land also helped ease the tension. The main source of release, however, remained the clearing of vast tracts of land. The second factor, a by-product of the Industrial Revolution, was the extension to agriculture of the process by which low entropy from mineral sources was substituted for that of biological nature. The process is even more conspicuous in agriculture. Tractors and other agricultural machines have taken the place of man and draft animals, and chemical fertilizers, that of manuring and fallowing.

However, mechanized agriculture does not fit small family farms which have at their disposal a large supply of free hands. Yet even in this case it had to come. The peasant who practises organic agriculture, who uses animals for power and manure as fertilizer, must grow not only food for his family but also fodder for his helpers. The increasing pressure of population thus forced even the small farmer, practically everywhere, to do away with the beasts of burden so as to use his entire land for food [5, 11, 26].

The point beyond any possible doubt is that, given the pressure of population in the greater part of the globe, there is no other salvation from the calamities of undernutrition and starvation than to force the yield on the land under cultivation by an increasingly mechanized agriculture, an increasing use of chemical fertilizers and pesticides, and an increasing cultivation of the new high-yield varieties of cereal grains. However, contrary to the generally and indiscriminately shared notion, this modern agricultural technique is in the longrun a move against the most elementary bio economic interest of the human species.

First, the replacement of the water buffalo by the tractor, of fodder by motor fuels, of manure and fallowing by chemical fertilizers substitutes scarcer elements for the most abundant one – solar radiation. Secondly, this substitution also represents a squandering of terrestrial low entropy because of its strongly decreasing returns. What modern agricultural technique does is to increase the amount of photosynthesis on the same piece of cultivated land. But this increase is achieved by a more than proportional increase in the depletion of the low entropy of terrestrial origin, which is the only critically scarce resource. (We should note that decreasing returns in substituting solar for terrestrial energy would, on the contrary, constitute a good energetic deal). This means that, if half of the input of terrestrial energy (counted from the mining operation) required by modern agriculture for one acre – cultivated, say, with wheat – is used each year, in two years the less industrialized agriculture would produce more than twice as much wheat from the same piece of land. This dis-economy – surprising as it may seem to the worshipers of machinery – is especially heavy in the case of the high-yield varieties which earned their developer, Norman E. Borlaug, a Nobel Prize.

A highly mechanized and heavily fertilized cultivation does allow a very large population, P_i, to survive, but the price is an increase of the per capita depletion of terrestrial resources s_i, which *ceteris paribus* means a proportionally greater reduction of the future amount of life (Section VIII). In addition, if growing food by "agro-industrial complexes" becomes the general rule, many species associated with old-fashioned, organic agriculture may gradually disappear, a result which may drive mankind into an ecological cul-de-sac from which there would be no return [5].

The above observations bear upon the perennial question of how many people the earth could support. Some population experts claim that there would be enough food even for some forty billion people at a diet of some 4,500 kilocalories provided that the best farming methods were used on every acre of potentially arable land.* The logic rests on multiplying the amount of potentially arable land by the current average yield in Iowa. The calculations may be as "careful" as boasted – they represent, nonetheless, linear thinking. Clearly, neither these authors nor those less optimistic have thought of the crucial question of *how long* a population of forty billion – nay, even one of only one million for that matter – can last [5, 11]. It is this question which, more than most others, lays bare the most stubborn residual of the mechanistic view of the world,

**This position has been advanced, for example, by Colin Clark in 1963 [see 5, 11] and very recently by Revelle [63].*

which is the myth of the optimum population "as one that can be sustained indefinitely" [33; also 27, 32].

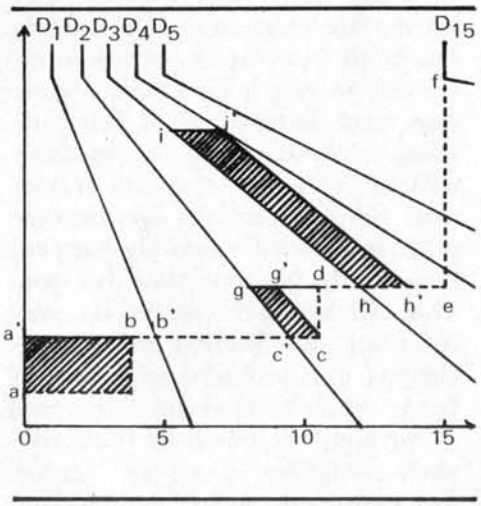
XI. A Minimal Bioeconomic Program

In "A Blueprint for Survival" [33], the hope is expressed that economics and ecology will one day merge. The same possibility has already been considered for biology and physics, with most opinions agreeing that in the merger biology would swallow up physics [11]. For essentially the same reason – that the phenomenal domain covered by ecology is broader than that covered by economics – economics will have to merge into ecology, if the merger ever occurs. For, as we have seen in the preceding two sections, the economic activity of any generation has some influence on that of the future generations – terrestrial resources of energy and materials are irrevocably used up and the harmful effects of pollution on the environment accumulate. One of the most important ecological problems for mankind, therefore, is the relationship of the quality of life of one generation with another – more specifically, the distribution of mankind's dowry *among all generations.* Economics cannot even dream of handling this problem. The object of economics, as has often been explained, is the administration of scarce resources; but to be exact, we should add that *this administration regards only one generation.* It could not be otherwise.

There is an elementary principle of economics according to which the only way to attribute a relevant price to an irreproducible object, say, to Leonardo's Mona Lisa, is to have absolutely everyone bid on it. Otherwise, if only you and I were to bid, one of us could get it for just a few dollars. That bid, i.e., that price, would clearly be parochial.*

This is exactly what happens for the irreproducible resources. Each generation can use as many terrestrial resources and produce as much pollution as its own bidding alone decides. Future generations are not, simply because they cannot be, present on today's market.

To be sure, the demand of the present generation reflects also the interest to *protect* the children and perhaps the grandchildren. Supply may also reflect expected future prices over a few decades. But neither the current demand nor the current supply can include even in a very slight form the situation of more remote generations, say, those of A.D. 3,000, let alone those that might exist a hundred thousand years from now.



Not all the details, but certainly the most important consequences of allocation of resources among generations by the market mechanism may be brought to the fore by a very simple, actually a highly simplified diagram. We shall assume that demand for some mineral resources already mined (say, coal-on-the-ground) is the same for each successive generation and that each generation must consume at least one "ton" of coal. The demand schedule is also assumed to include the preference for protecting the interests of a few future generations. In Figure 1, D_1, D_2, . . D_{15} represent the aggregate demands of successive generations, beginning with the present one. The interrupted line *abcdef* represents the average cost of mining the deposits of various accessibilities. Total reserves amount to 15 tons. Now, if we ignore for a moment the effect of the interest rate on the supply of the coal *in situ* by the owners of the mines, then the first generation will mine the amount $a'b'$, the shaded area representing the differential rent of the better mines. We may safely regard aa' as the price of the coal contained in these mines. The second generation will mine the amount $b'c'$. But since no mine will earn a differential rent, the price of the coal *in situ* will be zero. During the third generation, the marginal cost of mining will be at the level of h; the quantity mined will be gh, with the quantity $c'c' = gg'$ earning the rent shown by the shaded area. Finally, the fourth generation is left with the amount hh' (determined by the condition that $g'd' = h'e$), which will earn a pure scarcity rent, represented by the shaded area $hh'i'i$. Nothing will be left for the following generations.

Several things are now obvious. First, the market mecahnism *by itself* results in resources being consumed in higher amounts by the earlier generations, that is, faster than they should be. Indeed, $a'b' > b'c' > gh > hh'$, which confirms the dictatorship of the present over the future. Should all the generations bid from the outset for the total deposit of coal, the price of coal *in situ* will be driven up to infinity, a situation which would lead nowhere and only explode the entropic predicament of mankind. Only an onmiscient planner could avoid this situation by simply allocating one ton of coal to each of the first fifteen generations, each ton consisting of the same qualitative composition.*

Bringing in the interest rate modifies the picture somewhat and allows us to see even more clearly the impotence of the market to prevent the excessive depletion of resources by the earlier generations. Let us consider the case which I earlier called a bonanza era. Specifically, it is the situation in which the best quality of coal mine suffices to

*Yet the economist's myth that prices reflect values in some generally relevant sense is now shared by other professions as well. The Meadows group, for example, speaks of the cost of resource depletion, and Barry Commoner, of the cost of environmental deterioration. These are purely verbal expressions, for there is no such thing as the cost of irreplaceable resources or of irreducible pollution.

*In a pioneering work [64], Hotelling demonstrated once for all that one cannot speak of optimum allocation of resources unless the demand over the entire future is known.

ENERGY AND ECONOMIC MYTHS - PART 2

satisfy the present demand as well as that of the future generations *as far as* the present economic time horizon goes. Within this horizon, then, there is no rent at any time and hence no inducement to save coal *in situ* for future generations. Coal *in situ* can thus have no price during the present generation.

The question ignored by the few economists who have recently tackled some market aspects of natural resources [e.g., 6] is why resources *in situ* may, after all, have a positive price even if there are no self-imposed restrictions by the mine owners. The answer is that if present resources have a price, it is not ordinarily because of present scarcity, but because of some expected differential scarcity within the present time horizon. To illustrate the rationale of this process, let C_1, C_2, C_3 be coal mines of different qualities, the costs of mining one unit of coal being $k_1 > k_2 > k_3$, respectively. Let us further assume that C_1 is expected to be exhausted during the third generation after the present one, when C_2 will become economically efficient. Let us also assume that C_2, in turn, will be exhausted during the second generation thereafter, and that C_3 will then suffice for the remainder of the time horizon. During the third future generation, C_1 will prove to enjoy a differential rent $r_1 = k_2 - k_1$ with respect to C_2, and after two more generations the differential rent of C_2 over C_3, $r_2 = k_3 - k_2$, will become manifest. Only C_3 has no differential rent. and hence, as we have seen in the previous paragraph, its price is zero throughout. On the other hand, because C_2 necessarily earns a rent in the fifth generation from now, it must have a present positive price, namely, $p_2{}^0 = r_2/(1+i)^5$, where i is the interest rate (assumed constant throughout the time horizon). In the j-th generation from now, the price will be $p_2{}^j = r_2/(1+i)^{5-j}$. A similar logic determines the present price of C_1. Only, we must observe that during the generation when the differential rent of C_1 becomes manifest, the price of C_2 is $p_2^3 = r_2/(1+i)^2$. The rent must therefore be added to this price. Hence, the present price of the coal of C_1 is $p_1{}^0 = (r_1 + p_2^3)/(1+i)$.[3]

The formulae just established show that the effect of the interest rate in the presence of a qualitative spectrum of mines is to extend the use of coal mined from more accessible sources (in comparison to the quantities determined by Figure 1). In some rather idle way we may say that the existence of the interest rate helps the economy of resources. But let us not ignore the far more important conclusion of the foregoing analysis, which is especially striking in the case of an era of bonanza. Serious scarcities may become effective (as will certainly happen) beyond the present time horizon. That future fact can in no way influence our present market decisions; it is virtually inexistent as far as these decisions are concerned.

Nothing need be added to convince ourselves that the market mechanism cannot protect mankind from ecological crises in the future (let alone to allocate resources optimally among generations) even if we would try to set the prices "right."* The only way to protect the future generations, at least from the excessive consumption of resources during the present bonanza, is by reeducating ourselves so as to feel some sympathy for our *future* fellow humans in the same way in which we have come to be interested in the well-being of our *contemporary* "neighbors." This parallel does not mean that the new ethical orientation is an easy matter. Charity for one's contemporaries rests on some objective basis, namely, the individual self-interest. The difficult question one has to face in spreading the new gospel is not "what has posterity done for me?" — as Boulding wittily put it — but, rather, "why should I do anything for posterity?" What makes you think, many will ask, that there will be any posterity ten thousand years from now? And indeed, it would certainly be poor economics to sacrifice anything for a nonexistent beneficiary. These questions, which pertain to the new ethics, are not susceptible of easy, convincing answers.

Moreover, there is the other side of the coin, also ethical and even more urgent, on which Kaysen [17] and Silk [52], in particular, have rightly insisted. The nature of Mohammed-men being what it is, if we stop economic growth everywhere, we freeze the present status and thus eliminate the chance of the poor nations to improve their lot. This is why one wing of the environmentalist movement maintains that the issue of population growth is only a bogy used by the rich nations in order to divert attention from their own abuse of the environment. For this group, there is only one evil — inequality of development. We must proceed, they say, toward a radical redistribution of productive capacity among all nations. Another view argues that, on the contrary, population growth is the most menacing evil of mankind and must be dealt with urgently and independently of any other action. As expected, the two polarized views have never ceased clashing in useless and even violent controversies — as happened especially at the Stockholm Conferences in 1972, and, quite recently, at the Bucharest Conference on Population.* The difficulty is again seated in human nature: it is mutual, deep-rooted mistrust — of the rich that the poor will not cease growing in numbers and of the poor that the rich will not stop getting richer. Sane reason,

*The economist's characteristic confidence in the omnipotence of the price mechanism led many of my auditors to counter that the choice between satisfying present or future needs, with the usual reward for postponing consumption, will set the prices right for optimal use of resources. The argument fails to take into account precisely the limitation of our time horizon, which does not extend beyond a couple of decades. Even Solow, in an illustration defending the standard position, assumes a horizon of thirty years only.

*For a highly interesting account of the cross-currents at the Stockholm Conference, see [65].

however, invites us to recognize that the differential gradient between the poor and the rich nations is an evil in itself, and although closely connected with continuous population growth, it must be dealt with directly as well.

Because pollution is a surface phenomenon which also strikes the generation which produces it, we may rest assured that it will receive much more official attention than its inseparable companion, resource depletion. But since in both cases there is no such thing as the cost of undoing an irreparable harm or reversing an irrevocable depletion, and since no relevant price can be set on avoiding the inconvenience if future generations cannot bid on the choice, we must insist that the measures taken for either purpose should consist of quantitative regulations, notwithstanding the advice of most economists to increase the allocation efficiency of the market through taxes and subsidies. The economists' plank will only protect the wealthy or the political protégés. Let no one, economist or not, forget that the irresponsible deforestation of numerous mountains took place because "the price was right" and that it was brought to an end only after quantitative restrictions were introduced. But the difficult nature of the choice should also be made clear to the public – that slower depletion means less exosomatic comfort and that greater control of pollution requires proportionately greater consumption of resources. Otherwise, only confusion and controversies at cross-purposes will result.

Nor should any reasonable ecological platform ignore the basic fact that, from all we know about the struggle for life in general, man will probably not let himself down, when pressed for his needs, natural or acquired, by sparing his competitors (including future humans). There is no law in biology stating that a species must defend the existence of others at the cost of its own existence. The most we can reasonably hope is that we may educate ourselves to refrain from "unnecessary" harm and to protect, even at some cost, the future of our species by protecting the species beneficial to us. Complete protection and absolute reduction of pollution are dangerous myths which must be exposed as such (Section V).

Justus von Liebig observed that "civilization is the economy of power" [11]. At the present hour, the economy of power in all its aspects calls for a turning point. Instead of continuing to be opportunistic in the highest degree and concentrating our research toward finding more economically efficient ways of tapping mineral energies – all in finite supply and all heavy pollutants – we should direct all our efforts toward improving the direct uses of solar energy – the only clean and essentially unlimited source. Already known techniques should without delay be diffused among all people so that we all may learn from practice and develop the corresponding trade.

An economy based primarily on the flow of solar energy will also do away, though not completely, with the monopoly of the present over future generations, for even such an economy will still need to tap the terrestrial dowry, especially for materials. The depletion of these critical resources must therefore be rendered as small as feasible. Technological innovations will certainly have a role in this direction. But it is high time for us to stop emphasizing exclusively – as all platforms have apparently done so far – the increase of supply. Demand can also play a role, an even greater and more efficient one in the ultimate analysis.

It would be foolish to propose a complete renunciation of the industrial comfort of the exosomatic evolution. Mankind will not return to the cave or, rather, to the tree. But there are a few points that may be included in a minimal bioeconomic program.

First, the production of all instruments of war, *not only of war itself,* should be prohibited completely. It is utterly absurd (and also hypocritical) to continue growing tobacco, if avowedly, no one intends to smoke. The nations which are so developed as to be the main producers of armaments should be able to reach a consensus over this prohibition without any difficulty if, as they claim, they also possess the wisdom to lead mankind. Discontinuing the production of all instruments of war will not only do away at least with the mass killings by ingenious weapons but will also release some tremendous productive forces for international aid without lowering the standard of living in the corresponding countries.

Second, through the use of these productive forces as well as by additional well-planned and sincerely intended measures, the underdeveloped nations must be aided to arrive as quickly as possible at a good (not luxurious) life. Both ends of the spectrum must effectively participate in the efforts required by this transformation and accept the necessity of a radical change in their polarized outlooks on life.*

Third, mankind should gradually lower its population to a level that could be adequately fed only by organic agriculture.** Naturally, the nations now experiencing a very high demographic growth will have to strive hard for the most rapid possible results in that direction.

Fourth, until either the direct use of solar energy becomes a general convenience or controlled fusion is achieved, all waste of energy – by overheating, overcooling, overspeeding, overlighting, etc. – should be carefully avoided, and if necessary, strictly regulated.

Fifth, we must cure ourselves of the morbid craving for extravagant gadgetry, splendidly illustrated by such a contradictory item as the golf cart, and for such mammoth splendors as *two-garage* cars. Once we do so, manufacturers will have to stop manufacturing such "commodities."

Sixth, we must also get rid of fashion, of "that disease of the human mind," as Abbot Fernando Galliani characterized it in his celebrated *Della moneta (1750).* It is indeed a disease of the mind to throw away a coat or a piece of furniture while it can still perform

**At the Dai Dong Conference (Stockholm, 1972), I suggested the adoption of a measure, which seems to me to be applicable with much less difficulty than dealing with installations of all sorts. My suggestion, instead, was to allow people to move freely from any country to any other country whatsoever. Its reception was less than lukewarm. See [65].*

***To avoid any misinterpretation, I should add that the present fad for organic foods has nothing to do with this proposal, which is based only on the reasons expounded in Section X.*

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its specific service. To get a "new" car every year and to refashion the house every other is a bioeconomic crime. Other writers have already proposed that goods be manufactured in such a way as to be more durable [e.g. 51]. But it is even more important that consumers should reeducate themselves to despise fashion. Manufacturers will then have to focus on durability.

Seventh, and closely related to the preceding point, is the necessity that durable goods be made still more durable by being designed so as to be repairable. (To put it in a plastic analogy, in many cases nowadays, we have to throw away a pair of shoes merely because one lace has broken.)

Eighth, in a compelling harmony with all the above thoughts we should cure ourselves of what I have been calling "the circumdrone of the shaving machine," which is to shave oneself faster so as to have more time to work on a machine that shaves faster so as to have more time to work on a machine that shaves still faster, and so on *ad infinitum.* This change will call for a great deal of recanting on the part of all those professions which have lured man into this empty infinite regress. We must come to realize that an important prerequisite for a good life is a substantial amount of leisure spent in an intelligent manner.

Considered on paper, in the abstract, the foregoing recommendations would on the whole seem reasonable to anyone willing to examine the logic on which they rest. But one thought has persisted in my mind ever since I became interested in the entropic nature of the economic process. Will mankind listen to any program that implies a constriction of its addiction to exosomatic comfort? Perhaps, the destiny of man is to 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 an earth still bathed in plenty of sunshine. □

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Unknown artist's impression of smallpox epidemic among Massachusetts Indians.

INDIAN HEALTH AND DISEASE

by Virgil J. Vogel

We have all been brainwashed into believing that primitive man was, among other things, riddled with disease, and that it required the paraphernalia of modern medicine to extract him from his misery. The more we learn about the health of primitive man, however, the more we realise how healthy he really was. Virgil J. Vogel, in this chapter from his interesting book *American Indian Medicine* shows that this was certainly true of the American Indians before the arrival of the Europeans.

Early European observers, in nearly unanimous accord, proclaimed the relative good health of American Indians, and their freedom from deformity. Since Indians were not disease-free, these accounts partly reflect the comparatively low state of European health in that period. Europe, with its urban centres and higher population density, was more subject to the spread of contagions which were unknown in America. The circumstances of civilized living, poor as it was by present standards, also operated to preserve many infirm and defective individuals who might have perished or left no progeny under the rigorous environment of America, where neolithic conditions still existed in the greater part of the land.

Columbus was the first to remark upon the absence of deformity among the Indians.[1] A few years later, the French essayist, Michel de Montaigne, declared:

> . . . as my testimonies have told me, it is verie rare to see a sicke body amongst them; and they have further assured me, they never saw any man there either shaking with the palsie, toothlesse, with eies dropping, or crooked and stooping through age.[2]

In Panama, Lionel Wafer found the natives to be "streigt and cleanlimb'd, big-bon'd, full-breasted and hansomly shap'd." Moreover, he "never saw among them a crooked and deformed person. They are very nimble and active, running very well." He was impressed by their "white even teeth."[3]

When Boston was still a village on the edge of the wilderness, William Wood remarked of the New England Indians:

> I have been in many places, yet did I never see one that was born either in defect or redundance a monster, or any that sickness had deformed, or casualty made decrepid [*sic*], save one that had a

bleared eye, and another that had a wenne on his cheek.[4]

Most of them reached fifty, he declared, before "a wrinkled brow or gray hair bewray [*sic*] their age," a happy situation owing to the circumstance that "they are not brought down with suppressing labour, vexed with annoying cares, or drowned in the excessive abuse of overflowing plenty." Besides being possessed of "lusty and healthful bodies," they did not know:

> . . . those health-wasting diseases which are incident to other countries, as fevers, pleurisies, callentures, agues, obstructions, consumptions, subfumigations, convulsions, apoplexies, gouts, stones, tooth-aches, pox, measles, or the like; but spin out the thread of their days to a fair length, numbering threescore, fourscore, some a hundred years, before the worlds universal summoner cite them to the craving grave.[5]

In the same period, John Josselyn pronounced the New England Indians "tall and handsome timber'd people," who live long, even to a hundred years of age, if they be not cut off by their Children,[6] war, and the plague, which together with the small pox hath taken away abundance of them." While he mistakenly thought that the "great pox" [syphilis] was a native disease caused by cannibalism, he declared "there are not so many Diseases raigning amongst them as our *Europeans.*" Among their afflictions however, were "pestilent Feavers, Plague, Black-pox, Consumption of the Lungs, Falling sickness, King's evil, and . . . *Empyema.*"[7]

The unanimity of opinion about the generally blissful health of the Indians was not confined to the English. A Dutch account from New York related that "it is somewhat strange that among these most barbarous people, there are few or none cross-eyed, blind, crippled, lame, hunch-backed, or limping men; all are well fashioned people, strong and sound of body, well fed, without blemish."[8] In French Canada, the Baron de Lahontan found that "the Savages are a robust and vigorous sort of People, of a Sanguine Temperament, and an admirable Complexion." They were "unacquainted with a great many Diseases that afflict the *Europeans,* such as the *Gout, Gravel, Dropsy, &c.* Their Health is firm, notwithstanding that they use no precaution to preserve it." As elsewhere reported wherever Indians were in contact with whites, Lahontan noted that the chief killer was smallpox.[9]

In North Carolina at the beginning of the eighteenth century, John Lawson declared that the Indians:

> . . . are never troubled with the Scurvey, Dropsy, nor Stone. The Phthisick, Ashma [*sic*], and Diabetes, they are wholly Strangers to. Neither do I remember I ever saw one Paralytick amongst them. The Gout, I cannot be certain whether they know what it is, nor not. Indeed, I never saw any Nodes or Swellings, which attend the Gout in Europe; yet they have a sort of Rheumatism or Burning of the Limbs, which tortures them grievously, at which time their Legs are so hot, that they employ the young People continually to pour Water down them. I never saw but one or two thus afflicted.[10]

Nevertheless, the ravages of the white man's gifts, smallpox and rum, were so devastating that Lawson believed that only one sixth as many Indians survived within two hundred miles of the white settlements as had lived in the same area half a century earlier.

Peter Kalm held that rheumatism and pleurisy were the chief afflictions of the Indians, which arose "from their being obliged frequently to lie in the wet parts of the woods at night, from the sudden changes of heat and cold . . . and from their being frequently loaded with too great a quantity of strong liquor." Kalm cited several newspaper accounts of Indians who were reputed to be over a hundred years old at the time of their deaths.[11]

It is difficult to draw conclusions concerning the life expectancy of early Indians, especially without figures on infant mortality and the death rate from accidents and disease in the early years. Reports of aged Indians, however, are not uncommon, even in recent times.[12] The brother and successor of Powhatan, Opechancanough, was said to be ninety-nine years of age when he was shot in 1644,[13] though some reports placed his age even higher. European beliefs that Indians were a short-lived people, Lawson wrote, were contrary to his observations, since they lived "to as great Ages as any of the Europeans, the Climate being free from Consumptions, which Distemper, fatal to England, they are Strangers to."[14] From skeletal remains, Wilton M. Krogman, a modern scholar and anthropologist, estimated that the life expectancy at birth for white Americans in the late eighteenth century was estimated at thirty-five years.[16]

During the last third of the eighteenth century, travelers continued to report favorably on the physical condition of the Indians. Robert Rogers commented that "you will rarely find among the Indians a person that is in any way deformed, or that is deprived of any sense." He found that Indians generally were "of a hale, robust, and firm constitution."[17] Jonathan Carver reported the Indians to be generally healthy and free from many of the diseases of "civilized nations," but subject to afflictions caused by their arduous way of life. Among these were "Pains and weaknesses in the stomach and breast," and above all, pleurisy, which they treated by sweating. Dropsy and paralytic complaints were "very seldom known among them." From the absence of venereal disease among the "Naudowessies" [Sioux or Dakota] and other western tribes he concluded that "it had not its origin in America."[18]

It is noteworthy that within the area which now comprises the United States, no explorer has reported from observation the presence of venereal diseases among Indians prior to their contact with whites. Diron d'Artaguette, governor-general of Louisiana, writing of the Illinois Indians in his journal of April 19, 1723, declared: "as for the other diseases which came from the corruption of the blood, they did not have them at all before seeing the French."[19] Dr. Colden was convinced that the yaws came from Africa but that the "Lues Venerea" (syphilis) originated in America.[20] This belief may have been rooted in Oviedo's dubious account, cited earlier. Dr. Barton

claimed to have made an "extensive inquiry into the subject," and was satisfied that both syphilis and gonorrhea were unknown among North American Indians before white contact.[21] In the next century, Dr. Joseph M. Toner was convinced that syphilis was introduced to America from the Old World, where its presence had long been concealed from investigators by varying nomenclature.[22] In the present century, Dr. Aleš Hrdlička, a noted paleopathologist, insisted: "Notwithstanding some claims to the contrary, there is as yet not a single instance of thoroughly authenticated precolumbian syphilis."[23]

Philadelphia's imperious Dr. Rush flatly held that "the *small pox* and the *venereal disease* were communicated to the Indians of North America by the Europeans." So far as other diseases were concerned, he declared that gout was rare among them, and he knew of no evidence that they were ever subject to scurvy.[24] There were few instances of mental disorder. Incorrectly, he asserted that there were no accounts of "diseases from worms,"[25] and that they "appear to be strangers to diseases and pains of the teeth."[26]

One eighteenth-century observer who maintained that Indians were "not less, rather more subject to disease than Europeans," was David Zeisberger (1780), who argued that their "rough manner of life and hardship of travel and the chase" were contributing causes. Rheumatism was common, "often leading to lameness, deafness, or blindness," and women suffered in the back and neck from carrying burdens on their head. Moreover:

> They are subject to festering sores. Cured in one place, they break out in another. Chills and fever, dysentery, hemorrhage, and bloody flux in women are very common among them. Venereal diseases have, during the last years spread more and more, due, doubtless, to their disorderly life.[27]

It is relevant that the Indians of Zeisberger's experience (the Delawares), in contrast to those of earlier observers, had long been in contact with whites. Except for the venereal disease, however, there is no doubt that the ills he mentioned had long been prevalent among Indians.

Zeisberger's fellow missionary, John Heckewelder, reported that the Indians were untouched by a scarlet fever epidemic that swept frontier Detroit in 1785. "However," he added, "a disorder called the Hooping-Cough, attended at length, with a sore throat, I have known to prove destructive to the Indian children, in their settlements." He saw no cases of "the Itch" (scabies or eczema) and ascribed it "to their different mode of living; namely, their food, their well-aired houses, or huts, &c."[28]

As the above report indicates, the penetration of whites into the trans-Appalachian wilderness was altering the pleasant picture painted by the earliest visitors. This escalation of disease continued to be reflected in the literature. In 1798 it was reported that Indians at Onondaga, New York, had been reduced from 133 to 105 in three years, and that most died of "phthisis pulmonalis" (tuberculosis).[29] As early as 1738, the Cherokees were reduced by one half in a year's time, Adair reported, from smallpox which was "conveyed into Charles-town by the Guinea-men [slaves], and soon after among them, by the infected goods."[30] Later they were swept by "intermittent fevers" (malaria) and "head-Pleurisy," which caused 350 to perish in one week of 1779.[31]

". . . among these most barbarous people there are few or none cross-eyed, blind, crippled, lame, hunch-backed or limping . . . all are well fashioned people, strong and sound of body, well fed, without blemish."

A French traveler among the Miamis in the early nineteenth century, Le Compte C.F. Volney, reported that the Indians were afflicted with "diseases of the stomach, intermittent and bilious fevers, consumption, and pleurisy," and above all, smallpox. The Quaker and Moravian missionaries maintained, according to Volney, that Indians under their influences were less subject to sickness than "the untamed savages." Volney held that many of the ills to which Indians were prey resulted from alternating hunger and gluttony, which "must necessarily impair the stomach and destroy the health." Deformed or infirm Indians were rare, he maintained, at least in the northern tribes, because defective babies and the helpless aged were put to death.[32] The last statement raises a large question, with strong witnesses on both sides.

Dr. Rush claimed that the weaker Indians were naturally eliminated by the rigorous environment:

> It is remarkable that there are no deformed Indians. Some have suspected, from this circumstance, that they put their deformed children to death, but nature here acts the part of an unnatural mother. The severity of the Indian manners destroys them.[33]

Alexander von Humboldt, the versatile German who spent the years 1799-1804 in exploration of Central and South America, declared of the Indians on the Orinoco:

> I saw no person who had any natural deformity; and I may say the same of thousands of Caribs, Muyscas, and Mexican and Peruvian Indians, whom we observed during the course of five years.

He maintained that this circumstance was not due to deliberate destruction of handicapped persons, since the mission Indians were also well formed. He attributed it to the fact that deformed women in savage tribes did not find husbands, whereas in Europe they might, if they had a fortune.[34]

On the other hand, there are credible reports of mercy killing among some Indian tribes. As early as 1612-14, the Jesuit priest, Marc Lescarbot, reported that some Canadian Indians let the aged sick die, as a merciful act, and because their nomadic life did not allow for the care of the sick.[35] "In some countries," declared Charlevoix, "when the patient is despaired of, they dispatch him to keep him from languishing." He reported that the Onondagas even did away with infants who had lost their mothers.[36] Gabriel Sagard said that nomadic tribes, being "touched and moved

by compassion," put to death those who were too old to follow the others.[37] Josselyn reported that Indians sometimes ended the lives of their aged parents "if they lived so long that they become a burden to them."[38] In the Missouri valley in 1850, Thaddeus Culbertson was told that "it was common for the Indians to leave the old to perish on the prairies." Instances were also cited of a blind Crow Indian being taken to battle in the hope that he might be killed, and of a small boy who was abandoned because of a severe leg injury. Culbertson affirmed, however, that these acts did "not necessarily arise from a cruel and unfeeling disposition," but from the belief that death would be preferable to their burdensome condition, and that they would be transferred "to a state of happiness and abundance."[39]

In the main, as Sagard pointed out, the sedentary tribes did not destroy the infirm. Moreover, no reports of the practice appear in the writings of such observers as De Liette, Lahontan, Beverley, Lawson, Carver, Hunter, and many others. The evidence we have seems insufficient to warrant the conclusion that mercy killing, or suicide,[40] fully explain the healthy condition of the Indians as it was described in the early years. It appears more likely that environmental factors, operating through the centuries, weeded out the weaker types in the process of natural selection, as Rush suspected. Dr. Erwin Ackerknecht, in a study of white captive children among the Indians, concluded that the disease resistance of the Indians "was the effect of continuous natural selection and nurture rather than of true racial heredity."[41] They were not prepared, of course, for the new diseases brought by the invaders.

Some years before the sprawling population of the young nation began to spill into the Great Plains, Dr. Edwin James observed (1820) that "few if any, instances of pulmonary consumption occur among the Indians of this region; the same remark is probably as true of the original native population of New York and New England."[42] Thirteen years later, at Fort Clark on the upper Missouri, Prince Maximilian reported that the Indians were troubled with bowel complaints, catarrh, and violent coughs.[43] Only a few years later, as the vanguard of trappers and traders increasingly penetrated this region, the Indians were decimated by epidemics of cholera and smallpox.[44] Early accounts are filled with depressing descriptions of the havoc wrought by introduced contagion. In 1842, Audubon heard much about the prevalence of smallpox "which destroyed such numbers of the Indians."

> Among the Mandans, Ricarees, [Arikara], and Gros Ventre [he wrote], hundreds died in 1837, only a few surviving, and the Assiniboines were nearly exterminated. Indeed, it is said that in the various attacks of this scourge, 52,000 Indians have perished.[45]

Deformed or infirm Indians were rare . . . at least in the Northern tribes, because defective children and the helpless aged were put to death. . . .

It was reported that in 1849 about two hundred Cheyenne lodges were wiped out by cholera.[46] Pestilence swept across the plains like a great grass fire. The Blackfeet, living near the "shining mountains," were hit by smallpox, which destroyed two-thirds of them in 1837, and the scourge returned in 1869-70.[47] Everywhere the dismal story was the same, as disease did more to clear the West for settlement than the cavalry.

It is readily seen that there are some discrepancies in the early accounts of Indian pathology. Some accounts, such as Rush's, were secondhand, others were of local application, and many failed to distinguish, or inaccurately distinguished, between indigenous and introduced diseases. Identification of some ills is confused by chaotic nomenclature. It is significant, however, that the greatest number of disorders is reported by the later observers (*e.g.*, Volney), who saw the Indians after they had long been in contact with whites.

There are methods other than the study of historical documents by which to determine the health and disease conditions of the early Indians. One of them is archaeology, and its branch, paleopathology, the study of primitive skeletal remains. A specialist in this field was the late Dr. Aleš Hrdlička, who also investigated the ills and medical practices of the Indians of his own time, particularly in the Southwest. His studies tend to confirm that the aboriginal Indian was generally healthy compared to Europeans of the colonial period:

> The skeletal remains of unquestionably precolumbian date [he concludes] are, barring few exceptions, remarkably free from disease. Whole important scourges were wholly unknown. There was no pathologic microcephaly, no plague, cholera, typhus, smallpox or measles. Cancer was rare, and even fractures were infrequent. There was no lepra [leprosy] . . . there is as yet not a single instance of . . . precolumbian syphilis. There were, apparently, no nevi [skin tumors]. There were no troubles with the feet, such as fallen arches. And, judging from later acquired knowledge, there was a much greater scarcity than in the white population of many diseases of the skin, of most mental disorders and of other serious conditions.

The chief diseases to which the ancient Indians were subject, he added, were digestive disorders, particularly in children and older persons, pneumonia, arthritis, and localized maladies such as nutritional disorders.[48]

Indian graves yield more than bones. Frequently they contain works of art, including sculpture and pottery. One who has studied such artifacts with a view to learning something of Indian health is Dr. Abner I. Weisman, clinical professor of obstetrics and gynacology of the New York Medical College, who has collected some three thousand items obtained primarily from graves in

Mexico and Central and South America. In numerous statuettes in his collection, Dr. Weisman indicates that pre-Columbian sculptors depicted many of the diseases and physical states of their people and the knowledge and skill of their physicians and surgeons. According to his analysis, these figurines illustrate, among other things, the symptoms of malnutrition, deformity, physical and mental illness, the stages of pregnancy and childbirth, the techniques of amputation, trephining, and possibly Caesarian section. Some of the figures appear to represent individuals suffering from headache, toothache, arthritis and spinal defects, neck pains, endemic goiter, obesity, phlebitis, leg deformation – possibly due to calcium deficiency, eye diseases, skin ailments, angina, and perhaps hernia.[49] Since some of the other maladies listed above (*e.g.*, deformity, goiter, obesity), have seldom, if ever, been reported among the "wild" tribes, it is possible that the more sedentary Mexicans, from dietary or other causes, were subject to more disorders than the so-called savages.

A contemporary writer holds that in the last century "there developed an utterly false belief . . . that the Indian was a paragon of health. This was supposed to be so partly because of his medicines, more because of his mode of life."[51] The image of the robust aborigine may not be as mythical as some have believed. Brickell reported that "these naked Indians will lye and sleep in the Woods without any Fyre or covering, being inur'd thereto from Infancy."[52] Their feats of endurance could scarcely be performed by weaklings. "An Indian," wrote Loskiel," makes nothing of dragging a deer of one hundred or one hundred and fifty pounds weight home, through a very considerable tract of forest."[53] Indeed, those who led this strenuous life were not immune from all ailments, but it appears that they were spared from most of the infectious and deficiency diseases.

A summary of the opinions of recent studies of aboriginal health and healing[54] indicates that rheumatism and arthritis, dysentery and other digestive disorders, intestinal worms, and eye disorders were present. There were mastoid infections and respiratory ailments, but disorders caused by vitamin and mineral deficiencies were uncommon and were localized. Neurological and psychic disturbances, heart disease, arteriosclerosis, and cancer were rare.

Among the infectious diseases, it is generally held that scarlet fever, typhoid, cholera, diphtheria, smallpox, and measles were absent in pre-Columbian times. Malaria and yellow fever, according to an authority on tropical medicine, were introduced after the Spanish conquest.[55]

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25. *Cf.* Barton, *Essay Towards a Materia Medica,* II, 51, who reported that worms were common among them. Rush later added a footnote that they were not free of worms.
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40. Adair reported that Cherokee Indians disfigured by smallpox often committed suicide. *History of the Indians,* 233.
41. Ackerknecht, "White Indians: Psychological and Physiological Peculiarities of White Children Abducted and Reared by North American Indians," *Bulletin of the History of Medicine,* Vol. XV, No. 1 (January, 1944), 15-36.
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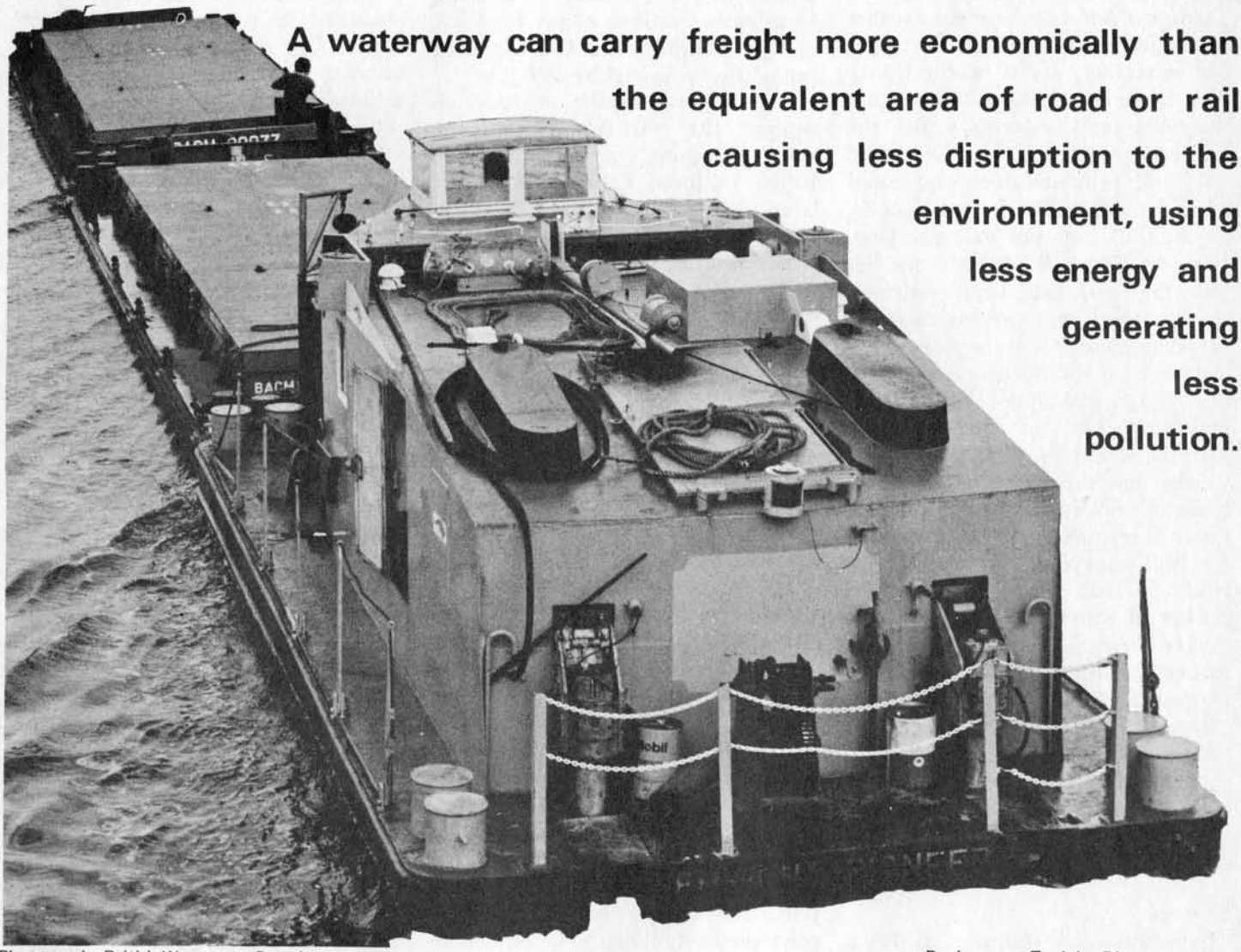
The Case for Water Transport

by M. G. Miller

A waterway can carry freight more economically than the equivalent area of road or rail causing less disruption to the environment, using less energy and generating less pollution.



Photograph: British Waterways Board.

Pusher-tug Freight Pioneer guides two 140-tonne *Bacat* barges through Castleford on the Aire and Calder Navigation, on their way from Leeds to the Humber Estuary.

When water transport is mentioned many will think of a brightly painted narrowboat towed by a horse or powered by a Bolinder semidiesel and chugging its way along a meandering canal. The scene is very picturesque but it has little to do with modern transport. Certainly when Britain's canals were dug 200 years ago they provided the freight carrying capacity for the industrial revolution, but the narrow 7 foot gauge of the Midlands hub of the system limited cargoes to 25 or 30 tons. Thus today they are splendid for pleasure cruising but are irrelevant for bulk transport, although as we shall see, many of our wider canals are still in intensive commercial use.

On the Continent water freight is increasing quite rapidly. Over the period 1963-71 the annual tonnage carried in France grew from 76 million tons to 106 million (= 31% of her total freight transport), in West Germany from 167 million tons to 229 millions (= 33% of total transport), and in Holland from 151 million to a staggering 245 million (= 66% of total). By contrast in Britain in 1972 only 30 million tons (1% of total) were carried on inland waterways and the amount is declining. Why should this be? Basically it is a case of how much money is spent on developing the canals for modern freight carrying. At present France is spending £30 million annually on

improving her waterways, West Germany £60 million, whilst British Waterways Board gets a laughable £4 million annually to cover both maintenance and development.

True, these figures must be compared with mileage. Only 350 miles of British Waterways Board's 2000 miles of waterway are designated as 'commercial' under the 1968 Transport Act, but there are another 450 miles of independent commercial waterway, whilst on the Continent there are 12,000 miles of commercially used waterways. But the intensity of use must also be looked at. The Continent's rivers and canals carried 1000 million tons of goods, i.e. 80,000 tons per mile per year. Britain's figure is 40,000 tons per mile per year, and itself contrasts sharply with the carrying capacity of other modes of transport – railways carry 16,583 tons per mile per year and roads a mere 8,100 tons/mile/year. This also highlights the fact that a waterway can carry more freight than the equivalent width of roads or railways. Also, surprisingly, water transport is sometimes faster for bulk carrying, if manpower is held constant. For example, John Harker of Knottingley uses 500 ton tanker barges to carry oil from Hull to Leeds. Using 3 crew members the trip takes 16 hours, whereas 3 men driving 20 ton road tankers would take 50 hours – 4 times as long – to transport the same amount. And this is reflected in costs. When Esso switched from road to water the transport cost dropped a third.

Cargoes

Obviously water transport is not a universal panacea. It is not of much use for local distribution of small loads. Where it does show its advantages is in the carriage of bulk commodities. This is borne out on the Continent where the basic materials carried in bulk include ores, chemicals, fertilizers, petroleum products, construction materials and agricultural produce. Furthermore it is found that half of this is an extension of ocean shipping, where bulk goods continue from the port by waterway to an inland destination.

One big advantage, particularly in these fuel conscious times is the greater efficiency – water carriage needs much less energy, partly because friction on a boat is less than the rolling resistance of a lorry, and partly because water is level whilst lorries climb hills. For example, whereas a lorry carrying a 10 ton load will need a 60 horsepower engine, a mere 20 h.p. is sufficient to power a pair of narrowboats carrying 55 tons, or looking at a more realistic cargo load for modern conditions, a 450 ton boat can easily be moved by 120 h.p.

Two recent studies in America support the relative efficiency of water transport. In 1972 the Oak Ridge National Laboratory calculated the difference in miles per gallon per tonne transported between cities as:

Air	3.7 mpg/tonne
Road	58
Rail	200
Waterway	250
Pipeline	300

And at an American Society of Civil Engineer's Internal Water Resources meeting at Memphis it was estimated that one dollar would move one ton of freight the following distances:

by air	5 miles
by road	15 miles
by rail	67 miles
by water	335 miles!

There are differences of detail between the two sets of figures but the overall pattern is clear – water transport uses less fuel than do other modes of transport. When it is considered that in the USA over one-fifth of their total energy resources are used for providing transport, the rapidly rising world oil prices make it increasingly important that the least wasteful methods are used.

Environmental Aspects

Sheer use of fuel is not the only consideration. A lorry's life is only about 5 years whilst a boat's minimum life is fifteen years. Similarly a lorry engine needs replacement every 2 years whilst a boat's will last for 5. And a lorry uses items like tyres and antifreeze which need periodic replacement. Then there are the less tangible factors like pollution, noise, vibration and public acceptability. It has been calculated that large vessels, compared volume for volume with diesel trucks, cause only a third as much air pollution! Similarly although boats are not noiseless they do not cause tyre or road noise, they don't have squealing brakes nor are their engines continually being revved up to accelerate away from traffic lights or to climb a slope, and whereas vibration is transmitted to buildings from lorries, a boat's vibration is absorbed by the water on which it floats. The accident rate also is lower on waterways than roads, and serious injury is rare.

More subjectively, a boat on a canal may enhance the attractiveness of a view but a stream of lorries on a motorway will in most cases detract from it. Also a towpath walk need not be spoilt by the presence of boats in the same way as heavy lorries often make walking unpleasant in a town. And you can't fish from a pavement!

At present the true relative costs are concealed by different methods of accounting, e.g. haulage firms are hugely subsidised by the taxpayer's contribution to road maintenance, but Ian Breach writing in the 'New Scientist' reckons that if all the costs of each mode of transport are taken into account, both of building and running them, plus the environmental effects, then water transport costs the community only 20% of what road traffic does!

Britain's Prospects

Accepting that there are sound arguments for utilising water carrying, what scope is there for developing this in Britain? It is estimated that the amount of freight carried in the U.K. is likely to keep growing, adding another 25 million tons by 1975. And although at present only 1% is carried on inland waterways, 17% travels by coastal shipping, much of which could complete its journey on a canal if it were large enough. Size is also an important key to economic efficiency, a lesson which the Continent has already learnt. In Britain much of our canal system will carry boats of a *maximum* capacity of 25 tons, whereas 350 tons is the *minimum* commercial standard in Europe although some smaller boats are still in use. Their class 5 waterways will take 1350 ton boats, and some will accommodate 'push-tow' units (one pusher

tug plus several barges) of up to 8,000 tons. Significantly the British canals on which traffic is currently expanding are those larger than average, such as the Gloucester & Sharpness (1200 ton boats) and the Aire & Calder (500 tons).

New developments already in hand which make water transport even more attractive include the LASH (lighter aboard ship) and the BACAT (barge aboard catamaran) systems. The former carries 80 lighters of 435 tons each, the latter 18 140 ton barges, and both enable inland waterway traffic to be carried across open seas for its onward

140-tonne Bacat barge

journey to inland destinations without any intermediate handling of individual cargoes i.e. the barges or lighters are hauled aboard bodily, acting as floating containers. The first BACAT entered service in 1974, whilst no less than 24 LASH are under construction. BACAT was developed specifically by British Waterways Board to link our canals to Europe's by carrying barges across the North Sea from Hull to Rotterdam. Meanwhile on the Continent itself there are several canal building and improvement schemes which will increase the potential of water traffic, the most important being the Transeurope Waterway which by using the rivers Rhine, Main and Danube will provide a 2,200 mile unbroken link between the North and Black seas for push-tows up to 4000 tons. Thus barges loaded in Leeds or Doncaster might travel all the way to Belgrade or beyond without any intermediate cargo handling.

Current Progress

Even in Britain public opinion and official attitudes appear to be changing from hostility towards grudging acceptance. The Department of the Environment after an initial refusal has now given the go-ahead to British Waterways Board to seek the necessary power from Parliament to modernise the Sheffield and South Yorkshire Navigation. A feasibility study carried out for BWB by Inbucon has found that the capacity of this 35 mile waterway could be quadrupled for only £3 million, the cost of building just 2 miles of rural motorway. 700 ton barges could reach Rotherham, where British Steel's new £23 million plant will otherwise need extra road capacity equal to a second M62 to deliver its raw materials and finished products. By questioning firms and inspecting freight records it has been calculated that if the canal were modernised traffic would rapidly grow from ½ million to 2 million tons a year, and that the operating costs would *drop* by 25 to 30% thus giving all round benefits to the community.

Currently Inbucon are carrying out a study jointly for BWB and the GLC to see whether the Grand Union Canal through London could be modernised to enable lorries to unload at a Slough or Watford motorway canal terminal, rather than as at present driving through London to the docks. A similar proposal has been suggested for an M6/River Weaver 'port' at Winsford, and more ambitious schemes suggest making Peterborough and Nottingham inland ports, or even digging a new canal between Birmingham and the Wash! Even without any outlay Britain's canals could carry 3 times as much as at present, whilst modern expenditure would increase capacity by 8 to 10 times. 100 miles could be modernised for a mere £20 million. The situation is well summed up by Frederic Doerflinger, Chairman of the Inland Waterways Association's Inland Shipping Group, who states:

"In a nutshell, development of inland waterways will be both to the commercial advantage of freight forwarders and to the economic and environmental advantage of the nation." □

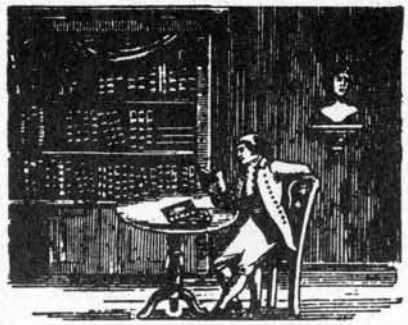
This month's authors

Dr. Alison Anderson and her husband Professor Jay Anderson were contributors to *The Limits to Growth* and its sequel *Toward Global Equilibrium*. They have lectured throughout the United States on *Limits* and are currently interested in the relationship between the stability and the diversity of large environmental systems. Dr. Anderson has also served as a consultant to the Environmental Protection Agency, and has written an operators manual for remote terminal computer groups.

Nicholas Georgescu-Roegen was born in Rumania and educated at the University of Bucharest, the Sorbonne and University College, London. He is now Distinguished Professor of Economics at Vanderbilt University in the U.S.A.

Virgil J. Vogel Ph.D. is associate professor of history in Amundsen-Mayfair College in Chicago. He also teaches American-Indian history at the American Indian Center in Chicago and is the author of *Indian Place Names in Illinois* (Springfield, Illinois 1963).

Michael Miller, B.A., A.B.Ps.S., is a psychologist employed as a careers adviser at Leicester University. He has a long-standing spare-time interest in inland waterways and is an enthusiastic canal cruiser.



Books

There are More Things in Heaven and Earth

THE BIOLOGY OF GOD by Sir Alister Hardy, F.R.S. Jonathan Cape Ltd. £4.50

In 1858 two papers, one by Charles Darwin, the other by Alfred Russel Wallace (the "co-founders" of modern evolutionary theory) which were to rock the nineteenth century scientific and theological world were delivered before the Linnean Society. Shortly afterwards the Society's President, himself an eminent scientist, reviewing the year's proceedings observed that it had "not been marked by any of those striking discoveries which at once revolutionise . . . the department of science on which they bear"! One hopes that this brilliant scholarly work by Alister Hardy, Professor Emeritus of Zoology at Oxford, will elicit a more enlightened response from the contemporary scientific and intellectual world.

It is an unfortunate and erroneous supposition held by many "educated" people that science has reduced religious belief to mere "superstition" and that Freudian psychology has completed the job, explaining away the concept of Deity as a hang-over, from childhood, of a father figure. They might concede that it is only "modern" science which has had this effect. Bacon (the first exponent of the scientific method) pontificated that "they that deny a God destroy man's nobility"; Professor Langdon-Davies observed a few years ago "that the whole history of science has been a direct search for God, deliberate and conscious until well into the eighteenth century. Copernicus, Kepler, Galileo, Newton, Leibnitz believed that their work told humanity more about God than had been known before.

After completing Hardy's painstakingly-researched book one can only conclude that there are certainly more things on this earth than are dreamt of in our current philosophy and one is reminded of Einstein's dictum that, "God does not play dice with the world."

The book's epigraph, taken from Edmund Burke, provides a key to Hardy's main theme: "Man is by his constitution a religious animal". He then asserts that there is nothing inimical between contemporary science, *properly* understood and *true* theism and piety. On the contrary he has found sufficient evidence from a life-time of scientific research and speculation (he is among the world's leading Darwinian scholars) to warrant his establishing a research unit at Oxford to undertake a systematic study of records of religious experiences and will shortly begin publishing the unit's findings.

He feels strongly that a true biology should encompass the whole of life and the "science of life . . . should range from biophysics and biochemistry . . . to the study of man's emotional behaviour, both sexual and religious". Although he claims over-modestly, that his book deals with the spiritual end of this span, it embraces the whole spectrum of natural science and then poses the ultimate question: Why should men and women, some ordinary, some quite extraordinary, have felt throughout recorded history what Wordsworth called that "sense sublime", that consciousness of a transcendental presence that frequently intrudes when least expected and which is eloquently captured in the title of C.S. Lewis's *Surprised by Joy?*

Scientific rationalism, alone, cannot explain it, for existence itself is a scandal to pure reason. Patiently, Sir Alister examines the explanations of "reductionist" philosophies emanating from Darwin, T.H. Huxley, Freud, Monod and others, finding them all lacking in one respect or another, and quotes convincingly from sources as disparate as Haldane, Whitehead, Wells and Beatrice Webb ("I find it best to live as if the soul of man were in communion with a superhuman force which makes for righteousness") to indicate that man is, indeed, "a religious animal".

No review of this length can do justice to this remarkable work which encompasses evolutionary theory (itself, by definition, evolving), parapsychology, behaviourism, natural theology and the D.N.A. code, but one is left with a sense of exhilaration at the author's energy of spirit coupled with the joy of reading a book combining profound scientific knowledge with poetic, visionary style. For believers and agnostics this must prove inspiring, compulsive reading. Atheistic materialists might ponder J.B.S. Haldane's remark: "Not only is the universe a queerer place than we suppose: it may be queerer than we *can* suppose."

Duncan Williams

Resisting the Barbarians

THE BLACK RAINBOW. Essays on the present breakdown of culture. Edited by Peter Abbs. Published by Heinemann Educational Books, £3.80.

The essays which Mr. Abbs has collected together in this book attempt to illuminate "those forces of nihilism in our culture that now everywhere manifest themselves and which are expressed most generally in our society in the numbing loss of values, meanings, and aspirations."

Mr. Abbs himself considers the underlying world-view of our society. He identifies a predominantly mechanical interpretation of the world, which derives from the Renaissance scientists. The "informing commonplaces of our public life" are the glorification of Progress and an accompanying neglect of tradition, resting on belief in the four categories of growth, measurement, size and power. Readers of *The Ecologist* who have seen Henryk Skolimowski's article "The Myth of Progress" (Vol. 4, 7) and Robert Waller's "Our Gradgrind Society" (Vol. 4, 9) will find that much is familiar. Mr. Abbs is very good at adducing everyday examples of these informing assumption; he is

less good at demonstrating why these assumptions should have taken root.

The remaining essays each take one aspect of our culture and survey it with a disapproving eye. In compiling a book of 240 pages, there must obviously be a very careful selection of the topics to be included. Mr. Abbs has been guided in his choice by the hope that when "the nature of the modern nihilism and barbarism" has been understood it will more readily be possible "to refuse to succumb." At the present time, those aspects of our culture which are most difficult to resist are not the arts, but the insidious manipulations of the mass media. The arts are well represented in the volume under review, but there are no essays devoted to advertising (although Mr. Abbs wrote a valuable article on that subject in *The Ecologist* last year), to the press, or to television (Raymond Williams' recent book is a useful beginning here).

More all-pervading and more fundamental than any of these is the influence of the urban environment, which conducts "the daily education of the senses" (Louis Mumford). The essay "Roads, Office Blocks and the New Misery" by Fred Inglis explains the politics of urban re-development and of motorway building. City centres are sacrificed to tower blocks, because empty office blocks are amongst the more profitable forms of land speculation; and road building continues (again disrupting our cities — Mr. Inglis compiles an impressive roster of urban casualties), because the car industry, the heavy transport lobby, and the heavy engineering and construction industries are regarded by the government as crucial to the maintenance of economic growth. As a detailed and vigorous account of the mechanical world-picture in action, Mr. Inglis' essay can be strongly recommended.

Our attitudes to the world and our awareness of the options open to us are conditioned by the language we use, and here too the prestige of technology has had a deadening effect. A. C. Capey claims that educational theory is suffocating under the weight of fashionable catchwords. He offers a piece of specimen prose:

> "If we and our work are to be relevant, we must stimulate involvement and student participation in decision-forming processes, referring unresolved conflicts back but meanwhile making as much eye-ball contact with our pupils as our resources permit. Ideally each contact-session is an unstructured shared experience: a multi-media, multi-form course with performative elements is the viable route to semantic hygiene. In such a democratic situation the role of the teacher is non-paternalist, open, and exploratory."

As Mr. Capey comments, by the time we reach the end, stupefaction has set in. The contribution of philosophy to the ruling world-view has been to direct thought into certain harmless channels; in a difficult article F. R. Lea asserts that philosophy must again concern itself with questions of value.

It is easy to agree with these contributions to this book which report the unhealthy state of the arts, although this situation seems to be primarily a symptom of what is wrong in our society and must be remedied by changes elsewhere. "The Limits of Permissiveness" by the late Herbert Read points to a tendency in literature, deriving from Joyce and exemplified in Beckett, to convey the lack of meaning in human communication and the consequent sense of the meaninglessness of life; and a parallel tendency in the visual arts to escape, at whatever cost, the influence of the modern masters; and deplores both. S. W. Dawson is able quickly to dispose of the contemporary novel. He remarks interestingly that the lack of life so manifest arises because today the author has a "reading public" but no audience. The novel has entered the realm of consumer goods.

John McCabe portrays the classical music world as a microcosm of the larger culture, afflicted by a neglect of national tradition and by overcentralisation. Mr. McCabe also outlines the role of fashion in preventing the development of promising composers. Charles Parker, in his account of the pop scene, makes rather heavy weather but unlike some previous commentators on pop he is both informed and sympathetic. His conclusions are not reassuring. Pop is "a peerless form of social control." Whereas traditional societies initiate the adolescent into manhood, our culture has substituted induction through pop into an "utterly synthetic and deliberately abstract environment . . . built up . . . in complete rejection of the real external world in which men and women have to make a living."

The daunting "Suicide: The Condition of Consciousness" (by Masud Khan) offers a convincing interpretation of Albert Camus' *The Fall* as a case study in egotistical alienation, seen as the endemic disease of our industrial culture. The novel takes the form of a conversation in which one participant comes entirely to dominate: he perverts communication into the issuing of a communiqué and his wish to relate to another individual degenerates into the wish to be understood. For light relief, there is "Paper Tygers", Ian Robinson's very funny dismissal of pop poetry. Mr. Robinson, conscious perhaps that he is shooting at a sitting duck, contrives not to be too painfully condescending. (Those yet to meet the work of Michael Horovitz or those who had assumed his permanent eclipse some years ago might like to note his three-line poem in a recent *Resurgence* (Vol. 6, 1) in which he rhymes "bloom", "gloom", and "room".)

Finally, David Holbrook takes Ted Hughes to task for having written *Crow*. *Crow* seems to have become a central target in the attack on nihilism in the arts (the phrase "the black rainbow" itself is taken from *Crow*), not only because it is seen to embody that nihilism within itself, but because it has been espoused by fashionable literary circles. David Holbrook's analysis is long (apparently it has been "severely cut" before publication), elaborate, impassioned, and plausible. However, it is not convincing; the feeling persists that *Crow* is not all bad. As Mr. Holbrook says, "the nihilistic energy of the poems implicitly gives the lie to the denial of meaning", and it *is* possible to bring from the book the sense that "we are not

nothing despite the death that overwhelms us personally, or shall overwhelm our species when the Earth dies."

In the second part of his essay "The Mechanical World-Picture", Peter Abbs considers the possibilities of change in the ruling assumptions of our society. Noting that at the high point of a world-picture, alternative conceptions of the nature of the world will already be in circulation, he traces the change in scientific thinking consequent upon Heisenberg's Uncertainty Principle. Nature can no longer be regarded as a machine that the scientist observes from without; the scientist, in his attempts to observe, alters what he seeks to observe; he is a participant in nature. Mr. Abbs suggests that this idea of man as participant rather than observer, developed in *Blueprint for Survival* and the ecology movement (and earlier in the writings of William Morris and "the tougher and more alert side of the Romantic Revolution"), could lead to the establishment of small decentralised communities, "where production and need, beauty and function, work and pleasure would be reconciled." It must be said, however, that a world-view becomes dominant in a society, not by chance nor for lack of an alternative, but because it rationalises the conditions obtaining in that society; and in our present case it seems likely that, until drastic change in those conditions (a shortage of natural resources, perhaps) *forces* a change in the political and economic structures the mechanical world picture will persist. Meanwhile Mr. Abbs is to be thanked for producing a worthwhile, stimulating, and well-intentioned book.

Bernard Gilbert

Culling with Kindness

AMONG THE ELEPHANTS by Iain & Oria Douglas-Hamilton. Collins & Harvill Press, £3.95. pp. 285.

In this study of the elephants of Lake Manyara National Park in Tanzania, the problems that Iain Douglas-Hamilton outlines, those of a large population in a restricted area, bear a disturbing resemblance to those of man today. Should the elephants be left to find their own population levels, or should man intervene, for example by "culling", bearing in mind that the balance of nature is often upset even further once an eco-system has been interfered with?

In pursuing these questions, Iain Douglas-Hamilton, later joined by his wife Oria, lived for four years with the elephants – learning to know them as individuals (he calls one Innominate when he runs out of names), observing their habits, plotting their movements, noting their births, illnesses and deaths. These four years are recorded in exciting detail, the authors' experiences being given a tremendous immediacy and vitality by the excellent photographs (most of which were taken by Oria).

This is, however, a study not *merely* of elephants but of elephants *and* their environment, and Iain Douglas-Hamilton notes that his first year's work will "have to include both the study of the number of elephants and the state of acacia trees" – a favourite food.

On visiting Murchison Falls National Park (later named Kabalega) in Uganda, he discovers that there, elephants, confronted with bare plains where once *Terminalia* woodlands grew, are attaining puberty later and giving birth at a greatly reduced rate, compared with former times. Can this decline be due to the fact that there are no more trees to eat or is it "intrinsic to overcrowding"? This is an important question because "if it (can) be shown that elephants (have) the capacity to regulate their own numbers, then it might, theoretically, be possible to avoid cropping."

On the question of elephant cropping or "culling" we meet with compelling arguments from both sides, although that of Desmond Foster Vesey-Fitzgerald is by far the funniest and most succinct. When confronted with the damage to acacia trees by elephant herds in search of food he snorts:

"God man, that's not damage, that's habitat modification."

Ian Parker goes to the other extreme by setting up his own private company 'Wild Life Services', which organises elephant cropping schemes under contract. He paid the Murchison Falls National Park £5.00 for every elephant he killed and still made a profit. (It must be noted that Ian Parker had good and cogent reasons *why* it was more humane to remove elephants now, rather than face another disaster of the magnitude of the Tsavo tragedy.)

My one criticism of *Among the Elephants* (and it is a very minor one) would be the inclusion of the section by Oria Douglas-Hamilton, which has, to the determined reader, rather the character of a forced detour, although attractive in itself. It is interesting, nevertheless, as an alternative viewpoint on camp-life and her husband's work.

Otherwise this book is witty, *packed* with fascinating detail and superb photographs, and above all, is highly readable and enjoyable even for someone who knows nothing whatsoever about elephants. It cannot in my opinion, be too highly praised both as a book in its own right, and as a painstaking and detailed record of the elephants of Lake Manyara National Park – whose story, we are pleased to learn, ends on a note of hope: subject to the permission of the regional authorities, extra land is being purchased for the park, with contributions promised from sources as far-ranging as Anglia Television and the Frankfurt Zoological Society.

Victoria Hutchings

Also Received:

Readers might also like to note the recent publication of *Elephants and Their Habitats* (Clarendon Press: Oxford University Press, £15.00) by R.M. Laws, I.S.C. Parker (founder of Wild Life Services mentioned above) and R.C.B. Johnstone. This is a highly scientific approach to the problem of elephant overpopulation in the Murchison Falls (kabalega) National Park in Uganda. The decision to 'crop' is examined and justified with a wealth of statistical data, and the results of the research carried out on the carcasses are reported.

Letters

Britain's Food Supply

Dear Sir,

In your issue for June 1975 Edward Goldsmith attacks me for "seriously advocating the continuance of present-day agricultural practices:– artificial fertilisers, pesticides, the grubbing up of hedgerows, monocultures and the lot". He also calls me a "famous government 'expert' specialising in underplaying ecological problems".

This latter statement which is libellous, amused the publishers of my book *Can Britain Feed Itself?* (Merlin Press 2/4 West Ferry Road, London E.14. Price £1.95) as they described me as a "critic of inefficiency and humbug in governmental and academic matters" and describe how I show that "official policy – regarding food supplies for Britain has been misconceived". Mr. Goldsmith is therefore both wrong and libellous in calling me "a government expert" but as such remarks are generally considered to be an accolade I shall not sue him for damages!

In the specific points Mr. Goldsmith raises, he is wrong on all counts. First, I do not advocate further grubbing up of hedgerows. I state in my book, and in an article which appeared in *The Times* on 3rd January, that: "No more hedges need to be removed, no more coppices uprooted . . ." and that: ". . . with proper planning, a little self-sacrifice by the more carnivorous, and a joint effort by all sections of the community, we can build a better fed and more beautiful Britain in the future."

However, I do plead guilty to saying that this can only be achieved by maintaining our present cereal yields on our present acres. This can only be done by a proper use of our organic manures, and I have always deplored their waste. In addition we must use both chemical fertilisers and pesticides with care and good sense. This, Mr. Goldsmith implies, will cause soil deterioration. His statement that in "the last fifty years . . . there has probably been more soil deterioration than during the whole of man's previous history . . ." is, in terms of Britain, and this is what I was writing about, – the most utter rubbish. Most of our soils are in better heart than ever before. The Report of the Agricultural Advisory Council, *Modern Farming and the Soil,* showed that continuous cereal growing with only chemical fertilisers had harmed little of our land, and that better drainage with an occasional grass ley would restore areas which had been damaged. This does not mean that we might not get even better results with more organic manures, better rotations and the proper use of grazing stock. But any policy which greatly reduced our yield of cereals would be criminal as well as silly.

Yours faithfully,
Kenneth Mellanby,
Hill Farm,
Huntingdon.

WOOF

Dear Sir,

Robert Waller's review gives an able survey of the problems of the organic movement, but one that is of little value to the thousands of young people who want to work on the land away from chemical agriculture. As Director-Secretary of the largest organic movement in Britain, may I offer some practical advice?

Both the Soil Association and ourselves run registers of people who want jobs in organic horticulture and agriculture, but the problem is that these all need experience, and those who have capital and wish to become self-sufficient need knowledge and skill even more urgently. There are also far more seekers than jobs.

The answer to this problem is W.W.O.O.F., which stands for *Working Weekends on Organic Farms,* invented by Sue Coppart, and perhaps one of the best original ideas in the organic movement. It is composed of young people of both sexes who go down to organised weekends, arriving on Friday night and work all Saturday and most of Sunday, for accommodation and meals only. There is a choice of sites, market gardens, organic gardens, self-sufficiency holdings as well as farms, and a list of about 60 for longer stays. The subscription is £2.00 per year and a booking fee of 20p per weekend. Write to: Mrs. Rowan Malcolm, 143 Sabine Road, London, SW11 for fuller details.

Our trial ground at Bocking is on the list and we have entertained many parties of Woofers, who not only learn the basic skills of organic horticulture and agriculture, but whether they can stand the hard work, the wind and the weather. Many Woofers have gained permanent jobs on the sites, and this is why there is now room for more. Winter and Autumn are the best times to start, because there is nothing like struggling to do a hard job in the rain to sort out who is good enough to survive on the land and who would do better as commercial artists or stage designers indoors.

Married couples can join for one subscription and it is far better to spend six months Woofing and learn not only horticulture and agriculture without chemicals, but communal living (several communes belong) than to spend your capital and find yourselves tied to a life you loathe. Both husband *and* wife should share the life on the land before throwing away the one they now lead.

Yours sincerely,
Lawrence D. Hills,
Henry Doubleday Research Association, Braintree, Essex.

Technological Determinism

Dear Sir,

The Mathes and Gray article (May 1975) describing the engineer as an unwitting social radical raises funddamental issues of the relationship between technology and social change. Unfortunately, the authors are almost entirely mistaken in their arguments.

1) It is hard to accept the supposed inevitability of a world-wide 'socio-technological system' in which cultural differences vanish beneath a common technology. Mathes and Gray minimize the gulfs in conditions and individuals' life-expectations between nations. They confuse projection with prediction, falsely assuming that *today's* USA represents the *future* for less advanced nations. They neglect (a) national political, social and geographical differences; (b) the complicating factor of developing nations confronting domination by already industrialised nations. This factor imposes on late-comers conditions which leading countries escaped. Moreover, Mathes and Gray ignore profound differences between the social systems of capitalist and state socialist nations (J.H. Goldthorpe, ed. P. Halmos, 1964). Wages and life-chances are more open to *political* regulation in the latter. Market forces are more important under capitalism. In short, we are still far from an all-embracing 'technological civilization'.

2) Mathes and Gray are inconsistent in their attributions of inexorable social power to technology. One claim is that technological development is 'radically and irrevocably' altering life. Another view gives more hope to remediable social engineering: it is simply a matter of 'guiding technological development to avoid unanticipated and undesirable side effects. . . .'

3) The engineer, say the authors, produces unintended, unwanted change. Indeed, their opening sentence implies that technology has escaped control. But, here again, Mathes and Gray are self-contradictory. Technology is not being used 'effectively'; some (at least) of its aspects are undirected. Yet US technology is elsewhere characterised as requiring 'centralization of power to be used efficiently'. So, for Mathes and Gray, technology is both insufficiently guided, and yet subject to ever increasing central control.

4) In general, the authors overestimate the autonomy both of engineers and of processes of technological development. They attribute to technology *per se* properties that more accurately belong to Western consumer industries. Much development indeed addresses 'pleasure and ease' but 'technological devices' do not just *happen* – they are the *direct* product of the motives *not of engineers* but of those who commission R & D.

5) The authors mistakenly identify a *direct* link between technology and individual reactions. They claim: 'technological development has led persons to experience and "need" continual change'. This again forgets that technology and its effects are mediated through the political, social and economic situations of all who control, produce or use technology. Consumer manipulation, not technological development as such, produces a 'need' for change. Desires can be, and *are*, manipulated for sectional benefit (Packard 1957). Mathes and Gray are naive in their assertion that the 'culturally unique' goal orientation of the technological revolution is the ideal of 'secular happiness of mankind on earth'.

6) If technology truly conditioned individuals to 'need' change, we should have difficulty explaining why certain Trade Unions come to resist technologically advanced work innovations. The Mathes-Gray error is to largely exclude from consideration human motives and perceptions, (in the above case, a belief that innovation was inimical to one's interests). The '*need*' for change assertion is ill-considered. In addition, it conflicts with the authors' claim that people, especially engineers, may be *counter-suggestible* in the face of radical change, ('The conservative . . . believes the social processes of a pretechnological society should be preserved'). Confusingly, the authors see technology as generating both personal 'need' for change *and* conservative ideologies among engineers at the very heart of industrialism.

7) The authors set up a simplistic, *asocial* dichotomy between 'liberals' and 'conservatives'. Actual confusions of 'conservative' and technological (i.e. 'liberal') elements in existing bodies like the UK Conservative Party are ignored.

8) The authors confuse developments within certain industrial societies with *the* development of Industrial Society, e.g. their account of the technologically stimulated career and geographical mobility of engineers. Their account of high mobility is true of the USA, but not of *all* industrial societies. In Japan, career mobility is very different. In fact, there is very little inter-firm mobility there, (R. Dore 1973/Chie Nakane 1973). Mathes and Gray again mistakenly proceed straight from technology to generalised comments on industrial society. The mediation of industrialisation through local cultural and political circumstances is ignored.

Conclusion: The Mathes-Gray model of technological determination of society is inadequate, since the roles of institutions and individuals are neglected or misrepresented. The authors allow for merely one-way causality from technology to institutions and individuals. Technology is allowed to operate *on* but not *through* these agents. There is no realization that technology may be both *modifying and modified*, nor any sharing of David Dickson's insight (1974) that: 'technological innovation is intimately related to the issues of power and control in society', i.e. that it is a *socio-political* project.

If the ecological movement were to support the Mathes-Gray case, it would flounder into the irrelevance of arcadian idealism, and the ineffectuality of misplaced emotional boutades against the supposedly uncontrolled monster of technology.

Yours faithfully,

Alan Bradshaw,
Balliol College,
Oxford.

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Science with a Human Face

CSIRO

AUSTRALIA

RESEARCH SCIENTIST

DIVISION OF COMPUTING RESEARCH

CANBERRA ACT

The Commonwealth Scientific and Industrial Research Organization has a broad charter for research into primary and secondary industry areas. The Organization has approximately 7,000 employees – 2,200 of whom are research and professional scientists – located in Divisions and Sections throughout Australia.

FIELD: **COMPUTER SIMULATION OF BIOLOGICAL SYSTEMS**

GENERAL: A biologist is required to work in the Division's simulation group which is concerned with the modelling of complex systems which may have physical, biological and socio-economic components. Projects of biological interest include insect and parasite control, plant and animal growth and aquatic and terrestrial eco-systems. Such projects are carried out in close collaboration with staff of other Divisions of CSIRO in Canberra and elsewhere. The group aims to build up multi-disciplinary capabilities and already has expertise in computing, systems theory and the physical sciences, together with some experience in biological modelling.

The Division's research staff in Canberra are located in close proximity to several of the major biological divisions of CSIRO and to the Research School of Biological Sciences of the Australian National University. The appointee will have opportunities for close contact with biological scientists and modelling groups throughout Australia.

Other groups in the Division are working in the fields of operating systems, data-base management, picture analysis and numerical taxonomy. Research interests of the simulation group include programming languages, numerical methods and the general methodology of modelling.

The Division also provides a consulting service to the other divisions covering all aspects of computer use including data collection, numerical analysis and simulation techniques. It has branches in all states and a number of its branch consultants also specialise in simulation and co-operate with the simulation group.

The Division has a Control Data Cyber-78 computer with a capacity and expansion potential that provide an unsurpassed tool for their research and development projects. A rapidly expanding network of mini computers and terminals enables scientists in CSIRO laboratories throughout Australia to use the central facilities for either batch or interactive computing. It also functions as a communications network to facilitate sharing of data and co-operative development of programs.

DUTIES:
(1) Computer modelling and simulation of biological systems.
(2) Collaboration with other scientists in modelling complex systems and developing the computing tools for such modelling.

QUALIFICATIONS: A Ph.D. degree in an appropriate biological field or equivalent qualifications together with demonstrable research ability. Considerable computational skill and ability to develop computer models would be an advantage.

SALARY: The appointment will be made within the salary ranges of Research Scientist or Senior Research Scientist: $A11,653 – $A17,257 p.a.

TENURE: The position is available for an indefinite period and Australian Government Superannuation benefits are available subject to normal conditions.

Applications stating full personal and professional details, the names of at least two professional referees and quoting Reference Number 900/276, should reach:–

The Personnel Officer,
Australian Scientific Liaison Office,
64-78, Kingsway,
LONDON WC2B 6BD

by the 1ST OCTOBER 1975.

Applications in U.S.A. and Canada should be sent to:–
The Counsellor (Scientific),
Embassy of Australia, 1601 Massachusetts Avenue, N.W.,
WASHINGTON, D.C. 20036, U.S.A.

PERSONAL

ENTHUSIASTIC PEOPLE of any age, with capital, needed for community/educational project, to replace departing members. We have a large house divided into flats and community rooms, 3 acres of land, a barn and outhouses suitable for workshops. If interested please ring Mansfield 752373 or write to Josie Walter, Kirkby House Community Project, Chapel Street, Kirkby-in-Ashfield, Notts.

COUPLE (23) wish to participate in existing self-sufficient rural community or join others intending serious attempt at same. Small amount capital available. Prefer East Anglia or Wales, anywhere considered. BOX NO. PD 86.

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Female, practical and creative, sought by male late 30's. Has enquiring mind, interests self-sufficiency, rural crafts, music, nature and the simple things of life for common interests and friendship, later marriage?
BOX NO. PD 87.

MAN 28, active in conservation work. Interests include wildlife, ethology, anthropology. Would like to meet a mature female companion with similar interests and willing to travel at times. View to long-term or permanent relationship.
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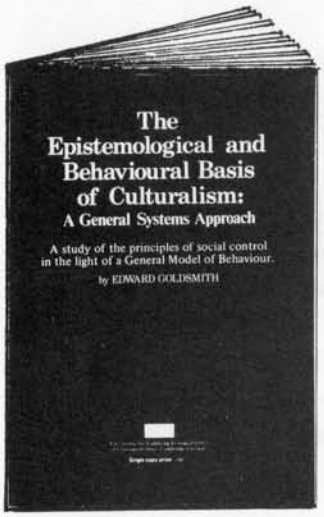

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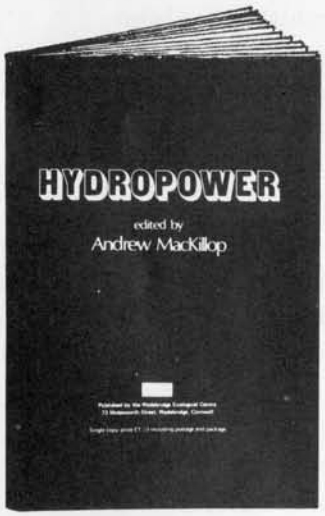

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INDEPENDENT COMMITTEE ON ENVIRONMENTAL POLLUTION

Appeal for Funds and Information

The Fourth Report of the Royal Commission on Environmental Pollution headed by Sir Brian Flowers (Cmnd 5780) was presented to Parliament in December 1974.

For many reasons we consider that this document is *grossly misleading.* The report glossed over a number of environmental hazards (i.e.: air-borne lead pollution and fertiliser run-off) as well as misrepresenting some issues (i.e.: SO_2 emissions) and totally ignoring others (i.e.: polychlorinated biphenyls). Since it was compiled by some of Britain's leading scientists there is a real danger that the Government will use it to endorse its own failure to commit itself to a constructive Environmental Policy.

For example –

Mr. Crosland, Secretary of State for the Environment regarded himself as justified when he stated that: "The sober and thoughtful analysis contained in the new report offers no support to those who fear that the quality of our environment is becoming widely and irretrievably degraded."

(Controlling Pollution. Pollution Paper No.4
Department of the Environment)

STATEMENTS SUCH AS THESE MUST NOT REMAIN UNCHALLENGED

To this end an independent commission on environmental pollution has been established under the guidance of Edward Goldsmith, Editor of The Ecologist, Michael Benfield of the PEOPLE, party and Norma Turner, Freelance environmental journalist. Its goal is to produce a realistic report on the state of environmental pollution in this country, which will be made available to policy makers at both National and Local Government level.

Information. Anyone who has relevant information or who is interested in assisting the commission is asked to get in touch with Peter Bunyard, Lawellan, Withiel, Bodmin, Cornwall, who will collate the information and edit the proposed report.

Funding. Funds for this work will be entirely by private donation, which should be sent to the Treasurer or the Secretary, Independent Committee on Environmental Pollution, New Buildings, Trinity Street, Coventry.