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The Unknown Ecologist

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Editorial

WILDLIFE AND SYSTEMS-THEORY

The London Zoo is a shameful establishment where wild animals, living in totally inappropriate conditions, are exhibited like postage stamps in an album. This reflects the personality of its secretary, Lord Zuckerman, president of the Fauna Preservation Society, who is no more fitted to preside over a Zoological Society or a preservation society than Col. Callan was to be Minister of Employment or General Amin is to be Secretary of the United Nations.

His recent speech on the subject of wildlife* should make this clear, as do his writings in general. These furnish a veritable museum of scientific misconceptions of every type, which have often been quoted in the pages of *The Ecologist* — and which seek to rationalize industrial man's systematic destruction of the natural systems that make up the Biosphere.

Lord Zuckerman appears to regard wild animals as an amenity and nothing more. Their extermination is quite justified if this serves a higher social purpose, such as combating starvation or paying for school meals. He does not seem to understand that man has evolved over millions of years as an integral part of the Biosphere along with all the other life forms, which he regards as expendable. He does not seem to realise that if we exterminate wild animals we are at the same time destroying the system of which we are part — the environment to which man must be regarded as but a long-term adaptation. The result of such an anti-evolutionary process must be to reduce the stability of the Biosphere and eventually to render it incapable of supporting complex forms of life, thereby further increasing starvation. The present epidemic of tree diseases throughout the world is but a symptom of this growing instability. America has now lost all its chestnut trees. Throughout the world elm trees are dying. In Florida and the West Indies palm trees are being annihilated by Lethal Yellowing Disease. A disease affecting beech trees is spreading through North America from Nova Scotia and one affecting the maple is also beginning to appear on this continent, while in the Mediterranean umbrella pines are dying and a disease is killing off male cypresses.

How long will it be before a similar disease exterminates the human species? Let us not forget that complex, long-lived forms of life are more vulnerable than the simpler short-lived ones, which can adapt more quickly to rapid environmental changes. That is why, in the long run, the pesticides to which Lord Zuckerman



attaches so much importance must do *more* damage to man than to the 'pests' they were designed to exterminate.

The notion that pesticides can make a significant global contribution to world food supplies is based on *ignorance*. The proportion of the U.S. food crop eaten by pests has actually increased, since their large-scale introduction, from 31.4% between 1941 and 1951 to 33.6% in the following decade.¹

The belief that they can stamp out infectious diseases is based on equal ignorance. They seem to work for a time, but become increasingly ineffective. Gonorrhoea is out of control in the U.S. and elsewhere. Malaria will probably account for several million deaths in India alone, this year. All these things, however, will only become evident to our very ignorant scientists once the 'reductionist' approach has been abandoned in favour of the 'systemic' one.

The notion that the workings of a complex system like the Biosphere can be understood by breaking it down into its component parts to be examined in isolation from each other — in 'controlled laboratory conditions' which is absolutely fundamental to modern scientific method, is based on ignorance of the structure and function of natural systems. They are made up of component parts which are interrelated in all sorts of subtle ways. Their character, in fact, is not only derived from the component parts themselves, but also, and it is this that is so important, from the way they are interrelated or organised. If it is possible to build up a great diversity of natural systems from so limited a number of components it is due to the *extraordinary difference in the behaviour of these components when used in different ways, i.e. when combined in a particular way with other components*. In other words, a system is *very much more than the sum of its component parts*. It is for this reason that studying systems in isolation from the larger system of which they are part, gives one very little information on the way they will behave in any conditions save the artificial ones of the laboratory in which the study is being conducted, and in which they alone occur. Indeed, isolated systems do not exist in nature, any more than do phoenixes or unicorns — and this makes nonsense of most scientific research carried out today — including Zuckerman's famous study of baboons in the London Zoo.

To illustrate this thesis, let us consider how little we understand of human nutrition. As Ross Hall, one of the few ecologically orientated nutritionists, has pointed out, the function of a vitamin or any other nutrient can-

*Closing address at the World Conference on Breeding Endangered Species in Captivity, London, July 8th 1976.

not be understood simply from its chemical composition. Its action, like that of all the other constituents of our food, is very different in different environmental systems. This means that when flour is refined and vitamins and other nutrients are lost, their subsequent reintroduction provides no compensation for this loss. For wholewheat is a system, which means that it is more than the sum of its component parts, and by enriching the devitalised flour, we do not restore its lost nutritive value. This may be confirmed by the fact that, although in Canada practically all the bread sold is enriched with thiamine and iron, a recent study by Nutrition Canada has revealed that a vast majority of Canadians suffer from thiamine and iron deficiency. The fact is that, once we have broken down the wholewheat into its constituent parts, we are incapable of putting it together again in the correct way. All the King's horses and all the King's men, as Ross Hall² puts it, cannot put Humpty together again, and what is more, *this is true of any natural system which we may have irresponsibly taken apart*. Thus, if one allows a family to disintegrate into its constituent parts, one cannot reconstitute it by forcing its members, who have grown up in isolation from each other, to come back and live together again. The basic interrelationships required to hold a family together cannot be easily restored. Still less, of course, can one recreate a biological organism that has disintegrated into its component cells or molecules or for that matter an ecosystem whose constituent populations have been exterminated.

If we cannot reconstitute a natural system once it has disintegrated, neither can we provide a substitute for it, which satisfies both the countless requirements of the smaller system which compose it, or of the larger one, of which it is part. *Whatever we introduce in its stead, in fact, can only be expected to satisfy a minimal proportion of these requirements*. A good illustration of this principle is our attempt, as part of the developmental process, to substitute cows' milk for human milk. Needless to say it is always easy to find experts, who, on the basis of a simplistic notion of human nutrition, assure us of its superiority. One reason often given for this is that it has a higher protein content. As Crawford³ points out, however, a calf needs more protein because, at birth, it grows more quickly than does a human baby. Much more important is the fact that cows' milk contains less polyunsaturated fats which are required for building up brain tissue than does human milk, enough to satisfy the requirements of a calf, in fact, but not that of a human baby, whose brain grows much more quickly. There are a host of other reasons why cows' milk is a poor substitute for human milk. Thus cows' milk contains an almost equal ratio of calcium and phosphorus, which is unsatisfactory for a human baby, which requires more calcium. The level of sodium in cows' milk is too high and may give rise to primary hypertension. The low level of copper in cows' milk has been related to the reduced transportation of iron and hence contributes to the iron deficiency associated with anaemia, which is common among North American infants. In human milk too, the proportion of long-chain polyunsaturated fatty acids and short-chain fatty acids is that which most favours their absorption and conversion to energy in the human baby.

Furthermore, the gastro-intestinal tract of a baby fed on human milk is colonised by the bacteria *Lactobacillus bifidus*. The important role played by this bacillus appears to have been grossly underestimated. Its presence appears to be essential to assure the absorp-

tion of protein and other nutrients in the milk. There is also growing reason to believe that the important relationship between the mother and infant, which develops during breast feeding, has a significant effect on the child's digestive capacities. Equally important is the role played by human milk in assuring immunisation to disease. Certain antibodies (IgG) are transmitted by the placenta which is permeable to them. This is not so with other antibodies (IgA and IgM). This means that babies are born without immunity to the diseases against which the latter provide protection. This includes those of gastro-enteric origin, which happen to be the leading causes of mortality among babies throughout the world. However, these antibodies IgZ and IgM are present in human milk in sufficient concentrations to provide protection against many gastro-enteric diseases such as those caused by *E. Coli* and also against polio, though it appears that this immunisation only occurs if the corresponding antigens are present in the child's immediate environment. Polio and Yellow Fever are partly at least diseases of hygiene. Children living in a natural environment in which they are exposed among other things to their own excreta, are unlikely to contract these diseases, as immunity against them is likely to build up — so long, of course, as they are also fed on their mother's milk.

As Katz and Young⁴ point out, it is likely that a real synergy exists among nutritional, immunological, psychoendocrinological and maternal responses, which foster infant development. *In fact, if one regards the family as constituting a system of which the mother and child are but interrelated parts and, together with the physical environment in which it lives, as constituting a larger system, it becomes obvious just how naive and irresponsible it is to suppose that a highly complex process such as breast feeding, which has evolved over millions of years to achieve its present degree of perfection, can be advantageously replaced by feeding an infant milk designed by evolution to satisfy a very different set of requirements — those of a baby ungulate — and contained in a bottle designed to provide but a crude imitation of its mother's teat*. Nor, of course, can a zoo replace a natural ecosystem as a means of sustaining wildlife populations.

Yet this is the sort of notion that is shaped by using modern day scientific methodology, based on naive empirical correlations made in laboratory conditions and innocent as it is of any theoretical concern with the structure and function of natural systems which have co-evolved as the interrelated parts of the Biosphere.

If Lord Zuckerman wants a course on Systems Theory, I would be willing to give it to him. In the meantime, if it is to avoid being totally discredited, the British Zoological Society must find itself another Secretary.

Edward Goldsmith.

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Forests and Man

by Roy A. Rappaport



Primitive agricultural techniques employed by the Maring people of New Guinea enable them, by cultivating about 45 acres of cleared forest at a time, to support as many as two hundred people to the square mile. This they achieve without damaging their environment, but it requires an attitude to the forest that is the very antithesis of our own.

During most of man's three to four million years on earth he has subsisted by hunting and gathering. As primitive hunter and gatherer he participated — and continues to participate here and there in the world — in ecological systems much as any other medium-sized omnivore would, which is to say that he fits into a larger system which he did not devise, and which he cannot alter radically or regulate.

Despite their narrowly defined self-centred purposes, men are likely to form compatible parts of ecological systems which they do not dominate simply because they must make do with, that is adapt to, what is there. It is upon what is given by the region that they must depend for their subsistence, and their ability to alter a locality is limited by the energy they are able to extract from that locality. This energy must be largely in the form of food since the most important power mechanisms likely to be available to them are their own arms and backs and legs.

It is no surprise that where the ability to alter the environment is limited and where technology is simple, men's goals are not likely to be grandiose. Temples need not be built, nor enemies conquered nor cities fed by hunters and gatherers. The purposes of such men seem to be to feed themselves, to protect themselves from the climate and from predators, to enjoy themselves and perhaps to worship. Contemporary hunters and gatherers, at least those of the tropics, far from wrestling miserable and precarious livings from unwilling environments are among the world's most leisured people. Bushmen, who live in the Kalahari Desert in South Africa, need to work, which is to say hunt, and their wives need to gather, only a day or two each week to provide themselves with enough (Sahlins 1972) — and there is nothing material beyond "enough" to spur them to greater productive efforts. Although figures are not available, the Pygmies of the Ituri Forest probably don't have to work any harder. Both the Bushmen and the Pygmies dance a lot — in some Bushmen camps, all night long as many as four nights a week.

Dancing for both Bushmen and Pygmies is both recreation and worship, as it is also for the Andaman Islanders (Radcliffe-Brown 1964) and the Australian aborigines (Meggitt 1962). Indeed, the Pygmies don't make a clear distinction between recreation and worship (Turnbull 1961). That is, worship, which involves most im-

portantly dancing, singing and the playing of flutes is undertaken, Pygmies say, to entertain the god *Ndura*. Now *Ndura* is not exactly a god of the forest. *Ndura* is both god and forest, or if you prefer, forest as god, but a god that is co-extensive with the natural world. The forest, which is to say the world, is thus *personified* and *sanctified*, and the object of religious ritual is to make *Ndura* — the forest — happy. If *Ndura* is happy no ill will befall *Ndura's* children, men. One keeps *Ndura* happy by entertainment and by respect for *Ndura's* person, which includes animals, plants, and even streams and rocks. It is interesting to observe, that *Ndura* is thought to become immanent, if "immanent" is an appropriate term, in a fire, called "the Heart of *Ndura*" ignited at the commencement of religious rituals. There are strong suggestions that the fire is a male symbol, but beyond that it seems to represent life or at least some sort of vital force, consuming on the one hand and invigorating on the other, a principle or agency that recovers life from death, or, if you prefer, transforms that which has died into new living shapes.

We cannot, of course, make judgments concerning the theological soundness of Pygmy religious conceptions, any more than we can concerning those of Christianity or Judaism. But it may be observed that they explicitly establish with the ecosystem what Martin Buber calls an "I-thou" relationship (a relationship in which the alter is treated as an equivalent of ego, in contrast to an "I-it" relationship, in which the alter is treated as a mere object to be exploited). The Pygmy religious conception is also reminiscent of the theology of Paul Tillich who took what he called "The Ground of one's Being" to be synonymous with "The Ground of All Being". Although Buber loved Yahweh and Tillich, Christ, they would have agreed that the Pygmy love of *Ndura* is highly moral. But morality aside, I think we could agree that the conception of the forest as a deified person serves to direct man's purposefulness toward goals coinciding with the needs of the larger natural system of which man is a part. Whatever its theological virtues it would seem that animism, the attribution of divine character to natural objects or natural systems, is ecologically sound.

It may have been with his elevation to the role of ecological dominant, a role assumed with the emergence of plant and animal cultiva-

tion perhaps 10,000 years ago, that man's purposefulness began to become seriously disruptive. Cultivation, after all, demands that complex climax communities of plants and animals be replaced by simple communities composed of smaller numbers of species selected by man according to criteria of apparent usefulness, and arranged by him in limited numbers of short food chains, in all of which he himself is supposed to be the terminus.

Needless to say, such communities are usually less stable than the climax communities they replace. The relatively degraded nature of these anthropocentric ecosystems is in part a function of their mere simplicity and is in part due to the nature of the constituent species. But man himself is a poor dominant. It is significant that in non-anthropocentric systems of any size the dominants are almost always plants — the "A" stratum trees in the rain-forest, the algae in the reef, the grasses of the savannah. Plants, because they are without conscious purpose, are well-suited to be dominants: their mere existence fills the role, and the conditions which they set for other species tend to be stable. Men, on the other hand, must act and act continuously to maintain their dominance, and the action of men is less to be relied upon than the stolid existence of oak trees or algae. Men, unlike oak trees and algae, are also capable of making mistakes, and since the self-interested purposes of men may not coincide with the requirements of the systems they dominate, the conditions set by men tend toward instability.

But while it may have been the development of plant and animal culture and the assumption of ecological dominance that first introduced the possibility of large-scale human disruption into ecological systems, primitive horticulturalists were — and here and there in the world continue to be — rather successful in maintaining equilibrium in their ecosystems. I have worked with such a group of forest cultivators, a people called the Maring (Rappaport 1968, 1971).

Slash and Burn Agriculture

The Maring occupy the central Simbai and Jimi valleys in the Bismarck Range in Australian New Guinea. Completely autonomous local groups ranging in size from around 150 to about 900 people occupy territories several square miles in area, most of which rise

from the river of one or two thousand feet to the ridge top of seven thousand to seven thousand five hundred feet. The region was probably covered by climax (or at least very mature) forest until fairly recently. Now the zones below five hundred feet are largely under secondary forest and garden with small remnants of climax forest remaining on ridge tops. Somewhat larger stands of mature forest persist at the lowest altitudes, where there are also extensive groves of cultivated pandanus. In the Simbai Valley most horticulture takes place between three and five thousand feet. Gardens are found at somewhat higher altitudes in the Jimi Valley.

Maring horticulture is of the sort called "swiddening", "bush-fallowing" or "slash and burn". Each year a gardening pair — usually a man and wife — will clear cut one or more gardens in the secondary forest. These are seldom more than an acre in extent. After clearing the underbrush and felling and pollarding the trees and making fences from some of the logs, the slash is burned. Burning not only disposes of the litter but also liberates the nutrients in the cut vegetation making them available to the crop about to be planted. Since the stratum of fertile soil under Maring forests is seldom more than two inches in depth and easily depleted the nutrients freed by burning are highly beneficial, if not crucial, to the growth of garden plants.

When the burning is completed a great variety of cultigens — banana, taros, sweet potatoes, yams, *Rungia*, sugar cane, hibiscus, beans, *Setaria*, *Saccharum edule* and many others — are interplanted in the same garden in what appears to be, but is not, helter-skelter fashion. The Maring gardener is expert at taking advantage of micro-environmental variations and there is a reason for each plant to be where it is.

Weeding is selective. Herbaceous species are removed, but arboreal species are allowed to remain from the day of planting on. After fourteen or fifteen to twenty-eight months, depending on the altitude and other factors, the regenerating trees have made harvesting so difficult that the gardeners abandon whatever crops remain to their pigs, whom they confine in their gardens for a week or more. The pigs, in their quest for tubers, soften and aerate the soil and thin the regenerating seedlings. Secondary forest then takes over completely and the site remains fallow until a canopy has formed on trees twelve inches or

more in diameter and until the ground becomes soft again. This takes eight to forty or so years, depending upon the altitude.

The Maring derive perhaps 99 per cent of their diet directly from their own gardens and from their pigs, which themselves obtain some of their sustenance from gardens (they also wander loose, foraging through the forests). Thus, these slash and burn gardens must be highly productive. In fact, only .15 to .2 acres need be put into production each year to feed an adult, and about as much for a grown pig. In 1962, the local group with which I resided, the Tsembaga, with a population of 204 persons and about 170 pigs put only 45.75 acres into production. The pig herd was very large that year,

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and when the herd is smaller less acreage is planted.

Energy return for energy input on such gardens is high, approaching 20:1. On this index alone, Maring horticulture compares very well with "more sophisticated" agriculture practised elsewhere in the world. But it should also be remembered that unlike many other kinds of cultivations, Maring gardens provide the gardeners with much more than calories. Most of their daily protein intake also comes from the gardens.

I have implied that the Maring maintain high population densities with this sort of horticulture — in some localities, in fact, *densities exceed 200 persons per square mile of arable area*. But I would also like to emphasize that slash and burn, as practised by the Tsembaga Maring, whom I know best, *does not seem to do serious damage to the ability of the climax to return to sites from which it has been removed*. My

evidence for this is not entirely sufficient, but it is at least strongly suggestive. While regrowth on abandoned gardens is pioneered by fast-growing sun-loving second growth forms such as *Alphitonia iacana* and *Dodonea viscosa*, as it develops more and more species characteristic of climax, or at least mature forest, appear. Of thirty-six species at present on one site sampled four years after abandonment, eighteen were part of climax associations found at that altitude. On another site cultivated twenty to twenty-five years earlier, eighteen out of twenty-six species were climax forms, with such families as *Fagaceae*, *Lauraceae* and *Moraceae* being well represented.

We may reflect here on the general strategy of slash and burn forest horticulture. It is to establish temporary associations of plants directly useful to man on sites from which forest is removed, and to encourage the return of forests to those sites after the useful plants have been harvested. The return of forest makes it possible, or at least much easier, to establish again an association of cultivated plants sometime in the future. The Maring recognise this, of course, and are almost as solicitous of the trees growing in their gardens as they are of their cultivated plants. Their appreciation of the regenerating forest is clearly reflected in their term for it: *nduk mi*, which means "mother of garden".

We may be reminded here that both Roman Margalef (1968) and H.T. Odum (1971) have argued that in complex ecosystems successful species are not those that merely capture energy more efficiently than their competitors, but those that sustain the species upon which they depend. It is clear that the Maring nurture not only the garden species that provide them with food directly, but also those species upon which they indirectly, but nevertheless ultimately, depend: the forest species that make it possible for the garden species to flourish from time to time.

The Superiority of Maring Practices

We can only observe in passing that Maring horticulture in some ways resembles lumbering more than it does modern agriculture. First, it makes use of fire to dispose of slash and to release nutrients into the soil (the latter is perhaps not important in modern timbering in temperate regions). Second, sustained yields in both Maring horti-

culture and in lumbering depend upon forest regeneration but I suggest that the reader make a quick and informal comparison of the two. The comparison is difficult, but I believe the conclusion forced upon us is that *modern clear-cutting and firing practices do not sustain forest yields as well as Maring cutting and firing practices sustain horticulture yields*. I suggest that this follows from the fact that the survival of the Maring gardener depends upon the maintenance of the environment in a condition that insures sustained yield. The survival of a lumber company, on the other hand, particularly when it is operating in forests that it does not own, does not depend upon the maintenance of sustained yields, at least in the short-run, and short-run considerations — profit taking particularly — are decisive. Needless to say profit taking and the maintenance of sustained yield are not synonymous. In fact, they are often contradictory. But what is proposed to us more generally by this comparison is that particular techniques — firing, and clear-cutting in this instance — are not, in and of themselves, necessarily sustaining or destructive of ecological systems. Whether or not they sustain or destroy is a function of the social and economic conventions that regulate their use. We shall take up this general problem again in a little while. Let us return here to the Maring.

It seems to be the case that the Maring, although ecological dominants, disturb the circulation of materials through their ecosystems as little as it is possible to do while still practising horticulture. That they are not ecologically disruptive is easy to understand. Local groups of only a few hundred people are politically autonomous and largely self-sufficient as far as subsistence is concerned. They neither import nor export foodstuffs, and it is necessary for any local group to raise whatever its members wish to consume. Subsistence cultivation is diversified cultivation and diversified cultivation is more stable and reliable than specialised cultivation. But economic self-sufficiency and production for use protect ecological integrity and viability in ways more important than simply maintaining diversity. For one thing, the management of subsistence cultivation is hardly concerned with or responsive to events in the outside world. It attends almost exclusively to the biological needs of the cultivators and the species sustaining them. Distantly established prices,

for instance, which are crucial considerations in the management of commercial agriculture, and which may lead to actions detrimental to the survival of local ecological systems, simply don't exist for the Maring. Further, in the absence of exotic energy sources the ability of the Maring to abuse the species upon which they depend is limited by those very species because it is only from them that energy for work can be extracted. However, among people such as the Maring, abuses need seldom be revenged by declining yields because trouble is likely to be signalled sooner by subtler signs of environmental degradation. Effective ecological regulation, which is to say the maintenance of the circular structure of ecosystems, depends, in systems dominated by men, on effective information feedback from the environment to those operating upon it (the flow of information through ecosystems, like the flow of materials through the same systems, must be circular). Information feedback from the environment is sensitive and rapid in small autonomous ecological systems in which everyone is a gardener. There are, further, no special interest groups in the societies participating in such autonomous local systems. It is clear to all men living in such systems that their survival is contingent upon the *maintenance*, rather than the mere *exploitation*, of the larger community of which they *know* themselves to be only parts. They comprehend more clearly than hunters and gatherers, I think, and more clearly than modern men the circular structure of their world, and they are likely to understand well that their own purposes or goals are limited by that circular structure and the need to maintain it. It is worth noting here that the Maring and other New Guineans conceive the world as a set of cyclical processes. Not only are gardens and forests, in their view, merely different phases in the same cycles, so are growth and decay, for young plants grow out of the decomposition of older ones. The Maring call those spirits concerned with the fertility of gardens, of pigs and of people *Rauwa tukump*, which means "Spirits of Rot" and the Spirits of Rot are responsible not only for fertility, but also for death.

Ecological Structures Lost in State-Organised Societies.

It is in state-organized societies that the purposes of men finally become seriously destructive. Let us briefly note some of the salient

characteristics of such societies.

First, they are large. Their populations may, as in many modern states, run into millions or even hundreds of millions.

Second, they are highly differentiated internally. Unlike the Maring and the Pygmies, among whom everyone is a farmer or hunter and among whom every local group is an approximate duplicate of every other local group, in the state-organized society there is a great role specialization. Some men are farmers, some surgeons, some men are policemen, others lumbermen or dentists. And some are administrators. The interrelations of the increasingly specialized parts become so delicate, complicated and critical that an increasingly deep and elaborate regulatory hierarchy is required to regulate, to coordinate and adjudicate.

There are a number of consequences of the increasing scale and complexity of social systems. We do not have the time even to mention most of them here. But one to which not enough attention has been given is the matter of how men conceptualize such systems and how they conceive of themselves within them. I would suggest that the ecological circularities that are apparent to the Maring horticulturalist are masked from men in state-organized societies by the sheer scale and complexity of these societies. Thus, ecological considerations are less and less likely to temper purposefulness simply because ecological awareness is diminished. And even where some understanding of ecological processes remain, this knowledge is likely to be less compelling in the decisions of increasingly specialised men than are their own special interests. Ecological "rationality" — a rationality that is concerned to maintain the circular structure of ecological systems, a rationality that may not be ashamed to invoke mystical conceptions and feelings — is replaced by economic rationality, the application of scarce means to the attainment of differentially graded ends for purposes of maximization of narrowly defined interests — in decisions concerning the management of ecological systems.

Related to this, it may also be suggested that in the state society, ecosystems are conceived in a way entirely different from the way they are conceived in the primitive society. To the members of a small, autonomous primitive group living within the forest, the forest seems to be all-encompassing, even to be co-extensive with god and the world.

But to the members of a huge and differentiated state-organized society, a forest is merely one vegetal association among many, one limited to one or a few regions among the many encompassed by the society. This is to say that the forest is no longer conceived to be a *generalized, autonomous, personified ecological system*, but to be, simply, one element or sub-element of *sub-system* in a *larger socio-economic system*. It is no longer mother and father to us all as it is to the Pygmy, nor an indispensable link in the circle of growth and death as it is to the Maring. It is now a "resource". It has been degraded from the status of the world itself to mere object, an "it", something to be used. And in the state-organized society, particularly the modern state-organized society, "use" is likely to become exploitation, by which I mean here overuse, because human purposes become at once more powerful, narrower and less constrained by ecological limits than they are in the primitive society.

That human purposes are more powerful in the modern society is obvious, as is their escape from ecological constraint. In the state-organized society it is relatively easy to organize large bodies of men to perform special tasks, and with the development of high technology, it becomes possible to focus enormous, indeed almost unlimited, amounts of energy upon almost any local ecosystem. The extent to which an ecosystem can be altered is no longer limited by the need of actors to derive energy from that local system.

That the purposes of individuals or groups become more and more narrowly defined is a concomitant of increasing specialization. What may be less obvious is that with increasing specialization, more and more trivial reasons become sufficient to justify environmental disruption. I suppose, for instance, that many thousands of acres of forest have been cut down to make cardboard containers in which to insert materials already packaged in metal or glass. Nobody really needs these containers, but their manufacture is nevertheless undertaken, not because it accords with the purposes of all men, but simply with the short-term purposes of a very few men. The narrow, specialized and *short-run* purposes of a very few become sufficient to disrupt large and *ancient* living systems, such as forests. The narrow purpose of those responsible for the disruption of these systems is, most importantly, that of monetary gain.

This brings us to further implications of the economies of state societies for the preservation or destruction of ecological systems. Of particular interest here is the presence of all-purpose money, which is absent from primitive societies. Money has an interesting ecological property: it is a universal solvent. *This is to say that it tends to dissolve the differences between all things by imposing one simple metric — that of dollars or whatever — upon the marvellous variety of things of which the world is made.* Now living systems — plants, animals, ecosystems — are themselves very diverse, and each also requires a great diversity of distinct materials to remain healthy. But with money, it becomes possible to

Among the most unstable ecological systems ever to have appeared upon the face of the earth are mono crop field plants.

make decisions affecting this diversity and complexity on the basis of a very simple arithmetic. All of the great range of unique and distinct materials and processes that together sustain or even constitute life are forced into an arbitrary and specious equivalence by reducing their values to monetary terms. What is the difference between a forest and a sub-division? The correct answer becomes one of the class: \$20,000 per acre. Differences in photo-synthetic rates, transpiration, run-off and species diversity are beside the point, for decisions concerning whether land is to remain in forest or to be split-level ranch houses can be and are, largely, made on the basis of the simple monetary metric.

There are further ecological effects following from the mere presence of all-purpose money. Money facilitates exchange, of course, and it was probably to facilitate exchange that money came into use. But increased ability to exchange what one produces for what one needs is not an unmitigated blessing. For one thing, it encourages local, regional or even national specialization. With agricultural production for the market rather

than for consumption, there is a movement away from the diverse horticulture we observed among the Maring and a movement toward monocropping. Whole countries are turned into banana plantations, cane fields or coconut groves. As a rule of thumb, ecological stability correlates directly with ecological diversity. Among the most unstable ecological systems ever to have appeared upon the face of the earth are monocrop fields planted in "miracle" grains that can only mature if they are given large quantities of fertilizers, herbicides and pesticides that often have to be imported, it may be added, over long and unreliable supply lines. It seems too that the species diversity of forests are also being reduced as a result of commercial exploitation. Timbering interests are tending to favour single-age species stands — as close as you can come in forestry to modern agriculture with all of its problems and shortcomings.

State-Organised Societies Regulated by Industrial Giants

There is another aspect of state-organized societies which has important ecological implications and to which we should therefore turn briefly. I said earlier that states, unlike primitive societies, are made up of special-purpose sub-systems — auto manufacturers, drug manufacturers and the like — and they also include administrative hierarchies that regulate these sub-systems, the relations among them and the relations between them and consumers. But with increasing industrialization, this regulation becomes increasingly difficult, because special-purpose sub-systems — the military establishment; the drug manufacturers, the lumber industry — become increasingly powerful. Indeed they become so powerful and are so well organized that they are often able to capture the agencies supposedly regulating them. Thus, the food and drug industry, for instance, comes to "own" the Pure Food and Drug Administration. The logical end of this process of special-purpose sub-systems capturing the agencies regulating them, and thereby promoting their own purposes to positions of increased importance in the larger society, is for one or another of them, or a combination of them, to become so powerful that the entire society is regulated in conformity with their interests or purposes. "What is good for General Motors is good for Amer-

ica" was a succinct expression of the ideology of this process; but it hardly need be said that this ideology and the process of which it is a part are hardly confined to the automobile industry. The statements of some lumbermen seem to ask us to accept the proposition that what is good for the lumber companies is good for the forests or society or both, and some writers have argued that the interests of lumbermen are more influential in the agencies regulating forest use than is in the public interest or is beneficial to forest ecology (Burk, 1970 Dahlsten 1971, Curry 1971).

Be this as it may, we might be outraged by the regulation of larger systems, such as societies or forests for the benefit of what are only parts of them, such as General Motors or lumber companies. We may be particularly outraged when such regulation permits destructive operations to take place on public property as when excessive clear-cutting takes place in national forests. In such an instance the trees are not simply being cut down. To borrow an expression from the young, they are being ripped off.

But it is not the morality of the process with which I am primarily

concerned. I am more concerned with its lack of adaptiveness. To regulate a general system such as a society or a forest in accordance with the narrow purposes of one of its sub-systems, such as a business firm or an industry, or even industry as a whole (as suggested by Calvin Coolidge's famous dictum "The business of America is business"), is to narrow the range of conditions under which the general system can survive. Survival, after all, is what living systems — organisms, societies and ecosystems — are ultimately about; and the institutions, conventions, economic practices or ideological commitments which narrow the range of conditions under which they can survive reduce their long-run survival chances.

The Consequences of Clear Cutting

The reduction of the survival chances of a living system may reach its logical limit in extensive clear-cutting in some regions. Undertaken for short-term gain, clear-cutting in some regions, according to Curry (1971), interrupts nutrient cycles with such finality that it may take

20,000 years for forest to regenerate, and it reduces both surface and deep slope stability disastrously according to Gray (1971). Clear-cutting in such regions destroys the larger system for the benefit of the smaller and is thus a process which bears a formal resemblance to parasitism. It not only violates the legally adopted principles of multiple use and sustained yield but it also violates the principle of circular structure that characterizes all ecological systems.

But I am not mainly concerned to criticize the practice of clear-cutting or any other particular forestry or timbering techniques. I am aware that society needs lumber, and I am aware that some honest and expert men take clear-cutting to be an ecologically acceptable practice under some conditions. Nor have I been advocating the abolition of money, the abandonment of high-energy technology or the dismantling of the state. I admit to being, like many anthropologists, and, I suspect, many foresters, rather Rousseauian. But it is clear that we cannot return to a primitive condition and I would not advocate that we do so if we could. I have been elaborating upon a statement that I made at the beginning: the social

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and technical advances that are the stuff of cultural evolution set new as well as solve old problems. I have been attempting to relate this generalization to forests and forestry by suggesting some of the problems set for ecological systems including forests by state organization, high-energy technology, money and production for profit. It seems clear that these problems remain to be solved.

I have no specific solutions to offer, but would make some general suggestions.

A Multimetric Accounting System.

First, it has been suggested that a "social accounting" be developed as part of the apparatus for making decisions concerning forests. I surely agree that social and ecological considerations be given greater weight than they have in the past. But I am not sure that there should be an accounting developed. The term accounting implies a metric, and, as I have argued, a metric implies the imposition of a specious simplicity upon a naturally and necessarily complex world. It is, furthermore, likely that equivalences would be found between this social metric and economic metric. This is to say that the simple metric of money would probably continue to dominate the world.

Yet, having expressed such misgivings, it strikes me as perhaps possible to devise a *multimetric* accounting, a system of accounting that could express and measure crucial aspects of social and ecological, as well as economic, processes in their own terms. The ecological metric would be easy to develop, for quantitative ecology is already a well-developed field. I would suppose that it would be concerned with such things as photosynthetic rates, the rates of circulation of energy and crucial materials through ecosystems, measurements of species diversity and so on. Acceptable limits of relevant variables could be established on empirical grounds and corrective action taken when those limits were violated or even approached. Ecological accounting would thus be a part of the information feedback system, contributing to the maintenance of the forest.

The social metric would be harder to devise because recreational, aesthetic and psychological amenities are badly represented, if not actually misrepresented, by quantification. For what they are worth

records might be kept of use rates and their relation to the scale of facilities so that overuse as well as underuse could be avoided.

Both of these metrics are compatible with the principles of multiple use and sustained yield. But, it may be observed, they are not commensurable with each other, nor is either commensurable with the monetary metric of business economics. I would urge that no attempt be made to reduce the three, and others could be added, to a common metric. Their non-equivalence is not a deficiency of the multimetric concept. It truly reflects the world's diversity and, as such, is a fact of life to which decision-makers should learn to adjust. But despite their non-equivalence, the several metrics could, and should, be given fairly explicit relative weighting. The logic of adaptation suggests that ecological considerations should outweigh social and economic considerations simply because social survival and economic operations are, in the long run at least, contingent upon the conservation of ecological systems, while the converse is not the case.

Let us now turn to another problem raised earlier, that which might be called the "General Motors Syndrome", the capture of regulatory agencies by the sub-systems they are supposed to regulate. It is tempting to attempt to correct such problems by throwing rascals out of administrations, or by attempting to reconstruct bureaucracies in ways which are less vulnerable to capture. But there are frequently no rascals to be thrown out, and although it may be possible to devise administrative hierarchies that are less vulnerable to capture than others, and while it may be possible to improve the effectiveness of regulatory operations, the cure for the G.M. syndrome does not lie in administrative reorganizations or changes in personnel. It is probably impossible to devise a regulatory structure that would be invulnerable to capture and even if it were possible it would be undesirable. An administrative structure that could not be captured would probably have to be unaccountable to, and therefore unresponsive to, its constituency.

It seems to me that it is in the matter of constituencies that much of the problem lies, and it is there that I think cures will have to be found. Any regulatory structure has a constituency to which it will respond. Such constituencies are composed, most importantly, not so much of

those who have an interest in their operations as those who take an interest in them. Every American has an interest in the regulation of the national forests, but few take an interest in this matter. If the "General Motors Syndrome" affects any of the agencies regulating forest use, the cure is to convince those who have an interest to take an interest, that is, to become in some way active in new and ever larger public interest constituencies standing in opposition to, or at least tempering, the older, narrower, private-interest constituencies that have been virtually alone in taking sufficient interest to be influential in the past.

In the case of forest-related constituencies, I take the term "public interest" to imply multiple use, and I take the principle of multiple use to be, *prima facie*, adaptive, for it opposes sacrificing long-term flexibility for over-specified and over-committed short-term gain. I would agree with Dr. White that, with the recent reawakening of ecological concern, the possibility of developing public-interest multiple-use constituencies for forests is better than it has been for a long time — perhaps since the emergence of the state, or since the development of money and production for gain, certainly since the industrial revolution. I would add that, since the ecological movement may be characterized more by fervour and commitment than by ecological understanding, foresters and other ecological specialists have special responsibilities to provide it with expertise and possibly guidance.

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The Administrative Trap

Randall Baker

The fragmentary approach adopted by Third World Governments to complex ecological problems, such as the Sahelian drought, reflects the division of responsibility into largely watertight compartments dealing in isolation with symptoms rather than causes. A much more co-ordinated approach is required if such problems are to be solved.

The Conflict between Administration and Ecology

During the recent drought (1968-1973) in the monsoonal areas several lines of argument were propounded on the possible causes of the disaster.* Briefly these were: the *Climatic Change* School which maintains that the world is passing through a period of short- and/or long-term climatic cycles related to major changes in the general atmospheric circulation; the *Environmental Mismanagement* School which lays the blame on gross overstocking which has led to degradation of the rangelands so that droughts, when they inevitably come, act upon areas of diminished resilience and; the *Feedback* School which combines the other two approaches and maintains that local changes along the margins of monsoonal conditions are strongly influenced by Man's misuse of the land by such media as changed albedo and dust in the upper atmosphere. Clearly, the substantiation of some of the above arguments requires long investigation and monitoring and, although such work is in progress, it will, of necessity, be some years before the evidence of climatic change may be considered convincing. However, there are

some elements in the degradation equation which appear, to the author at least, to be well-proven and about which something can be done quickly. Unfortunately, the solutions frequently involve the field of politics, and innovations in that quarter cannot be transferred with the ease of technology. In addition before any form of change may be anticipated it requires an awareness of the nature of the problem on the part of the administration concerned. After that a need may exist for an initiative which cuts across personal power or authority as well as other notoriously immovable forces. The resistance to change in this area of administration and decision-making structure is notorious.

It is with the administrative dimension that this paper is concerned and I hope to illustrate how the structure of most administrations in the drought-afflicted countries, particularly of Africa, may well have contributed to and accentuated the recent natural calamities and may, even now, be paving the way for a worse situation to come. This is neither sensationalism nor political axe-grinding; it is not an argument for Marxist versus neo-Classical thinking. It is, instead, merely an observation that the structure of government inherited from the colonial era is often inadequate for dealing with ecological problems and has, in many cases, been superseded by new structures in the administrations of the former

colonial powers themselves. The crux of the argument is that the division of responsibility into watertight, sectoral compartments means that the administration is neither able to perceive the nature of an ecological problem, nor is it able to do anything meaningful about it. This structure, in turn, influences the type of assistance that developing countries seek, and, since aid is not provided unless specifically requested, the type of assistance that these countries receive. So, the administrative trap has far-reaching repercussions and, because of its essentially political nature, it will be very difficult to remedy.

As mentioned earlier there are two stages to a remedy: drawing the government's attention to the nature of the shortcoming and then waiting for the government to take an initiative in the direction of administrative change. The former part of the remedy is an area in which outsiders can help us by using their experience and observations of the country concerned, and of parallel situations elsewhere, to make the government aware of the problem it is facing. In this field there has been an effort recently as part of the F.A.O./U.N.E.P. initiatives to formulate an International Co-operative Programme for the Ecological Management of Arid and Semi-Arid Rangelands in Africa and the Middle East (EMASAR). I shall draw on the work of both the expert consultative panel which met in May

*See *The Ecologist*: R.A. Bryson, "Drought in Sahelia: Who or What Is to Blame?" Vol. 3, No. 10; Randall Baker, "Famine: the Cost of Development," Vol. 4, No. 5; Ian Campbell, "Diagnosis of a Famine," Vol. 4, No. 5; Hubert H. Lamb, "The Earth's Changing Climate," Vol. 4, No. 1.

1974 and the International Conference which met in February 1975 (F.A.O. 1974, 1975) to highlight some official thinking on the need for administrative change. In respect of the second part of the administrative reform, the implementation stage, I shall examine some of the guidelines being laid down at present which are designed to assist without interfering directly in the thorny field of political sovereignty at the national level.

At its February meeting in Rome, the EMASAR group noted that "accelerated deterioration evident in recent years cannot be attributed solely, or even largely, to drought; that in many areas, human and livestock populations have, for some time, exceeded the carrying capacity of the land", and "that the majority of development efforts to date have not been very successful." In fact, far from being successful, many projects for the development of rangeland areas in tropical Africa have been positively harmful. One delegate went so far as to remark, "Proper range management prior to and during the drought could have reduced or even prevented this catastrophe" (Konaté F.A.O. 1975) This may be something of an exaggeration since drought is part of the natural equation in those areas, but the failure of rangeland planning and the more serious failure to control the growing imbalance of Man/Stock/Land relations finds its roots very largely in the hiatus between administrative structure and an ecological problem of grand proportions. Commenting on the failure of past rangeland projects, the F.A.O. consultative panel in 1974 identified the four following contributory factors:

- (a) the absence of a clear national commitment or strategy for range development;
- (b) the lack of information or understanding concerning ecological potentials and constraints and socio-economic conditions;
- (c) *the lack of an adequate organisation in the national government for the planning, direction and coordination of range development programmes and; (my italics)*
- (d) the inadequate local participation at the pastoral community level and insufficient attention to the problems of security of land tenure and protection from encroachment by outsiders.

I believe that the "Administrative Trap" plays a substantial part in

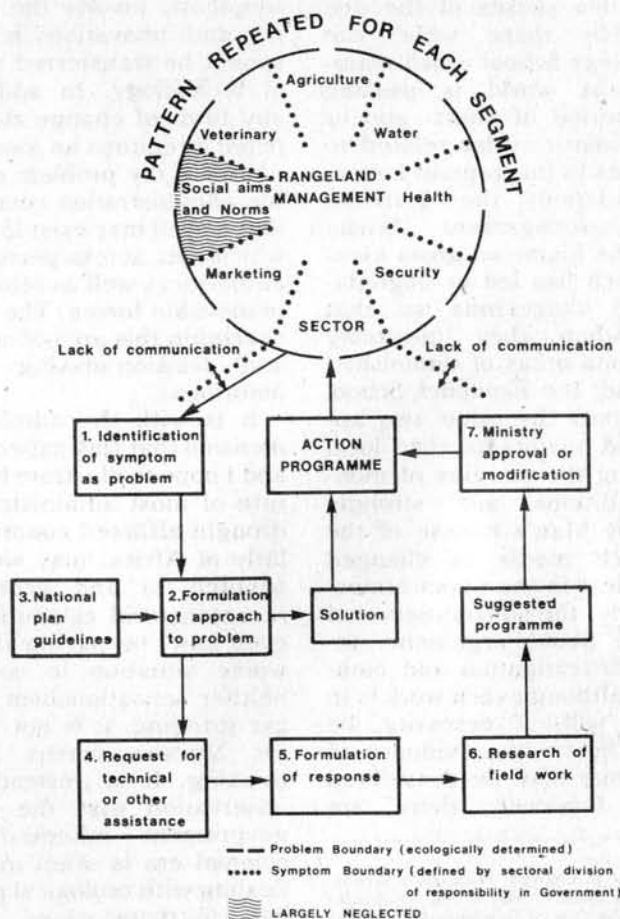
creating and accentuating these weaknesses in planning.

Briefly, the "Administrative Trap" refers to the way that the structure of an administration largely determines its capacity to recognise and deal with interdisciplinary problems, however devoted or talented its staff. Most governments in Africa have a conventional sectoral structure in which various ministries or departments are given functional, as opposed to areal, responsibilities. The affairs of a ministry are governed by its allocations in the National Plan or disbursements from the Treasury, the terms of reference of the other ministries or departments and, to some extent, the attitude of the person or persons in charge. Since this is by far the most commonplace structure, it is the weaknesses of this type that I shall examine in the following hypothetical example. The diagram, though not relating to any one country in particular will, I am sure, be familiar to all those who have worked in the rural planning field in the Third World. Since the drought worked its most serious havoc amongst the pastoral peoples of the

monsoonal belt I have elected to consider rangeland management as the ecological field against which to evaluate the "Administrative Trap". Any other broad interdisciplinary field would illustrate the case equally well.

In Fig. 1 the central problem is rangeland management which may be good or bad management but, quite simply, means the way in which the land use relates to the long-term quality of the land. It is an equation of quite extraordinary complexity as, indeed, most ecological relationships are. The boundary of the circle represents the boundary of the ecological "problem" of rangeland management: a set with subsets to use the jargon. An adequate awareness of the problem or a responsible approach to change must recognise and accommodate all the elements within this circle i.e. all the component parts of the environmental equation. These components such as agriculture, veterinary medicine, water development, stock control, marketing, community development and so forth, are all recognised as areas for government intervention. What is regrettable, however, is the way

Fig. 1. A Sectoral Path to Problem Solving



that they are recognised, for, instead of being taken as component parts of several ecological problems, they are taken as ends in themselves by the Ministry of Agriculture, the Ministry of Animal Industry, the Ministry of Minerals and Water Resources etc. . . . Each Ministry will deal only with the elements defined by its terms of reference and it will, perforce, regard these elements or symptoms of the general problem as ends in themselves (identified as stage 1 on figure). How this symptom relates to the overall problem of range management is the concern of no-one except, perhaps, a range management department of the Ministry of Agriculture which is itself restrained by the terms of reference of its own ministry and its inability to influence or effect changes in all but veterinary, grazing or, possibly, marketing fields.

This is, then, a problem of communication to some extent and it is an all-too-familiar feature of administrations that the component ministries have, at best, poor communication and, at worst, out-and-out rivalry or jealousy. Thus, problem identification will never get beyond the level of dealing with the symptoms of some ecological malaise. Of previous attempts to bring the contributory elements of rangeland planning under one roof *within the sectoral structure*, the F.A.O. consultative panel commented "Clearly, an executive or a planning unit hidden in the side office of a livestock division of an agricultural department of a rural development ministry, does not have much of a chance of success". The action programme (2) based on the Ministry's perception of the problem will, inevitably lead no further than to the treatment of symptoms.

This fragmentation has had a large part to play in the poor record of planning, for it encourages:

1. Palliative measures which are insufficiently related to co-operant factors i.e. the remedies are likely to cause an imbalance elsewhere. The best example of this is providing water without clear proposals regarding grazing control and increased offtake;
2. An approach whereby the only significant relationships which are taken into account are those within a sector e.g. how a change in livestock health in one area is likely to influence the same factor elsewhere and;
3. A regard for the country in terms of functional disaggregation

rather than, perhaps, spatial groups of related symptoms forming a "problem region". The Ministry of Agriculture looks at agriculture here, there and everywhere rather than considering how agriculture in area X relates to the communications, marketing, social and other inter-dependent factors in that same area. At present this is reasonable as the Ministry of Agriculture cannot do anything about non-agricultural difficulties.

In consequence many projects designed to cure symptoms have only the, now familiar, effect of worsening the overall problem. Once an imbalance begins, only a remedy for the cause of the imbalance can produce any improvement: patching up the effect of the imbalance is ignoring the problem completely and probably making it worse. That, in summary, is the history of rangeland planning in most parts of semi-arid Africa.

So far we have considered the domestic side of the "Administrative Trap" but it does have an equally serious international dimension. Most, in fact nearly all, aid or technical assistance is in response to specific requests from the recipient country. Therefore, it follows that in most cases what is provided will relate fairly closely to what is asked for and, in turn, what is asked for relates to what is *considered to be* the problem. Thus, a request for assistance (4) will contain within its terms of reference or contractual stipulations, guidelines as to what is required, usually by a specific ministry or department. The response to the request will, naturally, follow the terms laid down by the client (5) though, occasionally, shortcomings may be pointed out. If this happens the results of such an observation are likely to be limited if they are of an ecological nature, because the client ministry simply has no power or brief to operate outside its area of responsibility. It cannot, for instance, start investigating the work or approach of other ministries. So, the international assistance is sorely tempted, in the old Irish tradition, to tell the man what he wants to hear. This is not suggesting that the advice is poor or substandard, just that it will not deal with the problem in hand.

Once the assistance project is under way there will be little opportunity for the outside worker to recognise its inappropriateness because of his limited time schedule (6) his own narrow technical specialism in most cases and because he is

not being paid to criticise his terms of reference. And so the vicious circle is completed. It is necessary, from this argument, that care is taken when apportioning "blame" for what has gone on in the past. Clearly, much of what has been done in, for instance, the Sahel, has contributed to the present gloomy state of affairs. But this is not an indictment of the technical expertise involved: wells were often dug efficiently and the vaccines which have appeared in the last twenty years are the results of skill and aptitude. It is just that, at the level of interdisciplinarity encompassed by a problem such as range management, the organisation is stacked against success from the start. This same argument lies at the root of much of the failure of technology transfer, since the inappropriateness of an item of technology may well be attributable to a factor totally outside the mechanics of the item concerned, or even the field in which it most directly applies e.g. a tractor programme may fail because of the land tenure system, the credit infrastructure, the social organisation or the lack of vocational training.

One further observation remains to be made with regard to Figure 1. Although most of the component sectors of the range-management problem fall under the aegis of one or other ministry, there remains one critical gap. The social dimension of the range management equation has been either ignored or subjected to the worst form of insupportable generalisation. In this way many of the "solutions" provided to date have produced totally undesirable or unexpected responses from the people living in the areas concerned. This is very often not so much a case of bad information as of no information, because no department is specifically charged with the responsibility of finding out why people behave the way they do. So, in Figure 1, the social dimension is shaded as a separate class of symptom, one that is largely neglected. At best one is likely to find a community development structure in which a sociologist is involved, but once more a communications problem is likely to emerge as the community development service is, itself, part of a ministry and may suffer the same isolation from other ministries as was shown earlier.

Table 1 illustrates the administrative structure of some countries in Inter-Tropical Africa showing the ministry most closely connected with the planning of semi-arid areas under pastoral occupation. I have

excluded those countries which are in the humid tropics beyond the reach of the monsoonal drought threat. Almost universally the countries shown have the conventional division along economic

Administrative structure of selected African Countries relative to rangeland management

Country	Ministry most closely charged with the management of range-land
BOTSWANA	Ministry of Agriculture
CHAD	Ministry of Agriculture and Stock-breeding
ETHIOPIA	Ministry of Agriculture
GUINEA	Ministers for Local Development for Regions;
KENYA	Ministers of Rural Development
MALAGASSY REP.	Ministry of Agriculture and Animal Husbandry
MALI	Ministry of Territorial Planning; Ministry of Rural Development
MAURITANIA	Ministry of Production
NIGER	Ministry of Rural Development
RUWANDA	Ministry of Saharan and Nomadic Affairs
SENEGAL	Ministry of Agriculture and Live-stock
SOMALIA	Ministry of Rural Development and Livestock
SUDAN	Ministry of Agriculture
UGANDA	Ministry of Animal Industry
UPPER VOLTA	Ministry of Agriculture, Cattle Breeding, Rivers, Forests and Tourism.

source: Europa Year Book 1975.

and social functional parameters. Most have either a Ministry of Agriculture with a livestock element subsumed somewhere within, or a separate Livestock Ministry. In Uganda, for instance, Animal Industry and Agriculture are two separate entities which makes any form of unified policy towards the agro/pastoral Karamojong very difficult to achieve. This is not to say that development is impossible in the sectorally divided system since many of the now developed countries still retain this structure. However, many or most of the developed countries have come to appreciate the price that is paid for splitting problems in this way as the threat of pollution or unbearable social costs arise. In Great Britain, such an awareness partly lay behind the creation of the "super"-Department of the Environment.

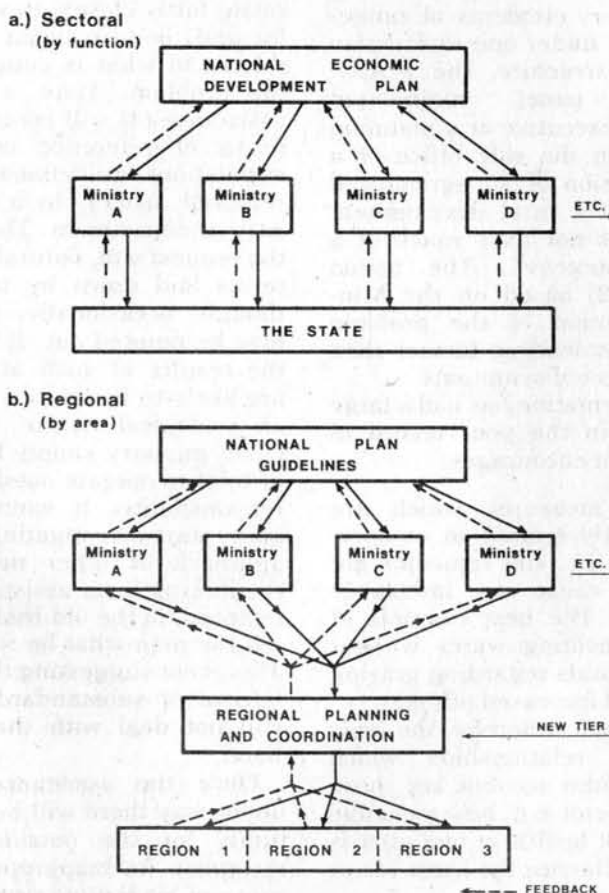
At first glance the structure of the Sahelian administrations appears encouraging for, in place of the usual Agriculture/Veterinary split Mauritania and Senegal have Ministries of Rural Development, Mali has a Ministry for Production, and Niger has a Ministry of Saharan and Nomadic Affairs*. However, on closer inspection, all the other ministries are there as well and so the effectiveness of these labels depends on how far they enable the umbrella ministry to coordinate or influence the work of the others.

To get to grips with the range management problem, therefore, requires a structure with the authority to effect coordination. It is difficult to see how any form of Range Management Department, short of its being housed directly in the Prime Minister's office, can possibly be effective. It is for this reason that I suspect that regional planning is the only hopeful prospect.

Figure 2 contrasts the approach of conventional sectoral planning and that of regional planning. In 2(a) we see what has been described as "the wonderland of no dimensions", or conventional economic development planning. In this, certain basic policy guidelines of a universal nature come down in the form of the Five (or other) Year Plan. The individual ministries act upon these guidelines, which are only of the broadest nature such as "Increase GNP by X%; Increase employment by X% etc.", and formulate their own policies and programmes much in the style of Figure 1. Feedback is direct to the ministries and so sectoral planning becomes a closed system. Figure 2(b) illustrates the regional planning

approach. Quite simply what has happened is that a new tier has been introduced in the planning process which gives it a spatial dimension. Once more, the basic national guidelines come down in the form of a National Plan to the ministries but now their policies cannot be translated directly into action sectorally across the nation, for they are first channelled into a regional-planning coordinating process. In the case of 2(b) I have shown this process as coming between the ministries and the regions partly because this is the easier form of regional planning to introduce since the ministries still feel they retain their autonomy. Individuals in power are unlikely to feel threatened by this type of structure and so may be that much more willing to see it introduced. Ideally, however, the regional planning and coordination structure should come between the national plan and the individual ministries. This would encourage a properly integrated approach to the planning of individual regions and regional policies rather than a coordination exercise for separate policies which is likely to be the alternative. Such

Fig. 2. Sectoral v Regional Planning



* I do not possess a detailed knowledge of these administrations and so, in most cases, I am working from titles.

truly regional planning is, naturally, seen as a threat to political power by many and so, *ceteris paribus*, 2(b) is more likely to be painless.

Briefly, in terms of managing semi-arid areas the advantages of the regional planning approach may be summarised as follows:

1. It effects an integration which is relatively painless for those concerned, as they feel they are equal partners. No one ministry pre-empts power in a regional planning structure and so no other should feel threatened. Under these circumstances the ground is laid for co-operation.
2. It recognises the spatial variable in planning. The blanket approach of much national or sectoral planning can work to the detriment of some areas so that, for instance, in a country such as Uganda where the semi-arid pastoral areas form only a fraction of what is, otherwise, a rich and well-watered agricultural domain, blanket policies are hardly likely to be well fitted overall.
3. It gives the pastoral areas at least an equal chance of being considered, and considered specifically, in the planning process. Feedback is also on a regional basis so planners should be made aware of specific areal needs and priorities.

In considering the administrative dimension of its EMASAR programme, the FAO consultative panel in 1974 made the following comment: "For most situations, the ideal procedure at the national level may be . . . to prepare multi-disciplinary regional and/or district plans, committing all relevant departments to agreed action within the plans; and to authorise a Range Department to execute the programme, with strong interdisciplinary functions and ability to employ other departments, individuals or contractors" (p.14). This is clearly a decision for the highest in the land and as far as an organisation such as FAO can possibly go before entering directly into the internal politics of sovereign states which is, clearly, not its role. The February 1975 meeting was designed to get this message across to ministers from the countries concerned.

Of the countries shown in Table 1 a few have already embarked on a regional approach to planning. Both Guinea and Malagasy have territorial ministers: a Minister for the Local Government of each Region and, a Minister of Territorial Planning respectively. Niger, as mentioned has its Minister for

Saharan and Nomadic Affairs and other countries have embarked on regional plans such as Mali with its plan for the Sixth (Mopti) Region. Most countries, however, retain the basic sectoral structure.

Outside Africa, Pakistan has taken the alternative approach of developing a Range Management Authority (known as the Range Management Committee) with (at least on paper) the necessary authority to have some effect. This committee has carried out feasibility surveys of many of the range areas and has prepared comprehensive development schemes, having been told by the Prime Minister "I will give you every possible support — political, moral and financial". In this particular case events were spurred on by the very serious problem of salination which has laid waste many tens of thousands of hectares of land under tubewell irrigation.

The general conclusion drawn from the EMASAR meetings was that, having laid down the guidelines for ecological management of semi-arid rangelands and the organisational changes required, FAO should establish an EMASAR programme to assist the countries concerned. Obviously what form of administration the individual governments select is entirely their business but much can be done to illustrate the strengths and weaknesses of different types of administrative approaches to the range management problem. Thus, the Central Secretariat of EMASAR would gather information on past experience with varying administrative structures. At the national and regional levels, EMASAR teams would "assist in strengthening range management organisations" and this might result in some international regional planning of rangelands based, perhaps on CILSS [*Comite Inter-Etats pour la Lutte contre la Sécheresse au Sahel*] or the EAC (East African Community).

The EMASAR initiative is valuable in that it specifically identifies organisation and administrative structure as subjects worthy of study and reform. Unfortunately the fairly firm statements in the consultative document (1974) become very watered down in the Programme (1975) but that may reflect the fact that there were politicians present at the second meeting! Nevertheless, the fairly strong terms in which the consultative document couched its administrative argument emphasise the importance that should now be attached to this long neglected dimension.

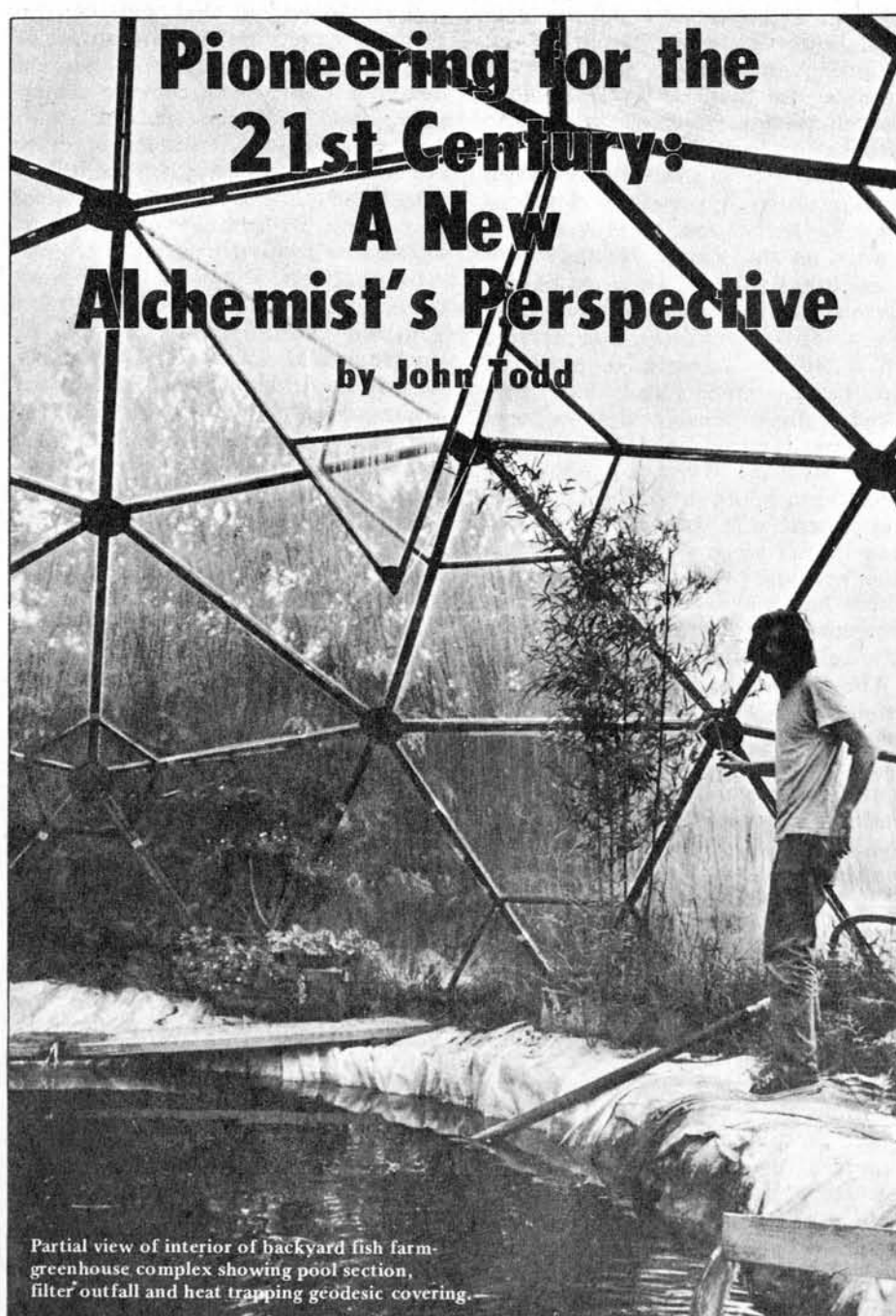
It is intended that out of the EMASAR meetings a programme of international co-operation should develop. This would provide assistance and guidance at the local, national and multi-national level to encourage the management of rangelands along sound ecological principles. By establishing, encouraging and guiding projects acting as a link between donors and recipient countries, EMASAR could form a valuable complement to ILCA, (International Livestock Centre for Africa) at Addis Ababa. This latter organisation (in the same family as the Mexico grain centre and the Rice Research Institute in the Philippines) is concerned with research along systems-analysis lines into livestock production; training and documentation. The results of ILCA work would form an essential foundation for the ongoing work of an EMASAR programme, especially as ILCA has abandoned totally a sectoral approach to research and has brought in the social dimension. "The systems approach is valuable both for identifying development strategies for immediate use (the best, or safest, strategies in the present stage of knowledge) and for selecting areas for research. Its value in research planning lies not so much in identifying problems, which are often self-evident, as in selecting what is likely to be the most profitable approach to problem solving. This is especially relevant to livestock production in Africa, where improvement in yield or output is as likely to come from social change or from range improvement as it is from genetic change in the animals themselves. As a general rule, therefore, ILCA/CIPEA will not undertake or support research on specific topics such as breeding, nutrition or forage production unless the relevance of the research programme has been demonstrated by systems analysis." (ILCA Prospectus 1974). The interdisciplinary revolution has proceeded apace at the research stage viz. Man and Biosphere programme of UNESCO but, only if individual governments are willing to take the political initiatives, would there seem to be a much sounder ecological basis ahead for livestock planning in the semi-arid areas.

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Pioneering for the 21st Century: A New Alchemist's Perspective

by John Todd



Partial view of interior of backyard fish farm-greenhouse complex showing pool section, filter outfall and heat trapping geodesic covering.

Humanity's survival may well depend ultimately upon a fundamental redesigning of the ways in which societies are sustained. It is the author's contention that a major reconstruction, as dramatic in its own way as the societal changes brought about through industrialization and the massive use of petroleum, is in order. Beyond the need for limiting growth lies a need for a conceptual change in the way we use the resources of the planet. Present day economies including their power requirements, food production, shelter, heating and/or cooling, transport and manufacture are predicated upon finite sub-materials. There is no precedent in human history for whole civilisations based upon non-renewable fuels. Hence there is little within our historical past upon which the future can be predicted.

A number of years ago a few of us, most of whom were scientists, began to explore tentatively the possibility of redesigning and restructuring the vital support elements of communities with the hope of coming more into line with the laws of nature. Once built, such communities would function almost exclusively upon renewable energy sources, particularly the wind, the sun and biofuels. We were seeking an adaptive future that could be widely applicable throughout the world. It was critical that our thinking be holistic and that our designing and science be integrative, encompassing from the outset energy, food, shelter and eventually manufacture and transport. All of these would have to be linked in turn to social and human concerns.

We sensed, although we were not then ready to articulate, that the next major intellectual and social revolution would involve finding ways of replacing the fuel consuming engines and hardware of industrial societies with equivalent processes derived from nature which when combined with appropriate and softer technologies would be able to sustain a new kind of society, perhaps extending the human experience. We envision a world unlike one we have known, in which biological systems driven by renewable energy sources and orchestrated by people and micro-computers will provide us with the essentials for full and creative lives. Such a future involves in essence a transformation from this society which is hardware intensive and exploitive of the planet, to one that is informationally extensive, working in close partnership with nature. We formed an Institute, which we called New Alchemy, to explore pioneering for the 21st century. I should like to describe the Institute briefly, for it is out of our work that an alternative vision of the future is emerging.

The New Alchemy Institute was established in 1969 to explore scientifically strategies that might prove adaptive for humanity in the future. This was undoubtedly a large perspective for a tiny organization, but in an age of compounded crises and patch-it-up perspectives, it was clear to us that some fundamental and independent scientific thinking and investigations were going to be required and that the interfaces between science, politics and society were of legitimate concern for scientists.

At the outset we were acutely aware that despite our aggregate training we were not able in any

concrete sense to design or comprehend the vital systems of society in their interconnectedness and entirety. We reasoned further that without some kind of holistic comprehension there could be no really significant science for the future. Piecemeal thinking had about run its course and an appropriate alternative was needed.

For us, the key to change was linked to scale. If an adaptive future meant working with tangible wholes rather than abstractions, then the scale of our scientific inquiry should be much reduced, yet involve, at the same time, the vital systems which sustain humanity. We felt it imperative to fuse science with the practical, scholarly and philosophic realms. There were traditions to guide us including the Taoist and Hermetic ones which at one time embraced science. In our own era, cybernetics and ecology have helped pave the way for the fusion of which I speak.

Over the years we have adopted a number of scientific guidelines which incorporate political, economic and ecological considerations. Since they are relevant in any discussion of the value of our work, I shall list them:

1. That N.A.I. begin to design and research on a micro level while maintaining a planetary perspective and a concern for linkages between levels of organization. By micro level, we meant the lowest functional units of society, the individual, or small group, and the elements which sustain them. The assumption was that larger units of organization can be no stronger than the elements of which they are comprised, and that the microcosm can be knowable in concrete terms often representing a tiny image of the larger world of which it is a part. It can, if broadly conceived, act as a model of organization. This perspective, which is characteristic of alchemical philosophy in many ancient cultures, inspired our name.

2. That N.A.I. emphasize food producing and energy systems that do not require large amounts of capital so that its findings could be widely utilized by those without substantial fiscal resources. This would also make its work useful, although by no means exclusive to third and fourth world countries.

3. That N.A.I. seek methods by which a gradual shift could be made from a hardware-intensive society to an informationally and biologically extensive one. We suspect that the next major human advance may prove to be the substitution of

strategies gleaned from nature, deriving their primary support from natural systems, for present day predominantly hardware strategies requiring high levels of energy to operate societies. The integration of these newly designed natural systems may be assisted by micro-computers and monitors which utilize minute amounts of power and, like humans, act as control elements. We believe that in societies organized into micro units, almost all the food, shelter and internal climates, power, and even transport can be transformed to biologically and informationally derived support elements. Since it is more difficult to make a commodity out of living entities, like an ecosystem, it seems possible that a future derived from this basis will be more egalitarian and considerate.

4. That N.A.I. emphasize participatory solutions in designing for the future which would be capable of involving large segments of society. We made the assumption that when the petroleum era wanes, the traditional ratio in which the great majority of humanity was involved in food raising would reassert itself. It has just been with the oil and gas based agriculture in the 20th century that it has been possible for a majority to shift to urban living. Since it seems likely at some future date that much of the population might have to return to culturing most of their own foods, we decided to research methods of food culture on a family level, which would be ecological and relatively inexpensive. The physical components would involve only part-time tending, be suitable for siting in such small spaces as suburban backyards. Further they would have to be designed so as to be comprehensible and useful to large numbers of people.

5. That N.A.I. explore bioregional approaches to the future that would augment the more "universal" approaches outlined in 1 through 4. Towards this end, it would establish small centres or projects in several countries and climates. In the best of all possible worlds there should be a balance between the regional and the global. Each bioregion should be physically and culturally unique, reflecting a dialogue between society, climate, environment and resources. It seemed to us that self-reliance, pride and independence could be restored in many regions if indigenous approaches to food production, energy, shelter and manufacture were given serious intellectual and scientific concern.

At its fledgling centres, the Institute has begun to identify and study bioregional directions in several areas as diverse as maritime Canada and the lowland tropics of Costa Rica.

6. That N.A.I. seek methods for incorporating in its designs renewable energy sources and durable material in lieu of finite substances and short-lived materials. Conservator societies will be predicated upon such shifts in energy production and use of materials.

I should like to outline briefly a number of our key experiments which are at present under way and which reflect the above approaches.

Backyard Fish Farm — Greenhouse

A number of years ago we posed a question — namely, would it be possible utilizing ecological principles, internal food cycles, and renewable energy sources for power, to produce the protein needs of a small group of people on a year-round basis in an approximately 50' x 50' space? Theoretically, at least, such systems might function initially as micro food gardens or survival tools. Ultimately they could point the way to a new approach to agriculture. New Alchemy's backyard fish farm-greenhouses are an outgrowth of our attempts to answer this question.

Basically the backyard micro-farms are semi-tropical aquatic and terrestrial environments covered by solar trapping structures which maintain and regulate year-round growing conditions for fishes, vegetables and some fruits and grains. The aquaculture component is the key to climate control, as the large volume of water provides heat storage for cold and sunless periods. Within the ponds, dense blooms of algae are cultured, providing the feeds for herbivorous fishes within. Tilapia, a herbivore from Africa, has been cultured on internal food chains to an edible size in as short a period as 3 months. The white amur, another vegetarian fish prized in China, have grown to over a foot in length in less than a year. Overall productivity is dependent upon internal biopurification. This is carried out in two small ecosystems adjacent to the culture ponds. We have not sought record levels of fish production; our emphasis to date has been on the creation of healthy aquatic ecosystems which are almost autonomous, self-regulating and self-purifying and which have incorporated into them a variety of food cycles, the end points of which are diverse foods suitable

for human consumption. These include fishes and edible aquatic plants such as water chestnuts. Rice has been successfully cultured in small batches using pond water. Production in shallow 18' diameter dome-covered ponds has exceeded 50 lbs. per crop of tilapia which are cultured only during the summer months. White amur and mirror carp are raised year-round in the same system.

Adjacent to, and dependent upon, the aquaculture are experimental terrestrial growing beds. During summer they contain tropical seed grain crops such as amaranth, vine crops such as squash, cucumbers, and tomatoes, and tropical fruits. During the winter, traditional temperate climate foods such as spinach, lettuce, onions, parsley and chard are grown. Their overall value may exceed that of the fish. Pests upon the plants are controlled biologically; *Anolis carolinensis*, a lizard, has been found an effective predator for most insects. Biocides can not be used within these terrestrial capsules as they disrupt the internal cycles, particularly the aquatic.

Although the original concept has been vindicated, there is yet much to be learned. Our growing structures are now at a stage where they are justified at the family level. Perhaps in some parts of the world, where food and water as well as fuels are scarce, adaptations of these micro-farms could prove extremely valuable.

The Miniature Ark

The miniature ark, a solar-heated wind-powered food-growing complex was designed to study biological concepts which we hope will lead to highly productive and economically valuable ecosystems for the raising of aquatic foods. It has, in addition, a small amount of greenhouse capacity. The design was inspired by productive ecosystems in nature, in particular a river in Java, a Louisiana estuary and a mangrove lagoon in Florida. All three ecosystems were characterized by rapid exchange and flushing rates of water which we felt were key to their ability to sustain large animal populations. The river had high nutrient levels derived from animal and human sewage and was capable of sustaining immense populations of organisms suitable for fish feeds. The Javanese cage culture 80-90,000 lbs. per acre of fishes annually in the better sections of the river. Both the Louisiana estuary and the Florida mangrove

lagoon were characterized not so much by high internal productivity as by accumulations of decaying detritus derived from surrounding terrestrial and aquatic environments. Because of the influx of oxygenated water from outside, large numbers of fish and crustacea were able to thrive in these zones to feed directly on the abundant detritus and associated organisms. In the absence of flushing, decomposing organic matter lowers oxygen to levels intolerable to desirable fish and crustacea species.

The miniature ark was designed to incorporate the best bio-energetic attributes of the tropical river, estuary and lagoon with respect to overall stability and productivity. Its aquaculture component is a circular "river" or closed loop, with solar heated water, high nutrient levels, a rapid flow with resulting high exchange rates, detritus, organic matter, and supplemental components for culturing additional feeds.

The flow is produced by a windmill which pumps water through the various sub-components of the loop. Several high capacity sailing windmills have been developed by New Alchemy for water pumping in third world countries and for aquaculture systems. Presently the Institute is attempting to develop pumps equal to the power of the windmills. It is expected that, within a year, flow rates on the miniature ark will increase fourfold with a concurrent rise in potential productivity.

Large fish populations are cultured in the largest pond of the loop or cycle. Bio-purifications take place, after the water has passed through the solar heater, in five small ecosystems. These variously house bacterial filters comprised of shells, earthen filters, open pools and "forests" of aquatic plants arranged to induce alternating carbon dioxide and oxygen dominating pulses. The ability of the system to purify water laden with toxic fish wastes has exceeded our most optimistic estimates. Plants from the bio-purification elements are fed to fishes periodically. In this way the nutrients are continuously recycled within the system.

Although the aquaculture component of the miniature ark is small, it has worked well and will be the model for larger systems. The design and early workings of the miniature ark and the backyard fish farm-greenhouses are described in the *Journal of the New Alchemists* volume number two.

Solar Ponds

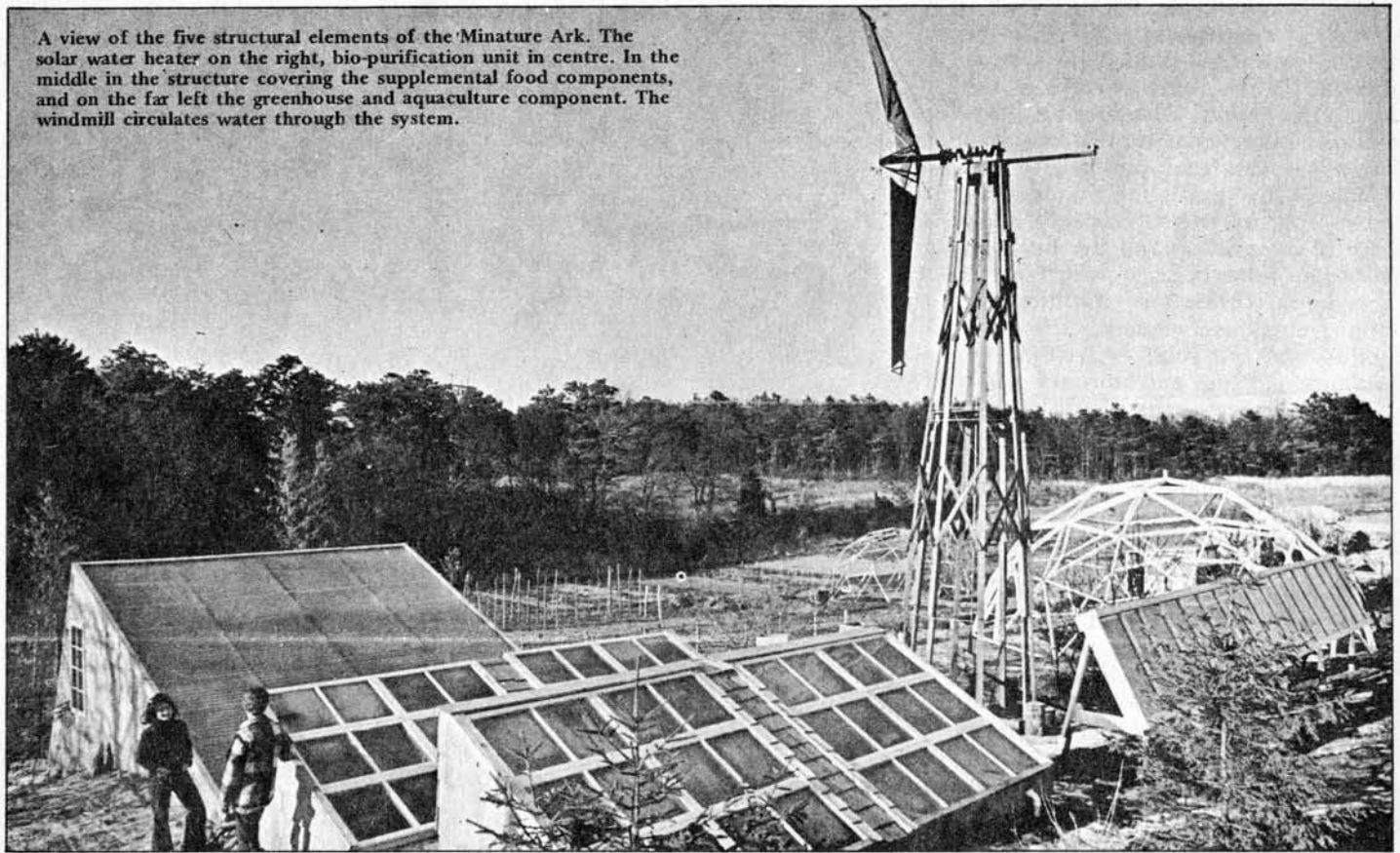
The recently conceived solar pond concept is an attempt to utilize living systems so that they serve simultaneously a number of critical functions in an integrated way. In their design the emphasis has been to have biological entities, in combination with an appropriate technology, serve roles presently played by machines and fuels. The solar ponds are an attempt to create suitable climates in living and food growing bioshelters while at the same time they perform as aquaculture ecosystems. As such they are an example of guideline 3.

The solar ponds are translucent pools placed above the ground into which light can enter from the top and all sides. Their walls and tops are built from a fibreglass material which permits a high percentage of available light to enter. Solar ponds act as both effective solar collectors and heat storage units. The planktonic algae absorb the sun's energy in much the same way as the black absorber surfaces of the plate collectors which are manufactured for houses and buildings. Within the ponds the energy from the sun is transformed by the plants into heat and plant growth. The water medium within which they exist is an appropriate storage material. A covered solar pond 5' high by 5' in diameter heats rapidly when the sun shines brightly. During the warmer months partial shading and venting is required even when they are outside.

In New Alchemy's "Ark for Prince Edward Island", which is a solar heated and wind-powered bioshelter encompassing a house, laboratory, greenhouse and aquaculture facility, there will be forty solar ponds. These will contribute considerably to maintaining living and growing climates year-round, as well as providing the backbone of the aquaculture systems. The Solsearch architects who are working with us on the structure predict that the ark will be able to function in the Canadian maritimes if the sun does not shine for a month. The complex will be one of Canada's contributions to the U.N. Human Settlements year.

The solar ponds represent a new approach to warm water fish culture. Because of their phenomenal light-receiving ability, algae production on a per unit volume basis is approximately ten times greater than in our other aquaculture systems. Consequently, proportionately larger grazing populations of tilapia are

A view of the five structural elements of the 'Minature Ark'. The solar water heater on the right, bio-purification unit in centre. In the middle in the structure covering the supplemental food components, and on the far left the greenhouse and aquaculture component. The windmill circulates water through the system.



presently being cultured within them. Within the ponds, we are experimenting with passive-vs-active bio-purification strategies. The "active" solar pond uses a small air pump to turn over water within bacterial filters on the bottom of the pond. This has resulted in extraordinarily dense algae blooms. The "passive" solar pond seems to be able to function effectively as well by relying upon the movements of the fishes to affect bacterial-algae nutrient recycling. Both solar ponds have an exceptional ability to take up and eliminate toxic ammonia.

Since this is our first season working with solar ponds, it would be premature to judge their worth as solar heaters and fish culture ecosystems. With more study and refinement they may prove to be one of N.A.I.'s most valuable contributions to the vexing problems of heating and food production.

The Cape Cod Ark

We intend to find out whether well-designed bioshelters can be developed that will produce foods in such abundance as to be economically viable, paying for themselves and providing a living income for their owners. An intensive garden/farm agriculture, based on small acreages and bioshelters which contain ecologically derived food

networks powered by renewable energy sources, may be a most adaptive strategy for a future when fuels are dear and in short supply.

The Cape Cod ark, a solar-heated, wind-powered greenhouse and aquaculture structure, was designed in collaboration with Solsearch architects to explore the micro-economic basis of the bioshelter concept. It is to be built in the fall of 1975. A small model, 25' by 15' in size has already been built to test a number of concepts and materials. These include the insulating and heat-trapping properties of the potentially valuable solar membrane invented by Jean Wellesley Miller and Day Charoudi of the Solar Lab at M.I.T. The model ark is the first test of the membrane within a growing structure. It is suspended in three layers under the south-facing fibreglass wall. The membrane may be an effective alternative to costly, difficult to manage shutter systems in solar heated growing structures.

It should be emphasized that the Cape Cod ark is a first attempt to design and build a commercial-size growing structure incorporating the principles described earlier. Much biological and bioengineering research will be involved, including the evaluation of crops most suitable to conditions within, biological controls for pests and disease, and internal climate regulation. We are optimistic that such arks eventually

will prove an important alternative to food scarcities when cheap fuels wane, but we are aware of the amount of work required to realize their potential. We also feel an obligation to design them so that they are not dependent upon experts and can be widely deployed through society.

An Ark for Prince Edward Island

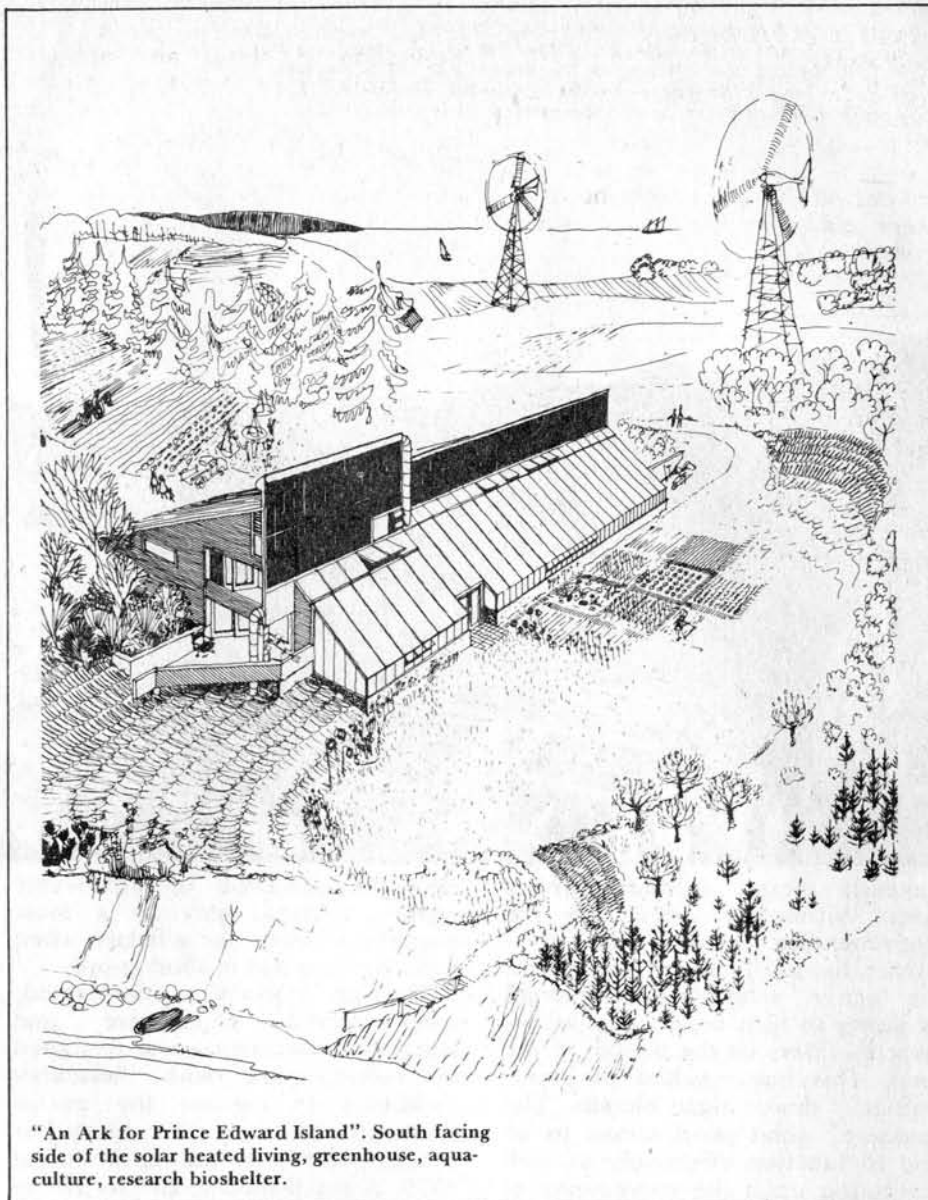
The Canadian ark is a complete system for living, research and food production which is autonomous and self-contained. It uses the sun and the wind to create housing and growing climates under the rigorous climatic conditions of Prince Edward Island in the Gulf of St. Lawrence. Presently under construction, it is New Alchemy's first attempt to test the feasibility for future living structures which are not continuous energy drains on society. They would be long-lived structures that generate their own power, utilize their own wastes and provide food and even commercial crops for their inhabitants. Through the ark we are trying to evolve bioshelters which are, in many respects, miniature worlds and will through the tending of them teach their inhabitants how the larger world works. An earth ethic may well have to begin where we live. If this is so, our houses should emulate the workings of nature.

A brief description of the ark for Prince Edward Island will appear this fall in the third *Journal of the New Alchemists*. The artist's illustration shows what it will look like when viewed from the sea to the south. What makes the ark unique, apart from its self-sufficiency, is the careful integration and the linkages between components which have not been connected traditionally. The greenhouse element, the solar ponds and the solar collectors, for example, all trap and store the sun's heat in several subsystems which, in turn, will be used for a diversity of vital functions. The 25kw wind-driven power plant will provide the electricity for control functions and for air and water circulation. During critical periods in winter, its electricity will be degraded to provide heat to sub-elements that require it. The ark will be very much like an organism, with the structure acting as the exo-skeleton. We shall study the various inter-relationships between such external inputs as sun, wind, length of day and temperatures, and internal biochemical, biological, climatic and storage variables. The emphasis will be on discovering the most appropriate ways of regulating the overall system and of optimizing on a sustained basis food production within.

During a period in history when, in temperate countries, fuel for heating and for food growing, transport and storage are rapidly consuming a high percentage of the world's finite energy sources, arks may represent a key step in integrating existing knowledge with indigenous, smaller scale approaches to the future.

Hydrowind . . . An Advanced Wind-Driven Power Plant

For many organizations a challenge may occasionally arise which seems sufficiently important that a change in course may be advised in order to meet it. On Prince Edward Island we have been confronted with just such a challenge. The Island province was planning to take part in a large nuclear project, but indicated to us that there was still time for other alternatives to be seriously considered. We proposed informally to the Premier and some of his cabinet and staff that a non-nuclear future might prove the wisest course both socially and economically. N.A.I. is opposed universally to nuclear power generation. In the case of Prince Edward Island, we recommended a gradual shift to a coal-wind-solar energy future. The wind is a renewable and plentiful island



"An Ark for Prince Edward Island". South facing side of the solar heated living, greenhouse, aquaculture, research bioshelter.

resource and coal is readily available in Nova Scotia. With about 2,000 hours of bright sun annually, the Island could well integrate supplemental heating into its buildings and crop driers, thereby reducing its fuel and electricity needs. Unfortunately, our arguments were weakened by the fact that there was no commercially available electricity-producing windmill either large enough, or suitable, for determining the efficacy of wind as a supplemental power source. In order to keep alive the ideal of a non-nuclear future, the Institute, with promised support from the Canadian Government, brought together a team of engineers to develop a New Alchemy windplant. Several design criteria were drawn up for it:

1. That it be rugged enough to withstand fierce winds and salt spray along the Island's coast;
2. That it have the potential to be scaled upwards in size to 100kw systems and larger;

3. That the first plant produce enough electricity to power readily a sizeable farm or the ark (a 25kw mill size was chosen);
4. That the design permit that it be ultimately manufactured and assembled on the Island;
5. That its economic future look promising.

The resulting design was the **Hydrowind** windmill electrical power system. It represents a break from orthodox windmill technology. A prototype is now under construction to be tested on Cape Cod. The **Hydrowind** uses hydraulics for power transfer, taking advantage of substantial improvements in hydraulics in recent years. The New Alchemy system transfers power via hydraulic pumps from the blades to a hydraulic engine on the ground, at which point it is transformed into electricity. There are a number of advantages to be gained including increased ruggedness, smaller

towers and top gear, potentially better air shapes due to having generators on the ground, hydraulic tuning of the blade pitch and opportunities for a scaling of size. Perhaps most important, inherent in the design is the ability to couple a number of windmills into the same power plant and operate a single generator.

The first **Hydrowind** power plant on Prince Edward Island will be comprised of four, 20' blade meter windmills linked together. The blade design is new, involving an integral core tension system and a light-weight aluminium skin.

The power plant will be connected to the ark and also to the Island's power network. We feel it will be valuable to test the mill on the grid in order to establish the feasibility of having windplants contribute to existing networks. It is our hope that an active debate will arise, on the Island and elsewhere, as a result of the ark system which will produce more power than it needs and sell the extra power to the utility.

Related Studies

There are a number of other studies and projects within the Institute including the culture of

insect larvae as supplemental fish feeds, diet studies on fishes, the evaluation of plants and animals from around the world for use in bioshelter food chains, tree crops and food drying and preserving. Efforts are being made to learn more about biological methods for increasing soil fertility and managing crops. Most of these studies are related and reflect a desire on the part of the staff to find more apt methods of managing living resources on a small scale. Central to our efforts is the testing of crop varieties for insect resistance and suitability to various climates.

I should like to emphasize that the various systems briefly chronicled here represent concepts in embryo. They are not end points, but new beginnings. They may seem simplistic, even quixotic upon first reading, as in some respects they are, but to see them only in this light might be akin to judging the worth of modern physics from a painting of Newton's laboratory. Within the next few decades many of these ideas will mature, particularly if the impetus can be maintained and others share some of the perspectives presented here. Several years ago I should have suggested that modern societies by nature would be

in opposition to utilizing small scale, holistically derived bio-technologies in designing communities of the future. At that time it was necessary to justify our research on the grounds that it behoves a mature society to explore diverse strategies for the future simultaneously so that when decisions are in order there are a variety of options to select from. This perspective, while central to our thinking, has been transcended recently by a growing awareness that new strategies for the future are required and urgently. In part this realization is arising out of a waning confidence in the ability of science and technology to salvage an industrialised growth oriented society in an ultimately finite world. It is becoming apparent that a science of steady states is needed to prepare us for the future. It will be different from the one we now know, having been created within a framework of ethical and moral considerations. There is emerging a widespread interest in building a future in which the majority of people are participants rather than spectators. If this is so, the work of New Alchemy and others like us may come to be considered relevant to the questions and problems of our time.

Learn more about Britain's Threatened Wetlands

European Wetlands Campaign

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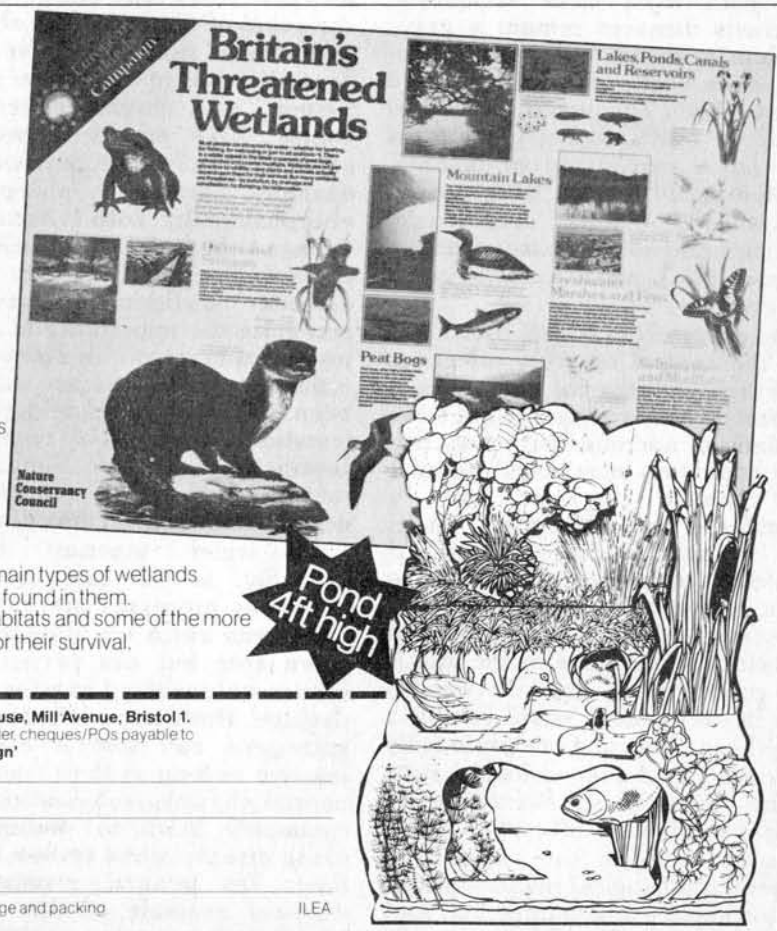
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The Future of Infectious Diseases

by René Dubos

The ecology of infectious diseases is more complex than was previously thought. Treatment lies much more in adapting to the pathogens in our environment than in trying to eliminate them, which could well be a futile effort.

The most destructive epidemics of the past have been brought under control by sanitation, vaccination and chemotherapy. This is what we mean when we speak of the "conquest" of infectious diseases, but we tend to exaggerate the magnitude of this achievement. As is the case with most other conquests, infectious diseases remain a grave problem, at times almost unmanageable, even where they are assumed to have been conquered. Microbial pathology still accounts today for a very large percentage of disease, hospitalization and absenteeism from school or work, even in the countries and social classes that can afford the most sophisticated medical care.

The explanation of this paradox is that the control of *acute* infectious processes — the great epidemics of the past — has brought to light other problems of microbial pathology that were commonly overlooked because their chronic character made it difficult to recognize their cause. This is particularly true for the problems associated with slow or latent infections. I shall mention a few such problems of current interest to illustrate that some of the infectious processes of greatest importance in the modern world exhibit a very slow course and are profoundly influenced by the physiological state of the host. These characteristics make it extremely difficult in many cases to establish the casual link between pathological manifestations and the initial event of infection. As I shall repeatedly emphasize in this

essay, the ecology of microbial diseases involves many factors above and beyond specific microbial etiology.

I. Chronic and latent infectious processes.

The discovery of the so-called "slow viruses" has dramatized the fact that years may elapse between the event of infection with the virus and obvious pathology. Several sub-acute diseases of the central nervous system, with chronic degenerative course, have provided spectacular examples of this phenomenon — for example: scrapie in sheep, mink encephalopathy, kuru in certain New Guinea tribes, the Creutzfeld-Jacob disease. One need not turn to such esoteric conditions, however, to recognize the importance of delayed processes in infectious diseases. For example, Brill's disease has long been known to be the delayed manifestation of rickettsial typhus first contracted early in life. Similarly, the measles virus can be responsible for delayed neurological disorders.

Of wider practical interest, probably, is the fact that many infectious processes are caused by pathogens which are ubiquitous in a given area but can persist in the carrier state without causing serious damage. However, while such latent pathogens can remain essentially inactive as long as their host is in a normal physiological condition, they commonly start to multiply and cause disease when certain stresses lower his general resistance. A classical example of this complex etiology — or rather ecology — is

provided by the herpes simplex virus. In our communities this virus is commonly acquired early in life and then persists in a latent form in the tissues — becoming "activated" and causing cell damage only when certain physiological disturbances upset its equilibrium with the host. Such "activation" can occur repeatedly despite the fact that the host generally possesses a high level of immunity against the virus.

What has just been stated concerning the herpes virus applies in one form or another to many viral, bacterial, and parasitic infections. For example, tubercle bacilli or staphylococci commonly remain inactive for many years at a certain body site but can multiply under certain circumstances despite the existence of cellular or humoral immunity against them. Much of infectious pathology in the future will certainly be the consequence of such reactivations of latent processes.

I shall mention only two of the many examples that symbolize the new kinds of phenomena that stand in the way of a true conquest of infectious diseases. Immunological tests have revealed that the hepatitis B antigen can be detected in approximately 0.5% of healthy persons in the countries of Western civilization, and in 5-20% of tropical African and Asian populations; there is evidence, furthermore, that persons who appear healthy can remain carriers of the virus for at least 20 years, and probably for their whole life span. Another fact now widely recognized

is that bacteria and fungi that were thought to be non-pathogenic a generation ago are capable of causing disease in human hosts whose general resistance has been lowered by some kind of stress.

In the light of these and many other similar facts, it is obvious that the understanding of the pathogenesis of microbial disease problems involves concepts of ecology as much as of specific etiology. It requires knowledge not only of the microbial agents themselves and of the immunological responses they elicit, but also of all the attributes of the host that affect host-parasite relationships.

II. Ecological determinants of chronic infectious diseases.

I shall briefly mention three different kinds of ecological examples to illustrate the wide range of factors that condition host-parasite relationships.

a) Malnutrition, surgical interventions, organ transplants, administration of cortisone and of anti-leukemia drugs, the use of immunological depressants, indeed almost any kind of traumatic experience including emotional disturbances can act as forces that reactivate latent infections.

Some progress has been made toward the understanding of the mechanisms through which factors that disturb host metabolism can enhance the ability of pathogens to multiply and cause damage *in vivo*. In fact, a few experimental models have been developed to study the mechanisms through which the metabolic state of a cell can constitute a determinant of resistance to infection.

The importance of the host's physiological state is striking in the case of mucormycosis, a disease which used to be regarded as having an almost uniformly fatal outcome. It is now realized, however, that exposure to the fungus results in serious disease only in certain abnormal physiological states, in particular diabetic ketosis. Indeed, control of the ketosis may be sufficient to arrest the infectious process, without antifungal therapy.

The fact that administration of cortisone decreases the body's resistance to a great variety of microbial agents illustrates still another aspect of the relationship between infection and physiological state. It points to mechanisms that might account for the common association of infectious disease with the kinds of physiological and psychotic states that disturb hormonal balance.

b) While it is obvious that mal-

nutrition commonly decreases resistance to infection, the influence of the nutritional state is at times far more subtle than appears from this simple statement. It has been shown for example that the multiplication of *Brucella* in certain experimental animals is dependent upon the concentration of the sugar erythrol in the infected organs. In experimental malaria, diets deficient in para-amino-benzoic acid foster resistance to the disease because the plasmodium requires this growth factor for its multiplication. Likewise, resistance to various viral infections is increased by deficiencies of the diet in certain vitamins or amino acids; thus, mice receiving a diet lacking folic acid have a better chance to survive infection with the virus of lymphocytic choriomeningitis. Both in this case and in the case of malaria, the experimental animals become carriers of the pathogen (the protozoan or the virus) but do not develop symptoms of the disease.

c) The composition of the indigenous microbial flora is another factor which can affect the host-parasite relationship. Prolonged isolation of persons or animals, either as single individuals or in small groups, can bring about the progressive disappearance from their bodies of several bacterial and viral types that were present in their so-called normal flora; furthermore, such loss may result in increased susceptibility to certain infections. A classical example of this phenomenon is found in the fact that small groups of men isolated for a few months in arctic stations commonly fall victim to the common cold as soon as they re-establish contact with the outside world.

It is not unlikely that the high levels of sanitation that will increasingly prevail in the future — at least among affluent people — will decrease resistance to microorganisms that used to be ubiquitous in the environment and were not considered pathogenic. An experimental approach to this problem has been provided by the study of animals born and raised under germ-free conditions. While such animals can survive and multiply in germ-free environments, they exhibit anatomical and physiological abnormalities that would make them unable to survive in the open world; for example, their lymphoid tissue is poorly developed and as a result they commonly succumb when they come into contact with pathogens (or even with common microorganisms) because they cannot make rapidly

enough an adequate immunological response to limit the proliferation of these microbial agents.

d) Studies in tissue cultures have revealed that the phenotypic expression and even the genotype of animal cells can be altered by the presence in the culture of viruses and other microbial agents. It does not seem too far-fetched to postulate that such cellular alterations can result in chronic pathological processes and perhaps also in neoplasia.

III. Approaches to the Control of Infectious Disease

Increased speed of travel, greater mobility of all social classes and almost universal urbanization will inevitably accelerate the spread of microbial agents. When pandemic influenza broke out in 1957, it moved at the speed of train and ship travel. If another kind of pandemic should occur now, its agent probably would be seeded through the world at the speed of air travel. The generalization and greater rapidity of human contacts make it probable that mankind is in the process of becoming a community with a microbial population of increasing homogeneity, not only with regard to pathogens but also with regard to less virulent components of the microflora and microfauna.

The rapid and generalized spread of pathogens naturally creates the possibility of disastrous epidemics, especially those caused by new mutant forms of the pathogenic agents. But it may also make the human species as a whole more resistant to infection through the development of what has been called "herd immunity".*

Although these types of responses appear contradictory, they are in fact compatible — for the following reasons.

Herd immunity against certain pathogens — the influenza and polio viruses for example — can unquestionably protect against well-established strains of these pathogens but does not suffice to prevent the explosive spread of their new mutant forms. Herd immunity, furthermore, does not seem capable of bringing about the eradication of infectious agents. Finally, since the resistance it confers commonly breaks down in persons exposed to various forms of stress, the evocation

* The expression "herd immunity" is rarely found in modern textbooks because its meaning is rather obscure. In some cases it may refer only to some non-specific kind of resistance and in others to specific immunity. But even though the precise mechanism of herd immunity is not known, this does not decrease its practical importance, which is acknowledged by all epidemiologists who have field experience.

into activity of the many different pathogens which exist in a latent form is likely to remain a common cause of disease.

On the basis of epidemiological and clinical experience it appears that the state of physiological well being (whatever this may mean) endows the host with a marked degree of natural resistance to many of the pathogens he harbours. But there is as yet no systematic body of knowledge that would permit to increase at will this non-specific type of resistance. The problem is mentioned here not to point to achievements but to emphasize the need for research.

The role of chemotherapy in the prevention and treatment of infectious disease is not likely to change appreciably in the near future. The discovery of new drugs will remain erratic and unpredictable as long as it continues to depend on empiricism. The development of a rational approach to their search will probably have to wait upon the identification in pathogens of structures and functions that do not exist in the host or that are of minor importance to his well-being; only drugs acting on such structures or functions can be hoped to have minimal toxic effects.

Sanitation and specific vaccination will probably remain the most practical and effective ways of limiting the spread of pathogenic agents. However, the fact that new mutant forms of these agents are likely to appear makes it advisable to establish throughout the world diagnostic laboratories (listening posts) for the early detection, identification and isolation of new strains; equipment should also be available for the rapid

production of specific antigens on a mass scale.

For many types of infection, living agents of attenuated virulence constitute at present the most effective vaccines. However, non-viable chemically purified antigens present advantages from at least two points of view: a) they eliminate the danger of back mutation to virulent forms; b) the more the antigen is purified the smaller is the demand it imposes on the immunological mechanisms of the host — a fact which may become of importance as vaccination comes to be practised against a larger number of pathogens.

Vaccines — whether living attenuated or non-viable chemically purified — could probably be made much more effective if their administration were associated with procedures and adjuvants capable of accelerating the host's immunologic mechanisms. Progress is being made in this direction.

The response of the human organism to any form of stress and to infection in particular is naturally conditioned by many earlier experiences. It is of importance in this regard that each individual person tends to retain, in many cases throughout his whole life, many of the microbial pathogens he acquires from his environment. There are a few facts suggesting that persistence of a pathogen tends to be greater if it is acquired very early in life. For example, children seem to become persistent carriers more frequently than do adults following infection with hepatitis B virus.

Lasting immunities (complete or partial) can result of course from the

acquisition and persistence of pathogens. But, as already mentioned, the persistence of the agent in a dormant form can be responsible for pathological states when stresses cause reactivation. For this reason, it would seem desirable to replace the accidental colonization of the human infant, which accounts for much of his so-called normal flora, by a controlled and systematic colonization with a microbial flora and fauna of known composition. Two different classes of microbial species might be considered for such controlled colonization.

Certain microbial species which have evolved in close association with *Homo sapiens* can be regarded as constituting what I have called elsewhere the autochthonous flora. These species are truly symbiotic with man and are indeed essential for the normal development of his tissues. Although the autochthonous flora is normally acquired from the mother at the time of birth or shortly after, introducing it into the newborn child might be of advantage in many situations of modern life.

On the other hand, the infant early comes into contact with pathogenic species that are ubiquitous or at least widespread in his community. It would probably be possible to develop attenuated mutant forms of these pathogens, which could then be introduced at a proper time early in life so as to produce under controlled conditions the kind of resistance that used to be called infection immunity and which has been designated more recently as bacterial tolerance.

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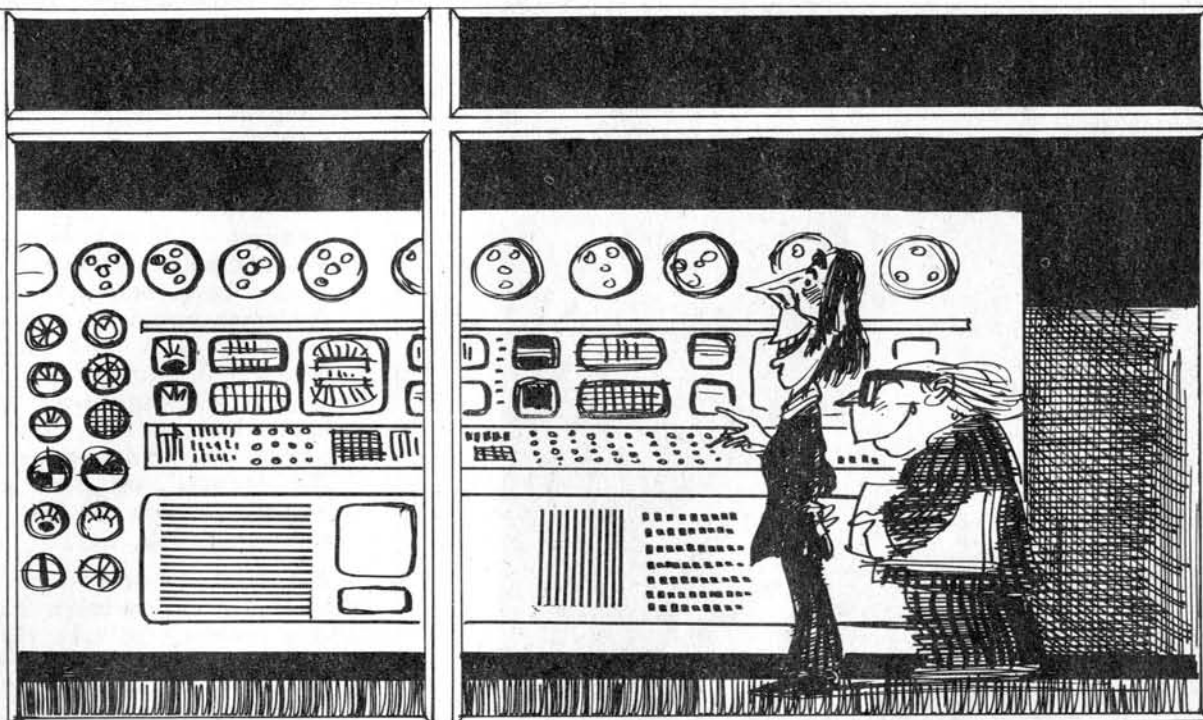
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The Unknown Ecologist

by Brian Morris



Radio Times Hulton Picture Library

Nearly a century ago Ernest Thompson Seton was writing animal stories that taught a generation of enthusiastic readers a great deal about wildlife and the significance of natural ecosystems. From his own observations of animals in the wild he developed theories that were too revolutionary for contemporary scientists. Like other men of vision he has been largely forgotten while his successors have been given credit for work and ideas that he pioneered.

A man who has been compared with Kipling as a writer, with Baden-Powell as a youth leader, with Audubon as a bird artist, and with Fabre as a naturalist, must surely deserve a niche somewhere. Yet who today of the conservation movement has ever heard of Ernest Thompson Seton? Very few I would venture to suggest. But I think a case could be made out for claiming that Seton was one of the founding fathers of ecology. The trouble is that Seton was not an academic; he went to art school not university, and spent his

boyhood and early manhood in the Canadian backwoods, the atmosphere of which is lucidly conveyed in his classic children's story *Two Little Savages*. He thus had no training in the biological sciences; and to aggravate matters, his sudden success at the turn of the century, when he was forty, was linked to an aspect of his life which ill accorded with the serious intents of the scientific community. It was through the phenomenal success of his popular animal stories — *Wild Animals I Have Known*, *Lives of the Hunted*,

Biography of a Grizzly, which are still widely read — that Seton first became known. And this led inevitably to a reaction.

Seton, in a sense, fell between two stools, and this is implied in the title of his autobiography *Trail of an Artist-Naturalist*, for he attempted to combine in himself what are usually considered to be distinct, even incompatible roles, namely that of the artist and scientist. In one of his stories he wrote, referring to the delicate tracks of one small mammal:

"Fairies — if only it could be! Would it not be delightful? I would gladly have believed, Christian Anderson would have insisted on believing in it, and then made others believe it too. But for me, alas! it was impossible; for long ago, when my soul came to the fork in the trail marked on the left 'To Arcadia', on the right 'To Scientia', I took the first, upland right-hand path."

But in fact he never went beyond the fork. He was too much of an artist and a romantic to take the right-hand path, and to him, a meticulous observer, a careful naturalist who refused to allow his imagination to wander too freely into the realms of fantasy, the other was forbidden. He never gave the poetry in his soul full play, or attempted to write 'literature', and so never approached the stature of Kipling. Yet his animal stories, unlike those of his contemporaries like William J. Long, were always rooted in facts; his interpretations and mode of presentation may be criticized, but no one has ever questioned the realism and the soundness of Seton's factual information. Nevertheless this literary approach did not find favour among more scientific naturalists, who perhaps found something unprofessional in his public acclaim. It was not surprising therefore that John Burroughs in 1904 published in *Atlantic Monthly* a bitter attack on Seton and other popular nature writers such as Long and Jack London, criticizing them for their anthropomorphism and labelling them 'nature fakers'. It is significant that the attack came from a highly literary naturalist like Burroughs, rather than from the museum zoologists like J. A. Allen and Hart Merriam, who were close friends of Seton. Encouraged by these and by President Roosevelt, Seton, in answer to his critics, published in 1910 his *Life Histories of Northern Animals*. This book, superbly illustrated by Seton (it is now a collector's piece), far surpassed any other books

on American mammals published at that period, and it did what it was meant to do — silenced his critics. Presenting, as it did, many of Seton's interpretations of animal behaviour, not as animal tales but as scientific material, the book served its purpose, but it hardly helped his reputation. Yet some of the ideas in this book, though they seemed bizarre at the time and were supported by very inadequate material, have a very contemporary ring about them. Had Seton devoted his life and energies purely to serious biology his reputation would have been assured, but *Life Histories* was too personal, too conceptually naive to be taken seriously. Nevertheless, it is an interesting prospectus of germinal ideas and trends of research that have since been explored in greater depth. It was in fact one of the first really serious attempts to study animals in their natural environment.

Seton's approach was essentially ecological. In a sense he is the zoological equivalent of such anthropologists as Boas and Malinowski. With a few notable exceptions, biologists at the turn of the century were largely museum academics; they were 'armchair' scientists, studying specimens and collating the information that was coming in from numerous sources — from traders, missionaries and explorers. Seton was one of the first of a new brand of scientist — the field biologist. Few men have spent as many hours observing animals in the wild as he did. One of the significant points to come out of the 'nature-faking' controversy was that some of Seton's critics had never actually seen a wolf in the wild. This sort of detailed field study is now commonplace; Seton pioneered it.

It was not only his mode of approach that was significant; Seton also hinted at certain features of animal life which seemed ridiculous at the time, but which recent research has seemed to confirm. He argued for instance that many animals had a rudimentary sign language, an aesthetic sense, property laws and a social system, and even wrote a book *The Natural History of the Ten Commandments*. Strange as some of his ideas may seem, contemporary studies of primates and of the social mammals have tended to confirm Seton's thesis, namely that there is a large 'social' or 'learned' element in the behaviour of animals. Even Ardrey's text on the 'territorial imperative' has echoes of Seton's

writings, for it was Seton who first noted the now obvious truism that animals do not wander at random in the environment, but have a definite 'home range'. This concept, now much refined as a result of Eliot Howard's studies, is still noted in the majority of ecological texts. Equally important was the fact that Seton was one of the first naturalists to record in detail the cyclic fluctuations of animal populations and the inter-dependence of predator/prey numbers. This is discussed in Barry Commoner's recent book, and is usually credited to Charles Elton whose classic book *Animal Ecology* was published in 1927. But it was Seton who first studied the trapping records of the Hudson Bay Company, and who recorded in detail the fluctuations of lynx and rabbit populations whilst on a trip to the Canadian Arctic in 1907.

Valid though Seton's contributions were to both literature (he originated a new literary form, the 'realistic' animal story) and to scientific natural history (as a pioneer in the ecological study of mammals), Seton also deserves credit for his part in directing public interest towards conservation and the preservation of wildlife — and through his books he reached an unusually large audience. Indeed, Fred Bodsworth suggested that it was Seton's animal stories that started the whole conservation movement almost a century ago. Certain it is that his writings show a deep sympathy for nature and for animal life — without ever being trivial or sentimental — and there are undoubted affinities between Seton and that other classic nature writer W. H. Hudson. But Seton's interest in nature was never purely literary, any more than it was purely intellectual and scientific; he was also a practical man, a skilled woodsman and an amateur architect of note. He could also imitate a wolf howl and light a fire without matches in under a minute! But such practical proclivities nowhere found a more satisfying or worthwhile channel than in Seton's founding of the first outdoor youth movement.

At the turn of the century, Seton, despairing of the destructive trespassing on his Cos Cob estate, and unwilling to take the advice of those who suggested repressive measures, initiated a weekend camp for the local boys. He hoped to channel their energies into less destructive pursuits. It proved a profitable experiment, opening new vistas to Seton's imaginative talents. He began to formulate a programme of

activities and a mode of organization for an outdoor movement for children. The first public announcement of the organization was in a series of articles for the *Ladies Home Journal*, beginning in May 1902. They achieved a wide popularity, and bands of 'Seton Indians' sprang up spontaneously in many places in America.

During the next few years the movement grew and Seton expanded his programme accordingly. In 1906 the *Birch Bark Roll of the Woodcraft Indians* appeared, setting forth the aims and methods of the new movement, keeping abreast with the camps that Seton held annually. In the autumn of that year, Seton was scheduled to lecture in England and had written to Baden-Powell asking him to chair one of his meetings. Knowing that the defender of Mafeking would be a great draw and aware of his interest in the Boys' Brigade, Seton felt he would be just the man to attract the audience he required for the propagation and extension of his woodcraft movement in England. The aim of Seton's movement was simple, and, as expressed in the *Birch Bark Roll*, was based on two cornerstones — namely:

"the promotion of interest in out-of-door life and woodcraft, the preservation of wildlife and landscape, and the promotion of good fellowship among its members . . . to discover, preserve and diffuse the culture of the Redman."

The key elements that constitute the organizational framework of this woodcraft movement can also be summarized as follows: first, an emphasis on outdoor life and camping, with woodlore, tracking and campfire ceremonies as important subsidiary components. Second, the award of decorations for personal achievement, a 'badge system' linked with totemic symbolism. Third, a strong emphasis on play and recreational pursuits; fourth, a degree of self-government by the children. And finally, a written ten-point code of behaviour. These elements you may well recognize, particularly if you have been a boy scout or girl guide. For Baden-Powell took these elements (without acknowledgement) and gave them new meanings and labels, masking the original source by illustrative material drawn from his African colonial experiences. For a time, Seton and Baden-Powell worked in close co-operation, and the former became Chief Scout of America. Indeed Seton looked upon the scout

movement as a joint enterprise. But the inevitable rift came during the First World War when the imperialist stamp of the boy scout movement was unmasked — for what Baden-Powell essentially did was to marry Seton's ideas on woodcraft with the imperialist sentiments expressed in the Edwardian era. The irony of history is that, whilst Baden-Powell not only reaped abundant honours in his own lifetime but finds a place in every biographical dictionary, Seton is virtually unknown. Perhaps in time we shall come to see things in a truer perspective. We now have a different approach to so-called primitive societies. We recognise that many have cultures that stand up to comparison with our own; that, in seeing an essential harmony or interdependence between man and nature, we may even have something to learn from them. And having read books like Dee Brown's *Bury My Heart at Wounded Knee*, we are beginning to see the history of the

Americas in a new light. But this book is but an echo of Seton's impassioned defence of the American Indian in his book *Book of Woodcraft* (1912) — a courageous stance taken over sixty years ago when jingoism and expansionist imperialism were rampant and taken for granted. How different this from Baden-Powell's *Scouting for Boys*, with its empire building and its illustrative material drawn from such imperialist episodes as the Ashanti and Matabele campaigns in which B-P played a major part, and about which he wrote books. Baden-Powell was all for the preservation of the Empire; Seton was a progressive educationalist (whose ideas on self-government antedate those of Homer Lane and the progressive school movement) and in essence a democratic socialist. He was always a severe critic, as his reasoned and impassioned pleas for the preservation of the natural world and of American tribal culture denote, of industrial capitalism.

In writings on academic ecology and on what has come to be known as the counter culture — with its diversity of spiritual and intellectual roots — the name of Ernest Thompson Seton is rarely encountered. He embodied, in his writings and life-work, some of the major currents and concerns that are now evident in the ecological movement; but when he died in the autumn of 1946, few newspapers carried an adequate obituary — he had it seemed become a forgotten figure. But *Time Magazine* carried a short moving extract. It described Seton simply as a man who "in an age of sweeping mechanization had loved the natural earth, its seasons and its creatures with a rare intensity", and it noted that Seton had had an unusual power of communicating his vision to others. This would have sufficed Seton, but the obituary significantly added that to naturalists his death would be "something like the falling of a forest tree." Such a man ought to be remembered.



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Disruption and Democracy

The road-transport lobby are probably more worried than they would care to admit over the activities of Mr. John Tyme and those who share his views. It is becoming obvious that in future no major new road is likely to be built except in the teeth of informed and militant opposition. At a number of public inquiries this year, most notably at Aire Valley and Winchester, protesters have found that deliberate disruption gets results whereas playing the game according to the rules does not.

Criticism of the protesters in the press has largely been on the grounds that it is undemocratic deliberately to prevent public inquiries from functioning. Nothing could be further from the truth: for the inquiries as at present constituted make a mockery of democracy. Public participation is confined to the question of *where* a proposed road should run: the wider question of *whether* a road is needed at all is left to the Department of the Environment — in practice, not even to our elected representatives, but to professional civil servants. The inspector at an inquiry is appointed by the Department; and if, even so, he shows some glimmering of an independent attitude, the Department is free to ignore recommendations.

Mr. Tyme's tactics are therefore entirely justifiable on moral, and probably legal grounds. Equally important, they seem to be working. So far, the cracks in the Department's defences are small — Inspectors may in future be nominated by the Lord Chancellor's office, objectors may be given the right at least to be told how a local road proposal fits in with national policy, and the Winchester inquiry has been adjourned until the D.O.E. can present a cost-benefit analysis of the proposed section of motorway, and a comparison with the objectors' alternative suggestion of improvements to the existing by-pass. The fact that even these limited gains have had to be wrung from the Department by agitation and disruption inspires little confidence in existing "democratic" procedures. Perhaps, in the present climate of opinion, *real* public participation would automatically squash any major new road scheme: is this what the Department of the Environment is scared of?

The Real Cost of Petrol

"In order to understand the future, we have to move to a 'cosmic' accounting system. I asked a noted geologist to do a study on how much energy nature expended in the making of petroleum. We found it cost nature, over the eons, a million dollars to produce a gallon of petrol, at the rate of which you and I pay for electricity. All those people driving in to work every day — they're each spending two or three million dollars a day, at least by nature's accounting."

Buckminster Fuller in *National Geographic Magazine*, July 1976.

Crumbs from the Rich Man's Table

The United Kingdom *wastes* enough food to meet the total needs of a country the size of Egypt — at a rough guess, about 35 per cent of all food produced or imported. (This figure refers only to what everyone

would recognise as waste, and takes no account of the 15 million tons a year of good human food given to livestock, let alone of the endemic gluttony which is an indirect cause of most pre-senile deaths.)

The estimated figure comes from a report by Dr. Robin Roy, *Wastage in the UK Food System*, (Earth Resources Research, 9 Poland Street, London W1, 75p). The total is inevitably based on a series of guesses, for food is wasted without a thought at every stage from farm to kitchen. Roy suggests that 20 per cent of homegrown food is lost on the farm, from a variety of causes. (One of them, certainly, is the inefficiency of mechanized harvesting methods — I have often gathered a sackful of potatoes in an hour from fields near my home, *after* the farmer had supposedly harvested the crop.)

Much of what leaves the farm or the docks is then subjected to processing in factories. The sorting, peeling, trimming, coring etc. involved at this stage involves further massive waste. Some industries are more guilty than others — for instance, the cheese-makers throw away millions of gallons of whey which in a more economical age would have been fed to pigs. Here, indeed, we come to the nub of the problem. Centralization and specialization make waste on a colossal scale almost inevitable. Roy outlines a solution: reinstate the mixed farm, where crop waste automatically becomes animal feed; establish closer links between town and country, so that factory and kitchen wastes are returned to the farm; and foster the old conservative cooking skills to eliminate waste at home. Easier said than done, of course: but when food imports cease, as they are bound to do before the end of the century, these and other measures will be implemented fast enough. Any government which could see beyond the ends of their noses, or the next General Election, would be starting to implement them *now*.

A Single-Minded Scientist

Work at the National Vegetable Research Station near Warwick has revealed alarmingly high levels of organo-phosphorus insecticide in carrots. The trouble is apparently aggravated by hot, dry summers, when the carrots grow more slowly and the poison lasts longer in the topsoil. A published statement from the scientist in charge of the experiments is a classic of its kind — "The main aim of our work is not to protect our fellow human beings against residues in carrots. It is to optimize the efficiency of the insecticide in every possible way. I do not think it would be humanly possible to consume the amount of food necessary to accumulate a toxic amount from the crop. Provided the chemicals are used in the correct way these residues should be acceptable."

Which, reading between the lines, means roughly: "The vegetable industry doesn't pay us to scare the public out of buying vegetables. Anyway, my job is to kill insects — the side-effects on human beings are nothing to do with me. Not that a reasonable dose of organic phosphates ever did anyone any harm. And if you insist on stuffing yourself with carrots, or if some

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fool of a farmer misreads the instructions on the pesticide packet, don't blame me if you make yourself ill. And anyway, would you rather not have carrots at all, like in the days before insecticides were invented?"

Accidents Will Happen

The appalling accident in July at an Italian factory, which tainted hundreds of acres of countryside with the highly poisonous chemical TCDD, is a portent and a warning. Considered as an isolated incident, it is horrifying enough. At the time of writing, several hundred people have been evacuated, and suggested remedial measures include the incineration of all vegetation and livestock and the removal of a foot of topsoil from the entire affected area. Every day brings further proof of the inability of the authorities to comprehend a disaster of this magnitude. There is no reason to suppose that the Italian response is less competent than any other nation's would be: it is clear that we know very little about the immediate consequences of contact with the chemical, and virtually nothing about the long-term ones. An ironic twist was given to the incident by the coincidental publication of a report *Ecological Consequences of the Second Indo-China War* (Arthur Westing, Stockholm International Peace Research Institute): for a derivation of TCDD was the main herbicide used by the Americans to sterilize thousands of square miles of jungle and farmland in Vietnam.

Predictably, spokesmen for the chemical industry are rallying to the defence of the indefensible. We will be told that the Vietnam war, and the Milan explosion, were isolated, untypical incidents: that all that is needed is more conventions, regulations, controls: that "provided the chemicals are used in the correct way" (see previous item) they can do no harm: that their beneficial effects on food production justify any slight unavoidable risk. All of which is unlikely to fool the public, who are understandably beginning to feel that a world where millions of tons of deadly poisons are manufactured every year cannot be a very healthy place to live. It is useless for the chemical industry to treat accidents and deliberate abuses as irrelevant. They are a normal part of human experience. As long as these devilish substances continue to be made, they will continue to be released, accidentally or deliberately, in other than the "correct way". (It is only a matter of time, for example, before someone realises their potential as a terrorist weapon.) A civilization which safeguards its food supplies by means of deadly poisons — and, one might add, its energy by methods involving an ever-increasing output of radioactive wastes — carries the seeds of its own speedy destruction.

Sense and Nonsense at the Zoo

The idea that zoos have a vital role as "Noah's arks" in which species extinct in the wild can be perpetuated, with a view to eventual reintroduction into their natural habitats, is a commonplace of modern conservationist thinking. Unfortunately, the process is nowhere near as simple as it seems. Some of the problems involved had an airing at the recent World Conference on Breeding

Endangered Species in Captivity, at the Zoological Society's headquarters in London.

changes induced by captivity: a zoo animal released in the wild may stand no more chance of survival than a civilized man marooned without possessions on a desert island. As one delegate to the Conference put it, "To breed animals in captivity is often to breed them for captivity".

The worst problems of all, however, are the genetic ones. A vertebrate breeding stock that starts with fewer than about fifty individuals runs serious risks from inbreeding, which increases the danger of epidemics, and may lead to infertility and other abnormalities. (The Hawaiian goose, one of the classic conservationist success-stories, is at present running into difficulties of this kind.) All this does not mean that efforts to breed rare animals in captivity are a waste of time: but it does suggest that conservation in the natural habitat is preferable wherever possible, and that where captivity offers the only chance of survival for a species, it is essential to have a large stock, well dispersed, with inter-zoo co-operation to avoid inbreeding.

Unfortunately, the Conference ended on an incongruous, if not farcical, note with Lord Zuckerman's closing address. To put it mildly, he seems to have



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chosen a curious venue to air a rag-bag of assorted prejudices. "Who said we have to return rare animals bred in captivity to the wilds? Let us ask how many people's lives are worth sacrificing for the preservation of a species of animal." One is tempted to reply that there are any number of people well worth sacrificing for even the most unprepossessing species: or, more seriously, that any human being who really believes that his own life is of more value than the survival of, say, the tiger or the gorilla, is a creature of such preposterous self-importance as to be unfit to survive in any case. But of course the choice Lord Zuckerman implies is an unreal one: to regard man and other animals as rivals or competitors is no longer a tenable scientific attitude, for reasons discussed by Edward Goldsmith in his editorial.

To analyse all the fallacies, in Lord Zuckerman's address would be enjoyable, but needs more space than I have available. In any case, a zoologist who can mention school meals and the conservation of rare species as equally important contenders for limited funds, deplore the recent reluctance of big chemical companies to produce new pesticides with possible harmful side-effects, and assert that the World Wildlife Fund is a "bandwagon of sentiment" and does not like zoos, does not really deserve the compliment of a reasoned reply. It is unfortunate that Lord Zuckerman's fame and official standing ensured more publicity for his worthless maunderings than was given to the serious and important contributions which had preceded them.

Nicholas Gould

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This Month's Authors

Roy A. Rappaport

is Professor of Anthropology at the University of Michigan. He is one of the principal figures in the new subject of Cultural Ecology. Author of *Pigs for Ancestors* which has now become a classic.

Randall Baker

is senior lecturer in Geography at the School of Development Studies, University of East Anglia. He is known for his in depth study of the Sahelian drought.

John Todd

is founder and Director of the New Alchemy Institute in Cape Cod which is being partially transferred to the ecologically orientated Province of Prince Edward Island in Canada.

René Dubos

One of the most prestigious figures in the Ecology Movement, he is Professor Emeritus at the Rockefeller University. His classic *Man Adapting*, published in the fifties, laid the foundations of the ecological approach to human health. Among his many publications are *So human an Animal* and *The God Within*. He is also co-author with Barbara Ward of *Only One Earth*.

Brian Morris

is a lecturer in Social Anthropology at Goldsmith's College, London University. He has published articles on a variety of subjects and a book on the Orchids of Malawi, published by the Society of Malawi. Recently engaged in anthropological research among a group of S. Indian hunter-gatherers, he is now working on a biography of Ernest Thompson Seton.

Friends of the Earth

FOOD DAY September 25th 1976

[Supported by Oxfam, Christian Aid and British Council of Churches]

Friends of the Earth, with the support of other organizations, is organising a national FOOD DAY timed to coincide with the Harvest Festival.

FOOD concerns us all. Daily we read of rising prices, global famine, health hazards, import bills and endangered environment.

FOOD DAY aims to bring together a variety of people and groups who are in one way or another involved with food. Environmentalists concerned with the strain put on our dwindling agricultural land by modern farming techniques; medical experts concerned with the implications for health of processed foods; those committed to overseas aid programmes; economists; allotment holders, co-operatives etc.

Attempts are being made to encourage the formation of local Food Day Action Committees to plan local programmes in each area.

If you can help please contact us as soon as possible.

FOOD DAY, Friends of the Earth, 9, Poland St., London W1V 3DG

I am willing to ☐ Help in ☐ a Food Day locally.
Set up

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Books

Eternal Delight

THE ENERGY QUESTION, by Gerald Foley with Charlotte Nassim. Pelican Books, 90p.

It was William Blake who said "energy is eternal delight". A writer on thermodynamics said that energy is the capacity for doing work. Einstein said it is equal to mass multiplied by the square of the velocity of light. As Gerald Foley points out, energy is all of these and many more.

How can anyone say anything new about energy? After the "energy crisis" our newspapers and magazines spawned millions of words on the subject. Indeed, there is little new that can be said, but the authors of this book have not attempted so impossible a task. They have simply drawn together many strands of argument to present a coherent picture of the whole of modern society's relationship to its energy sources, rather than just a part of it. The result is a balanced, broad view that is not concerned with the advancement of a particular industry or social group and so has a view of competing interests that is quite impartial.

The book succeeds because it does not allow itself to be drawn too quickly into arguments about fuels. It begins with a long section on energy itself, the energy that powers the major systems of the planet and the history of man's developing talent for focussing this energy to compensate for his inherent physical weakness in a strongly competitive environment. If we have strayed from the true path of ecological harmony, the authors suggest we left that path the day one of our pre-human forebears first threw a stone at an animal. They produce fascinating details to illustrate the ways in which amounts of energy available have dictated lifestyles. The narrow streets and small

buildings of a medieval city reflected the need of all services to be within walking distance of those they served. A couple of modern lorries are more effective than the entire transport system of an early city.

The discussion of fuels, which follows, lays some old ghosts. Politically and economically, the world is not a single "space-ship", so estimates of total reserves of any substance need qualifying. The USSR possesses very large coal fields, but has no obvious need to export coal, so are these reserves available to the world outside her borders? The more difficult extraction sites and technologies for many of the fuels that do exist and are counted, may prove impossible to work as the energy value of the fuel extracted comes to represent an ever smaller net profit when compared to the energy cost of extraction. There are other contrasts as well. Would the British permit the strip mining of, say, Bodmin Moor in order to obtain the uranium its rocks contain? Nuclear power seems to offer no solutions for even if its serious drawbacks — mainly of safety — could be overcome, it can produce only electricity, and only base-load electricity at that, for the output of nuclear power stations is so large that they cannot be turned off and on without disrupting the entire supply system. What is needed is either a flexible system for supplying peak demands or a system of storing energy or, ideally, both. Solar power offers little more, except locally in hot climates, for much the same reason. It supplies heat when heat is least wanted.

At times I wonder whether the book is a little too pessimistic? There are people who suggest that a society capable of placing a man on the moon in ten years can achieve anything. This view is countered by those who argue that most of the problems of the real world are not susceptible to simple technological solution. Yet the supply of energy can be conceived in purely technological terms and I would not underrate the possibility that a sudden advance may be made in, say, wave power systems or energy storage. Other developments, such as fusion power, are less likely; they have advanced far enough for us to be able to see the difficulties they entail.

The final part of the book surveys futures. It explains the ways forecasts are made and energy budgets calculated. Inevitably, the authors conclude that we must plan for

scarcity. "This approach is essentially much more sceptical than that usually taken by those who produce energy forecasts," they say. "It does not allow itself to be persuaded into believing that because industrial society would be in trouble without a steady increase in energy supplies, such an increase must occur. Neither does it allow itself to be seduced into accepting the argument that, because something is theoretically possible in an ideal world, it will actually happen in the real one." This is not pessimism, just good accounting. The consequences of over-estimating resources are more serious than those of under-estimating them.

This is a good book. Its arguments are always precise and supported by as much data as are necessary but no more. Technical terms are used, but explained carefully, so that the information they convey is available to the non-expert. The result is compelling reading. I hope the book is circulating inside the Department of Energy, where the policies are devised. I think it can help.

Michael Allaby

THE POWER THAT CORRUPTS

The threat of nuclear power promotion in Ireland

by

ROBERT E. BLACKITH.
D.Sc., F.I.S.

This is not a technical book about nuclear power, but a study of decision-making in the energy field. It contains translated excerpts from important French documents released during the past year, particularly by the Electrical Trade Unions, and scientists. Though oriented towards Ireland's problems, North and South, the book has a much wider scope.

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Our Unequal Brothers

ANIMAL LIBERATION by Peter Singer. Cape £4.95.

Suspecting an unrealistic waffle about the rights of pussies and budgies, some may be less happy with the title than with the subtitle of this book. In fact, the keynotes of Peter Singer's *New Ethics for our Treatment of Animals* are realism and commonsense. Its author, a young Melbourne don and a distinguished lecturer in Oxford and the USA, has written an impressively factual and challenging study of man's relationship with other species, confining the bulk of his attention to medical and industrial research, the use of animals for food with particular reference to life on the (factory) farm.

The facts of animal research are well known to readers of such books as those of the late John Vyvyan, or Richard Ryder's recent *Victims of Science*, but this latest presentation is by no means an exercise in mere repetition. Singer cites ample new horrors for those needing such stimulus, but perhaps his most disturbing emphasis is on the sheer triviality and pointlessness of a

huge proportion of experiments. In Britain alone over five million are performed annually, while globally a vastly greater number is inflicted for purposes ranging from the indefensibly repetitive to the empirically sensational. Routine academic experiments and tests for frivolous industrial products would seem to comprise the core of day-to-day research. As Szent-Gyorgi has said:

The desire to alleviate suffering is of small value in research — such a person should be advised to work for a charity. Research wants egotists, damn egotists, who seek their own pleasure and satisfaction, but find it in solving the puzzles of nature.

Whatever research may want, it would seem to have got a minority whose motivation is the relief of mankind's ills.

So Singer gives the facts, and the facts are deeply disturbing. But his strength is that he does not take an absolutist, emotional or sentimental stance. The depth of his thinking is equalled only by the placing of his priorities, the logic of his reasoning, and the clarity of his expression. This objective excellence is applied no less to animal research than to the field I suggest is long overdue for nomination as *dietethics*.

Dietethics is a subject no longer confined to the degree of suffering we are prepared to inflict on animals so that we may eat their bodies. Evidence of the inextricable entwining of our own interests and future with those of other species increases daily. The linchpin of ecological understanding is the interdependence of all species, and with it has come and is growing, particularly among younger people, a deep unease about the extent to which scientific and commercial motivation is prepared to bolster habit and pursue facts — often long-established facts — as ends in themselves.

Although *Animal Liberation* is a deeply moral book, it is far from being so in any narrow sectarian sense. It propounds an intensely relevant morality for our times, born of deep understanding of truths lying like trace-elements below the roots of a maturing humanism that marks the growing concern of more enlightened observers of our day.

It is the last two chapters of his book that present the most challenging and original aspects of his case. Borrowing Ryder's rather cumbersome term "speciesism", he argues that religious and scientific orthodoxy have established so deep a

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sense of man's inalienable dominion over other creatures that we are prepared even today to inflict upon them virtually any degree of suffering in our determination to allow no restriction on our pleasures and habits, however trivial or at variance with other accepted ethical standards. This attitude, he argues, linked with such other forms of prejudice as racism and sexism, is indistinguishable from our treatment of blacks, "gooks", mental defectives, women, social "inferiors" and all those other categories of our own kind who have suffered from their positions in the lower echelons of the pecking order.

So the essence of Singer's argument is his claim that "to discriminate against beings solely on account of their species is a form of prejudice, immoral and indefensible in the same way that discrimination on the basis of race is immoral and indefensible." I believe he makes out his case with total success and with strict regard for fact over sentiment, for sense rather than wishful thinking. His book deserves close study by all concerned not only with environmental priorities and consistent application of ecological knowledge, but with the quality of thought needed to build an effective and realistic educational structure for an endangered future.

Jon Wynne-Tyson

On Airs, Waters and Places

MAN, ENVIRONMENT AND DISEASE IN BRITAIN, A Medical Geography Through the Ages, by G. Melvyn Howe. Pelican Books, £1.25.

Professor Howe begins his book, appropriately, with a quotation from Hippocrates, who advises medical practitioners to begin their diagnosis of the complaints brought to them by examining the environment in which their patient lives and the length of time he or she has lived there. It was obvious to Hippocrates and it is still obvious, to all except the architects of our National Health Service, that illness is likely to be related closely to lifestyles and environmental conditions. This being so it is not surprising to find that diseases follow patterns of geographical distribution, or that as our way of life has changed through the ages, so each age has had its own characteristic diseases. Today it is the degenerative diseases that kill us. At one time it was smallpox. Earlier still it was the plague, more usually called "the pestilence".

It is likely that a genetic component exists that renders some individuals more susceptible than others to particular diseases. Britain is as much the product of the mingling of immigrant communities as is the United States, but much is known about the early settlers in these islands. We know who they were, from whence they came and, more important, where they settled. Even today they can be traced, through the strongly regional distribution of blood groups.

So it becomes possible to study disease geographically and historically. The result is often surprising and often horrifying, as much for what we learn of our own attitudes to one another as for the descriptions of the illnesses themselves. Plague, for example, seldom produced any political change, for it rarely attacked the wealthy or powerful. It was a disease of poverty and squalor. Smallpox, on the other hand, almost killed the first Queen Elizabeth and the mental state of several ageing syphilitic rulers has had political repercussions. If we fear what may happen should the majority of us believe we face imminent death — as from nuclear war, for example — then here, too, history has lessons, for the phenomenon has occurred a number of times. We may expect hysterical orgies of eating, drinking and sex, and unless they have changed their nature, the government and the wealthy minority will make for some safe, and remote, retreat, leaving the poor to fend for themselves.

Professor Howe is a medical geographer and he begins his book with a discussion of the general relationship between environment and health. He describes patterns of early settlements and then deals in more details with physical and biological environmental health hazards and with those hazards peculiar to our own times, such as

pollution, the use of food additives, and modern social stresses. Two thirds of the book is historical, though, and divided into the periods that correspond to changing conditions; pre-Norman and Norman, Medieval, Tudor, Stuart, early industrial, early and late Victorian, and modern.

We like to believe that the great killer diseases have vanished. So have some of them, but of the London smog of 1952, which killed 4,000 people in four days, Prof. Howe says: "Such mortality was as dramatic as the worst days of cholera in the nineteenth century or of plague in the fourteenth and seventeenth centuries." In 1918-19 there was a major outbreak of influenza: "... this was one of the most destructive pandemics in history and ranks with the Great Pestilence or Black Death as one of the severest holocausts of disease ever encountered." 150,000 people died in England and Wales alone. Yet the survivors forget and today we are more worried about cancer, or the state of our hearts, than about infectious diseases we believe are conquered. This could change. As Prof. Howe warns us, a serious failure of the hygiene services in a large city could bring back all the old fevers in unabated fury. The price of health is eternal vigilance.

The book is enlivened by a wealth of small detail handled confidently and with authority. The student of history will find it contains much useful background information. The medical student may learn from Prof. Howe that there is more to his craft than dispensing tranquillizers and killing microbes. The general reader will be able to evaluate the very real advances that have been made in public health. All of them will find the book stimulating and, if I dare say it of such a grim subject, entertaining.

Michael Allaby

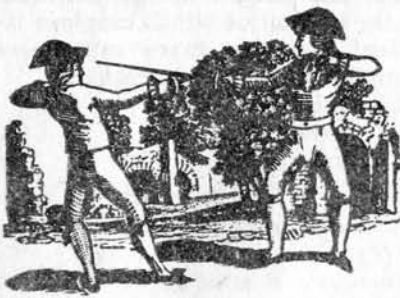
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Letters

The Old, Old Argument

Dear Sir,

I had an overwhelming sense of *déjà-vu* when I read your articles against "aid", and especially the advertisement by the Environmental Fund. This was because your arguments are exactly those which were used against taxing the rich to aid the poor in the last century. Let me quote from Alfred Marshall's evidence to the Royal Commission on the Aged Poor in 1893: my gloss in brackets will be clear enough:

"You see all these statements about wages [*income*] are repetitions of doctrines that were universal among the economists of the beginning of the [*nineteenth*] century; you have the same phrases, the same tone of thought; you can trace the economic dogmas of the Poor Law literature [*Ecologists* — at any rate on this subject] direct from those times; and the doctrines which they laid down I think were fairly true in their time. The doctrine is that if you tax the rich [*the developed countries*], and give the money to the working classes [*the underdeveloped countries*], the result is that the working classes [*the population of the underdeveloped countries*] will increase in number, and the result will be you will have lowered wages [*income*] in the next generation; and the grant [*over-seas aid*] will not have improved the position of the working classes [*as before*] on the whole."

Marshall went on to make other comments which are equally relevant to the present world situation:-

"... a change has come which separates the economics of this generation from the economics of the past; but it seems to me not to have penetrated the Poor Law [*Ecologist*] literature yet; and this is the main thing that I desire to

urge. That change insists upon the fact that if the money [*aid*] is so spent as to increase the earning power of the next generation it may not lower wages [*income*]. For while on the one hand the tax on capital would tend continually to cause a shrinking of capital, possibly some emigration of capital, and also some possible emigration of business men — while there would be that force continually at work tending to lower wages — there would be brought into action another force tending to raise wages; and it is reasonable to hope that instead of a mere reckless increase of population, which would have been the inevitable consequence early in the century there would be a rise in the standard of living, and wages would rise." (*Official papers*, p.225).

Yet it is exactly this nineteenth century argument against giving money to the poor, from taxes on the rich, on the ground that there will merely be more mouths to feed or some emotional expression, that is used in your columns to justify such a signatory of the Environmental Fund statement as the late Paul Getty. The crucial point that Marshall made is that the poor need to have facilities to produce the goods they need. From this point of view, of course, there have been excellent articles in *The Ecologist* on intermediate technology.

Yours faithfully,

John Gillard Watson,

Institute of Economics and Statistics, Oxford.

Beware of the Motive

Dear Sir,

I strongly disagree with Victor Gordon — *The Ecologist* Vol. 6, No. 4, p.123-4 — who contends that all aid should be stopped as soon as possible because, for instance, the world's long term food prospects would be improved by allowing a few millions to die from starvation now. I do not think the solution to the world's ills is made easier by lowering man to the level of animals.

Aid is a transaction between humans; and the only ethically satisfactory basis of aid (of any kind) is that one person's need is perceived by another who wishes to alleviate it. From this, three further points arise.

1. Aid must be for the recipient's benefit, not the donor's. The donor must not seek prestige, or profit, or gratitude for himself.

2. Aid must be given willingly

and openly, not grudgingly. The state of the giver's heart is more important than the size of his gift.

3. Aid must be designed to alleviate the recipient's real needs. Thus the needs must be fully understood, and this may also mean careful consideration of such factors as the form and timing of aid.

Aid cannot be said to be wrong in itself, morally it is one of the higher actions of mankind. Nor can it by any means be claimed that all overseas aid has been harmful. Such a conclusion is contrary to the testimony of countless workers who deal with the needy directly, though doubtless there are many instances where aid has gone wrong.

However, I suggest that the remedy for mistakes is not giving up but learning to do better. Perhaps we should begin by examining our own motives and really studying the needs of those we want to help.

Yours faithfully,

Roy Lorrain-Smith,

University of Bradford, West Yorks.

Patronising the Poor

Dear Sir,

I read Victor Gordon's Comment Aid — the Arch Enemy (*The Ecologist*, May 1976) with great interest, and congratulate you on having the courage to publish this piece. No doubt you will receive a lot of protest, but it seems clear to me that such a logical and dispassionate statement of an unpalatable truth is overdue.

Mr. Gordon writes "*Aid implies and subsumes the inferiority of the aided*". I would like to see that statement pinned on the wall wherever western men gather together to raise funds for the Third World.

Yours faithfully,

M. H. Napier-Clavering,

Sixpenny Handley,

Dorset.

A Trashy Piece

Dear Sir,

Generally, I am impressed with the very high standard of articles in your publication. I must take exception, however, to one recent paper. I refer to a trashy piece by Ms. Hazel Henderson, entitled 'The End of Economics'. The author apparently had no knowledge whatsoever of her subject matter. To offer a detailed critique, I would have to write an even longer paper than 'The End of Economics'. I therefore confine myself to a list of the most obvious criticisms.

1. Ms. Henderson confuses economic *theory* with economic *policy*. Her argument was that recent economic policies were largely responsible for our present predicament, and she used this as a stick to beat the economics profession. This is unjustified. Policies are decided by politicians, who always try to gain short-term advantage to get votes.
2. Politicians normally do have 'economic advisers' but it would be wrong to conclude from this that the peculiar economic policies which are implemented are originated by economists. There are three reasons why this is not so:
 - (a) 'economic advisers' are used to swell the entourage, and hence the prestige of holders of political office: their advisory function is often subordinate.
 - (b) politicians rarely listen to their economic advisers.
 - (c) even when the economists are asked for advice, the request is incorrectly formulated, e.g. the request is 'how can the long-term survival of the car industry be ensured, so that short-term redundancies are avoided', instead of the more relevant question 'How can we ensure an adequate standard of living for our citizens, and avoid short-term distress, when many of our major industries are in decline?'. The latter clearly opens the way to wider debate and a wider range of solutions than the former, but a politician would ask the first question, not the second.
3. Ms. Henderson sneers at the 'disarray' in the economics profession, and cites as evidence for the 'disarray' the fact that several economists favour economic policies different from those that national governments are currently enacting. Let me stress that these men are not lone voices crying in the wilderness: Boulding, Tinbergen, Galbraith, Davidson etc. are leaders in the profession, who are widely revered and respected, and whose views have a wide following.
4. Ms. Henderson's own policies for dealing with our predicament, to ensure a smooth transition to a better economic organisation, are a testimony to the power of economic theory. Nearly all her suggestions are based on well-established theory e.g. her suggestions for using the tax system to regulate economic

behaviour; her schemes for interfering in the allocations of credit, and for rationing by issuing coupons.

5. Point 4 above reveals that Ms. Henderson is attacking a caricature of economic theory, whose limits are actually much narrower than the boundaries of economics as it actually is. Another area which reveals this is where she attacks the profession for not being able to explain why society can 'afford' aspirin but not more police. The short answer is that society has problems in getting people to pay for more police. The police force is a public good. Once the policeman is on patrol, he is charged to protect life and property, whether or not the persons concerned have contributed to paying for the service. Hence, the incentive to make a voluntary contribution is reduced and there are obvious political barriers to higher taxes. By the way, the profession was aware of this problem, and discussed it, long before Galbraith's book was published. One comparatively modern economist who made an outstanding contribution to this debate was Paul Samuelson, whom Ms. Henderson vilifies.
6. One of Ms. Henderson's policy recommendations is more 'social ownership'. To make more effective use of our resources, more private ownership is needed, not less. This is because under social ownership, the administrator of property has no incentive to conserve the resource, or use it to the greatest advantage, whereas the private owner has.
7. Economists do not ignore external costs, and have worked for a long time on schemes to deal with them — see Edward G. Dolan 'Tanstaaf!' or G. Tullock 'Private Wants, Public Means'.
8. Ms. Henderson underestimates the power of market forces to force behavioural changes which will alleviate our predicament. For example, shortages of non-renewable resources e.g. minerals, will raise prices of goods made with these things, providing an incentive to economise on their use e.g. smaller cars, to recycle scrap (by repairing and patching up old cars, and recovering scrap) and to turn to cheaper alternatives based on more recyclable resources (bicycles, horses, walking). This will occur even when modern corporations are present.

Even though these views are my own, and should not be attributed to the institution which employs me, I feel sure that many other economists echo my sentiments.

Yours faithfully,
P. T. Wanless,
Lecturer in Economics,
University of Strathclyde.

Hazel Henderson's Reply:

My response to Mr. P.T. Wanless's comments to my article 'The End of Economics' will be brief, since most of them are highly subjective pleas on behalf of his fellow-economists for exoneration from the political consequences of economic theorizing and economic policy to which they so liberally contribute their advice.

Of course, it is possible to try and slip off the hook by specious efforts to detach economists and their theories from all those politicians Wanless sneeringly identifies as the real cause of our economic woes. It won't wash, however, since no one is forcing economists to labour as intellectual mercenaries. Offering advice is a dangerous, if lucrative and ego-gratifying profession, and part of the deal is accepting responsibility for the outcome or resigning in honest protest. Where are these economists' protests, public statements, petitions and resignations, similar to those we read about among ethically-concerned scientists and nuclear engineers?

Giving economic advice and consulting with large, powerful institutions, [they are the only ones who can afford it] is not a "value-free" activity and neither is economics a scientific discipline, as is attested by the rise of "advocacy" and "public-interest" economics and accounting. Volunteer organizations of both these professions have now joined with public interest lawyers and scientists in preparing analyses of economic issues for groups of citizens affected, who could not otherwise afford to challenge the biased cost/benefit analyses and the conventional advice prepared by economists hired by the dominant institutions in society to justify their policies.

I rest my case by quoting Kenneth Boulding, an economist both I and Wanless admire: 'I have been gradually coming under the conviction that there is no such thing as economics, there is only social science applied to economic problems'.

(As quoted in *Environmental Design Science Primer*.
Published by Earth Metabolic Design, New Haven.
Conn. July 1976.)

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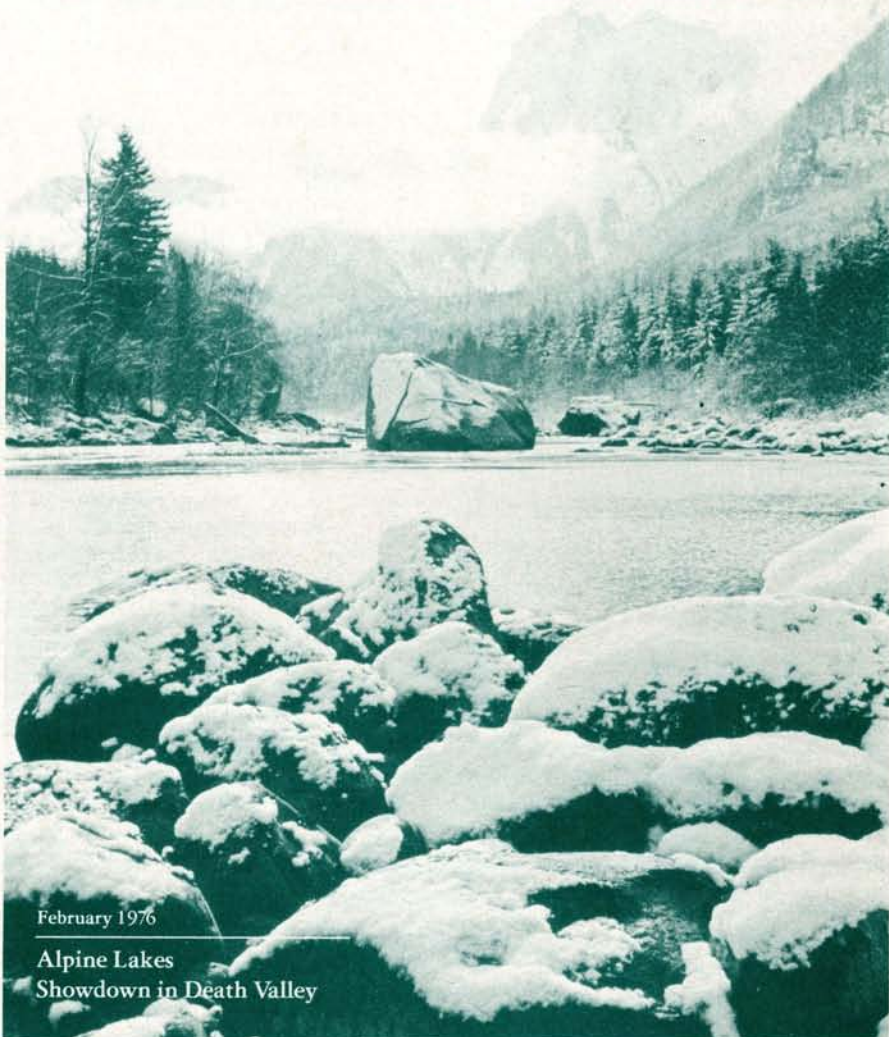
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