4s (20p)

The

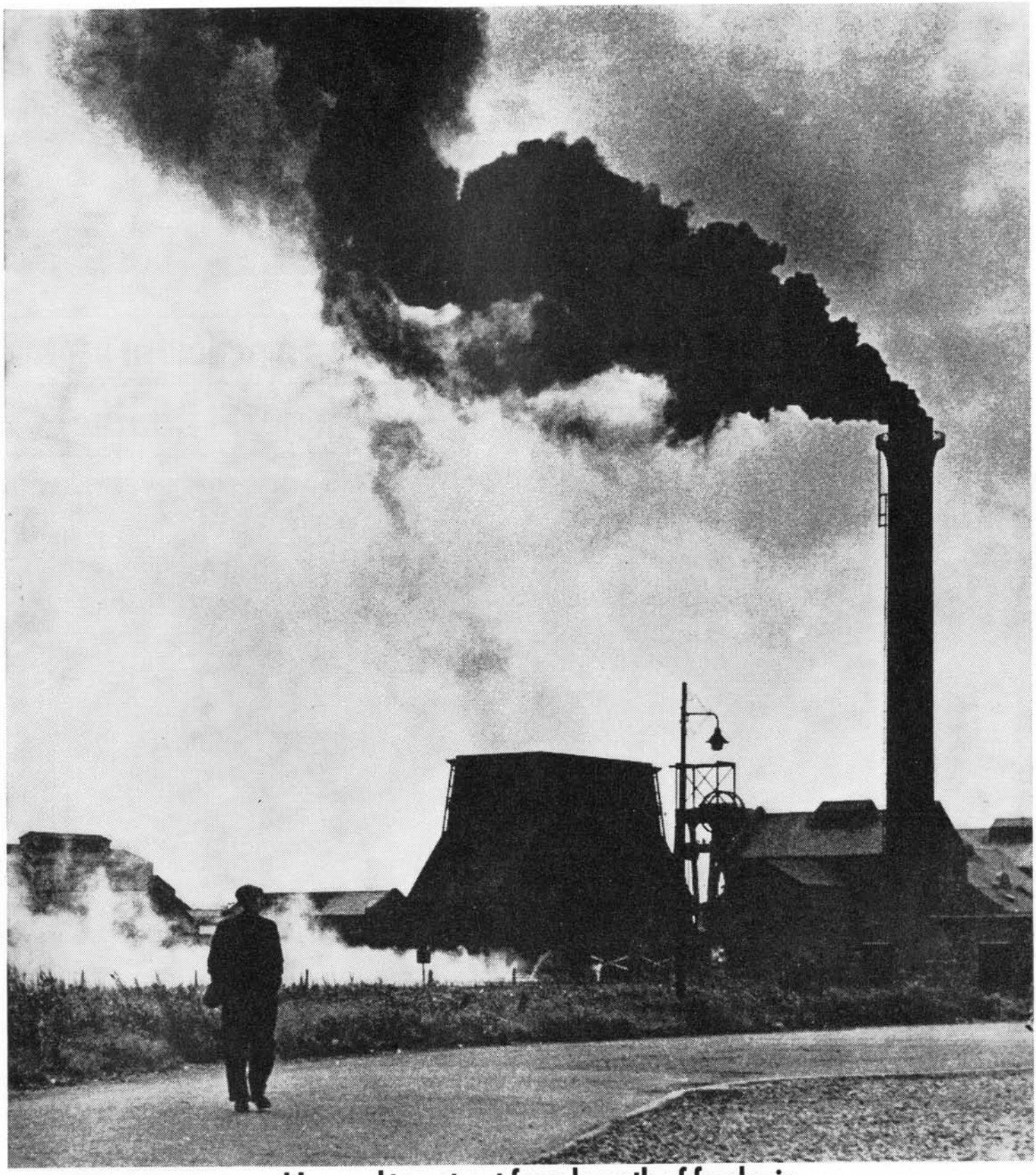
# Ecologist

Man and the environment ▪ The Quality of life ▪ Pollution ▪ Conservation

Vol. 1. N° 1 July

## Population control for Britain? · Is there a peaceful atom?

## Bringing order to chaos · Can we avoid a world famine?



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# The Ecologist




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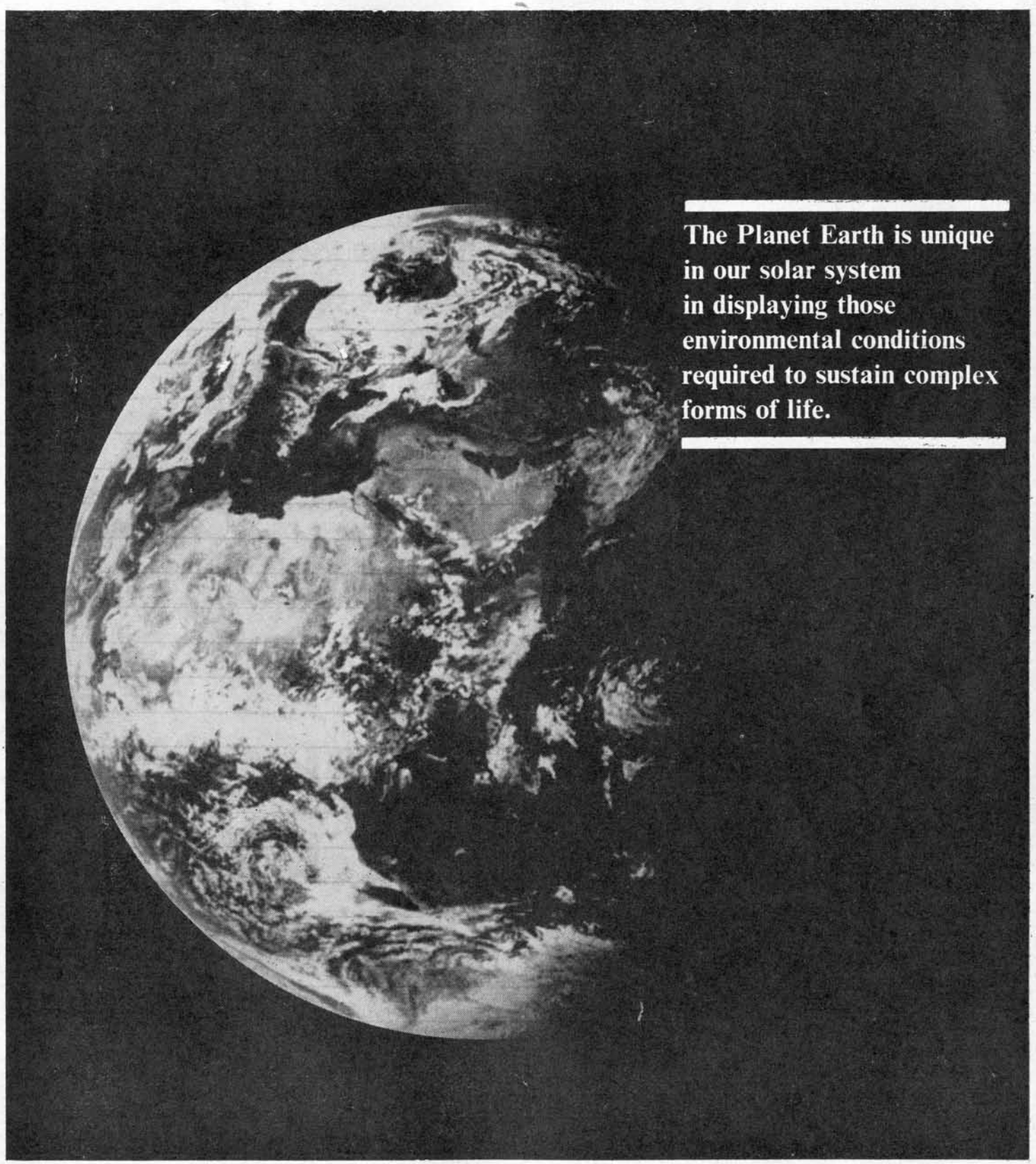
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# Editorial

The Planet Earth is unique in our solar system in displaying those environmental conditions required to sustain complex forms of life.

In what are, in evolutionary terms, very recent times, its surface or biosphere has been seriously disturbed by two events giving rise to tendencies which, if unchecked, could transform it into a lifeless waste.

The first of these events was the agricultural revolution that occurred some 10,000 years ago. Until then, man was a hunter-gatherer and the societies in which he lived were endowed with cultural controls that permitted them to fulfil their correct ecological functions within that vast integrated system that is our biosphere.

When he discovered agriculture, he possessed a means of increasing his numbers beyond ecological requirements.

He also developed new needs; and to satisfy them, he hacked down forests, extracted minerals from the earth and built great cities. Man had set out on his career as a parasite.

Fortunately, the host, our biosphere, had considerable resources. It possessed vast primaeval forests sheltering every type of bird and mammal, while its unpolluted oceans and crystal-clear rivers teemed with myriad forms of life.

Thus the parasitical activities of agricultural man caused only a localized infection which our biosphere soon learned to live with.

Meanwhile, to look at the other side of the medal, man, with his new wealth, developed a way of life that we have called civilization. It was characterized by great elegance of thought and form.

The second event that disturbed our biosphere was more serious. Man learned to harness the energy of fossil-fuels locked up within the earth's crust. He built machines driven by this energy, and industry was born.

The results were cataclysmic. The population of the world at the end of the 18th century was probably about 800 million and it had taken at least a million years to achieve. 100 years later it had risen by another 800 million. Forty years then sufficed for a further such increase, while today it will take eight years to add that many people to our congested planet.

Dr. Aubrey Manning in *No Standing Room* points to the intolerable consequences of this population explosion. That it is incompatible with the survival of civilized man is beyond doubt; that it might, if unchecked, lead to his extinction is not far-fetched.

In the meantime, more people has meant more agriculture to feed them, thereby permitting still more people requiring still more industry and in turn still more agriculture; and so the disease has spread and is still spreading, exponentially.

What, it might be asked is the pathology of this disease? In what way is our biosphere being affected?

## Waste

First of all, the disease gives rise to waste. In a balanced ecosystem, the waste products of one process serve as the raw materials for another and waste is reduced to a minimum; but when one of its parts expands beyond its optimum size, it generates more waste than the others are capable of absorbing.

In this way, the ecosystem, previously made up of finely differentiated parts, each with a specific role to fulfil, gradually accumulates random parts or waste which only serve to clutter up its delicate structure and reduce its "order" and efficiency.

We normally think of waste as things that cannot be made use of in the course of our every-day life: rubbish, in fact, that has not been collected by the dustman. However, we are reaching the point where, vis-a-vis the biosphere, we ourselves, the food we produce that will permit more of us, and the products we manufacture—motorcars, refrigerators and the like—are all waste. All have long since ceased to play any useful ecological role; all increasingly interfere with the subtle mechanisms of our ever less efficient biosphere.

## Natural resources

Waste, however, cannot be produced from nowhere. As in all processes, raw material is required. In this case it is our biosphere itself, whose essential parts are chewed up by innumerable machines and systematically transformed by innumerable machines into waste.

Until now, we have assumed that these parts, or resources, as we anthropocentrically refer to them, are limitless.

Progress, as we conceive it, to the achievement of which all our efforts are geared, demands a continually increasing standard of living, which chiefly means boosting our consumption of agricultural and industrial produce.

It is perfectly evident that such expansion is only conceivable if our stock of the requisite raw materials is also expanding. Yet we know that this is not the case.

Our planet's stock of minerals and fossil-fuels, for instance, is already sadly depleted, and it is only a question of time before it is totally exhausted.

Once this occurs, that already tottering technological superstructure — the "technosphere"— that is relentlessly swallowing up our biosphere, will collapse like a house of cards, and the

swarming human masses brought into being to sustain it, will in turn find themselves deprived of even this imperfect means of sustenance.

## Complexity

But our biosphere is being affected in yet another way. It is one of the basic principles of ecology that stability is achieved by increasing complexity, or diversity. Yet most human activities are tending towards the systematic simplification of our biosphere.

By cultivating one crop where previously there were countless varieties, we are reducing complexity and hence stability.

By cultivating a single high-yield strain of a particular crop throughout the world, we are replacing countless local strains (see *The Green Revolution: triumph or calamity?*) and thereby further reducing stability.

By destroying and absorbing countless non-industrial cultures, we are reducing cultural complexity, and thereby rendering our species that much less stable and that much more vulnerable. (See Robert Allen's *Eskimo Knell*).

By replacing subtle and highly complex natural processes such as those that normally prevent the explosion of bacterial and insect populations by crude ham-fisted technological ones such as antibiotics and pesticides, we are further simplifying our biosphere and further increasing our vulnerability.

## Social disorder

The disease is also affecting human societies. The latter, like all other systems, have an optimum structure that cannot be maintained when growth is too rapid and when they are subjected to environmental conditions to which they simply cannot adapt—and I include in this category the vast urban wastes that we refer to as our cities.

When societies cease to display their correct structure they become disorderly, and cease to act as adaptive units of behaviour. They break up into their constituent parts and their members, who cease to regard themselves as bound by any duties to a larger longer-term whole, become unhealthily preoccupied with the petty and the short-term to the detriment of the important and the long-term—a situation which can only lead to further social disintegration.

## Short-term preoccupations

To cater for these short-term requirements is the principal function of industry, whether it be organized on a capitalist basis as with us or in vast state enterprises of the Communist type.

It is thus not surprising that we should be so preoccupied with economics as to have lost the ability to take into account the host of factors equally affecting our lives which are not neatly quantifiable in the narrow, technical jargon of economists geared to the study of short-term economic currents.

This is reflected in current agricultural practice. As Professor Lindsay Robb writes in *Agriculture and Medicine—is a merger needed?*: "Almost everywhere . . . agricultural policy is based on the production of the largest quantity in the shortest time at the lowest cost and the highest cash profit. There is virtually no regard for quality, nutritive value or the future of the land."

Medicine is also concerned with the short-term. Its main preoccupation is with fighting the symptoms of disease, not the disease itself. Thus, Lindsay Robb describes our National Health Service as "a repair service for current sickness, rather than a health service".

International bodies such as FAO are equally preoccupied with the short-term. The solution to the world's long-term food problems advocated by FAO —the intensification of agriculture—is essentially a short-term one as Michael Allaby shows in: *A Jump Ahead of Malthus.*

Politics are exclusively concerned with short-term issues. In fact our government is a sort of universal nanny, showering short-term benefits of every conceivable sort on an ever more demanding and self-indulgent electorate.

Unfortunately, to take the measures required to prevent the further spread of the disease means persuading the electorate to forego some of these benefits in the interests of its future.

In fact the nanny must become a schoolmaster. But is she willing to undergo so radical a transformation? Is she in fact capable of it?

On this score, the pronouncements of our politicians are not reassuring. Mr. Crossman publicly announces that Britain can easily support 75 million people, while Mr. Wilson and Mr. Jenkins even consider this desirable as it will increase consumer demand and enable our industry to benefit from the economies of large-scale manufacturing.

Such ignorance of the long-term factors involved in determining an acceptable population for this country, and such blind preoccupation with short-term economic values on the part of those called upon to direct our destiny are truly terrifying.

Needless to say, the Strasbourg Conference, one of the highlights of the European Conservation Year, reflected an identical attitude on the part of continental governments. All took it as axiomatic that the disease would be allowed to spread unchecked. Population growth and economic expansion were regarded by all as inevitable and though many expedients were proposed for rendering the ravages of the disease that much less intolerable, that effective action might be taken to check its spread was not so much as suggested.

Unfortunately, one cannot solve long-term problems with short-term solutions. One cannot cure the disease by eradicating its symptoms. On the contrary, by rendering it more tolerable one simply contributes to its perpetuation.

As Doctor Aubrey Manning writes in *No Standing Room*: "How can the planners be so myopic as not to realize that to plan man's environment we must begin to plan the numbers of man himself?" And so too, must we plan his level of consumption, i.e. his "standard of living".

To do so requires a radical change in our way of looking at man's relationship with his environment, for it must involve taking measures that in many cases are contrary to our accepted values.

Thus, to control population we may have to interfere with "personal liberty", while to reduce economic expansion we are forced to curb "the march of 'progress' ". But surely all this is but a small price to pay if we consider the long-term alternatives to such a policy.

## A unified science

It is perhaps at the scientific level that the most basic change is required. At the moment science is divided into a host of watertight compartments, each one concerned with a specialized aspect of our biosphere. The latter, however, is not compartmentalized in this way. It is, on the contrary, a closely integrated system that came into being over thousands of millions of years, as a single process. By regarding its differ-

entiated parts as separate self-sufficient fields of study, scientists like everyone else in our society, become preoccupied with the petty and the short-term and are blind to the long-term problems that beset us.

In addition, the factors that may influence a situation whose course they wish to predict and that must therefore be taken into account if such predictions are to be at all accurate, will not be conveniently limited to one such specialized field of study.

As a result their predictions will not be sufficiently accurate to guide any major aspect of public policy.

Indeed, if the object of science is to organize information so as to make predictions, then it is clear that modern science is simply not scientific.

To adapt Clemenceau's famous formulation: "Science is too serious a matter to be left to the scientists". And this will be so until they have developed a unified science, in terms of which it will be possible to understand the interrelationship between such diverse things as societies, plants, and minerals, in the light of their specific contributions to the workings of the biosphere.

Cybernetics or General Systems provide a tool for such an undertaking (see E. Goldsmith: *Bringing Order to Chaos*) and it is up to them to make use of it.

Once this is done it is but another step for our educational apparatus to imbue people with that sense of values and to supply them with that information which will enable them to fulfil their correct functions as members of their families, communities and ecosystem.

In this way they will be able to learn to attach greater importance to the quality of life than to increasing their standard of living measured in terms of the accumulation of goods and services. Only then will man become capable of living with nature, instead of against it and thereby halt the spread of the disease with which he is afflicting the biosphere.

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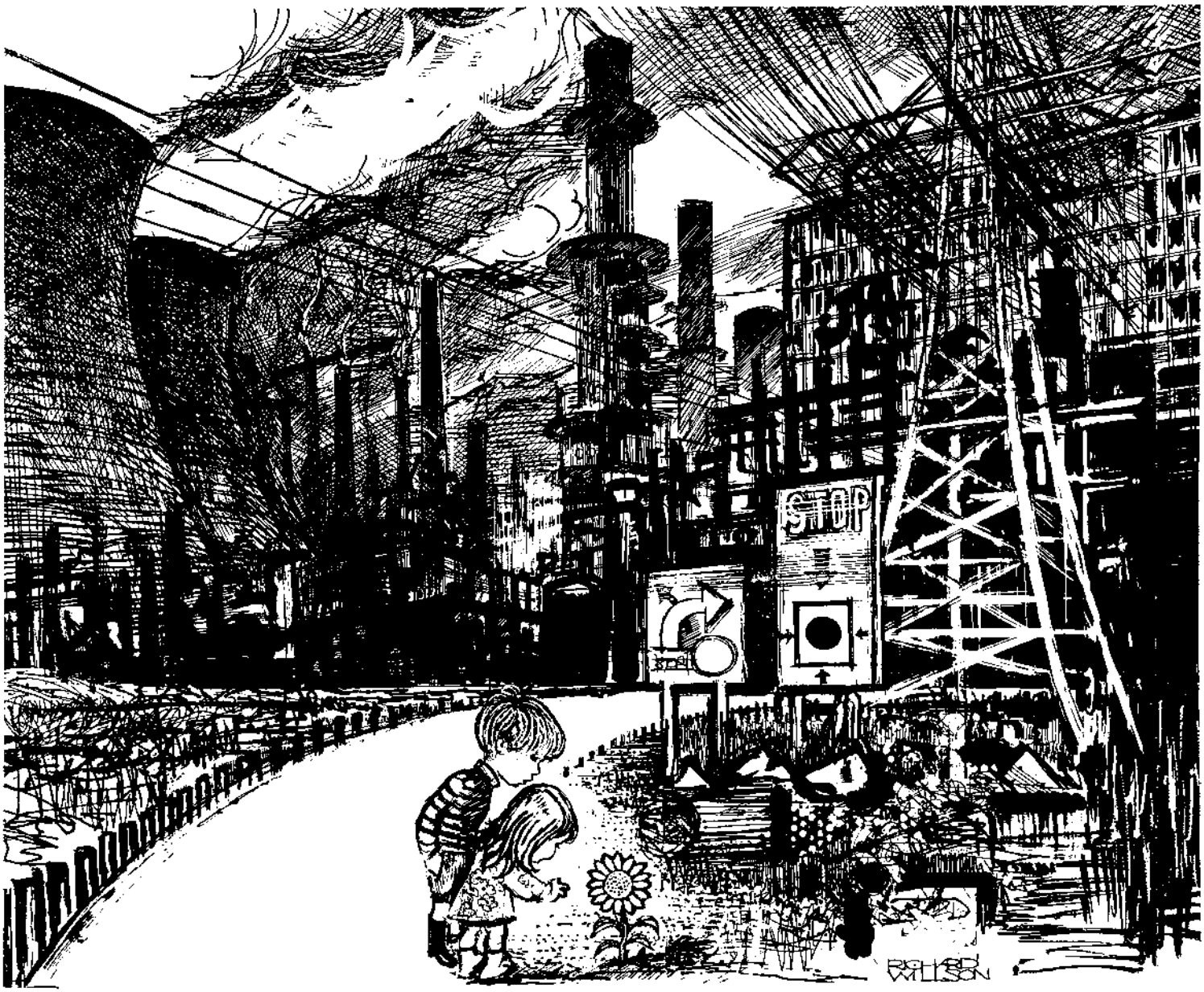
**. . . this sceptred isle, this earth of majesty . . . this other Eden, demi-paradise, this fortress built by Nature for herself . . . this precious stone set in the silver sea . . . this blessed plot, this earth, this realm, this England.**



# Coming events

**1 July 31 August**—Exhibition—"Wild Animal Species extinct in the wild but conserved in Zoos"—at Whipsnade Park Zoo, Dunstable, Bedfordshire.

**7–9 July**—International Symposium—"Scientific management of plant and animal communities for conservation"—at the University of East Anglia, Norwich. Information from: Nature Conservancy, Monks Wood Research Station, Abbots Ripton, Huntingdon.

**9–11 July**—Conference—"Decay and Renewal"—at Bretton Hall, Wakefield, Yorkshire. Information from I. K. Shaw, 8 Woodhouse Square, Leeds.

**10 July**—Conference—"Needs for and attitudes to conservation in planning of Northern Region"—at Curtis Auditorium, University of Newcastle upon Tyne. Information from Town Planning Institute, County Planning Department, Northumberland County Council, County Hall, Newcastle upon Tyne, NE11SA.

**13–16 July**—Conference—"Roads and Leisure"—at Keele University. Information from: Ministry of Transport, St. Christopher House, Southwark Street, London, S.E.1

**14–23 July**—International Conference—"Youth and Nature Conservation—at Homerton College, Cambridge. Information from: Department of Education and Science, Curzon Street House, Curzon Street, London, W.1.

**18 July**—Open day at the Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire.

**22–29 July**—One week course on Conservation. Talks, films, practical projects and experiments—The Soil Association in cooperation with the Warden, Rhyd-y-Crenan Field Centre, Betsw-y-Coed, Caernarvonshire, Wales. Charge £17 inclusive.

**25 July–8 August**—Conservation Course at the Glynllifon Agricultural Institute, Caernarvon. Charge £13 inclusive. Informations from F. David Connor, District Secretary, Workers Educational Association, 39 Bluecoat Chambers, School Lane, Liverpool L1 3bx.



## The next issue of The Ecologist, brings you:

**The sardine syndrome,** by Claire and W. M. S. Russell—crowding and social behaviour

**Bringing order to chaos** (Part 2), by Edward Goldsmith—a cybernetic approach to the study of society and the ecosystem

**The farm drugs scandal,** by Joanne Bower—antibiotics and factory farming

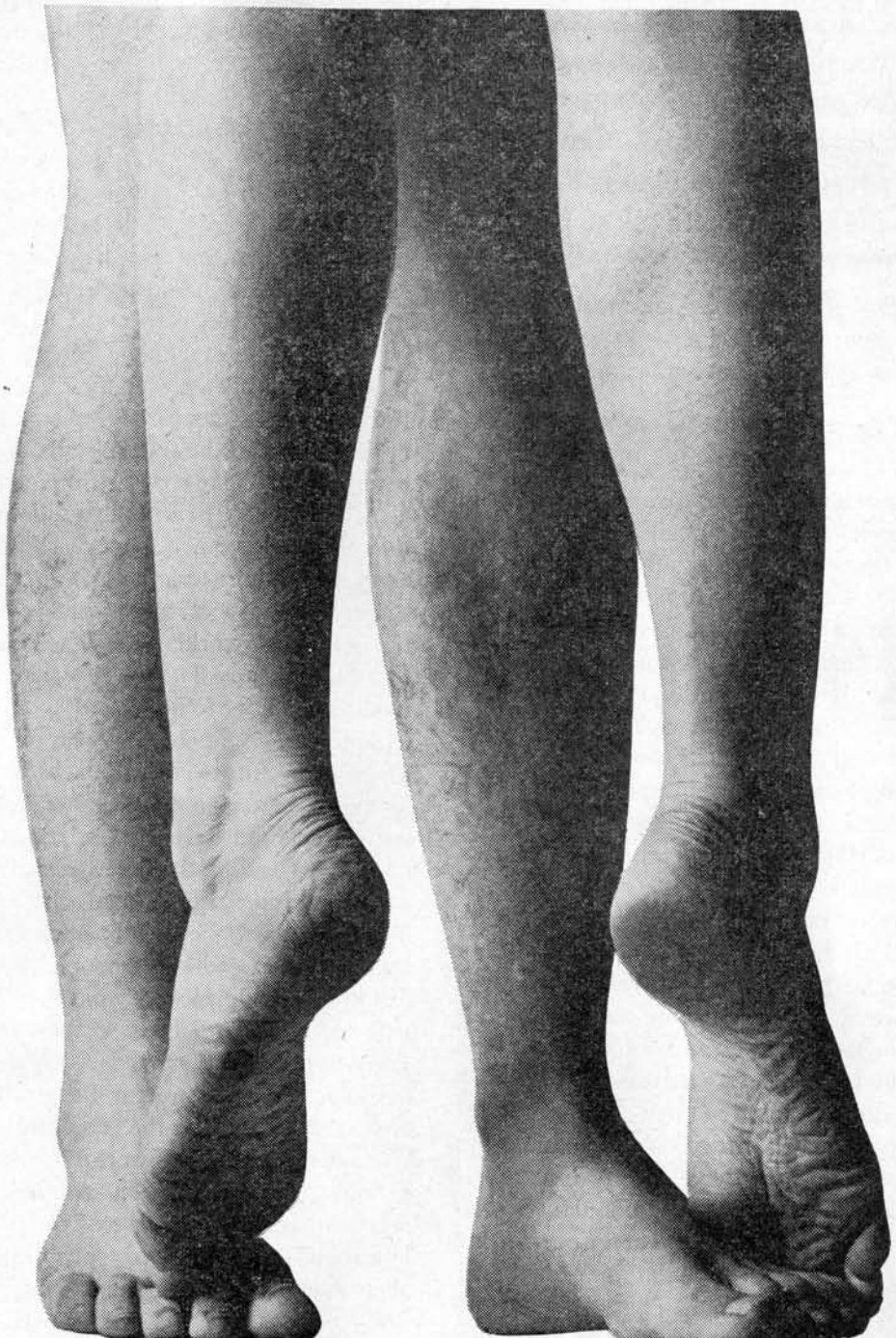
**The diseases of civilization,** by Robert Waller—the declining health of urban man

**Mined out!,** by Preston Cloud—population growth and our diminishing resources

**The last hunters of the Sahara,** by Bruce Chatwin—the Nemadi of Mauretania

# No standing room

**by Dr. Aubrey Manning**
*Reader in Zoology at the University of Edinburgh*



Of all the pollution problems facing mankind, over-population is undoubtedly the most serious. Britain, with heavy dependence on food from abroad is as vulnerable, if not more so, than any of the developing countries and in the near future it is likely to find itself in a grave plight, facing severe shortages of food, space and the general amenities of modern living.

Britain faces an immediate population problem and unless we do something rapidly to curb our growth the quality of life will plummet. We all recognize the situation in the "developing world"; we wring our hands at the tragic plight of India whose future is clouded by the desperate pressure of 12 million extra people every year, of Mauritius, now cleared of malaria, with nearly a million people crammed on to an island of 710 square miles which exports nothing but sugar. The urgent necessity to halt population increase in such situations is universally accepted yet we assume that our small islands can go on for ever keeping us, not just in the manner to which we are accustomed, but with an ever-rising standard of living.

Britain already suffers from all the pollution of affluence. Everyone expects a vast range of material things including a heated house, access to lucrative work, a hospital service, 30 gallons of clean water each day and the use of a car. These requirements make each Briton equivalent in consumer terms to at least 20 Indians living in their own country on the bare essentials of subsistence. But already we in Britain average 226 people for each square kilometre of land—1½ times more than India and 10 times more than the USA. It is only because most of us live in towns that there is any open country left and in any case we lose 50,000 acres every year to urban development.

At present our population is about 55 million and, although our birth-rate is currently falling, there is still a daily surplus of births over deaths of more than 800. Every day 800 extra Britons join us with their rights and expectations of the good life. If we are to meet these it means the equivalent of 400 new houses and a new school every day, a new hospital every month or a new city the size of Leeds *every year*.

There are no signs that these requirements can be met. At the present moment we have an enormous backlog of house, school and hospital building and clearly we cannot hope to catch up so long as our population continues to increase. No matter how well we try to plan development there can be no end to waiting lists for houses, overcrowded classrooms, congested roads and all the other drawbacks of continual growth. Further, we shall inevitably fall behind in the battle for full employment; 800 new jobs a day scarcely looks

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like a realistic achievement especially when automation is rapidly making large labour forces unnecessary.

## Quality of life

These purely practical arguments provide an urgent case for stopping the growth of our population, but there are others too—the qualitative ones. The 800 extra Britons who are born every day are not just statistics requiring processing, they are human beings with the right to some kind of fulfilment in their lives. It is a sick society that is forced to regard its new recruits as an embarrassing strain on already overtaxed resources, but this is the position to which North America and Europe must come within the next generation unless the population stabilizes.

There are many barriers which have so far prevented the advanced countries seeing ecological sense and committing themselves to a sane population policy; none of these barriers are wholly rational and all of them tend to promote the upward drift of our population. For example, we have been disastrously slow to recognize how population pressure constitutes a threat to our future; the effects of population growth are slow and insidious. Thus, although we are very good at responding to sudden disasters—an earthquake or a flood—we just don't seem to see our rivers slowly becoming fouler year by year, green fields giving way to industrial estates or cities clogged with traffic, until things become intolerable. Yet the trends were there for anyone to measure years in advance. It may be argued that people do not care, the onrush of material progress is all that they want—but in my opinion they have never had any real choice, for the issues and alternatives are not made clear.

## Industrial growth

We now face problems that are qualitatively as well as quantitatively unique—men have never had to face them before. Yet in spite of all the evidence to the contrary we still pin our hopes on more of the old solutions. Crowding, redundancy, pollution, all are supposed to yield to controlled industrial growth, gentle reflation of the economy and refinement of technological skills. We still talk of a growing Britain selling its products abroad for the food that we cannot provide for ourselves. Talk like this must have diverted the Gadarene swine on their way down the slope.

We need a complete change of thought—we must think far ahead, to the kind of world our children will have to face. Most of the warnings about our environment have come from biologists, particularly ecologists, because their special knowledge forces them away from short-term thinking to take a long-term view on the slow time-scale of the natural world. This view is hard to find outside biology, even where one would most hope to find it.

Amongst the planners who are to shape our future environment there seems to be a passive acceptance that populations must rise; indeed I get the unpleasant feeling that they regard this as an exciting professional challenge. There seems to be a tacit assumption that an area without people is by definition "undeveloped" and therefore ripe for a change. In a recent lecture Professor Colin Buchanan, describing his view of the future for Britain, lists various threats to the environment. "The first and most powerful is urbanization: the urbanization required to accommodate the increase of the population and to deal with the problems of overcrowding that already exist. No one," he says, "knows exactly what the increase of population will be, but we would be unwise to assume a figure much less than 17 or 18 million by the end of the century." His lecture contains a number of value judgements yet he makes no comment on the desirability of these extra millions.

## Need for variety

I find this particularly depressing because I totally agree with Buchanan's view of what sort of Britain we want. A country with great variety: cities, towns, villages, farmland and empty wilderness with clear-cut divisions between them, a country with many relics of the past, clear and easy to study and with rich wild-life—it would be difficult enough to get this if our population stayed constant, there is no hope if it grows much more. How can the planners be so myopic as not to realize

It is a sick society that is forced to regard its new recruits as an embarrassing strain on already overtaxed resources.

that to plan an environment for man we must begin by planning the numbers of man himself. They should learn some basic ecology to give them some idea of what it is they are handling.

## Obsession with economics

Our assumption that growth equals progress leads us to connive at rising populations. This attitude is usually conceived in economic terms. Indeed the western world has been obsessed with economics since World War II, largely because of a justified horror of high unemployment, and its economists and most of its politicians are totally committed to the idea that in a wealthy country with plenty of capital available, a rising population increases wealth through its continuous stimulation of production backed up by an increasing labour force.

Consequently the idea of continuous economic growth is deeply entrenched in our thinking. Few economists turn any attention to the economics of a static society, whose population would remain constant; rather most seem to agree that a declining population would lead to economic disaster. Presumably the most growth-obsessed economist would admit that the British Isles are incapable of holding more than a certain number of people, houses, cars, airports, oil refineries, reservoirs, industrial complexes, etc. The question is simple: we must decide when we need to take action to curb growth—we shall have to face it sometime, why not now?

## Population and influence

Apart from its presumed links with economic growth, population growth is often regarded as a good thing in itself both by politicians and society at large. Dr Gordon W. Perkin discusses how in south-east Asia many political leaders equate population size with influence. In Thailand it has been suggested that "no country of less than 50 million people ever amounted to anything". Further, in countries like Ceylon where there are ethnic divisions, the leaders of the minority group (in this case the Tamils) are reluctant to support family planning measures for fear of reducing

their relative numbers and influence. Western societies can ill afford to be condescending about such attitudes amongst the developing nations. The Gaullist party in France clearly felt that 50 million Frenchmen were not enough to lead Europe and actively encouraged large families. Extremists amongst the American Negroes regard family planning campaigns as an attempt by the white man to produce his own final solution to the Negro problem.

Thus in the face of an ecological crisis common to the whole human race we have governments using the concepts of Stone-Age power politics for boosting population growth.

## Numbers equal progress?

It is also common to find amongst the extreme left-wing in Western nations a less well-defined but nevertheless powerful barrier to rational thinking about population control. Some socialists seem to feel that if there are now 10 people where previously there were five, an advance has been made and the human race has progressed. They consider that population control is anti-people and almost fascist in its implications—after all Hitler advocated a population curb, albeit of a rather special type. It is perfectly true that anybody who advocates a population policy for Britain is soon approached by those who want to sterilize the coloured immigrants. Yet this is nothing more than the age-old custom of creating the scapegoat against which to lay the ills of society.

So it is quite obvious to me, if we are to have a future, that at every level—politicians, economists, planners and ordinary people—there must be an awareness of the terrible danger of a burgeoning population. Our attitudes towards human reproduction and the family will have to change rapidly. We will have to resist all kinds of culturally determined emotions about the desirability of having children at whatever cost. It is madness to induce multiple births by the use of fertility drugs when there are abandoned and deprived children waiting to be adopted and cared for. It is wildly unrealistic to waste a moment's attention on the pseudo-problem of test-tube babies. Why bother to produce babies this way when the normal channels provide an unremitting flood of extra people?

We must abandon the outmoded concepts that the production of a child

> How can the planners be so myopic as not to realise that to plan an environment for man we must begin by planning the numbers of man himself.

concerns only the parents. Now that children nearly all survive and now that society as a whole shares their responsibility for the education and welfare of all its members, then people who deliberately produce large families are behaving selfishly towards the rest of us.

## Accidental large families

In fact, most large families are not deliberately produced. For all our lip service to private choice for parents and the right to have the family size we want, children are conceived with a monumental irresponsibility. Most of our population growth in Britain is "accidental". Estimates vary and must remain speculative, but some gynaecologists suggest that only one half of all conceptions are planned. Now I concede that such is the attraction of children and their power to evoke parental responses that the majority of unplanned children become loved and accepted. A significant and distressing minority are not; illegitimate birth rates are rising (they constitute 10 per cent of all births in some places) and the numbers of children in care of public authorities is also increasing. If we could eliminate every unwanted birth in Britain, we could probably stop our population growth almost at once. The state of education and medical practice here is such that it would be possible to do this immediately if we only had the will to do so. The range of contraceptive methods available is good and getting better every year and abortion could be used for the occasional accident. Most would agree it is a basic right of children to be born to parents who actively welcome them. Why cannot we achieve this civilized state?

## Churchmen and doctors

The predominant attitudes of the Church and the medical profession do not help. It is truly amazing that with a few honourable exceptions (see, notably Canon Montefiore's book *The Question Mark*) Christian leaders, whose influence extends far beyond formal church membership, and who ought above all to be concerned with the quality of human life, have practically nothing to say about population control. Most of them seem more worried by the supposed threat to conventional sexual morality posed by contraception than the benefits it can mean in the reduction of births. The medical profession remains obsessed with death control which reflects, not unnaturally, the chief obsession of their patients.

This is fair enough as far as it goes, but the success of modern medicine must increasingly force doctors into making decisions about the *quality* of the life they struggle to promote and to preserve. This is difficult and often distressing for them—it is not traditionally their preserve—and the training of medical students contains nothing to equip them for such problems. Instead of sheltering behind a lot of misplaced professional ethics, the medical profession should take the lead in bringing such matters out into the open and encourage society to discuss them.

One of our most desperate problems is unwanted fertility, and I wonder how much longer doctors and their patients will tolerate the present situation in which it is possible to have a kidney transplant costing many thousands of pounds within the National Health Service, but generally impossible to be sterilized without paying a sizeable fee. Contraceptives are not provided by the Health Service and must be bought, so whilst the State subsidizes death control it penalizes those responsible people who control their fertility and thereby save the State the considerable subsidies it would hand out for a birth.

Population control is not primarily a medical matter but at the very least one might hope to hear loud and clear that doctors *are* concerned about such anomalies, and not just engaged with the ethics of test-tube babies and transplant surgery.

## Positive incentives

In my opinion the State should launch a crash programme of positive incentives to reduce the birth-rate. Since every birth costs us over £200 in direct grants and care, why not offer a similar amount or rather more as a bounty for submitting to sterilization? Or we could operate a system of annual tax-free bonuses for women of child-bearing age who do not produce a child during the year. Such positive systems would have a good psychological effect in showing that Britain is committed to population

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control. At present we simply subsidize all births.

I am certainly not in favour of reducing family allowances—there cannot be many in Britain who actually produced a child to get the extra 18s. a week, and whoever else is to blame for an unwanted birth, it isn't the child. The Child Poverty Action Group estimates that at present over three-quarters of a million children live below the poverty line. Increased family allowances, if coupled with handsome financial incentives not to produce more children than one actively desired, would be the best way to help rescue the "underprivileged and over-fertile" from the vicious circle in which they are trapped.

## Contraceptive assistance

We have a long way to go. As it is we have not even reached a position where contraception is readily available to all who need it. We require a much more advanced domiciliary service which is totally free so that advice and help can be offered in the home to people who may not have the courage to seek it for themselves. Family Planning is not enough—we need a commitment to population control involving smaller families than many would like to plan—but it is a basic essential without which no advance is possible.

At the moment most clinics are still forced to operate in a hole-in-the-corner manner. Local authorities are now empowered and instructed to spend rates on family planning clinics, but at a recent count only 39 out of 250 were doing so, and the Government is not even pressing them hard. The subject is still regarded as rather unsavoury, particularly when it is suggested that unmarried people be given contraceptive advice.

Apparently many people still feel that this is just an invitation to promiscuity and that there is nothing like the fear of pregnancy for maintaining good behaviour in the young. Though it fails to do so, the guardians of public morals never seem so concerned by the birth of an unwanted child as by its conception.

It never ceases to amaze me how little sympathy is lavished on the unwanted child, inhumanly handicapped from the outset. The Society for the Protection of the Unborn Child tries to stop abortion, but surely it must realize that its name in effect is the Society for the Propagation of Unwanted Children. Abortion poses moral questions, is unaesthetic and has a poor image. It ought not to be necessary, if people behaved responsibly with regard to contraception, but it is always better than an unwanted birth.

In spite of rearguard actions by a number of pressure groups, it seems

Family Planning is not enough—we need a commitment to population control involving smaller families than many would like to plan—but it is a basic essential without which no advance is possible.

For all our lip service to private choice for parents and the right to have the family size we want, children are conceived with a monumental irresponsibility.

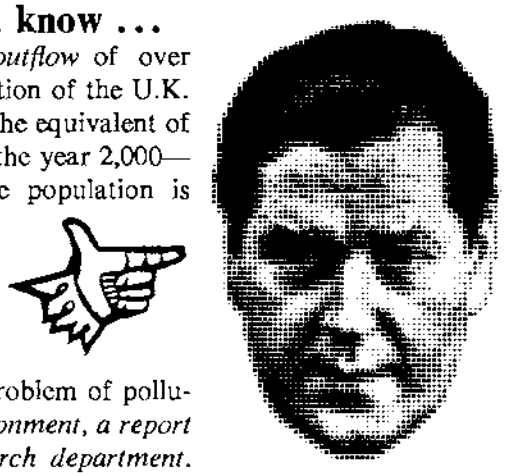
likely that contraception will become the rule, not the exception, at least for the coming generation of child-bearing age. We may shortly have effective long-action contraceptives so that instead of having to do something positive to prevent conception, the situation is reversed and one must do something positive in order to conceive. Universal sex education in schools is also coming closer and with it the possibility of introducing children to the idea of population control and the need for small families.

## A continuing campaign

Our population problem in Britain is, in one sense, simple. The adjustment we need to make to the birth-rate is very small and the physical means to attain it are readily available. It requires only the commitment, and this will come when enough people have convinced the Government that it must launch a continuing campaign for a sane population policy. Governments, now and in the past, have not hesitated to try to change population by propaganda, incentives and penalties. They have banned contraception and subsidized fertility in order to push populations upwards. We must bring them to their senses and direct their efforts towards achieving population stability. Slowly they are beginning to get the message that if they don't try persuasion now they will be forced to use compulsion before very long.

## Let not thy left hand know ...

Every year, despite a net *outflow* of over 50,000 emigrants, the population of the U.K. increases by some 250,000—the equivalent of a city the size of Bristol. By the year 2,000—a mere 30 years away—the population is likely to have grown to close on 70 million. Yet it is population growth, combined with the growth of affluence, that provides the major dynamic behind the whole problem of pollution. *Pollution and our environment, a report by the Labour Party Research department.*



## ... what thy right hand doeth

England and Wales will have an estimated population of 58 million in AD 2001, Mr Anthony Crosland, Secretary for Local Government and Regional Planning, told the committee (Commons Select Committee on Science and Technology.)

Mr Crosland said this latest figure was eight million less than the 1964 estimate. He was not convinced that there was a need for an active Government population policy.

*The Guardian, Thursday 14th May, 1970*

# Medicine and Agriculture

**by Prof. R. Lindsay Robb**
*Agricultural consultant to the Soil Association*

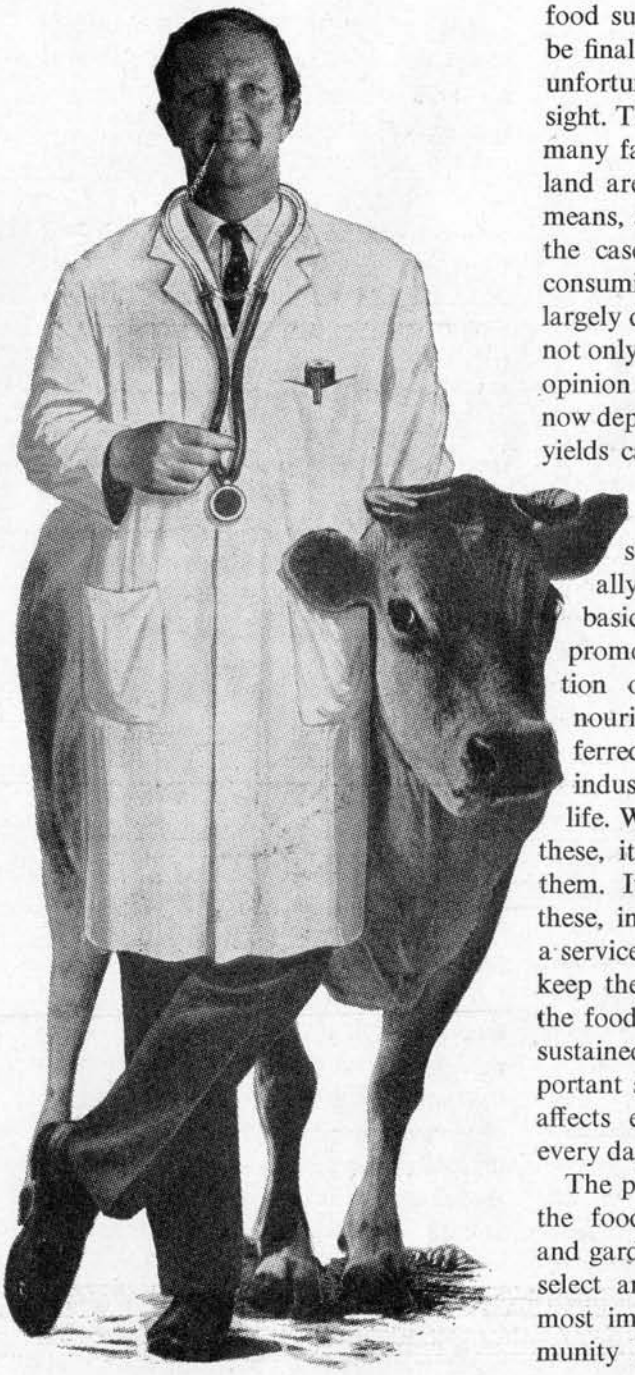
Since time immemorial there has been a close affinity between agriculture and medicine. The source of human nourishment is the soil on which the continuity of life depends: human food, in fact, is nothing more than soil fertility, synthesized by plants and animals. Throughout the ages plants have provided many of the remedies for human illnesses and accidents. Many indigenous plants, wild or cultivated, in any environment have special medicinal value for the conditions prevailing in that particular environment. On the purely human side medicine has had—and still has—a strong attraction for sons of the land, and many doctors seek retirement in agriculture.

Today it is increasingly accepted that the most important single factor in health is nutrition and that nutrition is largely dependent on good quality food of pleasing flavour. This immediately brings us into the realm of argriculture—to the chief source of food, which is the land, and incidentally the first link in the chain which connects agriculture to the world of medicine.

If food is the dominant single factor in nutrition, medicine should be deeply concerned about the types and quality and the condition in which it reaches the consumer. At present there are no indications of such concern from the medical world.

Almost everywhere in the world today, agricultural policy is based on production of largest quantity in shortest time at lowest cost and highest cash profit. There is virtually no regard for quality—nutritive value—or the future of the land. This is the result of political pressure to make agriculture more efficient in the purely economic sense. Higher and higher production is remorselessly demanded of the farmer to meet the steadily rising demands of an ever increasing population for more and more food and the annually increasing costs of its production. These demands can only be met by increasing the production from existing land and livestock or by acquiring new land. To what heights can such a policy rise, or to what depths may it descend before disaster overtakes, through lack of population control?

> "We put drugs of which we know little into bodies of which we know less, to cure diseases of which we know nothing at all."
>
> *Voltaire*



If by the aids of science and technology annual increases were limitless and so permanently assured, the problem of food supplies and world hunger would be finally solved. But these assurances, unfortunately, are not yet even within sight. There is growing evidence that on many farms further increases from the land are unobtainable through existing means, and this is more pronounced in the case of livestock, since the food-consuming capacity on which increases largely depend is definitely limited. And not only so, but many farmers are of the opinion that the increases obtained have now depressed soil fertility, since present yields can only be maintained through increased artificial aid. Since we rely on the land as the main source of food, it follows naturally that the function of agriculture, basically, is to nourish people and promote health, and that the function of the farmer is to produce nourishment. Farming is often referred to as a science, an art, an industry, a business and a way of life. While it may well embrace all of these, it is not exclusively any one of them. It is something more than all these, individually or collectively; it is a service, a service to the community to keep the national larder supplied with the food to maintain the population in sustained good health. It is the most important service in the world, because it affects every man, woman and child every day.

The people on the land who produce the food—the farmers, horticulturists and gardeners, and the housewives who select and prepare it for us—are the most important members of the community because they contribute most

Medicine should be deeply concerned about the quality of food. At present there are no indications of such concern from the medical world.

to the vital necessities of life and welfare, and they deserve to be adequately rewarded.

Since the basic function of medicine is also to promote health there should be the closest co-operation with agriculture. This seems so obvious that complete union at the highest administrative level suggests itself in a single Ministry of Health and Land Use. Some doctors contend that the basic function of medicine is care of the sick but this, surely, is an integral part of the wider function of promoting health.

There are many problems which demand joint action between agriculture and medicine for their solution. From available data we learn that there is an increase in the degenerative human diseases. There is apparently an increase among livestock, and the rapid and widespread increase in the use of toxic sprays indicates a rise in incidence of plant disease. On the evidence of soil erosion and impoverishment of land there may well be an increase in soil sickness. These are treated as separate problems under medicine, animal husbandry, agronomy and soil chemistry, whereas in fact, they are all related parts of the same ecological problem embracing the soil-plant-animal-man relationships.

It is a curious fact that the relationship between human health and soil health, between human malnutrition and soil malnutrition, is hardly recognized. In tackling these problems of illness in man or beast, a common approach is to seek specific remedies for specific diseases through drugs, injections, antibiotics and so forth, to protect crops by using specific pesticides to kill specific pests and by engineering works to save the soil from being blown or washed away.

This failure to recognize fundamental relationships, coupled with piecemeal treatment of symptoms, is likely to result in a race between the emergence of new forms of sickness and the discovery of new material to combat them. If so, man will be fighting a losing battle.

Our survival and continued existence on this planet depends not so much on the discovery of wonder drugs and pest-killing sprays as on being able to maintain a high level of soil fertility. There is no other known way of meeting the nutritional demands of the future.

It is a truth of history that no civilization has yet survived which was unable to maintain the fertility of the soil and preserve essential vegetation.

The fusion of agriculture and medicine within a single Ministry of Health and Land Use would make it possible to begin promoting health at its true foundation, which is soil. This new administration would be able to estimate, within broad limits, the nutritional needs of the population in terms of food, and how far these could be met within a farming policy based on human health and adequate safeguards for the future of the land.

This, of course, would be a complete departure from the present policy based on bulk production, speed of turnover and highest profit in terms of cash, without regard to quality or maintenance of soil fertility.

Since the new administration would be responsible for the nutritional needs of the people, their responsibilities would not end with the production of food. They would include the processing, preserving, transportation and marketing and such problems as the treatment and return to the land of sewage and town wastes which concern health and fertility.

All organizations concerned would be responsible to this administration for compliance with the regulations governing the processing, transportation and marketing of food. This would ensure that from soil and seed to supermarket the food would not only be of the highest possible nutritive value but would also be free from anything detrimental to health during production and subsequent handling. There could hardly be any higher contribution to nutrition so fundamental to health.

From all this, one could expect the emergence of a new philosophy of fitness based on promoting health from its source—the soil, with less emphasis on the more negative aspect of curing disease. It seems reasonable to assume that a rising standard of health "the faculty for mutual synthesis of organism and environment which is wholeness"* —would achieve a corresponding decline in the incidence of disease. To promote health from its source is the foundation of any health service, and the recognition that the problems of health extend far beyond the purview of the medical schools would be a major step in awareness towards a more complete understanding of their nature and implications.

Our survival depends not so much on wonder drugs and pest-killing sprays as on being able to maintain a high level of soil fertility.

Under this new regime agricultural students would receive tuition in the fundamentals of human nutrition, and the medical schools would likewise teach their students that agriculture holds the key to vital sources of nutrition and health. And the graduates from both fields would realize with a new awareness that to promote and maintain health is a joint agro-medical responsibility, with each having a vital part to play in this crucial aspect of human welfare.

Operating separately, under present conditions, neither agriculture nor medicine can make its maximum contribution to human welfare. Farmers can only survive under existing political and economic pressures by increasing output in terms of bulk. They must increase their sales of produce annually to meet the steadily rising costs of production, and since prices of their commodities are on a basis of quantity there is little or no regard for biological quality, which can be an important health factor. It is not the amount of food that matters, but the amount of nutrition in the food.

Under present conditions medicine is no less handicapped in making its full impact. It is responsible for the administration of a health service which many doctors regard as no more than a running repair service to cure recurrent sickness. They also consider that they are overburdened with non-medical duties which impair their effectiveness as doctors. Medicine at present is denied participation in one of the major aspects of health—a voice in the production and subsequent treatment of food on which nutrition so largely depends.

Unless the basic functions of agriculture and medicine are recognized as services to promote health and the shackles

removed which prevent their effective functioning, their respective contributions to human welfare will continue to be limited until they join forces and operate as a single authority.

There is a crisis in agriculture today, and there may well be one in medicine too. In agriculture there are two widely divergent views in the approach to farming. The traditional approach to farming is based on husbandry for the sustained high production of good quality crops and livestock commodities and maintenance of the land in good heart. Traditional farming, or husbandry, has its roots deep in history, with a high record of achievement based on the experience and cumulative wisdom of many years. Virtually all the British breeds of livestock were built up to a standard of excellence which made Great Britain the stud farm of the world. And this feat of applied intelligence which surely had the spark of genius, was achieved without any assistance from genetics, which contributes so much to scientific breeding today. There was apparently an awareness, too, of that fundamental truth of history, that sustained high production from the land is only possible if its use simultaneously includes adequate measures for its preservation. Traditional farming—husbandry—is imbued with the essence of permanence and continuity.

The modern approach, which is comparatively new, is based on the underlying principle of industrial development —maximum conversion of raw material into finished product in shortest time at lowest cost and highest cash profit. The modern intensive and superintensive systems of farming aim at maximum cash profit from highest quantity of produce in shortest possible time. And since profit is based on quantity, there is no incentive to consider quality or nutritive value.

But there are fundamental differences between agriculture and industry. The raw materials of industry, mainly inorganic, are not self-renewing, and each conversion depletes the stock. Substitutes, of course, may be found or produced synthetically to replace exhausted supplies. The raw material of agriculture is life. We cannot create it, and there is no substitute for it. Conserved and fostered within any biologically sound system of land use, it is perpetually self-renewing, but failure here on our part would end all hope of survival.

**Operating separately, under present conditions neither agriculture nor medicine can make maximum contribution to human welfare.**

Again, in industry, manufacturing costs can be calculated with mathematical precision. In agriculture they cannot, because production costs are affected by fluctuating factors beyond calculation or assessment. The cost of producing the same crop on the same farm by the same treatment and management may well vary from year to year and may vary on different fields on the same farm every year. There are no such things as average farms or average men, and it is well to remember that crops and animals don't live on averages.

The crisis in agriculture today is not entirely due to the conflict of views about the respective merits of traditional and modern ways of farming. It goes much deeper, and is, indeed, a conflict between two philosophies—the philosophy of husbandry based on human terms of quality and service and the modern philosophy based entirely on economic terms.

It is contended by many doctors that there is also a crisis in medicine. They are severely critical of the National Health Service which they regard as a repair service for recurrent sickness rather than a health service. In its present form, the "Health Service" does not promote health except in so far as it provides for the treatment and cure of sickness. Many National Health Service doctors complain that too much of their time is taken up with administrative non-medical duties, which reduce their time and consequent effectiveness for the purely medical services required by their patients. They are also critical of the fact that they have so many patients on their panel that they only know them through fleeting sickness visits, without sufficient opportunity to acquire knowledge of history and background.

The National Health Service, as at present constituted, cannot function according to its title because medicine has no say in the production of food—the most important aspect of nutrition on which health so much depends. Medicine is thus deprived of the means of discharging one of its own major responsibilities. This is an absurd situation which union with agriculture would immediately rectify.

And no health service can succeed without the farmer, since one of the basic needs for good health—food—is unobtainable from any other source.

It is difficult to imagine a more worthy objective in national life than to concentrate on a land policy for health now and in the future. Not only is this an enduring foundation for human welfare but also a complete safeguard for the future of the land and those who will depend on it for their daily bread.

The fusion of agriculture and medicine into the new partnership within a single ministry would herald the dawn of a new era in human welfare. The shackles would be automatically removed. Life would be seen as a whole and relationships between population and food production explored for adjustments. Farming as an essential service with adequate rewards and released from the intolerable burdens imposed by relentless political, economic and population pressures, would concentrate on a policy which not only served the highest human needs but also ensured the future of the land. And the National Health Service would become what its name implies—a service which promoted health from its source, and included all aspects which contributed to, or reacted against, man being in perfect equilibrium with his total environment.

All this is possible and practicable within the forseeable future provided population control equates numbers to be fed with the available quantity of food of required quality. A transitional period is necessary to build the bridge required for the eventual union of agriculture and medicine into a single authority. The duration of this period will depend on the vision—or lack of it—of those who are responsible for the factors which promote health or retard it. And the most powerful influence here is neither the agriculturist nor the doctor, but the housewife—that unglamorized, usually unconsidered factor, who nonetheless has the care and health of all of us in her hands.

The attainment of positive health is one of life's greatest achievements: to promote it in others is one of the greatest contributions to mankind.

* *Science, Synthesis and Sanity*, by G. Scott Williamson and Innes Pearse

Reprinted by kind permission of the editors of Guy's Hospital Gazette, 20 July, 1968.

# Down to Earth

by Lawrence D. Hills

## The Menace of the Milk Bottles

It looks very much as if we're on the way to stemming the DDT tide now that eight countries have imposed severe or total restrictions on its use. But overall it's very much like trying to stop up five holes in a bursting dyke with two hands and two feet. All we have left to manoeuvre with is a head, and if we stick that in we might drown. Still, nothing less than using our heads will do. For if DDT has retired for the moment to lick its poisoned wounds, a brother-in-law is already coming round the corner at us.

The commonest organo-chlorine compound is not now DDT even though an estimated million tons of this famous pesticide are now in permanent circulation in the soil, the sea, the air and the body fats of every living creature. It is PVC or polyvinyl chloride, a strong cheap and lasting plastic with thousands of uses, from hoses and water pipes that stretch instead of bursting when frozen, and roof gutters that need no painting, to "leather" jackets for Hell's Angels and boots for Skin Heads.

Because it is made from waste gases from oil refining, and waste chlorine from alkali manufacture, combined into what used to be called a "chlorinated hydro-carbon", there is no limit to its quantity or the new uses its cheapness makes possible. Almost every week a new product goes into a squeezeable PVC bottle or rigid container and every new fashion seems to demand more, like the high "bootleggers" that extend to a girl's knees or the gay plastic macks that shine in the rain.

The first whisper of a drawback to this wonder plastic has come from Portuguese fishermen, finding bonito and tunny killed by internal obstruction from eating expendable PVC drinking cups. Every passenger liner today carries dispensers for tea, coffee and soft drinks, like those in thousands of factories and offices, and when sixpence buys a drink the container goes over the side like scraps from the galley to be snapped up by the fish that have been following ships since the days of sail. Not even a shark's digestive juices will break down PVC.

This is only a minor but increasing hazard to the world's fisheries, like the nylon nets with hollow glass floats torn lose by gales that drift eternally catching and killing with no one but the Flying Dutchman to haul them aboard, but PVC opens up far more dangerous prospects. The poly-olefines, of which polythene is the best known, burn to carbon dioxide and water in a refuse incinerator, but when PVC burns it releases the chlorine as hydrochloric acid gas, exactly like the old Leblanc process for making caustic soda, which has been illegal in Britain ever since the 1860s.

The gas destroys vegetation, attacks metals, brick, stone and mortar, and readily dissolves in water, as on rainwet brickwork or dewdrops on hedges, to become still more corrosive and poisonous. It is a nasal irritant with a smell so penetrating that it was said in the 1840–50 period when the process was in its heyday, that when the wind was in the east, the Runcorn and Widnes factories converting Cheshire salt into alkalis for export, could be smelt in Liverpool 15 miles away.

The first Government action against Air Pollution since King John forbade the burning of coal in London because of the smoke, was the founding of the Alkali Inspectorate, now a branch of the Home Office and they still keep a careful watch on every industrial process involving chlorides. Among the caustic and washing soda manufacturers, electroplaters, metal refiners and other trades, there is a factory that burns old electric wiring and cables to recover the copper. This has shown HM Inspectors that when a ton of PVC (insulation in this case) is burnt, it releases just as much hydrochloric acid gas as making a ton of caustic soda by the forbidden Leblanc process.

The regulations insist that no factory chimney shall discharge smoke containing more than 400 parts per million of the gas, and that no employee shall work in a concentration of more than 5 ppm, for men and animals are wet inside and breathing in the gas is hazardous. These regulations do not apply to Council refuse incinerators and however new and efficient these are, they cannot transmute the elements. The chlorine is still in the PVC waiting to turn back into the gas the Victorians banned.

Even the safe limit at chimney level can come down to house heights in temperature inversions, like those responsible for the London smog of 1952 and those of Los Angeles. No Borough Engineer can know what the gas from the mounting level of PVC in the refuse is doing to the metal parts and brickwork of his incinerator built when cinders were the main burnable ingredient, or to the throats and lungs of the ratepayers, until something goes badly wrong. To pick out the PVC would be impossibly costly and it would be still more expensive to scrub the gas out of the mixed smoke to dissolve 43 per cent in water and sell as industrial hydrochloric acid in 12 ton tanker loads, as alkali factories do with the pure product.

Waiting round the corner on the road of "Progress" which 1860 had the courage to stop, is the menace of the milk bottle. The Metrification Board demands that we scrap our more than 500 million glass milk bottles and replace pints with half litres, rather less than a pint for the same money on a now well-known principle. If all these new bottles were PVC the cost would be a fraction of the 6d. each for the glass ones the public lose, smash or take out of circulation for uses ranging from cemetery vases to growing ferns inside. They would banish early morning clattering, be light enough to take 20 per cent more on the same vehicles, cut out collecting, off-loading, washing and sterilizing, and beat the blackbirds. For test marketing surveys have shown that the waxed paper cartons used for shop and machine sales are attacked by blackbirds at the sides, wasting up to half the milk, unlike the tit's modest share of cream from the tops.

These new bottles could be opaque, with the advantage that Sweden enjoyed from using brown glass bottles, of stopping the loss of Vitamin C and Riboflavin from morning sunshine as they stand on the step. Though *half litre* bottles are so much lighter that they risk blowing over, making the minimum order *one litre* would mean weight enough, and altering all the bottling machines would be repaid by the saving in distribution costs.

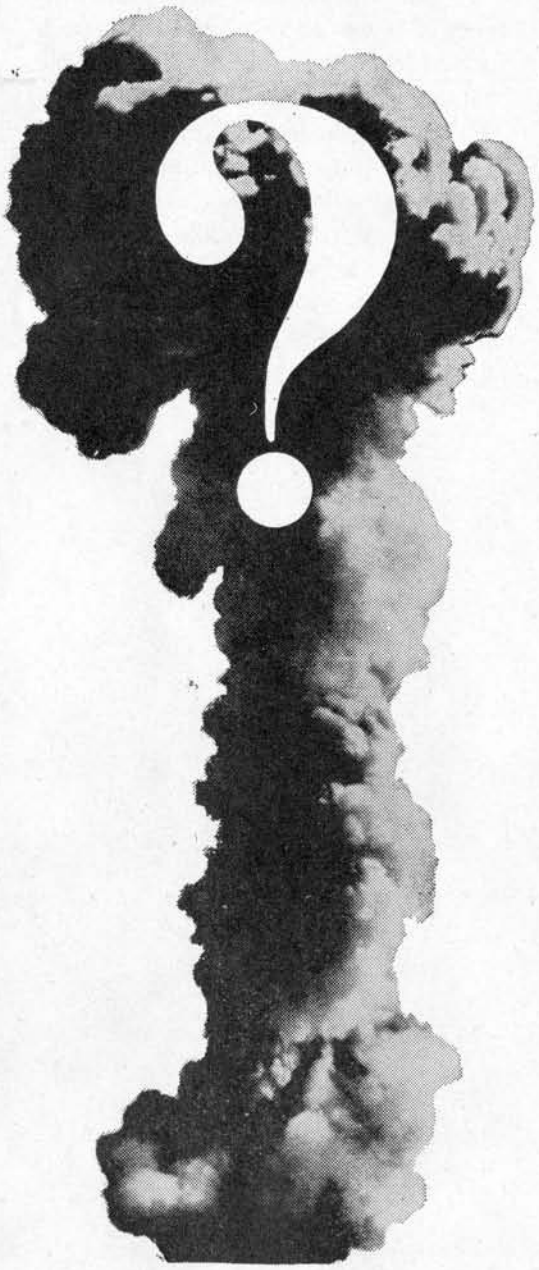
This is ideal for the plastic makers, fine for milk retailers, a saving of vitamins and noise for the customer, but chaos for the local councils. Collecting about 200 million litre bottles in the dustbins every week means many more loads per district. Moreover, the air in them

*cont. on page 48*

"Surely it is time for the nuclear industry to reflect on what sort of world they are going to leave us and our children. . . ."

# Is there a peaceful atom

**by Peter Bunyard**



Slowly, insidiously, the levels of man-made radiation will be rising over the next decades as man commits himself further to the use of nuclear energy. Some of this radiation will be discharged from nuclear reactors which are springing up one after the other in both industrial and developing nations. Some will result from fall-out of nuclear devices that have been used in grand engineering adventures such as the blasting out of new harbours and of gigantic shipping canals. The rest—outside of a nuclear war potentially the most significant—may burst upon the hapless environment through an accident. The chances are that sometime, somewhere, a nuclear reactor and its container structure will be breached by an explosion; or that a sealed tank full of seething radioactive waste to be entombed far from man's dwelling places will get ruptured. The consequences in either case could be a radioactive cloud several hundreds of times more lethal than that which settled upon Hiroshima or Nagasaki.

These predictions may sound alarmist and more than a little exaggerated. Yet we know that the nuclear reactors in existence are silently discharging small quantities of radioactive waste into the environment and are even as at Windscale in Cumberland (photo over) stepping up their effluent production by as much as a factor of four. We know that Russia and the United States are continuing with their underground tests and that the US Atomic Energy Commission (AEC) is committed to "Plowshare"—the peaceful uses of nuclear devices. And we know of some accidents that have already happened.

Windscale is one famous example where in 1957 the number one pile went "critical" and during the last-ditch attempts to suppress it, it vented more radioactive waste than had fallen on Hiroshima after the bomb. Luckily for both the nuclear power industry in Britain and for the local inhabitants around Windscale a fortuitous cloud inversion carried the radioactivity upwards into the atmosphere where it was diluted to relatively harmless levels. The United States too has suffered a lot of accidents, perhaps none so terrifying as that which happened to the Enrico Farmi breeder reactor in 1966. This reactor went so "critical" as to make the authorities fear for the safety of more than 1½ million people living in Detroit.

So far the total discharge of radioactive wastes into the environment—including the fall-out from bombs exploded in the atmosphere—does not add up to much after its dispersal, for by far the largest proportion of these man-made wastes are bottled up in "impregnable" containers. For these reasons the great majority of radiation experts feel that the small increments in radioactive levels anticipated over the next few years will be of little consequence. Indeed they point out that man is naturally subject to much higher levels of background radiation; from cosmic radiation for example and from naturally occurring radionuclides contained in the soil.

But are the experts right—can we really discount these additions to our background radiation? Several facts must be borne in mind. Firstly, the evolution of life, including man, has not taken place haphazardly; the environmental conditions at any one time and place have been critical for the type of ecosystem generated and radiation as a major cause of genetic mutations (some of them undoubtedly useful in the long run) has been one of these conditions. Increasing the levels of radiation by any degree could conceivably upset the subtle mechanisms by which life sustains itself. Secondly the fission products from nuclear plants are a million to a billion times more toxic per unit weight—in terms of visible damage—

than any other industrially known materials. Thirdly some of these fission products like plutonium 239 have very long half-lives and once formed they are going to be around for a big chunk of man's future—assuming he has one.

## Background radiation

Despite these facts the radiation experts are virtually unanimous on what they consider to be the working levels of radiation to which man can expose himself without apparent far-reaching consequences either to him or to his successors. All of mankind is therefore in the hands of these experts who through such organizations as the International Commission on Radiobiological Protection (ICRP) have established that the general population should not be exposed to more than 0.17 rem a year above natural background radiation—the rem being a measure that includes an estimate of the biological effectiveness of different types of radiation. This level of radiation, which adds up to 5 rem over 30 years, is unquestionably small and people living in Kerala, India, or in Guarapary, a Brazilian coastal town, both of which have high background radiation from high concentrations in the soil of naturally occurring radionuclides such as thorium, will be subjected to more radiation over an equivalent period of time.

Nevertheless initial studies carried

**Breach of a nuclear reactor by explosion would produce a radioactive cloud several hundreds of times more lethal than Hiroshima or Nagasaki.**

out by the AEC on the inhabitants of Guarapary show that they contain a statistically significant increase in chromosome aberrations, and many radiation biologists are now realizing that any radiation—just one single alpha particle produced by the decay of a radium atom for example—is hazardous. Indeed experiments have shown that the numbers of white cells in the body are depressed for a time and that some detectable abnormalities are caused such as two nuclei in a cell instead of the normal single nucleus.

## Radiation and cancer

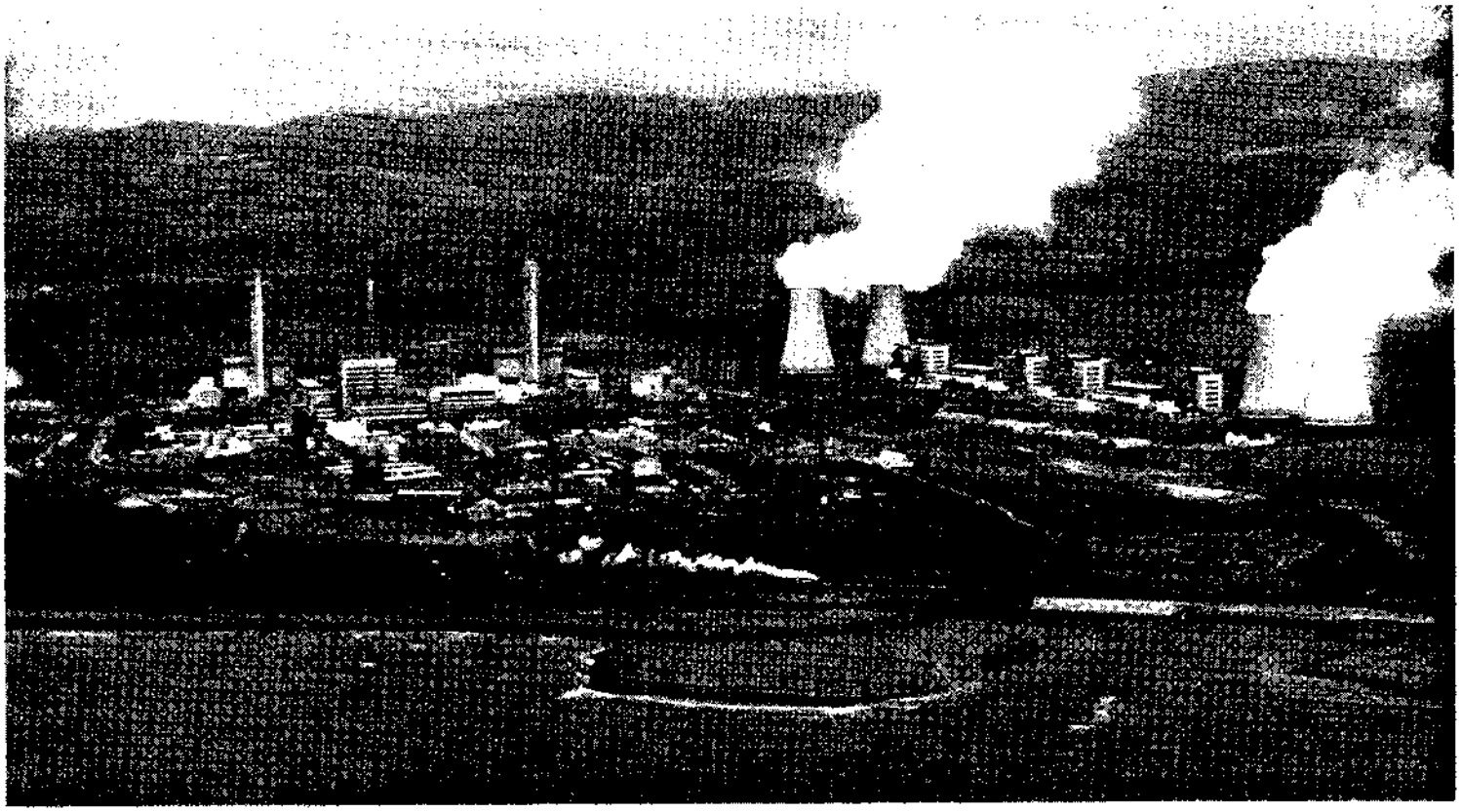
Radiation is now known to induce all types of cancer and not just certain ones such as leukaemia, and it is conceivable that given time—perhaps as much as 25 years—a cancer will originate from a very low dose of radiation. Because of this possibility two nuclear scientists from the AEC's Lawrence Radiation Laboratory in California, believe the present Federal Radiation Guide of 0.17 rem above the background to be too high by a factor of 10 at least. Dr John F. Gofman and Dr Arthur G. Tamplin have predicted that if everyone in the United States received this additional amount of radiation each year from birth, the death rate by the age of 30 would increase by 5 per cent.

Other radiation scientists feel that these two AEC scientists have exaggerated the issue. Studies of populations that have been exposed to fall-out, the survivors of Hiroshima and of Nagasaki for example, and the Marshall Islanders who were exposed to fall-out during the Pacific Tests, do not show anything like the effects, say the critics, that Gofman and Tamplin would predict from the dosages of radiation received. But we are now coming to realize that all the studies of populations that have been exposed to fall-out are inadequate on one count in particular—while focusing on the more conspicuous aspects of heavy radiation they have neglected to look at the effects of *low dose* radiation on a sufficiently large number of people.

It costs a lot of money to look for minuscule changes, and the returns after intensive work are very small. For the same reasons studies in the cloistered surroundings of the laboratory of the effects of low-dose radiation on experimental animals have also been extremely limited.

## Malformations

But there is one survey of a human



population which indicates a possible strong link between very low-dose natural radiation and congenital malformations. This survey painstakingly carried out by Dr John T. Gentry and his colleagues shows that the incidence of these malformations in New York State is significantly increased in those areas where the underlying rock formation contains high amounts of naturally occurring radionuclides such as thorium 232.

In New York State the radiation is emitted from three areas; from the igneous bedrock of the Hudson valley and Adirondack mountains; from river valleys in the Allegheny Plateau, and from recessional moraine areas with igneous or black shale bedrock left as glacial deposits as the ice sheets of prehistoric times advanced and retreated.

Dr Gentry classified any townships or cities falling within these three areas as *probable* and those falling outside as *unlikely*. He then looked at birth certificates of children born in New York State exclusive of the City in the years 1948 to 1955 for any record of congenital malformations. He also studied the death certificates of any children who had died before the age of five.

The incidence of congenital malformations in the *probable* areas was always higher than in the *unlikely* ones, and within the *probable* areas was higher in rural than in urban ones. In the same way children of fathers who had rural occupations such as farming in the *probable* areas showed a higher incidence of congenital malformations than those of fathers with jobs in the towns, whereas no such difference was apparent in the *unlikely* areas.

> Increasing the levels of radiation by any degree could conceivably upset the subtle mechanisms by which life sustains itself.

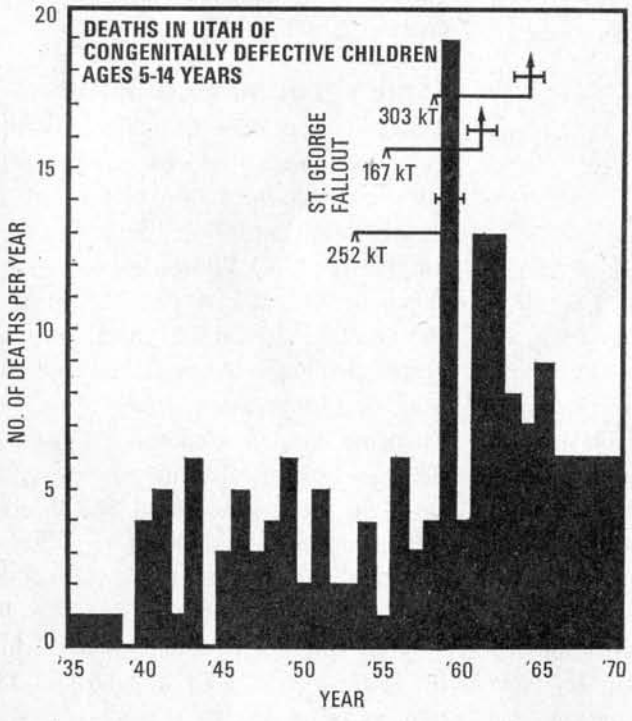
The pattern was maintained when the water supply was looked into; children of parents who used wells and springs in the *probable* areas had a higher incidence of malformations than those children of people using large surfaces of water such as rivers and lakes. In other words the closer the contact the parents had with the radioactive source the more likely were their children to be born with congenital malformations. It is difficult to explain away these results in terms of such factors as socio-economic ones or differences in medical treatment; the populations from the two areas—the *probables* and *unlikelies*—are just too comparable. Nor can altitude—bringing with it such physiological burdens as a more rarefied air and a generally more extreme climate—be the complete answer, even in the Adirondacks, which in parts exceed 3,000 ft., for much of the data was compiled for populations living nearer sea level.

## Radiation accumulation

One phenomenon, in particular, has largely been overlooked by radiation scientists; the unbelievable capacity of living organisms to concentrate certain highly diffused radionuclides. Norman Lansdell, for example, in his book *The Atom and the Energy Revolution*, reports a study of the Columbia River in the western United States in which the radioactivity is seen to accumulate progressively up the food chain in a remarkable and alarming way. The water itself contained very low concentrations of radioactive substances. But the radioactivity of the river plankton was 2,000 times greater; the radioactivity of the fish and ducks feeding on the plankton was 15,000 and 40,000 times greater respectively; the radioactivity of young swallows fed by their parents on insects caught in the river was 500,000 times greater, and the radioactivity of the egg yolks of water birds was more than a million times greater.

Man himself is very much part of the food-chain and measurements of zinc-65 in the same area around the Columbia River showed that while the water contained only twenty-five thousandths of a picocurie (a billionth of a curie) per gram of this radionuclide, an average-sized man drinking milk and eating meat from the area could contain more than 4,000 picocuries. The zinc-65 is produced in a reactor when zinc components are bombarded with neutrons

*World Medicine*




*Thames T.V.*

*Dr Robert C. Pendleton, director of the University of Utah's radiological health programme, has grown increasingly concerned at the effects of low-dose radiation from fall-out and has urged President Nixon to cancel any nuclear testing in Nevada that might result in the release of radio-active materials into the atmosphere.*

—the particles released from decaying uranium-235. But zinc-65 is just one of many radioactive substances produced during the normal running of a reactor, and some of these radio-nuclides—iodine-131 for example, are potentially more dangerous for they accumulate in specific regions of the body, like the thyroid gland.

Dr Robert Pendleton radiation biologist at the University of Utah, has reported what can happen as a result of fall-out of iodine-131, which in fact is a fast-decaying radio-isotope with a half-life of around eight days. What is particularly disturbing in this story was the Federal Radiation Council's lack of concern.

## Monitoring the Sedan shot

On July 7, 1962, the day after the 100 kiloton "Sedan Shot" had been exploded at its Nevada test site, Dr Pendleton and a group of students, were some 20 miles south east of Salt Lake City measuring the background radiation near various rock formations.

A large dust cloud appeared on the horizon: "Not," remarks Dr Pendleton "an unusual event in Utah during the summer." But when the cloud reached them the radiation level shot up to 2 milliroentgens per hour—some hundred times higher than background.

Two days later the gross activity in the air had risen to 900 picocuries per metre and eight days later samples of milk contained more than 2,000 picocuries of iodine-131 per litre. Dr Pendleton had suggested to the Utah State Department of Health that the contaminated milk be used for making cheese or be powdered or condensed so as to give the radioactive iodine time to decay and prevent the public being exposed, but his plea was rejected by the Federal Radiation Council.

During July contamination of milk samples taken from all over the State rose to a peak and then fell off. Nevertheless an individual drinking a litre a day of milk from one of the more contaminated sources could have taken in a total dose of up to 800,000 picocuries and, says Dr Pendleton: "it is evident that a considerable fraction of Utah residents exceeded the current yearly protection guide for iodine-131 of 36,500 picocuries".

## Infant thyroid sensitivity

Doctor Pendleton was particularly worried about children under two years of age because of the sensitivity of their thyroids to any irradiation. At that time there were about 53,000 children of this age group in Utah alone. If any of these got a full dose of the contaminating iodine-131 it would mean a total thyroid dose of 14 rad. The permissible dosage at the present time is reckoned at 0.6 rad in a year.

> Radiation is now known to induce all types of cancer and given time cancers may originate from very low doses of radiation.

Dr Pendleton's concern appears to have been vindicated: now—more than 20 years since bomb testing began—public health figures for the State show an increase in thyroid disease among children and young adults. Even more startling is the increase in children dying between the ages of five and 14 with congenital malformations.

Because Utah gets more than its fair share of fall-out from the Nevada bombs, whether tested in the atmosphere or underground, Dr Pendleton has suggested that the State should have been selected for studying the effects of low dose radiation. "Yet," he says, "though we pressed for large-scale studies to follow up these children only 2,000 in one place and perhaps 2,000 in another were examined. To follow up such low doses of radiation some 20,000 children at least should have been studied—but the objection was that it would cost a lot of money. In fact, for just a fraction of the cost of one of those large weapons we continually detonate we could have had some answers to essential questions about the hazards of low dose radiation."

## Ignorance of effects

Despite a fundamental lack of knowledge about the effects of low dose radiation the AEC continues to press ahead with its Plowshare Program. Already the Commission envisages using nuclear explosions to blast holes underground to stimulate natural gas production and for gigantic civil engineering projects such as boring out a sea-level canal in Central America to replace the Panama Canal.

In December 1967 the AEC launched its "Gasbuggy" experiment in New Mexico to see how much natural gas could be produced. The gas was produced all right, but according to reports, as well as being contaminated with krypton-85 and carbon-14 it was excessively contaminated with tritium. All these radionuclides are known to be taken up by biological systems. Krypton, though an inert gas, is absorbed into fatty tissue, and both carbon and hydrogen (of which tritium is an isotope) pass through all the metabolic pathways of living organisms, including those concerned with synthesis of DNA —the organisms' hereditary material.

## The Rulison Project

Yet, in the face of the unknown hazards of boosting environmental radioactivity, the AEC are still thinking of going ahead with the *Rulison Project* to create a large natural gas source under Rifle, Colorado. The AEC proposes to supply the contaminated gas, mixed with uncontaminated gas from other sources, to the public. The underground explosions may also cause groundwater to become contaminated with radioactive substances, and there is more and more documented evidence that "faults" are appearing in geological strata many miles away from the blast. One explosion for example has set up disturbances in Denver which has never before suffered an earthquake.

Dr Edward Martell, who is now with the National Centre for Atmospheric Research in Boulder, Colorado, is highly critical of the Plowshare Program and is fearful of the consequences should a sea-canal be blasted out in Central America.

## Underground explosions

Problems of fall-out aside, it is difficult, he points out, to predict with sufficient accuracy the effects of an underground explosion. "Sulky", for example, was a 0.1 kiloton explosion at a depth of 90 feet in Basalt and most of the ejecta material fell back into the crater giving rise to a small mound with a central depression. "Palanquin" on the other hand, a 4 kiloton explosion at 280 feet in hard volcanic rock, erupted through the surface and the fireball pushed up through the void.

While the refractory radionuclides were more or less contained with Sulky a large fraction of them escaped into the atmosphere with Palanquin. The experts estimate that if nuclear crater-

For just a fraction of the cost of one of those large weapons we continually detonate we could have had some of the answers to essential questions about the hazards of low dose radiation.

ing is to be effective and not too deep or shallow then up to 10 per cent of the radiation will unavoidably escape into the atmosphere.

## Nuclear blast canal

Fall-out in Central America would be particularly hazardous, says Dr Martell. The annual rainfall is high, sometimes registering 400 inches and more. The winds too are very complex; easterlies predominate between 5,000 feet and 30,000 feet, westerlies between 30,000 and 55,000 feet and easterlies again higher still. The surface winds vary in their directions.

If fission devices were used many of the radionuclides, such as strontium-90, caesium-137 and iodine-131 would be biologically active. If, however, a clean Plowshare device were used, involving 99 per cent fusion and only 1 per cent fission, the hundred-fold increase in fission products would be largely offset by massive tritium production. And the dangers of tritium for living organisms are now being realized more and more.

While the canal was blasted out and for some time afterwards local populations would have to be evacuated. Some of these would include frontier settlers and primitive Indians such as the Cuna Indians who since time immemorial have made their living there. Such a disruption of the environment would seem to be not only indefensible but unnecessary.

Dr Martell has vividly described the canal blasting. "The ejecta lip," he says, "will form a thick unsightly layer of radioactive mud and rock in a swathe several times as wide as the canal. Throwout and air blast will extend the devastation by flattening forests and structures for miles around in each direction. Seismic and acoustic waves generated by the nuclear blasts will produce unpredictable levels of damage up to distances of tens to even hundreds of miles. And there will be a serious concentration of some radionuclides in the terrestrial and marine biosphere in nearby downwind and downstream areas." That man can still propose using nuclear devices to blast obstacles out of his way seems utterly crazy. But we must not forget that nuclear reactors with none of the drama and noise of the nuclear devices are also generating unbelievable quantities of radioactive waste. The AEC estimates that by the end of the century 800,000 cubic feet of solid waste will require 700 acres of abandoned salt mines for storage. To take one radioisotope in particular—strontium-90—and make these figures more real, it is estimated that if nuclear power grows in the United States at the rate predicted there will be 6 billion curies of strontium-90 by the year 2000, and we know that a human can die from absorbing less than one curie of strontium-90.

## Strong radioactive waste

We are hearing spine-chilling tales about some of the storage problems of these radioactive wastes. For example, nine tanks have failed out of 183 tanks located in Washington, South Carolina and Idaho and the contents have had to be put into new tanks.

These failures have occurred after less than 20 years and yet the contents of the tanks are utterly lethal for thousands of years. In addition the tanks have to be kept cool otherwise they will burst from the rising temperature and pressure of the contents. Can we hope to keep these tanks safe for a millenium—and not only from our own mishandling but also from natural phenomena such as earthquakes?

Getting the radioactive wastes out of the reactors and into "safe" storage requires a number of highly complicated processes. Dr David E. Lilienthal, formerly chairman of the United States AEC and once an advocate for power from nuclear reactors, now looks upon the nuclear energy programme of the United States with alarm and dread. He has stated how "these huge quantities of radioactive wastes must somehow be removed from the reactors, must—without mishap—be put into containers that will never rupture; then these vast quantities of poisonous stuff must be moved either to a burial ground or to reprocessing and concentration plants, handled again, and disposed of, by burial or otherwise, with the risk of human error at every step."

The United States AEC has come under very sharp attack in the past year for its nuclear energy policies and various authors including Richard Curtis and Elizabeth Hogan (*The Perils of the Peaceful Atom*) have revealed all kinds of terrifying and unsavoury facts about nuclear power and reactors in the US. In Britain and Europe, on the other hand, the public has accepted the nuclear industry without much question and has little or no knowledge of the hazards of having a reactor on its doorstep, nor indeed of the hazards of radiation. In fact, Britain at the present time has a higher concentration of reactors than anywhere else in the world: by 1985 up to a third of Britain's electricity generating capacity will be nuclear, with a total capacity exceeding 100,000 MW.

## Time to reflect

Even if the safety margin is wider in Britain compared with the US (and for the sake of the British one hopes it is) there can be little doubt that if we continue to commit ourselves to nuclear energy we are going to leave our successors with some very unpleasant disposal problems, even if no major radiation accidents should occur. Surely it is now time for the nuclear industry whether in the US, Britain or wherever, to reflect again on precisely what sort of world they are going to leave us and our children?

"... a world power economy based on nuclear fission is very uncomfortable to contemplate. The problem of radioactive waste is already acute, and with increasing power it will soon be out of the question to dump waste into the sea. Besides, the life of a nuclear station is only about 25 years; after that it is so thoroughly poisoned with fission products that it has to be shut down. Nobody can be happy when thinking of a world of the future full of dead power stations, surrounded by barbed wire...."

Dennis Gabor, *Inventing the future*, p78, 1963.

# Bringing Order to Chaos

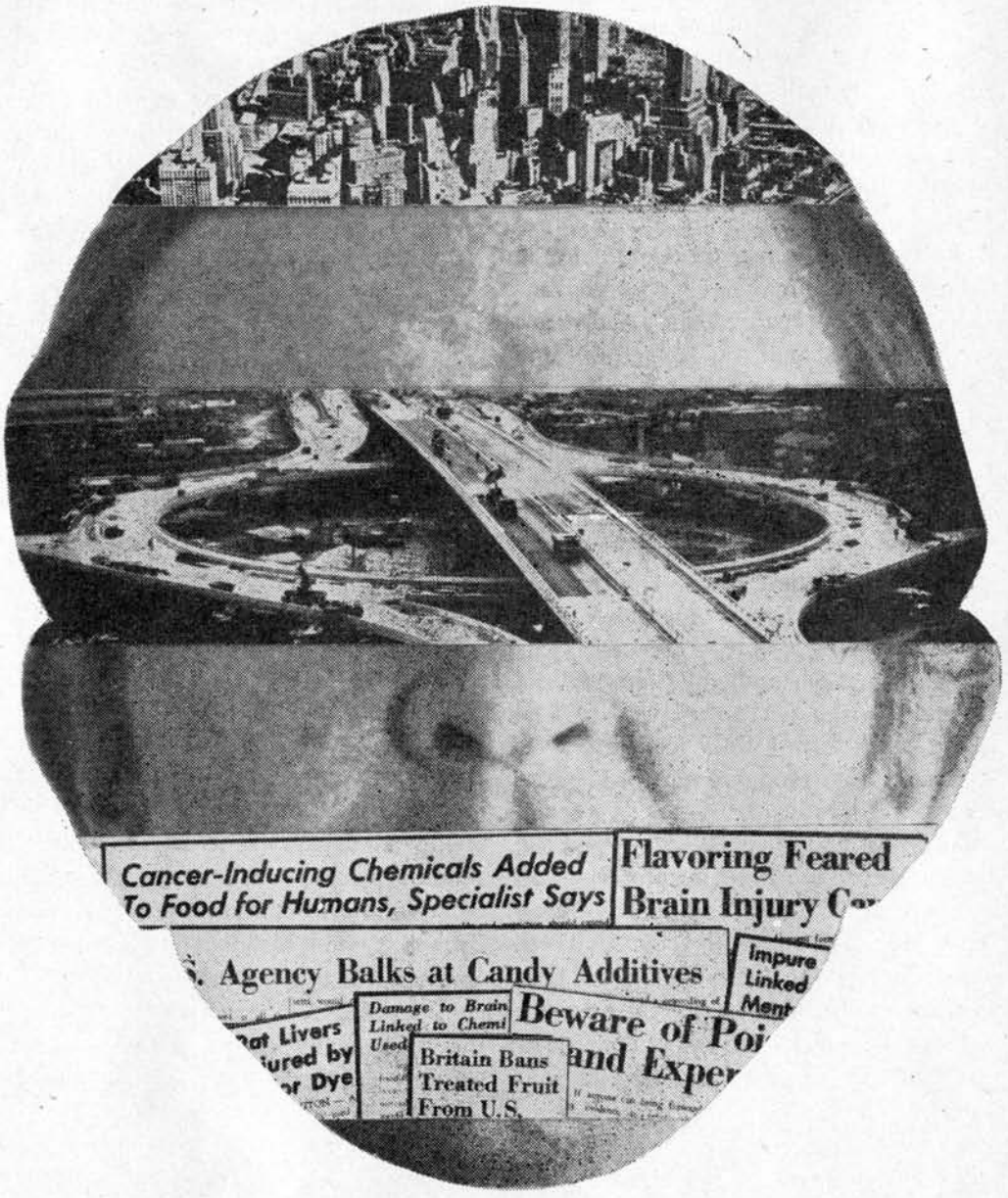
Cybernetics is the science of control. The term was first used in this sense by Norbert Weiner in 1948 and it derives from the Greek word for a helmsman. Cyberneticians assume that things which act as autonomous units of adaptive behaviour do so because they possess a control mechanism. Whether they be molecules, amoebas, human beings, machines or business enterprises, the control mechanism must have certain things in common. It is these things that are studied by cybernetics. The control mechanism, together with what it actually controls, are best regarded as constituting a system. Systems must also have certain things in common, and these are usually studied by an allied discipline called General Systems, associated with the name of Ludwig von Bertalanffy. Since a control mechanism is an integral part of a system, it is very difficult to study the one without the other. I shall therefore regard them as different aspects of the same thing, and refer to them both as cybernetics.

Cybernetics has been made use of to study all sorts of very different behavioural processes. Its best-known application is in the design of computers, but it has also been particularly useful in the field of psychology. One of the main advantages of using the cybernetic approach to study human behaviour is that it becomes possible to view it in objective and functional terms, not the usual subjective ones. Thus the process normally termed *perception* is broken up into its functional components: isolation of data relevant to the system's behaviour pattern, its transduction into the information medium of the brain, and its organization into information. Seen in this way, this process is a very different one from the *perception* of the Empiricists. Similarly, what we refer to subjectively as the *mind* can be regarded as a specialized type of control mechanism in use at the level of the individual human being. *Thinking* simply becomes the process of organizing information in the brain which, if fruitful, serves to increase its value, while the *memory* is seen as a hierarchical organization of information. There is no reason why the same method should not be applicable to the study of societies and ecosystems, and I am equally certain that this must be the most fruitful approach.

In this article, I shall examine what are the principal characteristics of systems in order to show how our view of society and of the ecosystem would be modified if they were to be studied in this light.

## Interrelationship

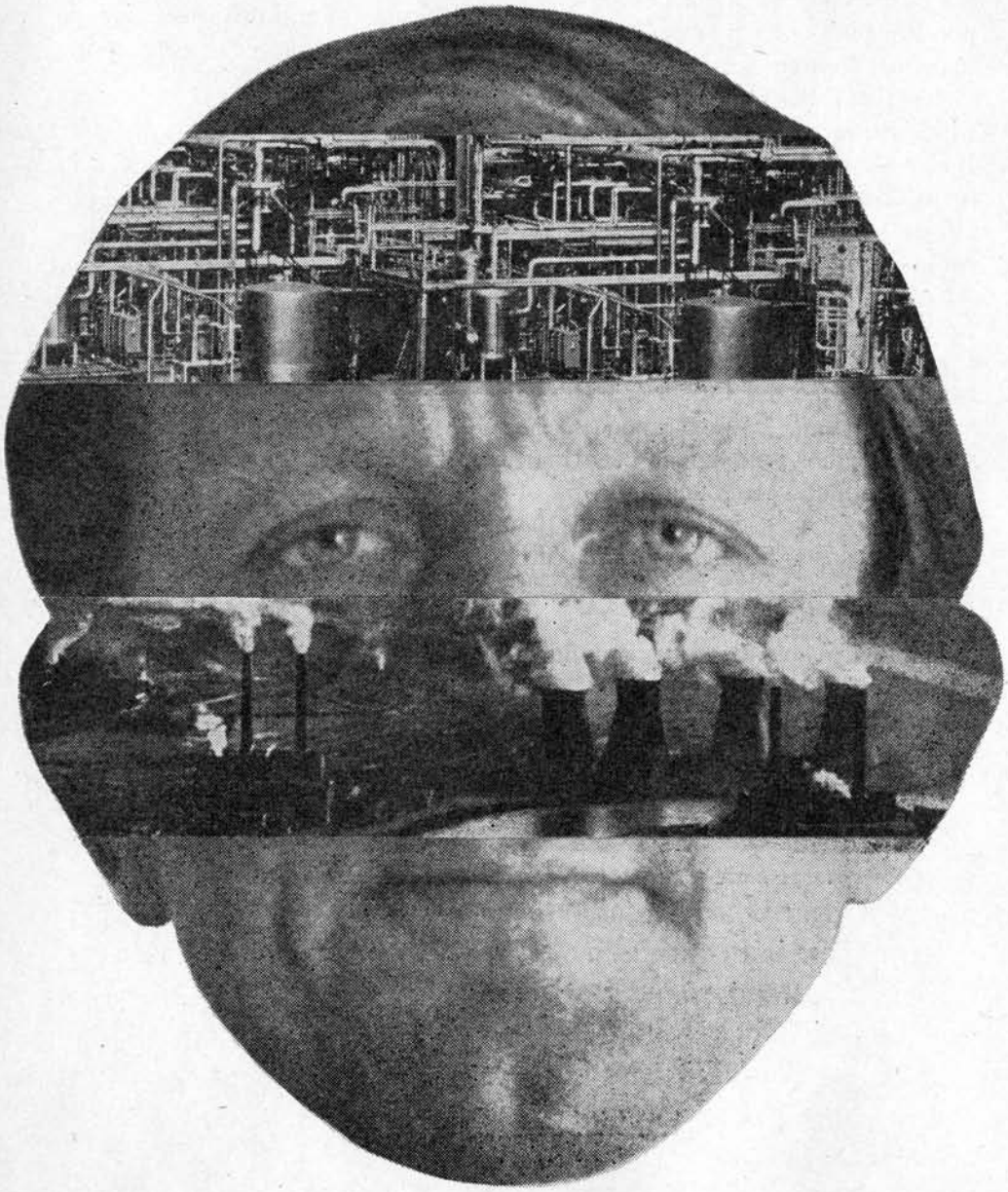
The parts of a system are all closely interrelated. We cannot alter the value of any one of them without affecting that of the others. What is important is that cause and effect relationships between any two sub-systems can therefore



never be examined in isolation, but only in terms of the system of which they are part. It must follow that to determine the effect of any local change, we must build a model of the system, which first involves carefully establishing the interrelationship between each of the variables used. We are then in a position to simulate the system by calculating the effect which the change in the value of any one of the variables will have on that of all the others, and hence on the model as a whole. We can then predict the effect of a corresponding change in any of its parts on the system as a whole. This method is known as systems analysis. It must be the only scientific method for working out cause and effect relationships in natural systems.

## Vertical structure

The concept of levels of organization, mainly made use of in biology, is applicable to all systems. Take the case of an atom. It cannot grow indefinitely. A point is reached where development is only possible by associating with other atoms, thereby forming a molecule. Similarly with a molecule. When it reaches its maximum size it must associate with others to form a cell. A biological organism is thus made up of cells, which are in turn made up of molecules, which are in turn made up of atoms, and it is not possible to move from an atom to a biological organism without passing through the intermediary stages. This is as true of societies and ecosystems as it is of biological organisms and cells. Every system must be taken as having an optimum structure, deviation from which must reduce stability, and major deviations from which can only lead to total breakdown. Thus one cannot pass from the individual to a society, nor to an ecosystem, without passing through equally essential intermediary stages, of which two are undoubtedly the family and the small community. The implications are far-reaching. For instance, growth cannot occur at a rate inconsistent with the maintenance of the correct structure. Nor can systems get too big —they all have an optimum size. This points to the fallacy of the present-day worship of size and craving for vast centralized corporations or political units.



In biology, cancer is an example of the growth of tissue that no longer displays the correct structure. In society a modern city is an equally good example.

## Horizontal structure

A system must also have an optimum horizontal structure: thus the correct ratio must be maintained between all the differentiated cells making up a biological organism; or between the different members of an ant colony; or between the different specialists—accountants, salesmen, clerks, etc.—that make up a business enterprise. If this optimum structure is not maintained there will

The parts of a system are all closely interrelated. We cannot alter the value of any one of them without affecting that of the other

be unintegrated parts that will behave in a random manner—noise or distortion in a machine—which can seriously compromise the correct functioning of the system.

## Law of the optimum value

Assuming that all the parts of the system can be quantified, we can then formulate the essential principle of all systems, which we can refer to as the law of optimum value. There must be an optimum value for every part of the system, which is determined by that of the other parts. To allow one of these values to increase without reference to the others is to destroy the essential structure of the system, and bring about its breakdown. So if we regard the United Kingdom as a system, there is an optimum population at any given moment. There is an optimum number of houses, an optimum number of cars; there is also an optimum standard of living, an optimum differential between the wages paid to different people; there is an optimum longevity and even an optimum amount of social deviation. It must follow that there is no conceivable variable whose value can be increased or decreased indefinitely without bringing about the breakdown of the system. Nothing is good or bad *per se*.

Things cannot be judged against an absolute standard of values, but by their ability to fulfil their specific function within the system of which they are part. The implications of this principle are colossal and affect practically all our most cherished values. For instance, it reveals the illusory nature of the conventionally accepted idea of progress which provides us with a justification for the havoc we are wreaking today on our environment.

## Goal

Science consists in the organization of data into information that can be made use of for making predictions. If it is possible to organize data in this way it is because the world displays order. Order is the opposite of randomness. Systems come into being and behave in an ordered way, not in a random one. This implies that they are *goal-seeking*. This principle is of the utmost importance. If one does not accept that processes are goal-seeking, one must also deny the possibility of studying them scientifically. Scientific method in such conditions would then be limited to the study of purely static things, and since these do not exist, one would be denying the possibility of science. Since a cultural pattern can only be regarded as a system, it must also be goal-seeking. The cultural traits it must follow cannot be regarded as having come into being at random. They all have precise functions within their specific cultural system, and are goal-seeking, like all other parts of a system. They can therefore be examined scientifically, in terms of measurable variables, like any other aspect of behaviour. The same is true of any of the differentiated parts of the total ecosystem. This principle is totally incompatible with the Empiricist approach and in particular with Hume's law of causality. Its methodological implications are crucial, since it allows us to deduce from the very existence of any system that it has some function to fulfil within the larger one of which it is part. It also allows us to use this information for mediating its future behaviour, and also to judge it according to how far it fulfils this function.

Such a *teleonomic* or a *posteriori* approach is in fact constantly used by scientists in the physical sciences, regardless of accepted notions of *scientific method*—but is frowned upon in the sciences dealing with human behaviour.

It is, in fact, simply another form of deduction which, as we have seen, is the correct means of acquiring information.

## Stability

Incomplete man-made systems have been created to fulfil a specific goal. Once achieved, their *raison d'être* has gone. An example is a guided missile. *Natural* or complete systems do not have a goal that can be pinpointed in space

. . . if we regard the U.K. as a system, there is an optimum population, standard of living and longevity, an optimum number of houses and cars and even an optimum amount of social deviation.

If there is a tendency for systems to become more and more complex, it is because complexity renders them more stable.

and in time. It is more like a carrot held in front of a donkey's nose, i.e., it will never be attained. It is, in fact, best described in terms of a trajectory in which disequilibria and hence corresponding corrections or rejections will be ever further reduced. In this way, the system will become more and more stable, or *homeostatic*. This can be achieved in two ways, either by modifying the environment in such a way that disequilibria will be reduced—by increasing environmental order, or else by increasing the system's ability to deal with environmental disequilibria—by increasing cybernismic order.

If one accepts that this is the goal of all systems, including societies and ecosystems, one is then in a position to make use of the deductive method in building up a science of behaviour.

## Complexity

If there is a tendency for systems to become more and more complex, it is because complexity renders them more stable. Another way of looking at complexity is in terms of variety, assuming that the variants do not occur at random, but together constitute an integrated system—though in the case of a population or *gene-pool*, the degree of integration is not very high. The greater the variety, the greater the system's ability to deal with improbable changes. Serious disruption of its basic structure also becomes less likely.

A reduction in variety, resulting in simplification, will thus lead to a reduction in stability. It is worth noting that the destruction of the numerous cultures of primitive people throughout the world, and the absorption of their cultures, has produced a radical and dangerous simplification at the cultural level of organization—reducing our stability and rendering our species vulnerable to changes or accidents that would normally affect only a small section of it. In agriculture, monoculture is a drastic simplification of plant life. Antibiotics and insecticides are drastic simplifications in that they are replacing complex controls that normally keep insects in check by indiscriminate killers.

Technological processes, when used to replace natural ones, are further simplifications. In all these cases, stability is being reduced and vulnerability increased. We are forced to accept the unpleasant fact that practically all man's efforts today are tending towards the simplification of the total ecosystem and that we are becoming ever more vulnerable to environmental changes.

## Order

Another way of increasing stability is by increasing order. This can be defined as the influence of the whole over the parts. It is also defined as limitation of choice, for the greater the influence of the whole over the parts, the greater must be the constraints imposed on them to ensure that they behave in a way that will further the interests of the whole.

Every system owes its existence to the operation of a specific set of constraints. As it increases order so as to increase its ability to face a given challenge, there is an increase in the constraints applied, and hence a reduction in the range of choices open to the parts of the system. As the system develops and achieves new levels of organization, e.g. as molecules join together to form cells, or as families join together to form small communities, and small communities to form larger ones, new constraints are imposed. Each system possesses an organization of information which we can refer to as a *cybernism* which constitutes a model of the environment and at the same time provides the system with a goal-structure and its corresponding constraints. That set of beliefs cherished by every ordered society constitutes its cybernism, in terms of which it interprets environmental data and mediates responses to them.

We can best understand such a cybernism as part of a control-mechanism that applies the constraints that will ensure that each member of the society behaves as a differentiated part of it. Once these constraints are no longer observed, the society will disintegrate.

One of the implications of this principle which we might not be too happy to accept is that permissiveness can only be regarded as another word for disorder—as the inevitable sign of social disintegration.

## Economy

Systems tend towards increasing their order so as to increase stability, or homeostasis. They will not do so indefinitely because of the law of optimum value, which will favour the optimum stability or homeostasis of the larger system of which it is part. This value will be the minimum that will enable it to fulfil this function, in accordance with the law of economy. In this way the complexity and order of a system will only increase when there is a need for it, or, in other words, systems will display the minimum complexity and order. This means that adaptive systems are as small and decentralized as possible. This is of urgent relevance to present-day society with its seemingly uncheckable tendancy towards ever greater size and centralization.

Adaptive systems are as small and as decentralized as possible. This is of urgent relevance to our society with its uncheckable tendency towards over-centralization and size.

## Differentiation

A system grows in order to become more complex, not simply in order to get bigger. In becoming more complex, it does not develop new basic goals, it simply becomes capable of satisfying pre-existing goals more satisfactorily in a way that will ensure higher homeostasis. The mechanisms ensuring the achievement of these goals become more differentiated. Feedback mechanisms ensure the development of parts of a system adapted to varied environmental requirements. When feedback development breaks down, differentiation ceases to occur. Instead, parts come into being by multiplication. The system therefore gets bigger but not more complex, and unintegrated parts come into being. These constitute surplus capacity—noise in a machine or disorder in society—which may lead to the eventual collapse of the system.

## Integrity

A system, as we have seen, has an optimum structure, no surplus capacity, and the parts are all differentiated. It is an integral whole, and the destruction of any of its parts can lead to total breakdown.

This is a point which has rarely been taken into account at a cultural level. Colonialist powers have constantly interfered in the most irresponsible way with the cultures of the societies they controlled. Missionaries and colonial administrators have tampered with the delicately adjusted cultural systems of highly stable and ecologically sound societies which they regarded as "primitive" or "barbarous" and brought about their breakdown in most instances. The consequences for the inhabitants of these societies has been disastrous. They usually become rootless members of a depressed proletariat in the shanty-towns we are thereby methodically creating. The consequences for the ecosystem as a whole have been equally disastrous. By reducing order as well as cultural variety or complexity, we have seriously reduced the stability or homeostasis of the world's human population.

*The second part of this article will appear in the next issue.*

*I find it helps to think of myself as an ECOLOGICAL EXECUTIVE*

# One jump ahead of Malthus

**by Michael Allaby**

As the world population relentlessly expands, it becomes ever more urgent to ensure adequate food supplies for the millions of extra hungry mouths. The Food and Agriculture Organisation (FAO), a specialized agency of the U.N., has published its own scheme to boost food production—the Indicative World Plan. Michael Allaby examines it here and declares it doomed to failure even before it is operational.

The trouble with Thomas Malthus is that he was right. Human populations especially disordered ones, whose cultural controls are no longer operative, tend to increase to use up available re-

Of every 100 additional people born between 1965 and 1985, 85 will live in the "poor" countries, requiring an increase in food supplies by 1985 of 80 per cent.

sources—and in fact a little beyond. At this point death from disease, starvation and war bring the population back into line. Malthus wrote in 1798. Darwin drew inspiration from him when formulating his own theories of survival.

For 150 years or so, technological innovations so increased the resources available to man that his numbers have increased dramatically, and so far mass starvation has been avoided. This has led most people to question the validity of Malthus's theories. Today, however, it is becoming increasingly clear that technology only provides a short-term means of maintaining the vast populations that it gave rise to, and it is now feeling the effects of the law of diminishing returns. Malthus's reputation has thus been fully restored and the greatest problem today facing mankind is how to redress the colossal imbalance that, had he known anything about technology, he would undoubtedly have predicted.

Unfortunately, the population explosion is not distributed evenly. In 1965 the economically developed countries of Europe, the USSR, North America and Japan had somewhat more than 1,000 million inhabitants. A further 800 million lived in the communist countries of Asia. Some 1,500 millions lived in the less developed countries. By 1985 the population of the "rich" countries will probably have increased by 25 per cent, while that of the "poor" countries will have increased by 60 per cent. Thus, of every 100 additional people born between 1965 and 1985, 85 will live in the "poor" countries. This increase in population alone would call for an increase in food supplies by 1985 of 80 per cent. Such an increase assumes, however, that *per capita* incomes will not rise in the countries concerned. If they do, as has been calculated they may, then the food demand may increase by as much as 140 per cent.

This is the world food problem and it is this that the Food and Agriculture Organisation (FAO) of the United Nations was created to solve. In August 1969, FAO published its Indicative World Plan for agricultural development (IWP). Work on the IWP began after the First World Food Congress held in 1963 as part of FAO's Freedom from Hunger campaign.

The IWP postulates a population increase of 2.6 per cent per year, which, combined with the increased income which it also assumes, would call for an annual increase in food supplies of 3.9 per cent. From 1956-66 food production rose by 2.7 per cent per year. If the difference between production and demand were to be met from imports, the cost to the developing countries would be 26,000 million dollars by 1985, and more if prices were to rise above their 1962 level. Since the countries concerned found great difficulty in meeting their 3,000 million dollar food import bill in 1962, it is not unreasonable to conclude that food production must be increased in the countries where the demand is to be met. People must be able to feed themselves.

This is only one reason for increasing the efficiency of agriculture in the developing countries. In some, frustration at the slow rise in food production has led to rapid industrialization, in an attempt to by-pass agriculture altogether in the quest for an economic "take-off". This has worked where there have been rich oil or mineral deposits, but elsewhere it has created far more problems than it has solved. Factory industry is often not labour-intensive and provides few jobs. If investment is diverted from agriculture to pay for it, there is an increase in unemployment and a consequent reduction in demand for industrial products, combined with a reduction in the rate of increase of food products. The flow of raw materials into industry slows down, exports flag, while imports rise. The balance of trade swings heavily into the red. With less money coming into the country a vicious spiral is created and the situation gets worse and worse. A sound agriculture is vital to all subsequent economic development. After all, centuries of wise and skilful husbandry preceded the Industrial Revolution in Europe and provided the economic base for it.

The need, therefore, is for agriculture to provide the additional food that will be required in the years to come, to earn and save foreign exchange, and to provide a large part of the additional employment that will be needed, while at the same time providing still more employment outside agriculture itself in the

A sound agriculture is vital to all subsequent economic development. Centuries of wise and skilful husbandry preceded the Industrial Revolution in Europe.

"agro-allied" industries.

When we talk of agriculture we are talking largely of cereal production. It is cereals that provide the staple foods and the feedstuffs for livestock. Thus, if agricultural production is to be increased the necessary first step will be an increase in cereal production. Not only are cereals of prime economic importance, they are also psychologically important. Even we, urbanized and sophisticated as we are, still call bread "the staff of life". The IWP therefore devotes a great deal of attention to ways in which cereal production may be increased.

There are two ways in which this can be done. Existing farm land may be cultivated more intensively, or new, "virgin" lands may be brought into production. The IWP opts unequivocally for the former. There is much to be done to improve standards of husbandry in existing farmed areas, and to bring new land under the plough would divert scanty investment and spread it too thinly over projects which would be expensive, slow and uncertain. In any case, the amount of new land which could be ploughed up is limited. In India much of the land available to agriculture is already in use and at the present rate of expansion into marginal land there will be no virgin land left in the world by 1985. Curiously, the intensification of existing farms would bring more employment, rather than the reverse since there is considerable under-employment in rural areas where more people live on the land than can be usefully employed on it, but are unable to leave it because of lack of alternative employment elsewhere. The intensification of farms would find work for many of them.

Although cereal production is regarded as the essential first step in overcoming the world food problem, the most serious aspect of it is what is called the protein gap. The daily requirement of protein varies from one country to another, but averages about 48.4 grams per person. At the present time this is supplied in the developing countries

mainly from vegetable sources. In India, for example, in 1963 (the IWP base year), of a total protein consumption of 50.1 grams per day, only 6.4 grams were of animal protein. In Mauritius in the same year, of a total 49.1 grams per day, 13.4 were animal protein. This pattern is general throughout the Far East, Near East and Africa. The amount of protein available remains fairly constant from year to year and therefore, although the 1963 average consumption is above the minimum requirement, production is rising more slowly than demand. The simplest first solution may be to increase the protein content of cereal crops by introducing new, high-protein varieties. An increase of a few grams in the protein content of rice would at one stroke improve considerably the protein/calorie balance and eliminate much of the protein deficiency in Asia. Other high-protein vegetable crops may also be introduced, such as soya, and then, with a secure cereal base to provide concentrate feeds, livestock may be introduced to increase the availability of animal protein.

Thus the IWP argues that the first need is to increase cereal production on existing farms. How shall that be done? The answer is deceptively simple: by the introduction of the new, "high-yielding" cereal varieties. These are a series of hybrids which are highly responsive to heavy applications of fertilizer. Extravagant claims have been made for them which the FAO deplores. They are short-stemmed, which reduces the risk of lodging (being flattened by the weather), and quick-maturing, which means that up to three crops a year may be taken from the same land. IR8, the new "miracle rice", was developed in the Philippines. Its performance varies from country to country, but the highest recorded yield, in the Quezon Province of the Philippines, was 10,000 lb per acre, as against the local varieties 1,330 lb. The recorded results are impressive and it is understandable that high hopes should be entertained for a new breed of plants which promise so much. It is even understandable that the IWP should regard them as the cornerstone of the entire plan. Unhappily, the cornerstone may be unsound and the construction may fall.

IR8 requires 70 to 90 lb of fertilizer per acre. Indeed, the IWP defines the high-yielding variaties as those which can give a linear response up to at least 90 lb per acre. If two crops are to be grown in a year this means 140 to 180 lb per acre, for three crops, which is considered possible for this variety, 210 to 270 lb. In 1962 the fertilizer consumption in Latin America averaged 10.6 lb per acre (12 kg/ha) and this figure was higher than that for Africa south of the Sahara, the Near East, N.W. Africa or the Far East. If the new varieties are to succeed we will have to find ways of increasing fertilizer availability throughout the entire developing world so that each farmer has access to up to 27 times the fertilizer he uses at present. Where is this fertilizer to come from and how will it be paid for? Domestic production of fertilizers is growing impressively says the IWP, so that by 1966 the developing countries were producing 50 per cent of their requirements. This is nothing like enough. So, the first likelihood is that there will be a major fertilizer shortage.

> It seems a little unfair to launch the developing countries on an industrial and technological path based on a commodity which we know to be running out.

Let us assume, however, that the fertilizer becomes available. The effectiveness of fertilizers depends on the structure of the soil on which they are used. Many, though not all, of the soils we are considering are badly depleted and seriously eroded. This is particularly true in India and in parts of Africa. Experience in the developed countries which use large quantities of fertilizers has shown that much of the fertilizer applied to a soil with a poor structure drains away. It ends in the local water supply usually, where it causes eutrophication problems, that is, excessive nutrients cause a proliferation of algae which when they putrify, de-oxygenate the water, killing fish and, eventually, rendering the water unusable. At the same time there is some evidence that even given a good soil with a sound structure, repeated application of heavy fertilizer doses will damage the structure, so reducing the effectiveness of the fertilizer itself and undermining the fertility of the soil. In Britain the government is currently conducting an enquiry into the long-term effects on soil of repeated fertilizer applications. It is highly probable that over a number of years the use of fertilizer on the scale demanded by the new cereal hybrids would cause damage to the soil and pollution to the environment. It is also likely that the applications would become heavier as, with declining structures, more of the fertilizer applied was lost, and so the demand for fertilizers would grow from 90 lb per acre to an unpredictable high level if yields were to be maintained.

The introduction on a large scale of any new plant variety may have further ill effects. It may cause changes in the ecology of the area which may result in an increase in crop pests, weeds and disease. To some extent this is inevitable and we must live with it. The new hybrids, however, appear to be more than usually vulnerable to pests and disease. This may be due in part to the intensity with which they are grown, or to the high degree of specialization which, in breeding for one quality alone, upsets the homeostasis of the organism. Whatever the reason, there will need to be an increase in the use of pesticides, herbicides and fungicides. In the period 1962-64, 20 per cent of the world's pesticides were used in the developing countries, on some 70 per cent of the world's farm land. Where are the additional chemicals for crop protection to come from and how are they to be paid for? Clearly, there will be a shortage here, too.

Nevertheless, let us persist—the IWP does—and assume that the miracle worker who gave us the rice can also give us the fertilizers and sprays we will need to grow it. It is in the developed countries that most of the experience of the use of chemical sprays has been gained and it is in these countries that it is now realized that their effectiveness is limited, because pest species develop immunities to them, and that the cost to the environment and possibly to the health of man, is too high to be borne. Whereas pests can develop immunity, it seems that we cannot. A growing number of countries are either banning the use of some of the most popular ones, including DDT, or severely restricting their use. DDT and BHC are the cheapest pesticides, they have little immediate danger for the user, although we know little of the long-term effects. Farmworkers in Britain who have been exposed to pesticides for a number of years are now complaining of impotence. However, the crop protection programme for the new varieties is

At the present rate of expansion into marginal land there will be no virgin land left in the world by 1985.

almost certain to centre on these cheap pesticides. It is inevitable that there will be great problems from pollution. There are likely to be serious pest, weed and disease outbreaks because of the disturbance of delicate ecological balances, and as resistance to the chemicals develops, as we know it will, there will be an almost irresistible temptation to move on to other, more sophisticated, more toxic compounds, which will further aggravate the situation.

Never mind. At least we will be feeding people, even if we are destroying their soils and poisoning them to do it. But for how long can we go an feeding them?

Fertilizers, pesticides and their production, transportation, mechanization, all depend on petroleum. It has been calculated that the world's reserves of petroleum will last for something like 70 years at current rates of consumption. If the standard of living in the developing countries rises and they intensify their agriculture, their demand for petroleum will grow and the stocks will be depleted more quickly. In fact they will probably last for about fifty years. It is true, of course, that as they become exhausted the developed countries, too, will have to make radical changes in their way of life, but they are stronger and better able to change. It seems a little unfair to launch the developing countries on an industrial and technological path based on a commodity which we know to be running out.

There are two other main requirements for the new hybrids: irrigation and "a continued flow of suitable new varieties, resistant to the major pests and diseases and capable of high yields in response to the application of modern farming technology. This implies both a multi-disciplinary breeding and research programme to produce and test the varieties; and a well-organized multiplication and distribution programme to ensure that quality seed is available to the farmers in adequate quantity". In other words, a constant supply of seed. Surely, this is unusual? Farmers retain seed from one harvest for sowing the next season. The IWP does not say so, but the probable reason is that the new hybrids are genetically unstable. After a limited number of generations they may revert to the old varieties. When this begins to happen, crops will contain a mixture of old and new. Since the old varieties are long-stemmed and stand taller, they will shade their new-variety neighbours and so depress yields.

In the end, the decisive limiting factor may be the large amount of irrigation which will be necessary. Irrigation on this scale will produce violent ecological changes whose results are largely unpredictable, and will place an intolerable strain on the water resources of the areas concerned. After all, there is only so much water on the planet, and only a certain, constant proportion of fresh water. In spite of years of research into the desalination of sea water the cost is still prohibitively high for developed countries, let alone developing ones. Thus, we do not manufacture water and our efforts to redeploy it, far from increasing its overall availability, may increase surface loss by evaporation and so lower water tables that areas which are now arid will become drier than ever.

Still, if we can find the fertilizer and pesticides and the water and the seed, and the people don't mind what we are doing to the soil, we can feed them. The people don't seem too overjoyed with IR8. It becomes soggy when it is cooked and has chalky spots. This raises the whole question of the biological, nutritive value of the new varieties. It would be interesting to conduct feeding trials with them. In the case of IR8 we know that the protein content is only 5 to 7 per cent, as against 7 to 9 per cent in transitional varieties.

The picture we are left with is far from satisfactory. The entire FAO plan for the short and middle term is based on the new hybrids. If we consider only 1975 and 1985 as the IWP does, the programme may well be just feasible. However, if the new varieties are introduced on the scale proposed, and if they are to be grown, as they must be grown, with very heavy fertilizer applications and elaborate spray programmes in order to produce two or even three crops per season, then it is more than likely that by the 1990's the developing countries will be paying dearly for their short-term success in terms of damage to their environment and further depletion of their soils. They will have taken three steps forward and four back.

The IWP also argues that the availa-

The Indicative World Plan proposes to solve the long term with short-term expedients. The only effect can be to aggravate the problem.

bility of high quality animal protein must be increased. It is solving the problem instantly again, suggesting poultry and pigs (where these are permitted) be farmed along modern "industrial" lines.

Attractive though modern intensive livestock units may be from the point of view of rapid production, they require heavy capital investment, they can be operated only with the aid of sophisticated veterinary services and access to drugs, they produce food about whose quality there are growing doubts, and they cause serious pollution problems when they have to dispose of their effluents. At the same time they contribute nothing to the land. Indeed, they may even deplete it since they take food grains from it and return nothing.

Once more, IWP proposes to solve the long-term problem with short-term expedients and the only effect can be to further aggravate the problem, for which a real solution will have to be found.

Admittedly the problem of world hunger is highly emotive. It is all too easy to panic into attempting instant, miracle solutions. If we have learned anything at all from our history since the beginning of the Industrial Revolution it is that such solutions, and prosperity based on them, may exact a heavy price from future generations. There are countless instances of the long-term paying for the short-term, of the five-year plan from which it may take thirty years to recover.

What sort of solution do we then propose?

We can resort to various short-term expedients that do not appear to have important long-term side effects, such as cultivating single cell protein (SCP) from petroleum by-products, only in order to gain the necessary time to enable us to introduce sound long-term policies. These must include eliminating waste.

It is said for instance that in India available protein amounts to 71.5 grams per person per day, whereas consumption is around 51 grams. Halving of this wastage might increase the amount of food available up to 20 per cent and this appears to be technically feasible. An-

other thing that can be done—and this goes totally contrary to present day ideas on the way to increase food production—is to reduce the size of farms, i.e. to get away from intensive and industrialized agriculture and back to sound husbandry.

In many parts of the world, particularly in Latin America, the peasant produces most of the food crops for internal consumption, but he does so on small areas of the poorest land, since the best land is owned by estates whose productivity is low. In Chile, for example, 40.8 per cent of all agricultural families are peasants, yet they own only 7.4 per cent of the farm land. From it they produce 20 per cent of the country's total agricultural output. In Brazil 23.5 per cent of the agricultural population are peasants and they own 6.5 per cent of the land, from which they produce 21.3 per cent of the total output. A considerable increase in overall production might be achieved by land reforms which would allow the landless agricultural families—49.7 per cent in Chile, 61.9 per cent in Brazil—to own land held at present by the estates and to farm it as peasants. The IWP does mention land reform but greater emphasis should be placed on the need for it. But would a piecemeal approach of this sort enable one to get one jump ahead of Malthus?

It is indeed unlikely. The reason why there is a growing food shortage is not that less food is being produced today than yesterday, but that our population is expanding at an exponential rate.

Wherever the line is drawn, there must be a limit to the total population the planet can support. Probably the optimum population which could be supported indefinitely is about 1,500 million. All our efforts to increase food availability for a higher population must be eventually self-defeating. It is worth remembering that after thirty years of aid the developing countries are now worse off than ever.

We may be able to keep a jump ahead of Malthus, but if we are to avoid famine, war, civil strife, crime and the re-emergence of infectious disease in a series of world-wide epidemics, we must reduce our numbers at least by a half and stabilize them at that level. Unless we do, the best we can hope for is a series of postponements of the Malthusian disaster, each postponement shorter than the last and each making a solution of the problem that much more difficult.

**Gargoyle**
**by**
**Wayne Davis**

## Four billion Americans

The United States is the most seriously overpopulated nation in the world today. I define as most seriously overpopulated that nation whose people by virtue of their numbers and activities are most rapidly decreasing the ability of the land to support human life.

Compare the US to India, for example. We have 203 million people and they have 540-million on much less land. But let's look at the impact of people on the land.

The average Indian eats a few cups of rice a day, draws a bucket of water from the communal well and sleeps in a mud hut. In his daily rounds to gather dried cow dung to cook his rice he has a rather small impact on his environment. He does not clamor for highways, jetports, and steel mills.

An American on the other hand, will destroy a piece of land on which he will build a house, garage and driveway. His employer will destroy a piece of land to provide him with a parking space as will the developer of his shopping centre. The government will provide a road to his house and take out a piece of ground on which to dump his daily eight pounds of garbage.

With 38 times the per capita GNP of the Indian our citizen's demand for the latest fashion will cause cotton farmers to kill the southern streams with endrin, his demand for power will cause the miners to kill Kentucky streams with silt and acid, and his demand for steel to replace last year's auto will cause the US Steel Corp to kill the Great Lakes by increasing the daily equivalent of 130,000 junked autos *Life* says it dumps into Lake Michigan. And in hundreds of ways he will contribute to the pollution of our oceans causing the final death of our fisheries which the *Commercial Fisheries Review* for October 1969 described as a "national problem" and a trend which has "become precipitous in the past seven years."

To supply him with the 26,000,000 gallons of water he will pollute in his lifetime we will build a reservoir and flood the farmland. He will contribute his share to the annual 142 million tons of smoke and fumes which killed the spinach industry in southern California, are killing forest trees and decreasing the amount of sunlight reaching our land. He will contribute his share to the annual load of seven million junked cars, 20 million tons of paper, 48 billion cans, 26 billion bottles, and a rapidly increasing number of plastic *Chlorox* and antifreeze containers our environment is expected to absorb each year. He will poison the land with the lead, nickel and boron from the 21,000 gallons of gasoline he will use in his lifetime.

He will eat 10,000 pounds of meat. To supply this demand, cattle will eat plants on western range land and the nutrient minerals are passed to our friend who flushes them down the toilet and into the ocean. This life pattern, unknown in the Orient, has joined over-grazing erosion and lowering of the water table by pumping out ground water for irrigation, city and industrial use, to hasten the destruction of our land's capacity to support people.

Because the American is far more destructive of his land than citizens of other overpopulated lands are to theirs, I want to introduce a new term which I suggest be used in all future discussions of problems of human populations and ecology. We should speak of our numbers in "Indian equivalents" or IE. An IE I define as the average number of Indian citizens required to have the same detrimental effect on the land's ability to support human life as would the average American. This value is hard to determine. I take a conservative working estimate of 25. My Indian friends say this is much too low. One person suggested to me 500 as more realistic. Certainly the addition of 1,000 people to Lexington would do more to destroy the land than 25,000 new people in an Indian village. But let's use 25 as our IE.

In terms of IE, then, the population of the US is over four billion. And the rate of growth is even more alarming. We have by far the most serious population growth problem in the world. We are growing at 1 per cent per year, a rate which would double our numbers in 70 years. India is growing at 2.5 per cent. Using the IE of 25, our growth rate would be 10 times as serious as India's if our people had their life expectancy of 35 years. With our expectancy of 70

*cont. on page 48*

# Eskimo Knell

**by Robert Allen**

One of the last great wildernesses, the Alaskan tundra, is threatened by the new oil boom. Oil companies and conservationists naturally differ over the extent of potential damage, but plainly there are very real dangers: to the landscape, the caribou —and to the Eskimos.

Eight hundred miles of the largest oil pipeline ever to be built (4 feet in diameter) received the go-ahead some months ago from the House Interior Committee in Washington. The Trans-Alaska Pipeline System (TAPS), largely owned by the oil companies Atlantic Richfield (Arco), Humble Oil and British Petroleum (BP), has already taken delivery of steel pipe from Japan and is plainly confident that the Committee's decision will be ratified by Congress. The line, which is to run from Prudhoe Bay on the north coast of Alaska to Valdez on the south is regarded with enthusiasm by the state administration, with horror by the conservationists—who see the dangers that lie ahead.

The dangers are considerable. Much of the pipeline will have to run through the region of permafrost, permanently frozen ground which in places can be up to 1,300 feet thick. Any heavy or heated structure that is built on it must either be on piles or on insulating gravel pads. In summer, serious erosion can occur if the tundra is not so protected, for when the thin layer of thawed ground on the surface is broken the permafrost starts to melt. Thus it is not unusual for a tractor to alter the surface drainage of a wide area—indeed the trail one caterpillar tractor train blazed a few years ago is now a 50 foot gorge.

It is proposed that the pipeline follow river valleys as much as possible, since it can be buried in the gravel beds that are often found in them. This will slightly reduce the extent of permafrost affected by the pipeline, and correspondingly lessen the likelihood of its melting or otherwise being disturbed. However the risk of disturbance and of differential settlement is still high: the temperature of the oil when it enters the pipeline will be about 160°F, and friction and pumping energy will increase it. There will be a certain amount of heat loss to the frozen ground around the pipe, but it is estimated that the

temperature of the oil when it reaches Valdez will be as high as 100°F. The full capacity flow will be 10,000 barrels or 500,000 gallons of oil per mile of pipe, and given the frequency of pipeline leaks (in 1968 there were 500 in the USA alone, 100 of which were spills of between 1,000 and 12,000 barrels—and all of the pipes were less than half the size of TAPS) it looks as if Alaska's in for some spectacular accidents.

Naturally TAPS is aware of the problems. It has buried 600 feet of pipeline in the permafrost in which it will test the effects of oil heated in stages to 160°F, and it is also considering ways of stabilizing the soil in the areas cleared along the pipeline route. As this cannot be done with the indigenous vegetation because it grows too slowly, it is experimenting with exotic grasses in the hope that they will grow and seed quickly, prevent erosion, and then in the fullness of time, give way gracefully to the local plant-life. One senses. however, that what really preoccupies TAPS is not ecological reality but the many and stringent stipulations of the Department of the Interior which, among other things, requires TAPS to prepare contingency plans for dealing with oil spills (as if they were inevitable). The oil companies cannot seriously claim a responsible attitude to the environment when they have sections of pipeline waiting to be laid as soon as congressional approval is announced. The numerous environmental scientists they employ (either directly or indirectly) are most unlikely to be working on an overall ecological analysis, for that would take too long, but on ways of meeting the stipulations.

Perhaps this would not matter quite so much if one had confidence in the ways in which the stipulations were formulated, and in the ability and will of state and federal agencies to enforce them. Unfortunately, the Bureau of Land Management is under-staffed and has far too small a budget. It lacks the time, money and personnel to properly examine the ecosystems affected by the oil development, and indeed some of their surveys have been little more than ecological lucky-dips. Many of the stipulations are stringent merely because Secretary of the Interior Hickell has given instructions that his Department be tough when in doubt, but such enlightened ignorance is no substitute for a thorough understanding of the Arctic environment.

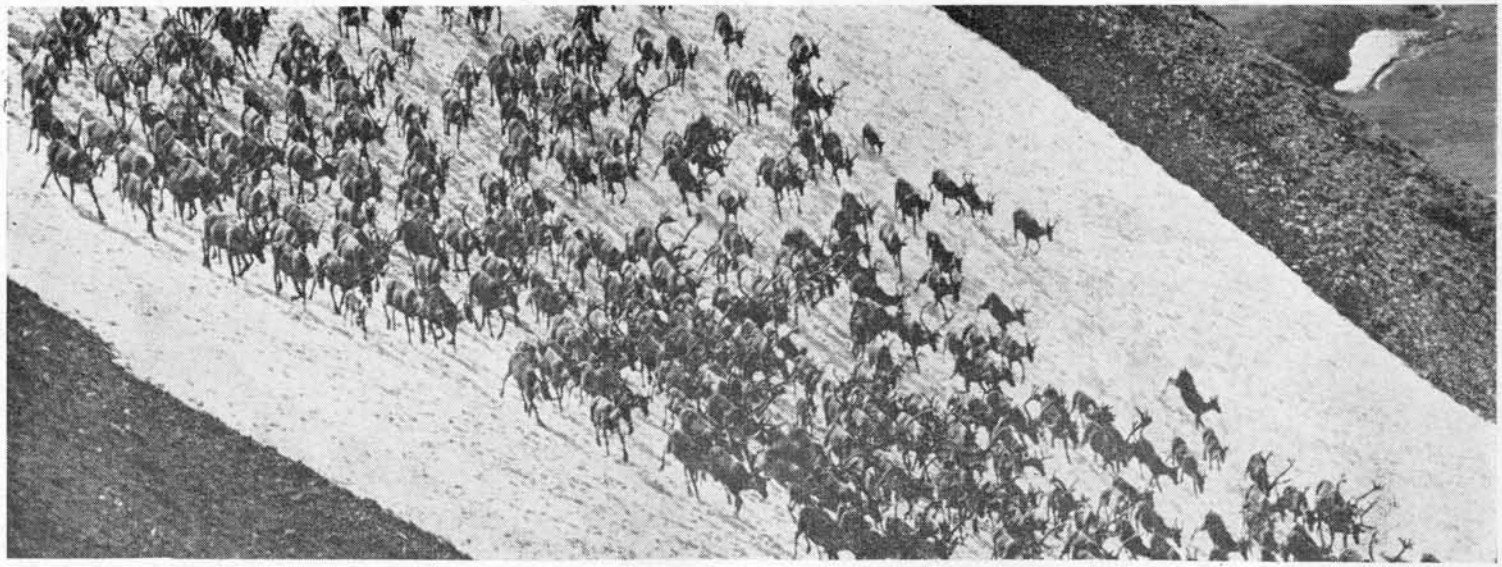
Little effort has been made to control the activities of oil companies. In Cook Inlet, since 1965, there have been 150 recorded instances of pollution from oil-drilling operations, and yet in only five of the cases have either state or federal authorities prosecuted the companies. Surveillance is generally inadequate, and some of the regulations make it very difficult for agencies to act effectively. For example some of the worst damage has been caused by geophysical survey contractors, who are paid on mileage and who have often violated official guidelines and seriously disturbed the tundra. They require no permit and the Bureau of Land Management may act only after the fact and try to make them repair the damage.

Alaska's administration, for its part, seems to be obsessed with development. Governor Miller wants the lands over which the pipeline runs to be transferred to the state. Already it has been agreed that the gravel access road to be used by TAPS for construction of the pipe will be handed over, which will give Alaskans and others easy access to hitherto remote areas, and open up the country for further (particularly mineral) exploitation. As such development expands, as it attracts more and more service industries, so destruction of the environment will increase.

It is with this in mind that we must view the caribou scare. Where TAPS considers it particularly unsafe to bury the pipeline, it will have to build it on pilings above ground. Conservationists and animal lovers have expressed alarm that these raised sections will hinder the migration of the caribou (a kind of reindeer, and a major food source for many Eskimos) which cross the Brooks Range in their thousands in the spring and autumn of each year. TAPS ecologists reject these fears arguing that, at the moment, there are to be only 80 miles of raised section in all, the longest section at a time being no more than 12 miles, and that the caribou seem not to be disturbed by the airstrips and roads of the North Slope camps, many of them resting on the gravel at night.

The TAPS ecologists seem to have ignored three factors. One is that we know very little about caribou migration and that six weeks' observation is not enough—one would learn more in half-an-hour's conversation with an Eskimo. The second is that we have learned merely that caribou will tolerate the present state of affairs, not what

On the north coast, older Eskimos can remember shooting caribou within 30 yards of their houses . . . Now it is unusual for caribou to come within a mile of Eskimo settlements.



will happen when development intensifies. The third is that what we do know about caribou migration suggests that it won't be very long before it is markedly upset.

The Nunamiut Eskimos, who now live at Anaktuvuk Pass in the Brooks Range and who are authorities on the caribou, insist that the first herds of the spring and autumn migration should never be disturbed. Later ones seem to be less sensitive, but the lead herds, once frightened, will turn back and it is then unlikely that any caribou will use that valley for the remainder of the season. On the north coast, older Eskimos can remember shooting caribou within 30 yards of their houses. That was in the days when villages were small, quiet and inconspicuous. Now it is unusual for caribou to come within a mile of Eskimo settlements. Oil derricks and mining camps are neither silent nor discreet and it would be oddly out of character for the caribou to ignore them. Besides, Eskimo observations have been made over a long time, while those of oil crews on the North Slope and ecologists on the TAPS route have been no more than samplings.

Most scientists are reluctant to listen to the findings of the Eskimos as, to them, it is inconceivable that such technologically backward peoples should be expert on anything, even an environment from which they have so ingeniously wrested a living. But Richard K. Nelson, who made an intensive study of the Eskimo's knowledge of sea-ice conditions for the US Air Force, writes: "Those who live with Eskimos over a long enough period find themselves questioning less, and following whatever they are told to do by their experienced native companions. . . . It is my opinion that information given by Eskimos relating to successful hunting or survival techniques is nearly always correct and well-founded, *regardless of how difficult it may be to accept initially*" (my italics). It should go without saying that knowledge of the behaviour and movements of the caribou is essential for successful hunting.

It is not only the experience of the Eskimos that has been ignored. In the rush to maximize profits their rights and their welfare are being forgotten. In 1964 the state applied to the Bureau of Land Management for some 2 million acres of the North Slope. Eskimos have traditionally hunted throughout this area, and yet the state claimed that it was "free of aboriginal use and occupancy". The Bureau of Land Management published notice of the application in various issues of the Fairbanks *Jessen's Weekly*. But *Jessen's Weekly* has a very small circulation in the northern villages, and the notice was framed in difficult legal language so that its full import was unlikely to have been appreciated by anyone giving it a casual glance. Surely the potential loss of 2 million acres should have been brought more forcibly to the notice of those who have always considered it theirs?

Eskimos, Indians and Aleuts have learned the lesson of such sharp practice. Now, *Alaska Natives and the Land*, the Report of the Federal Field Committee for Development Planning in Alaska states:

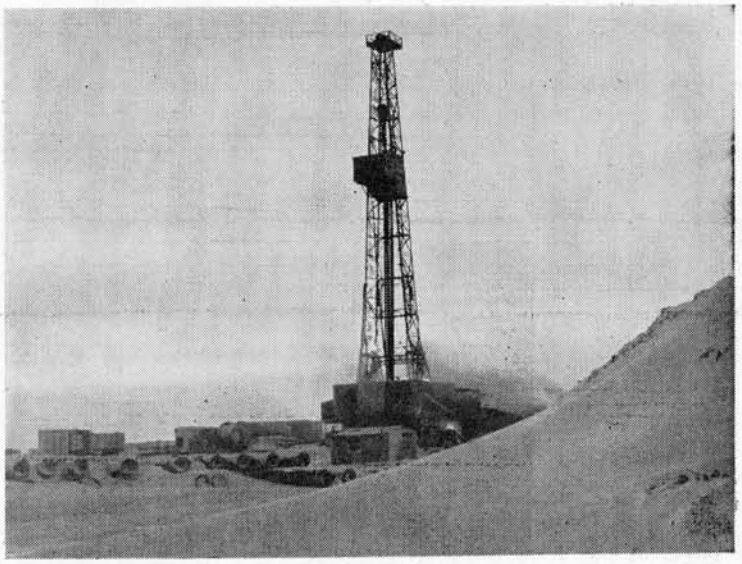
"Of the 272 million acres in the public domain, Natives claim 250 million acres; of the 85 million acres of land reserved by the federal government for specific purposes, they claim 75 million acres; of the 12 million acres thus far in process of selection by the state under the terms of the Statehood Act, they claim all but 100,000 acres; and of the 6 million acres already presented to the state or to private individuals, they claim 3 million acres." Because of these unresolved land claims the Department of the Interior introduced a landfreeze policy, which the oil companies, the state administration and TAPS are anxious to see waived with respect to certain areas like the pipeline route. It seems they are succeeding.

Meanwhile, since April 1969, Bills have been introduced in the Senate and House of Representatives which distinguish four elements in native claims:

1. Land for use by natives, i.e. as homes, businesses, hunting and fishing camps which, once surveyed, would be conveyed to the occupants, who would also be allowed to choose 36 sq. miles of surrounding land if they became incorporated as organized communities;
2. Subsistence resources, whereby those still pursuing the traditional way of life would be guaranteed access to necessary fish and wildlife resources, although control of such areas would be vested largely in the state. Some of these lands would be restricted to local people;
3. Lands previously taken, for which it proposed $100 million compensation would be paid into a Fund administered by the Alaskan Native Development Corporation (yet to be formed), in

Aerial view of an oil rig on the North Slope, showing the beginning of ground disturbance.

Pipes stacked in the snow, ready for the construction of the 800 mile pipeline.



which all natives of Alaska would be shareholders;

4. Compensation of remaining aboriginal rights, namely a further grant to the Alaskan Native Development Corporation of about 10 per cent of the current value of commercial resources (including oil) on the remaining public domain.

These, of course, are the bare bones of the proposals, and give no indication of the immense amount of thought that has obviously gone into them. All four can be criticized on the grounds that they are not wholly just, but the first two alone betray a poor understanding of the Eskimo situation.

Most Eskimos on the North Slope have a largely traditional diet, and there is medical evidence that they are much healthier than their fellows who have changed to a modern one. Even those who are highly acculturated and who rarely hunt will pay a lot for caribou meat. Besides, many of them live on the fringe of the cash economy and regard hunting as essentially their way of life. Provision is gradually being made for Eskimos reconciled to change: there are trade schools in Fairbanks and Anchorage to train them for work in the oil industry and related fields, and some of the oil companies have set up on-the-job training schemes. But although change has brought material prosperity to a few, most Eskimos are now in a cultural limbo, caught between an imperfect acceptance of the new and a reluctant rejection of the old, their community life ravaged by a rise in alcoholism, promiscuity and ill-health. By and large all that is left are those aspects of their culture that are crucial to the maintenance of their traditional food supply.

In 1965 Nicholas Gubser, writing of the Nunamiut, warned that "should many white men begin to take large quantities of meat, caribou hides, and furs out of the country, there is no doubt that strong sentiments of territoriality would be aroused. Similarly, when state and federal authorities try to tell Eskimos how, what, and when to hunt, they feel it a considerable imposition." Nunamiut territory extends from the watershed of the Brooks Range north to the Colville River, and from the head waters of the Colville east to the Itkillik. For any body, whether federal, state or private, to have control over the caribou hunting in that area would be unacceptable. Judging from past measures it cannot be claimed that such a body would manage the area any more wisely than the Nunamiut. In the late 1950s and early 1960s, for example, the US Fish and Wild life Service of Alaska so reduced the wolf population through its practice of setting strychnine-poisoned baits and of shooting them from the air that there weren't enough left to cull the caribou herds. Weak and sick animals were thus competitors for the food supply of healthy caribou, and the herds' general condition was lowered.

Furthermore, as the community at Anaktuvuk prospers it will expand and become too large as a hunting unit. The Nunamiut will therefore require room for a splinter band to form a village elsewhere in the territory. For as long as hunting is an essential part of the Eskimo economy, it will not be enough to give them legal title solely to the area already occupied. They must have title to all of their traditional lands, for without it more and more areas will be exploited for minerals, otherwise "developed" or taken over by white hunters, with grave effects on the ecology and on the Eskimo economy.

Perhaps some compromise could be devised whereby traditional lands not at the moment fully exploited by natives could become conservation areas, but with hunting and settlement rights reserved for the traditional occupiers. Certainly what the whole of Alaska urgently needs is an overall land-use plan clearly setting out those areas for conservation, oil development and other mineral operations. The US Government must consider the rights and welfare of the Indians, Aleuts and Eskimos against the ever more strident state demands to clear the decks for "development", the powerful impetus of the oil companies against the restraints called for by the sensitive and little known ecosystem of the tundra.

At the moment it seems that the formidable alliance of the state and the oil companies will win the day. It is likely to be a Pyrrhic victory. We know there's a lot of money to be made by rapid exploitation of the oil, we have no idea how much will be lost by our destruction of the environment. At the Tundra Conference at Edmonton, Canada, in October 1969, estimates of how long it would take us to gain a full understanding of the Arctic ecosystem varied from five to 50 years. Even if five years failed to bring us a full understanding, at least we might then have answers to such pressing questions as how will we get rid of human and petroleum wastes ("in the Point Barrow area the Navy and various other groups under contract for oil explorations have accumulated an estimated quarter of a million drums of human wastes because no feasible disposal method is available")--how can we prevent pollution when water is everywhere in the summer? What will happen to the total ecology when those oxygen-consuming wastes are added to the Arctic freshwater system, which is very low in oxygen anyway? At the moment we have no idea, and the oil companies and state authorities are going ahead as if it doesn't matter. If we find out the hard way (as doubtless we will), we will have lost a unique opportunity to weigh the balance carefully between development at its most irresponsible and conservation at its most sentimental, to consider all the variables (particularly the long-term ones) rather than those arbitrarily selected by short-term economics.

We used to hear a lot about rights from the United States. Now we hear a lot about Conservation. In Alaska, the US Administration has the opportunity to demonstrate its sincerity (or lack of it) about both. If it rejects it, we may one day recall the words of Alaska's Senator Ted Stevens who, exasperated by the kill-joy meddling of the ecologists, was driven to quote a dictionary definition of ecology: "Ecology deals with the relationships between living organisms," and to declare, "But there are no living organisms on the North Slope." We may scoff at his ignorance, but one day the Senator may be hailed for his pre-science.

## Further reading


*Newall, Valerie. 1970. The Alaskan oil bonanza,* Science Journal, *Vol. 6 No. 1 January, 1970*

*Barren-ground caribou, and Wonderland revisited,* Sierra Club Bulletin, *Vol. 54 No. 10, October-November, 1969*

*Nelson, Richard K. 1969. Hunters of the Northern Ice.* University of Chicago Press.

*North Slope: Oil Rush.* Science *Vol. 166 No. 3901. 3rd October 1969.*

*Alaska Natives and the Land, Report of the Federal Field Committee for Development Planning in Alaska. 1968.* Anchorage, Alaska.

*Gubser, Nicholas J. 1965. The Nunamiut Eskimos: Hunters of Caribou.* Yale University Press.

*Lotspeich, Frederick B. 1969. Water pollution in Alaska: Present and Future,* Science, *Vol. 166, No. 3910, 5th December 1969.*

# Reports

## The giant awakes . . . slowly

*Report on The European Conservation Conference, Strasbourg, February, 1970.*

None too soon, a major international effort to confront burgeoning menaces to the environment has been initiated with the Strasbourg conference in February. It was the opening event of European Conservation Year 1970, a project started in Britain several years ago which caught the interest of other European countries. Assignments were given by the Council of Europe to experts in several participating countries to report on four main themes which would be the subjects for discussion at the meeting: Agriculture and Forests, Urban Conglomerations, Industry, and Leisure. Inevitably, the themes overlapped on many levels as they do in the ecosphere. It was impossible to consider the effects of Industry, its products and its waste without seeing at once its enormous influence on the countryside with the increased use of tractors, for example, the consequent diminution of farm labour, the tendency of population in all the countries to move from farmlands to urban centres where new problems are created and aggravated, and, of course, the growing threat to health in both city and country by industrial pollution of land, air and water.

Changes in agriculture, according to the report of France's Professor M. E. Maldague, have resulted in part from a reduction in the area of cultivated land. Housing projects, industry and urban expansion have taken a toll of millions of acres of fertile lands in the countries of Western Europe (Eastern Europe, for the usual political reasons was not represented). Agriculture has played a decreasing role in national economies with a consequent reduction in the agricultural labour force. (In 1910, Western Europe's labour force was 42 per cent employed in agriculture; by 1955 the figure was only 24 per cent). The 10 million so employed in 1970 in the EEC will drop to 5 million by 1980 if plans underway are successful. The object is to eliminate the small farms which have not been economically feasible and in this way permit the remaining cultivators of land to live on a standard "corresponding to that enjoyed by the industrial classes". Already small farms are disappearing at an accelerating rate and large farms are steadily increasing in number.

There has been an overall increase in agricultural productivity every year in both crops and livestock while the labour force has decreased, with the result that there is a 7 per cent *per capita* increase in production annually. The report rather alarmingly recommends more intensive farming than ever while at the same time asserting quite correctly that the ecosystem is being dangerously simplified by man and that catastrophe is increasingly possible due to this loss of diversity. Professor Maldague calls for increased productivity on land with high agricultural potential by the adoption of all "necessary" technology and scientific methods. He does not say how he means to reconcile this aim with the warnings elsewhere in the report about the pollution of the soil, plant and animal life, air and water by pesticides and artificial fertilizers unless it is in his statement, "The more intensive farming is achieved by concentrating agricultural activities in relatively small areas, the easier it will be to plan and control the use of agricultural areas and to reduce the harm to natural resources".

Nor does the report take any stand against the use of hormones and antibiotics in the growing of food. Instead, there is a strange statement that among the most urgent specific aims of agriculture ". . . encouragement should be given to biological agriculture whose aim is to place on a market restricted to certain classes of society, vegetable and animal foodstuffs produced in conditions where contamination by pesticides or mineral elements is reduced to a minimum and where there are no residues of hormones and antibiotics. It is expected, especially in areas around large towns, that there will be an increasing demand for these 'luxury agricultural products' in the years ahead."

Apparently it is his position that not to have to eat contaminated and biologically hazardous foods ought to be considered a luxury and paid for accordingly by the few informed consumers who can afford to do so. Or does he mean to protect among his "certain classes" a healthy group who might preserve our species while the rest of us are subjected to the unpredictable genetic effects of the recommended contamination?

In the paper on urban conglomerations (an ungainly phrase, but more descriptive of the real thing than "town" or "city"), Mr R. J. Bentham of the Netherlands provides a depressing conglomerate of statistics. In France, 150,000 people working in agriculture leave the land every year to move to the cities. In the Netherlands, nearly half the country's population is living in a region covering no more than two ninths of the total area, and so on from country to country. And it is noted that due to standard-of-living rise "in economically advanced societies, each individual today requires five to ten times as much space for housing, employment and recreation as he did in 1900".

Suburban sprawl is the inevitable consequence of the standard-of-living illusion. People come from agriculture to town life, move into multiple dwelling blocks, wonder why they are not happy, begin to pine for the land and, already committed to an urban trade and/or living-standard cannot bring themselves

to abandon it, mod-cons and all, and compromise by taking an individual house in a monotonous row in the outskirts where a tiny garden may be all the land they can get. In America, this has been the major pattern, and Europe is following suit, as ever.

The report on leisure follows logically as it describes urban man, up to his ears in pollution, crowding, pressure and competition, making money and buying a second home in the countryside to relieve his standard-of-living-tattered soul. Thus, thousands of acres of natural landscapes are converted to accommodate the demand for these second homes and the nightmare gallops on.

No one suggests anywhere that it might not continue in the same destructive direction. Projections for the future are calmly based on the expected, unchecked population increase; urban and rural land-use, they say, must be mobilized to the last inch to serve the purposes of man. National parks and connecting parkways are recommended as well as "near-by recreation" areas for the urbanite. As already in America, it is not difficult to see what these mobbed green patches will be. Weekending picnickers, transistorized and "litterate" falling over one another in zones marked, "Stroll This Way", "No Picnics Permitted Beyond This Sign", "This Area Reserved For Contemplation of Nature's Majesty", etc., all jammed together, and with fights breaking out as tempers flare, children stumbling on broken bottles, suspicion and hatred for urban neighbours, veiled all week, stripped and assertive as they meet in the open.

Professor Passino of Italy, while intimating not for an instant that technological development or population growth should slow down, does give a sharp rap to the soft, white knuckles of the technocrat for "bad management". He describes the losses of plant and animal species, the fouling of water, land and air with its effects on the ecosphere and on man's health. On the subject of air he says, "pollution has become so intense that it has produced a change in the carbon dioxide content of the atmosphere: samples taken during the recent International Geophysical Year show that the carbon dioxide of the air is increasing by 0.2 per cent per year. Since the beginning of the industrial era up to today it is estimated to have risen by 10 per cent. If this rate continues, the atmosphere will become overheated . . ." The results of this overheating, among others, might include the melting of the polar icecaps and the flooding of coastal areas (where most major cities would go under) as the earth's water level rises by an estimated sixty feet. Abnormal filtration of solar radiation in cities covered with a "grey hood which floats at heights varying from 1,500 to 2,500 metres" alters the composition of the light spectrum so that, for instance, in Paris the ultra-violet rays in the centre of the city represent only 0.3 per cent of solar radiation whilst in the suburbs the percentage reaches 3 per cent. Visibility is progressively diminishing, of course, as well.

There are ominous statements at every turn, e.g. "the recent discovery that the heartbeats of an unborn child can be speeded up by noises to which the mother seems to be accustomed". "One can get used to odours, but this kind of tolerance nonetheless influences the ability to distinguish smells by increasing the olfactory threshold". "The plankton in Lake Constance in Switzerland has increased thirtyfold since 1950, the phosphorous content almost tenfold." Finland's "inland water is 10 per cent to 15 per cent polluted". "Most Swiss lakes are polluted." Synthetic detergents "give water a peculiar taste and poison flora and fauna". Industry accounts for 30 per cent of air pollution, people 10 per cent, motor vehicles alone are responsible for 60 per cent.

The need for international co-operation and national legislation was the keynote of the repressive and preventive measures recommended. The recommendations are made "in consideration . . . of the fact that industrial development is necessary for the well-being of the several nations and for the improvement of mankind's economic and social conditions . . ." a premise which remains unexamined throughout the four reports of the 1970 conference but which, I would hazard, will not allow us to continue to play ostrich for very much longer.

The end of the conference saw the adoption of a declaration in which the member countries resolved to promote international and national measures for planning, conservation and research. Among the stated principles in the declaration, perhaps the most significant will turn out to be this one: "The costs of conservation should be weighed against the costs of non-conservation."

*Jean Liedloff*

## Environmental research in Wales

Over a hundred people from the Welsh Office, county planning departments, river authorities, universities, conservation bodies, and public industries like the National Coal Board, the British Steel Corporation, the Central Electricity Generating Board, and the Forestry Commission, met to discuss environmental research in Wales, this April, in a conference impeccably organized by the Nature Conservancy and the University of Wales Institute of Science and Technology.

An interesting point that emerged in conversation during this conference is that Wales is blessed with a much less cumbrous bureaucracy than that across the border, and consequently there is great optimism that environmental action will be speedier there than in England. This was demonstrated by Mr G. T. Goodman (University College, Swansea) and by Mr Ted Rowlands (the Welsh Office) in their descriptions of the work of the Derelict Land Unit. Set up after Aberfan, this vigorous body has already reclaimed 1,600 acres in three years at a cost of £3.4 million, which compared with the reclamation rate in the rest of Britain is very creditable.

Yet in terms of the problem it is inadequate. According to official estimates, the amount of derelict land ("Land so damaged by industrial and other developments that is is incapable of beneficial use without treatment") in Britain is about 127,000 acres (of which 19,000 acres are in Wales). However, Mr Goodman felt this was an underestimate, and that 250,000 acres would be nearer the mark. Then for every acre that is truly derelict there are 10 that are substandard, and an additional 3,500 acres of land falls derelict every year. Thus, at present rates of reclamation, the acreage of dereliction will have doubled by the end of the century.

This amply demonstrates how easy it is for the deleterious effects of industrial growth to outstrip our willingness or ability to come to grips with them. A similar discrepancy can be detected when we look at some of the water pollution problems of South Wales. Professor R. W. Edwards (UWIST) described the situation in three catchments, the Ebbw "probably the most polluted river in Wales", Taff and Kenfig. The

main problems seem to be grossly overloaded sewage works, inadequate treatment facilities at industrial sites, and an increasing problem of acid mine drainage as pits close down. We saw the Ebbw for ourselves. At present the main source of pollution is from Richard, Thomas & Baldwins, Ebbw Vale Steelworks, and for 20 miles below the works the river is almost entirely devoid of animal and plant life. About 80 tons of solid material are dumped into it per day, the river is bright orange from the large quantities of iron hydroxide, and its bed is covered by 1 inch of iron hydroxide on top of 3 inches of tar. The situation is serious enough to deter other industrialists, and now the steelworks is building a new treatment plant at a cost of almost £1 million. This should reduce the level of polluting effluent from some 1,000 ppm to 30 ppm, when the local authority will be able to see what other industries are polluting the Ebbw!

£1 million seems a lot of money for an effluent treatment plant (though not against the £35 million R. T. & B. are spending on a new tinplating section), yet it is not intended that the river should support salmon far less return to anything like a self-regulating ecosystem. Throughout Britain local authorities are unwilling to force industry to prevent or pay for their pollution for fear that they will go elsewhere, and yet the longer we delay enforcement the more expensive it will be in the end. At the moment it is up to the community to prove the harmfulness of any development project rather than the developer to prove its safety, and until much more ecologically-based research is initiated neither side can really prove its case. As was intended, it was in revealing many of the research gaps that the conference was most successful. Professor Edwards, calling attention to the Severn Estuary barrage schemes, pointed out that "the capacity of the Bristol Channel to receive wastes is largely unknown and it is essential that a mixing and dispersion model of the Estuary is developed". And Mr M. D. Hunter, Chief Pollution and Fisheries Officer of the Usk River Authority, added that we did not know the effects of large quantities of sewage entering what would then be a non-tidal fresh water system.

Dr A. Nelson-Smith (University College Swansea) suggested that little is known of water movements in the Irish Sea and less of the Severn Estuary, other than that they are extremely complex, and that the quantities of effluent discharged into the Severn Estuary and Liverpool Bay do not seem to go very far away. Only about 5 per cent of this effluent is fully treated, even less receives partial treatment (i.e. screened or the solids chopped up), and most is entirely untreated; and "in North Wales and around Cardigan Bay, the discharge is almost doubled during the summer months." It is presumed that the resulting quantities of nitrogen and phosphorus that enter the sea do more good than harm unless they begin to "stimulate such a massive bloom of phytoplankton that the water is made unsuitable for other forms of life" (as in the American Great Lakes and some of the Norwegian fjords); but various effluents contain toxic wastes and pathogenic bacteria which may harm us either directly during swimming or indirectly through consumption of filter-feeding shellfish like mussels. One major difficulty is that "no one knows even the exact nature of the complex and varying effluent from, say, a modern petrochemical plant". In addition, a lot of nasty chemical wastes, like arsenic and war gases, have been dumped in the Irish Sea, where the dangers are those of "gradual dispersal or decomposition", of being brought up in fishing nets, or possibly of washing ashore.

Oil spills from tanker collisions or strandings have now penetrated the public's consciousness, but we seem to be unaware that similar acidents could happen to vessels carrying industrial chemicals, like the modern biocides, which could be much more toxic. The Ministry of Agriculture and Fisheries recently completed experiments to determine the maximum safe amounts per tank of sea water ¼ square metre by 5 fathoms. The result for DDT was 10 lb, for Dieldrin 1 oz.

Dr Nelson-Smith felt that the disposal of radioactive wastes was carefully enough controlled by Government Agencies, with bioconcentration in edible seaweeds and shellfish being taken into account. Yet he points out that the Bristol Channel/Severn Estuary area already has the greatest concentration of nuclear power stations in the world, and proposals to build yet more must be viewed with the greatest concern.

Finally there are the oil spills, resulting from collisions like that of the *Hamilton Trader* in April 1969 and the recent one of the *Efthycosta II*. These were both of heavy fuel oils; those in Milford Haven are of fresh crude oil and Dr Nelson-Smith thought it possible that long term changes may result "more from continual small-scale pollution than from single dramatic incidents". The sub-lethal effects of oils and the emulsifiers used against them are now being studied at Swansea, and one interesting item that has emerged so far is that limpets play a valuable part in removing oil in cases of minor pollution though they are highly sensitive to the solvent-emulsifiers.

Dr Tom Pritchard (Deputy Director, Nature Conservancy, Wales and Secretary, Countryside in 1970 Committee for Wales) warned the conference that it should be prepared for oil or natural gas discoveries in Cardigan Bay (still largely unspoilt) and called for advance studies of their likely effects. Doubtless the research now being undertaken at Swansea will be especially useful.

Of course, much good research is already being done, from studies of the rate of recovery of the river Ebbw to studies of fluorine deposits from the aluminium works in Anglesey and of atmospheric pollution (hydrogen sulphide, sulphur dioxide, ammonia, and particulate material) from a smokeless fuel (phumacite) plant at Abercwmboi. There is an increasing emphasis on multi-disciplinary studies, and it was encouraging to hear Dr D. F. Perkins of the Nature Conservancy propose systems analysis and the use of mathematical models and computer simulation techniques, to provide a framework for the efforts of multi-disciplinary teams, which should include "ecologists, planners, sociologists, economists, foresters and agriculturalists".

Dr and Mrs J. Edington (University College Cardiff) were called in to advise on the ecological aspects of the Rhonnda Development Plan, and Dr Edington amply demonstrated that one of the most valuable roles of the ecologist is in "the communication to the planner of accepted ecological principles". It is, therefore, a pity that in a conference that in every other respect lived up to its organizers' hope that it would be "a major contribution to European Conservation Year", these principles were little dwelt upon. On occasions, indeed, it seemed that the Welsh environment was merely a system of resources to be competed for by industry, agriculture and tourism, with sites of special scientific interest alone exempt from current market valuation.

Yet one result of European Conservation Year we should hope for is a greater readiness to substitute basic ecological principles for those of industrial economics. It will be increasingly hard for conservationists to hold their ground, let alone gain more, in the face of an exponential population rise and an unrelenting demand for a cheap and plentiful variety of food and goods. There is not much room in the economic dogmas of expansionism and productivity for considering our relationship with the rest of nature, and sometimes one fears that environmental quality will continue to be frittered away until it can be quantified in terms of the cost-effectiveness of fresh air and birdsong and the discounted cash flow of our rivers and streams.

Ecologists, like other scientists, dislike being thought of as prophets of doom, but it really is time they demonstrated more publicly and more often that our blatant disregard for ecological principles will have more than academic consequences. It is perfectly true, as Professor Brinley Thomas, Chairman of the Welsh Council, said, that "there is a terrific amount to be done that is non-contentious and non-political". Much is being done already, and much more will be done by bodies like the conference follow-up unit, which Dr Pritchard and Professor Edwards agreed to form. But will it be enough? A lot of money and energy is being spent on cleaning up mess, but a great deal more is being spent on creating it. So it will be, until it is widely understood that all ecosystems, except those grossly troubled by man, tend towards homeostasis, and that we should strive for a state of dynamic equilibrium and not for one so conditioned by the demand for growth and productivity that it is rendered highly instable. While man persists in over-simplifying his environment, in acting in the belief that he is exempt from laws which govern all other organisms, so he not merely impoverishes the world of his senses, but brings the survival of himself and his children seriously into question.

The alternative spur to action other than ecological plain-speaking will be a disaster, or series of disasters, grand enough to make the public and powers that be worry about the biosphere as a whole, and not as a compartmentalised collection of, for example, oil-menaced coastlines (remember *Torrey Canyon*) and tip-threatened villages (remember Aberfan.)

*Robert Allen*

## Environmental stress and heart disease

Join the congestion on the roads, squeeze your way into a rush-hour train bursting with humanity, get thoroughly irritated with everyone because you're overworked, eat and drink well, relish your cigarettes, don't use your muscles more than you have to—take every opportunity to use your car—and you've created just the right conditions for a sudden and unexpected death—from a heart attack.

Cardiologists are now discovering that they have been overlooking one of the prime causes of heart attacks. These do not result as they'd thought (and many still think) from the coronary arteries becoming blocked off with massive clots. Instead heart attacks are much more likely to be caused by a subtle sequence of events in which the trigger appears to be none other than *stress*. And Man, by living and working in his concrete jungle, with its excruciating noise, fumes, and frenetic movement has fashioned for himself an environment which is simply fraught with stress, frustration and tension.

The "explosive charge" triggered off by stress is *noradrenaline*—a substance which is closely related to the "fear, flight and fight" hormone adrenaline. Noradrenaline is secreted from sympathetic nerves into the blood-stream and although it vanishes very quickly, research workers in Britain, Europe and the United States have substantial evidence that levels of noradrenaline tend to be raised in people subjected to stress—and driving in town appears to be a particularly stressful situation. It has also been noted that people with a 'go-getting' more aggressive type of personality have higher peaks of noradrenaline activity in their blood than types with a quieter more subdued personality.

Noradrenaline has a number of powerful effects in the body; it brings about a rise in blood pressure by contracting the walls of the blood vessels supplying the skin, the skeletal muscles and the viscera, and because of this rise in pressure it causes the heart to slow down. But it also has another important effect—which is highly relevant to stress and heart attacks—it activates an enzyme which breaks down the fats stored in the liver into their constituent fatty acids and glycerol.

These fatty acids, now in their free form, pass into the circulation where they get carried to the heart. Noradrenaline also antagonizes insulin's action in controlling the entry of glucose into the cells of the body. Thus one of the basic sources of energy is no longer so readily available to the cell.

Dr Michael F. Oliver and his colleagues at the Royal Infirmary in Edinburgh have made a very careful study of patients being treated for heart attack in the hospital coronary unit and they have come up with a highly plausible theory as to the action of free circulating fatty acids on the heart.

"Normally," they point out in *World Medicine* (1970) "the myocardium (heart muscle) burns glucose as a source of energy, but should the blood contain elevated levels of free fatty acids it begins to turn to these substances as a source of energy. And to burn off fatty acids requires considerably more oxygen than is used in metabolizing glucose.

"A healthy heart can usually cope with the metabolic requirements of the free fatty acids. Some it burns off to supply it with energy and the rest it packages into the cells as fat. In fact, to convert free fatty acids into fats also needs energy and this is supplied from the free fatty acids that are being metabolized to carbon dioxide and water."

In the affluent industrialized nations very few people by the time they are approaching middle age have what might be called a "healthy heart". Usually they are showing some of the signs of degenarative disease—hardening of the arteries and the porridgy plaques (atheroma) caused by accumulations of cholesterol and other substances. Under these circumstances the blood circulation to the heart tends to be reduced and the myocardium becomes a little short of oxygen. If a stressful situation arises the myocardium has to cope with the onslaught of fatty acids without really having sufficient available oxygen.

"Then," says Dr Oliver, "the myocardium which might have been only mildly short of oxygen before the stressful situation will suddenly find itself suffering an acute shortage. And because of this shortage free fatty acids begin to accumulate in the myocardial cells where they remain unconverted into neutral fats."

Fatty acids *en masse* will make the cell become more acid, and at a certain point the cell ruptures and dies. If sufficient cells die in this way the action of the myocardium is drastically impaired.

Dr Oliver and his colleagues, Drs V. A. Kurien and T. W. Greenwood, have obtained substantial clinical evidence that high levels of fatty acids cause striking disruptions of the normal heart rhythm in patients who have just previously suffered a heart attack. Indeed those patients with very high levels of these fatty acids tend to die despite intensive care.

In one study Dr Oliver and his colleagues measured the serum fatty acid levels in 200 patients during the first 48 hours after an acute heart attack (myocardial infarction). The levels varied between 500 micrograms per litre (more or less normal) to above 1,200. At the highest levels found—1,200 and more—94 of the patients had serious abnormalities in the heart rhythm and 33 per cent, of them died within a short time of the heart attack (*Lancet*, 1968, *1*, 710).

They also carried out research on the action of fatty acids in dogs which had been given a myocardial infarction experimentally by blocking off part of the coronary arterial system. To get the high levels of free fatty acids they injected a fat emulsion and heparin—a substance which is not only a natural anti-coagulant but also causes the fat to break down into free fatty acids.

Dr Oliver and his researchers obtained unequivocal results—the very high levels of free fatty acids produced in the circulation caused abnormalities in the heart rhythm in those dogs with experimentally induced heart attacks, whereas they caused no such effect in normal healthy dogs (*Lancet*, 1969, *2* 185).

But how do these experiments relate to stress? The answer lies in some studies carried out by Dr Walter Somerville, Dr Peter Taggart and David Gibbons in the Department of Cardiology, the Middlesex Hospital, London. They accompanied drivers for about 20 minutes in the West End of London and they recorded their electrocardiograms (ECGs).

Even subjects with no history of heart-disease and a normal ECG were affected by driving in the heavy traffic around Piccadilly Circus and Trafalgar Square. Indeed most of them developed an accelerated heart beat—the highest recorded being in the range of 150 per minute. A small number of drivers showed more fundamental changes in their ECG patterns, changes indicative of incipient oxygen lack.

But by far the most dramatic changes were seen in those drivers with known coronary heart disease who developed extra ectopic beats, significant abnormalities in the heart rhythm, sign of oxygen lack in the myocardium, angina pectoris and in one case pulmonary oedema and left ventricular failure. Nearly all had an accelerated heart-beat —the highest recorded being 180/min.

Although Dr Somerville and his colleagues failed to find any striking changes in the noradrenaline levels in four drivers tested—three with heart disease and one normal—other research has shown that ordinary driving increases noradrenaline and adrenaline secretion in the body by 80 to 100 per cent. But the Middlesex Hospital cardiologists did measure the noradrenaline and adrenaline levels in a number of healthy racing drivers both during a race and some time afterwards. In all cases they report in the *British Medical Journal* (1969, *4* 130) the levels were significantly raised at the end of the race compared with the normal levels—sometimes by as much as 20 times.

Obviously the racing drivers were healthy and the very high levels of fatty acids in the circulation appeared to cause no harm. But what would happen to someone with advanced degenerative heart disease? The conclusion seems inescapable—he would have suffered dangerous abnormalities in his heart rhythm and conceivably could have had a fatal heart attack.

In fact coronaries are now the main cause of death in the affluent industrialized nations and younger people are being struck down in their prime to an increasing degree, most of them without any sign at all of a true "coronary thrombotic episode". It is apparent that cushy living and stress make for a highly lethal combination.

*Peter Bunyard*

## New voice for the Southern Sudan

*The Grass Curtain* is a new periodical produced by a group of Southern Sudanese, who are disturbed by the almost total silence on the sufferings of their people.

Since 1955 about a million of them, Negro and largely pagan, have died in the fighting against the Arab North. The total population now stands at 4 million, including 500,000 refugees (who have fled to Ethiopia, Uganda, Kenya, Congo-Kinshasa and the Central African Republic), but not counting 30,000 Arab troops.

The conflict has arisen because the South, which ethnically and culturally has nothing in common with the North, has long wanted federation, which the North has half-promised but never done anything about, rather than full union as at present. Now, according to Mading de Garang, the editor of *The Grass Curtain*, the Nile Provisional Government (the Southern leadership) are willing to negotiate a settlement. They feel the wisest solution is for a referendum to be held, under the watchful eye of the Organization for African Unity (OAU) to permit the South Sudanese to show for themselves whether they want union with the North, federation, or complete separation.

Although the Khartoum Government is powerfully supported by Moscow (not long ago they completed a £40 million arms deal), Mading de Garang is confident of victory in the end. Already the Nile Provisional Government hold 80 per cent of the Southern Sudan. Their military arm, the Anya-Nya, besides obtaining arms through the black market, is getting quite good at capturing East German, Czech and Russian weapons from the enemy. It also has the moral support of a number of sympathetic governments and religious organizations.

However, they cannot go on for ever. The South is made up of a large number of different Nilotic, Nilo-Hamitic and Sudanic-speaking peoples, the best known groups of which are perhaps the Dinka, Bari, Nuer, Shilluk and Azande. After fifteen years of war, community life has been seriously disrupted, and many of the tribes have broken up completely. It is estimated that if the war goes on for another 20 years there will be an irreversible breakdown of the social structure. This would not mean victory for the government of the North, merely that the task of repairing a broken land would be next to impossible.

What will happen if the Southern Sudanese win independence? Mading de Garang is fully aware that the fissile processes all Africa fears, and of which he is now a part, could be faced by an independent Southern Sudan. It is possible, he concedes, that once the Arab threat has subsided, one or two of the tribal groupings might themselves wish to break away. However, he thinks it

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# THE ASSAULTS ON OUR SENSES

## John Barr

The British in 1970 are members of a highly advanced industrial society living on a crowded island. Each of us may feel at times that his eyes, ears and nose are intolerably assaulted by ugly townscape, despoiled countryside or the noise and smells which go with much of modern life. Our senses of taste and touch are offended by the drabness and uniformity of mass-produced foods and artefacts.

John Barr's book is a critique of the outrages which characterize our environment in the seventies and offers an account of how they arise and how they can or could be controlled without abandoning the aims of technological progress or individual freedom. Illustrated with 21 halftone plates. 50s

METHUEN

RALPH STEADMAN

# Comments

## The worship of artifacts

An oil painting of an Indian cheetah by the celebrated 18th century animal painter George Stubbs was sold for £220,000, at Sotheby's last month. Institutions and international tycoons bid against each other to secure possession of this brilliant representation of an animal that is now extinct. With the passage of time and with the proviso that the human race survives at all, there may well be other painters of Stubbs' calibre, but the Indian cheetah is a masterpiece that has gone for ever, destroyed by his distant cousin—man. Soon the Indian rhinoceros that Albrecht Dürer drew so skilfully will have vanished from his last redoubts in Nepal and Assam. The superb Barbary lion that inspired Delacroix and Barye after him, is now only a dim memory. The last one was shot in 1909 in the Djebel Sarro in Morocco. I have a suspicion that Stubbs, Dürer and Delacroix would be deeply disturbed if they knew that their paintings were fetching sums in the open market today which, if allocated to conservation, might be instrumental in saving some of the great beleaguered mammals from the fate that the more short-sighted of us have lined up for them.

The educational and religious processes of Western culture have imprinted a whole range of pseudo-concepts on to the human psyche. One of the most pernicious of these is anthropocentric evaluation; the outcome of which is the absurdly exaggerated importance we place upon man-made artifacts together with a tragic lack of appreciation for the incomparably greater marvels of evolution. The Apollo rocket and the Boeing 747 are jejune and artless toys compared with the swift and the frigate bird; the former of which can actually mate in the air, while the latter can fly for six months without landing. Both, one must add, contribute to the purity and justice of the environment, whereas the hideous man-made behemoths pass their brief lives in a welter of nauseous gases and toxic effluents, and make inroads into the dwindling supply of fossil fuels and minerals filched from the lithosphere.

If St Peter's Cathedral in Rome or St Paul's in London were in need of repair, millions in cash would be forthcoming instantly, but to try to raise money to conserve nature's architectural miracles such as the Sequoias of California is up-hill work. The Redwood tree, *Sequoia Sempervirens* and the Wellingtonian Fir, *Sequoia Gigantea* are the largest of all animate things and the longest lived. Some were seeded a thousand years before Christ was thought of and no botanist can tell you how long they will live or how they can ever die. Neither lightning, insect, nor fungus can penetrate their resinous bark. They live breathing out munificent quantities of oxygen and so creating a micro-climate in which many lesser organisms find refuge.

The nuclear submarine and the supertanker are much admired by technologists, but how do they compare with the pelagic whales? Cousteau tells us that the dumping of a million tons of oil a year is destroying the Mediterranean and he assures us that radioactive waste is disrupting the life cycle of the oceans so that they may well collapse completely within a generation.

The ruling elites of today, gorged with a mish-mash of *idées reçues*, most of which have been proved false within the last century, are hardly fit to diagnose, let alone counteract the maladies that afflict the biosphere today—and threaten the equation of life itself.

The whole process of language seems to have conspired to perpetuate the fraudulent myth of man's innate superiority over the organic world. "Bestial", "beastly", "brutal", "brutish", tell us their own sorry tale, shored up as they are by an idiomatic host, uniformly pejorative in implication. The painstaking work of modern ethologists such as Lorenz, Carpenter, Schaller and Goodall, to name but a few, leave us in no doubt at all as to where aberrant and deviant behaviour is most in evidence today. Linnaeus could never have guessed the magnitude of his blunder when he proudly named his own species. I would suggest a taxonomical revision, less succinct, less flattering, but more to the point—Homo Rapiens Spoliator Ferox.

To end on a more hopeful note, the World Wildlife Fund has just reported several important gifts, £100,000 from the Merchant Bankers—Kleinwort & Benson—£250,000 and £100,000 from anonymous donors, one of whom wrote, "that the most important 'cultural' activity in need of support today must be the conservation of rare species".

## The vulnerability of our technological environment

The nightmarish situation brought about by the breakdown of the slaughterhouse facilities in Cape Town earlier this year gave us yet another glimpse of the extreme vulnerability of a society that depends too much on technology for its livelihood.

An estimated 510 cattle-trucks, containing about 20,000 cattle, sheep and pigs, were all piled up in the intense summer heat. Since there were no facilities for providing the animals with either food or water, it was not surprising that

they were dying like flies. It appears that, in spite of the frantic efforts of engineers and animal welfare officers, railway sidings were littered with the carcases of animals collapsing and dying in the oven-like cattle-trucks.

A further glimpse of our vulnerability was provided by the "heating emergency" in New York. According to Mayor Lindsey, "Breakdowns of heating plants have occurred in such numbers as to present a serious health problem to the citizen of New York".

Over 100,000 complaints were registered by families shivering in unheated flats in temperatures just above zero.

It is important that we realize that all processes, whether "natural" or technological, are subject to accidents. A 100 per cent rate of success is impossible. However, technological processes are vastly less perfect than "natural" ones, and correspondingly more susceptible to accidents.

In addition, as we create for ourselves an elaborate technological or "controlled" environment to replace the one we are so irresponsibly destroying, so we become proportionately more dependent upon it.

We must not forget what happened in New York only a few years ago during the famous great blackout. The whole life of the city came to a standstill. Office workers were stuck in lifts half-way up skyscrapers. Transport ceased, and the city was plunged into total darkness. People were so shaken that some thought that there was an invasion from Mars, others that the world had come to an end.

But think what could happen in the future, if the projects of those called upon to direct the fate of our societies actually materialize. Imagine what it will be like when after our fresh water supplies have been exhausted, we depend on desalination plants for our drinking water, when agriculture has totally given way to ever more ingenious forms of factory farming, and when the natural mechanisms providing us with the air we breathe have been so completely disrupted that vast installations are needed to pump oxygen into the atmosphere and filter out surplus carbon dioxide.

It must be clear that under such conditions, the slightest technical hitch or industrial dispute, or shortage of some key resource, might be sufficient to deprive us of such basic necessities of life as water, food and air.

There is a law of nature, from which, in our presumption, we consider ourselves exempt: organisms that obtain mastery over their environment become over-specialized and thus too dependent on the perpetuation of the very conditions that their success has brought about and to which they have adapted with so high a degree of perfection.

As a result, they are at the mercy of the slightest environmental change that might create a situation to which they no longer have the means of adapting. Man is even more vulnerable in that the very specialized environment on which he has become so dependent can only be maintained by ever more elaborate technical processes. These, however, spectacular they may be, are in fact very clumsy compared with those of nature and are much more susceptible to accidents. As a result, part of the price we must pay for our "success" is ever increasing vulnerability.

## Food, farmers and finance

If farmers were to be paid a salary of £1,500 a year, plus a return of 15 per cent on their capital, the overall cost would be in the region of £650 million in the coming year. This is the sum they feel is due to them. It would give a total income of around £3,200 a year on an average 200-acre farm. In fact, farmers' incomes have been falling, and that is what all the demonstrations have been about. The most successful farms, and there are only 82 of them, made less than £3,200 (per 200 acres) in 1968. Some earned as little as £750.

The annual farm price review was announced on March 18th. The National Farmers' Union, claiming on behalf of its members, demanded the difference between present actual incomes and their ideal £650 million. This meant an increase from the government of £120 million, a figure which could be reduced to £100 million if the award went mainly to increase the prices paid for produce.

The government has given the farmers a total increase of £85 million, ranging over all the guaranteed prices, subsidies and grants and benefiting most types of farm but especially the cereal grower. The cost to the taxpayer of the British agricultural support system will be £337 million in the coming year.

The NFU has rejected the award and the whole matter has been referred to the Prices and Incomes Board. The demonstrations may begin again.

Price review agriculture is riddled with anomalies, quite apart from the obvious one that the price of food in the shops is kept artificially low by subsidies paid from taxes. If the farmer produces the larger yields he is told to produce the price falls, in which event deficiency payments are made. Thus, the more he grows the more he must be compensated from the Treasury. In order to grow more and more he is encouraged by the Ministry, and particularly by the manufacturers, to use ever-increasing amounts of artificial fertilizer. There is an enquiry at the present time into the possible deleterious effects of heavy fertilizer applications. In the interests of efficiency, livestock tend to be housed indoors, on concrete, to be managed by specialists, while their feed is grown elsewhere, by other specialists. It is the age of the specialist. The livestock farmer now has serious, and growing, problems in disposing of his effluent (one cow produces as much effluent as five humans) while the cereal grower is short of organic matter to maintain his soil structure.

In many areas British agriculture overproduces. This is one problem our farmers share with their colleagues in the Common Market countries. British economists have suggested it would be cheaper to close down our farms altogether, re-direct the capital into industry and import our food from primary-producing countries. The mind boggles. In Europe the Common Market's advisers suggest taking large areas out of agriculture, closing down small, inefficient farms and encouraging the large "modern", intensive ones.

Perhaps it is time we all sat back and thought a little about what farming is, or ought to be, about. No one seems to bother about the nutritional quality of the food produced, or the health of the consumer, or the fertility of the soil on which it is all based. A grassland subsidy, for example, would encourage farmers to grow pasture, so helping structure, and to keep livestock out of doors, which would help with the effluent problem. Maybe next year!

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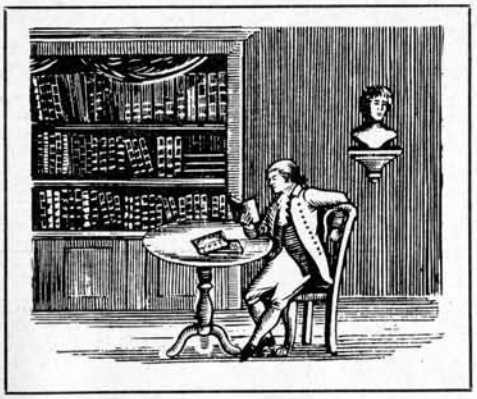


# Books

## Key Book

*Every month a key book in the field will be described and analysed in this column*

### Rehabilitation of the hunter-gatherers

MAN THE HUNTER *by R. B. Lee and I. Devore (Eds.). Aldine Publishing Company, Chicago 1968.*

Some 75 scholars, social anthropologists, human biologists, archaeologists, demographers and ecologists, participated in the *Conference on Man the Hunter* held at Chicago University in 1966. The results are embodied in *Man the Hunter*, thirty papers with discussions (grouped under the headings, Ecology and Economics, Social and Territorial Organization, Marriage and Models in Australia, Demography and Population Ecology, Prehistoric Hunter-Gatherers, and Hunting and Human Evolution) which bring home the immense importance of hunter-gatherer studies, and provide us with an invaluable reappraisal of Man the Hunter.

Lee and Devore, in the opening paragraphs of their introduction, leave us in no doubt of the book's significance: "Cultural Man has been on earth for some 2 million years; for over 99 per cent of this period he has lived as a hunter-gatherer. Only in the last 10,000 years has man begun to domesticate plants and animals, to use metals, and to harness energy sources other than the human body. *Homo sapiens* assumed an essentially modern form at least 50,000 years before he managed to do anything about improving his means of production. Of the estimated 80,000,000,000 men who have ever lived out a life span on earth, over 90 per cent have lived as hunters and gatherers; about 6 per cent have lived by agriculture and the remaining few per cent have lived in industrial societies.

To date, the hunting way of life has been the most successful and persistent adaptation man has ever achieved. Nor does this evaluation exclude the present precarious existence under the threat of nuclear annihilation and the population explosion. It is still an open question whether man will be able to survive the exceedingly complex and unstable ecological conditions he has created for himself. If he fails in this task, interplanetary archaeologists of the future will classify our planet as one in which a very long and stable period of small-scale hunting and gathering was followed by an apparently instantaneous efflorescence of technology and society leading rapidly to extinction. "Stratigraphically", the origin of agriculture and thermo-nuclear destruction will appear as essentially simultaneous."

Other contributors spell out the phylogenetic implications: "our intellect, interests, emotions and basic social life —all are evolutionary products of the success of the hunting adaptation . . . the biology of our species was created in that long gathering and hunting period" (Sherwood Washburn and C. S. Lancaster); "hunting is the master behaviour pattern of the human species" (William Laughlin); "much of the genetic equipment of contemporary man is likely to have been shaped by the selective pressures of the hunting and gathering era" (David Hamburg). Indeed "for those who would understand the origin and nature of human behaviour there is no choice but to try to understand 'Man the Hunter'" (Washburn and Lancaster).

Unfortunately, space does not permit a proper consideration of more than one or two of the many remarkable contributions to our understanding presented in this symposium. One of the most interesting is Richard Lee's chapter, "What Hunters Do for a Living", in which he helps to explode two prevailing misconceptions, one that hunter-gatherers primarily depend on meat, the other that their existence is, in the words of Hobbes, "nasty, brutish and short".

Lee shows that amongst the !Kung Bushmen of the Kalahari Desert plant foods comprise from 60-80 per cent of the total diet by weight. Meat is regarded as a special treat, and is welcomed as such but never depended on. This is an adaptive response to the greater dependability of plants as a food source over animals—animals are unpredictable and difficult to catch, plants on the other hand are predictable and stay put. A comparison of productivity per man-hour is illuminating: "One man-hour of hunting produces about 100 edible calories, and of gathering, 240 calories. Gathering is thus seen to be 2.4 times more productive than hunting. In short, hunting is a *high-risk, low-return* subsistence activity, while gathering is a *low-risk, high-return* subsistence activity" (Lee's italics). The !Kung Bushmen cannot be regarded as exceptional, for in a survey of hunter-gatherers throughout the world, Lee demonstrates that "except for the highest latitudes, where hunting contributes over half the diet in many cases, hunted foods almost everywhere else constitute 20 to 45 per cent of the diet. In fact, the mean, the median, and the mode for hunting all converge on a figure of 35 per cent for hunter-gatherers at all latitudes."

It is interesting that one of the few societies shown to approximate more closely to Hobbes' description of "primitive" life were the Netsilik Eskimo who, like other central Arctic peoples, subsist on a diet almost totally devoid of plant foods. As Marco Bicchieri pointed out, "the chances of productive failure, everything else being equal, are halved by a mixed hunting-gathering exploitation. . . . Thus the Kalahari Bushmen, with a hunting *and* gathering subsistence base are likely to resist environmental failures more readily than . . . the Cop-

per Eskimo who have to rely solely on hunting." It is only in the higher latitudes that we find man the hunter, in the middle and lower latitudes he is man the "eclectic subsister".

Lee attests to the abundance and reliability of the food resources available to the Bushman. There are 85 species of fruits, berries and melons and 30 species of roots and bulbs; all are edible and eaten, although 90 per cent of the vegetable diet is taken from only 23 species. As with vegetables so with meat: of the 54 species of animal classified by the Bushmen as edible, "only 17 species were hunted on a regular basis". This rich variety gives the Bushmen a wide range of alternatives and a good safety margin in time of potential want. Again his position is unexceptional: Colin Turnbull writes of the Mbuti Pygmies of the Congo, "Famine or anything approaching it is utterly unknown to the Mbuti who have an axiom that 'the only hungry Mbuti is a lazy Mubti' "; and James Woodburn of the Hadza of northern Tanzania, "For a Hadza to die of hunger, or even to fail to satisfy his hunger for more than a day or two, is almost inconceivable," and, "when tracking an animal wounded by a poisoned arrow, it will commonly be abandoned if it is not found in one day's tracking". Not the attitude of the anxiously hungry.

The nutritional soundness of hunter-gatherer diet also seems to have been confirmed. No signs of kwashiorkor, nutritional marasmus, rickets, infantile scurvy or vitamin B deficiency (often found amongst the malnourished of the tropics) were observed. The Bushmen and the Hadza seemed altogether better off than their agricultural and pastoral neighbours, largely because the wild plants yielded more regularly and reliably than cultivated ones.

The Bushmen studied by Lee were fortunate enough to live in the natural habitat of the mongongo (or mangetti) nut (*Riconodendron rautanenii* Schinz), of which "although tens of thousands of pounds . . . are harvested and eaten each year, thousands more rot on the ground each year for want of picking". The mongongo, because of this abundance and reliability, accounts for about half the plant diet by weight, but its nutritional qualities are even more considerable: "The average daily *per capita* consumption of 300 nuts yields about 1,260 calories and 56 grams of protein. This modest portion, weighing only about 7.5 ounces, contains the caloric equivalent of 2.5 pounds of cooked rice and the protein equivalent of 14 ounces of lean beef." One would like to know the amino acid balance of these nuts, and whether or not it would be worth while growing them in other arid lands where drought-resistant, rot-proof crops are required. And one can well appreciate why a Bushman, asked why he hadn't taken to agriculture, replied, "Why should we plant, when there are so many mongongo nuts in the world?"

"Work" or food-collecting takes up an extraordinarily small proportion of the hunter-gatherer's time. The !Kung Bushmen work on average six hours a day for a two and a half day week (rarely more than twenty hours a week). Hadza men seem to spend most of the resulting spare time on gambling, which (in the dry season) takes priority over hunting! Bushmen women will rest in camp, visit other camps, entertain visitors or do embroidery. The men, since hunting is so unpredictable and (relatively) unproductive, may work very hard for a week and then do nothing for a month (depending on a mixture of luck and inclination). When resting they, like the women, will visit or entertain. An important feature of their lives is the trance-dance. Over half the men in a camp will be medicine-men or trance-performers, and if a man has gone into a trance the night before it is unlikely that he'll go hunting the next day.

Life is plainly neither nasty nor brutish. It isn't short either: out of one group of 466 Bushmen, 17 men and 29 women (46 individuals in all) were over 60 years old, which compares favourably with the proportion of elderly in industrial societies. Furthermore, "long after their productive years have passed, the old people are fed and cared for by their children and grandchildren. The blind, the senile, and the crippled are respected for the special ritual and technical skills they possess. For instance, the four elders at !gose waterhole were totally or partially blind, but this handicap did not prevent their active participation in decision-making and ritual curing."

In the light of this new evidence, Marshall Sahlins was led to reconsider our notions of affluence, and to pronounce the hunter-gatherer as the "original affluent society". He pointed out that there are two ways of satisfying wants, either by producing more, or by desiring less. Our assumption that the hunter-gatherer's lot must be hard is based on the theory behind all market economies—that man's wants are infinite and can with difficulty be satisfied. The enviably short working-hours and freedom from anxiety of the hunter-gatherer must be based on a contrary philosophy—that man's wants are few and easily satisfied. The immense sophistication of our technology serves not to satisfy our needs but to increase them. The simple technology of the hunter-gatherer is perfectly adequate while he lacks the burden of our bourgeois impulses. It also has a much less radical effect on the environment.

There is much else besides in *Man the Hunter* to make us reconsider ourselves and our "development" from the hunter-gathering stage. Modern hunter-gatherer studies will have much to teach us about our fundamental attitudes and responses to territoriality, leadership, social controls, the resolution of conflict, and group psychotherapy, among others. Already, a good deal of stimulating data has been presented in this symposium, but there is very much more to be learned.

Further research is a matter of utmost urgency, for fewer and fewer unacculturated hunter-gatherers remain. There are a few beleaguered enclaves of them in South America, Africa and the Far East, but in India and Australia they have largely disappeared. In many places, for example in North America, they are struggling to retain the essentials of their culture, and it is fitting that Sol Tax, the Chairman of the *Conference on Man the Hunter*, should have referred to them in his final words: "we should study the reasons for the persistence of these peoples all over the world in the light of all the conditions militating against their persistence. I think that the case of the North American Indians is especially significant.

They seem to be waiting for us to go away. I am certain that there is something for us peasant agriculturalists or, if you like, industrialists to learn from the values associated with the tribal life and with the determination of these peoples to preserve this way of life at all costs."

*Robert Allen*

## Conservation commitment

THE ENVIRONMENTAL REVOLUTION *by Max Nicholson. Hodder & Stoughton, 1970. 84s.*

A book by one of the outstanding leaders in conservation, who was Director-General of the Nature Conservancy for 14 years and is still very active in the international field, is a major publishing event. Until the 1940s Mr Nicholson was mainly known as a distinguished ornithologist and it was not until the discussions leading to the 1947 Government White Paper on Wildlife Conservation that he became actively involved in the broader issues of land-use. Since then his commitment to conservation has become a passionate mission which has taken him to many parts of the world, presenting an unrivalled opportunity to assess the problems and dangers and to put his energies into promoting the growth of the movement.

This book is a very personal story, in spite of the array of facts, it is conservation as recorded in the remarkably perceptive and independent mind of a man who is utterly convinced of the rightness of his cause. This adds to its value in certain ways, but probably makes it less easy for the new convert to conservation to understand the problems in simple terms.

The opening chapters include too many historical digressions of marginal interest and the style of writing is often unnecessarily complicated. The rapid flow of ideas, facts and comments jostle each other in a disorderly fashion, forming a verbal curtain which obscures the outline of his main theme. It is rather like being presented with a magnificent menu at a feast and then finding that the meal which follows clogs up the digestion so that one needs frequent rests before chewing ones way to the next course.

The first three chapters deal with natural resources on a global scale and the use made of them by man. In chapter four, called "Seven Circuits Round the World", the author uses a novel and effective method of comparing land forms and environments in different parts of the world and the influence that man is having on them. However, it is not until chapter five, "The Marks of Man", that one begins to feel that, at last, the reader is getting to grips with the core of the problem.

This section is a wide ranging account of man's greed and folly and thoughtless exploitation of natural resources, from the earliest times, when his numbers were too few to cause real damage, up to the present industrial age when he has the power to bring about widespread catastrophe.

The following two chapters describe the "British Story" and the "American Story" in the development of conservation. The former seems to miss out some of the important aspects of scientific thought which influenced conservation policy in Britain during its formative stage, and the latter stops just when it gets interesting. The historical events in American conservation history are already well documented and Mr Nicholson would have provided us with a most useful account if he had included an analysis of how conservation functions in America today. Very few people outside America know how many official and unofficial organizations exist there and the contribution that each makes to the total effort towards effective care of the environment.

Chapter nine, "Towards Worldwide Action", is an account of some of the more significant events in the world which have influenced the course of conservation. It includes the early attempts at international co-operation, the birth of the International Union for Conservation of Nature, the Antarctic Treaty (the only really effective international agreement) and catastrophic events such as the "Torrey Canyon" oil spill. The description of the last is a remarkable piece of rhetoric and it is followed by an equally impressive account of the Aldabra affair.

The style of writing changes so that it flows swiftly and directly and reaches its target with tremendous impact. One wonders how the events leading up to the tragedy at Aberfan escaped similar treatment.

The last two chapters, "Where We Stand Now" and "The Way Ahead", are probably the most effective in the book. Mr Nicholson recognizes the advances which have been made in recent years and the greater public awareness of the importance of an ecological approach to land-use even though this has been achieved largely as a reaction to a series of major pollution and pesticide disasters. Nevertheless, he thinks that ecologists have wasted many opportunities and failed to take advantage of the immense public goodwill which has developed in recent years.

Few effective leaders have been produced, he says, and too many professionals are content to pursue specialized studies remote from the main stream. In this context it is surprising that he does not examine the very poor record of the universities in undergraduate teaching of ecology. In spite of several post-graduate courses which are now available, ecological teaching at a lower level is pitifully inadequate and not likely to improve so long as university chairs in biology are filled from the ranks of molecular biology, biochemistry and bio-physics.

In fact, this policy seems to be directly contrary to what the students themselves want. They are now more conscious of the importance of science in social affairs than ever before. The universities, like the churches, do not yet realize that the Environmental Revolution has begun.

Mr Nicholson has no more sympathy for the politician, land manager and technician who, he says, because of lack of training and education are often completely unaware of the limits of tolerance of land. He comments that when decisions relating to conservation are left to them "they use modern technological resources to inflict vast and enduring injuries often on lands to which they are strangers sent in the sacred name of technical assistance".

This is an angry book and with good reason when one reads the dismal record of man since the beginning of the Industrial Revolution. The author points the finger of blame at both sides: one for failing to take up the challenge more effectively; and the other for greed, selfishness and ignorance. There are few grains of comfort for the future and, in fact, Mr Nicholson believes we are in the throes of a Great Siege of Nature which will last another 250 years.

At present it is by no means certain that man realizes the magnitude of the effort he must make if he is to survive long enough to enjoy the new civilization which could emerge.

*E. Duffey*

## Carbohydrate crisis

DIABETES, CORONARY THROMBOSIS AND THE SACCHARINE DISEASE *by T. L. Cleave,* MRCP(Lond); *G. D. Campbell,* MD(Edin), FRCP(Edin); *with the assistance of N. S. Painter,* MS(Lond), FRCS(Eng). *John Wright, Bristol, Second Edition, 1969. 21s.*

Civilized western man's adaptive responses lag well behind his ever-changing environment, and this failure to adapt is manifest in a variety of physiological and social inadequacies, or more pertinently, diseases. There are many examples of this principle. For instance, lung cancer may be viewed as a lack of adaptation to contact with cigarette smoke. Anxiety neurosis as a failure to adapt to emotional trauma. Crime as a failure to adapt to current social *mores*. This evolutionary view of the human condition is rapidly gaining wide acceptance, with an increasing demand for the return to a more natural environment as a solution to such problems.

The authors of the present book, now in its second edition, have used the evolutionary argument to tackle nutritional disease. They believe that the most important unnatural factor in western man's diet is the consumption of vast quantities of refined carbohydrate—notably refined sugars and white flour, and that it is a failure to adapt to this new factor which gives rise to a fundamental nutritional disorder which they have called "The Saccharine Disease". This all-embracing term includes not only obesity, dental caries and diabetes, which have long been linked to the over-consumption of sugar, but also coronary thrombosis, peptic ulcer, constipation, varicose veins and even piles. The concept is supported by evidence gleaned from the world's medical literature, and rests largely on the fascinating work by Dr Campbell himself on the epidemiology of these diseases in the tribal and urbanized natives of Natal.

The argument is simple, concise, and very persuasive. It is expounded with the zest, fervour and single-mindedness of a politician. Inconsistent and insubordinate facts are swept summarily under the evolutionary carpet where only a conscientious statistician would think of looking. However, there is no doubt this is an extraordinary and disturbing book. As Dr Richard Doll points out with muted enthusiasm in his foreword, if only a few of the authors' predictions prove correct they will have made a bigger contribution to medicine than most university departments make in a generation.

*Alan Maryon-Davis*

## Readers digestion

FOOD & SOCIETY *by Dr Magnus Pyke, John Murray, 1968. 30s.*

Dr Magnus Pyke takes the reader on a swift tour of his vast subject with the concise readability and eye for a telling anecdote that makes good TV features and *Readers Digest* articles. He relates food not only to our society but to others, and the unreasonable prejudice we have against *entomophagy*—the eating of insects—is contrasted with the fried silkworm pupae, tinned wasp grubs and roasted waterbeetles of modern Japan, and the ritual meals of primitive tribes that are the anthropological background to the "working lunch".

This is a book for the general reader but with well-selected references so those who are seriously interested can follow the subjects further. In an excellent chapter "If It's Poisonous, Why Eat It?" Dr Pyke makes the point that Sir Walter Raleigh would never have been allowed to import the potato in this cyclamate-banning age, when the 400 parts per milliom of green ones has caused serious outbreaks of poisoning. Kale, cabbages, brussels sprouts and broccoli all contain oxazolidene which prevents the thyroid gland from accumulating iodine, so could cause goitre. Onions contain an alkaloid that can produce symptoms like pernicious anaemia in unlucky over-sensitives; broadbeans may be deadly to those whose red blood cells lack a certain enzyme, and the oxalic acid in spinach and rhubarb which merely locks up our iron and calcium in normal quantities, can kill in excessive quantities.

It is easy to avoid eating rhubarb leaves or green potatoes, the onion and bean risk depend on rare conditions while through centuries of cabbage eating we have become acclimatized to the goitre-producing substance, but our bodies have had no time to develop distant early-warning systems for food additives and pesticides accumulation. The subtitle of this book is "Fact, fallacy, religion and folk-lore—The background to scientific nutrition", and the reader soon finds that his own beliefs or his specialized knowledge, can fail to qualify as "Fact" from the standpoint of Dr Pyke who is a food technologist, determined to poke fun at the "superstitions of the unorthodox". His technique of quoting the earliest authorities on the other side, and the modern on his own, is also that of anti-vivisectionists and nature cure writers arguing with the medical profession.

The belief that plants obtain their food from humus was certainly discredited by Baron Von Liebig in 1840, but it does not "persist even to this day". Both the Directors of Rothamstead and Haughley are well aware that plant food minerals and trace elements are as essential to the growth of crops as carbon-dioxide or humus. They differ only in the importance they give to the last item, and the value of the minerals in the compost. Quoting Graham (of the American Graham cracker) and Widdowson and McCance on the relative values of brown and white bread, and neglecting later authorities, is as important as missing out *taste* and how much less bulk is required in a whole-meal better-flavoured loaf. Several million people think modern bread tasteless but thousands now bake their own and use half as much wheat to do it.

To the food technologist, our modern processed diet today, and our still more processed one tomorrow, should be entirely adequate, but Dr Pyke neglects the cooking, which can destroy up to half the vitamin C (even 80 per cent in hospitals with a long delay between kitchen and patient) and the many modern medicines that can lock up the vitamins in our food, especially liquid paraffin which makes A, D, E, and K unavailable. To balance his vitamin C lock-up, a smoker should eat one average orange after every two cigarettes.

Opposers of fluoridation are scorned, but without any discussion of the quantities of fluorine in tea that make it superfluous in Britain except for children below tea-drinking age, who drink a tiny proportion of our water compared with the 400 tons for every ton of synthetic rubber and 160 for a ton of paper. *Betain*, that useful choline substitute for Vegans and vegetarians, is ignored and so is *catalase*, the protective factor against cancer that cooking destroys.

Perhaps this is carping criticism, for Dr Pyke is entitled to his prejudices like anyone else. He has written a useful, interesting and often amusing book, as

easily assimilated as a plateful of puffed wheat with white sugar, synthetic cream and homogenized milk.

*Lawrence D. Hills*

## Ecology in paperbacks

FOOD RESOURCES CONVENTIONAL & NOVEL, *by N. W. Pirie*, 5s.
SILENT SPRING, *by Rachel Carson*, 5s.
HUMAN GUINEA PIGS, *by M. H. Pappworth*, 7s.
THE WASTE MAKERS, *by Vance Packard*, 5s.
MAN AND ENVIRONMENT, *by Robert Arvill*, 10s. 6d.
DERELICT BRITAIN, *by John Barr*, 7s.
**Penguin Books Ltd.**

This selection of paperbacks, read together, serves to show just what a mess we have made of our planet, each book attempting to find a solution to the particular problem that it poses. Taken together they demonstrate the errors of the past, the lethargy of the present and the blackness of the future.

Each book directly or indirectly puts the original blame for the present state of affairs fairly and squarely on the shoulders of short-sighted Industrial Revolutionaries; "Man and Environment", "Derelict Britain" and "The Waste Makers" directly, "The Silent Spring", "Food Resources Conventional and Novel" and "Human Guinea Pigs" indirectly. Nineteenth century liberalism and rapid technological advance have produced an atmosphere in which an artificial concept (economics) rules the day, and where morals, in all senses of the word, have shrivelled so badly that, regardless of the cost in terms of natural beauty, health or survival, the "survival of the fattest" has become the doctrine by which we now live.

As if this is not bad enough, there have been about another 40 years of scientific advance in addition to this, and so rapid has it been that not even the scientists themselves can keep up with all the progress made. We are now forced to live in the age of the specialist, and the notion that each knows "more and more about less and less" has brought with it an alarming lack of interest in the other man's problem; a lethargy for which we are all responsible.

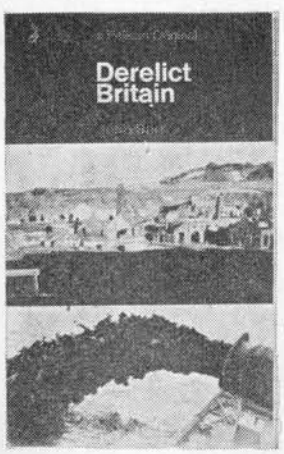
So the future, according to our six authors, is indeed a black one. Pirie warns of the maldistribution of world protein leading to wide-spread famine. Rachel Carson's magnificent book convinces us that among other things, what food we shall be capable of producing will be virtually unfit to eat. Those foods that merely make us ill, Pappworth loudly contends, will provide doctors with even more excuse for human experimentation. If we survive all this, then all we have to look forward to, according to Messrs. Arvill, Barr and Packard, is a devastated countryside, chequered by superb motorways but devoid of flowers, trees and fresh green fields, where we can drive our fashionable, obsolescence-planned cars in and out of the slag-heaps.

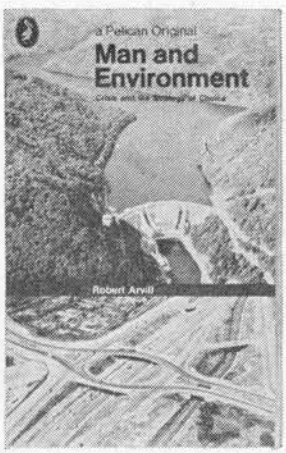
Back in the relatively secure comfort of the present, the situation, as shown by the six books, seems at first glance to be a frustrating one, for all the authors agree on one thing; that it is as impossible to inform those ignorant that they are doing wrong when their socio-political system actively precludes them from doing what is right, as it is to try and induce a sense of urgency into those too lazy to make the effort (when their local authority makes everything easy for them). So what the books all recommend is a change of outlook, not just by individuals, although these are the people who will eventually change our world, but by the politicians and educationalists. This much-needed change of attitude must start with those people who are in the best position to educate others. The Lower Swansea Valley Project is a twice-quoted example of the intensity of persuasion that is required in order, simply, to get things done.

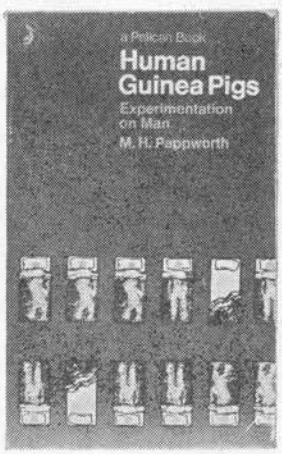
On the whole this selection makes distressing reading, for we can all see only too plainly the effects of too rapid an advancement in the way we conduct our lives. The world has very nearly outgrown its strength and badly needs a rest. But none of the authors believes that we can return to the day when everything in the world's garden was lovely. It is made more than plain that we have already gone too far. We may be able to add more variety to certain geographical "blocs" by, for example, preserving—or rather re-establishing—an ecological balance when we vary the type of crop, and thereby its dependence in any one area, but though this could eliminate the need for, say, insecticides, the amount of study that would make any such venture successful, would not at the moment elicit effective financial support. We cannot positively *return*, say our authors, we can only modify. We must not, however, simply adapt to suit our surroundings. We must try to make our surroundings better places in which to effect constructive rather than haphazard progress.

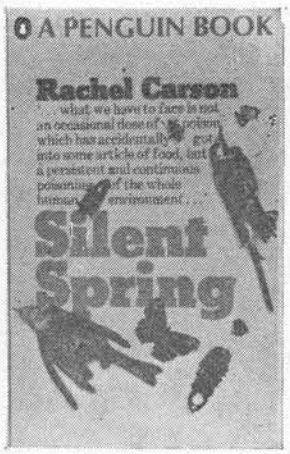
This selection of Penguins paints a grim picture, but it does give us a starting-point from which we can begin thinking about the future in realistic terms. It fills us in, with sometimes alarming frankness, notably Rachel Carson and Pappworth, on the background knowledge necessary for constructive thought, and if life in the future is to have any meaning at all, then the books are not only to be read, but are to be acted upon as well. Soon.

*Nicholas Rawls*









*cont. from page 40*

## Should man live longer?

In his interesting article "Longer Life by 1990" (*New Scientist*, December 11th 1969), Dr Alex Comfort, head of the MRC Group on Ageing, at the University College, London, claims that 40 million dollars are spent every year in the United States alone on research to prolong the human lifespan. Throughout his article, Dr Comfort appears to consider this a good thing, and he announces with pride that we can expect a 10 to 20 per cent increase in lifespan in the not-too-distant future, even before we develop the ability to control cancer. It is only in the last paragraph that he suggests that "We might do well to start considering psychological, political, business and demographic implications of increasing the lifespan—just in case." He is admitting, in fact, that we are busy trying to bring about a change without knowing what the effects of this change are likely to be.

This is typical of the blithely unscientific way in which things get done in our society, the approach that has led to the present environmental crisis. Surely it is not unreasonable to suggest that before making so serious a change—to enable people to live 6 or 12 years longer—one should first determine what the effects of this change are likely to be. It will be objected that to prolong human life must be good *per se*, and that to suggest otherwise is inhumane. Undoubtedly, we all have a powerful instinct for self-preservation. We also nurture a belief in the sanctity of human life. For these reasons, we think that the preservation of human life, and hence the increase in longevity, must be good *per se*. This is an instinctive or emotional approach to the problem, not a scientific one. The scientists must realize that nothing is good *per se*.

Things can only be judged by their effect on the system of which they are part. At any given moment, there must be an optimum value for any of the variables in terms of which a system can be described if it is to fulfil its functions within the larger system of which it is part. The variable *longevity* is not exempt from this rule. Admittedly, small deviations from the optimum are tolerable, more radical ones, however, must undoubtedly have side-effects.

The evolutionary process, as it happens, is remarkably effective, and our knowledge of it is so pathetically inadequate as to make interferences of this sort highly presumptuous. It must be remembered that death, contrary to what many people think and certain scientists have said, is not a disease. It is a highly adaptive process.

The fruit-fly has one generation every two weeks. Each one is that much more adapted to dealing with the changing environmental conditions in which it finds itself. If the longevity of the fruit-fly were doubled, it would be that much less adaptive, because its evolutionary processes would be that much less differentiated—unless, of course, it underwent many other compensatory changes. If we can afford to live longer than fruit-flies, it is because we have developed other adaptive mechanisms, such as a big brain.

Now, if man's longevity is to be further increased, what compensatory changes are we going to introduce to enable him to maintain his adaptiveness? It is clear that none is proposed, and, in fact, none can be until we have determined what are the full implications of such a change at all levels of organization.

Such an inquiry might provide a better method of spending at least part of the 40 million dollars.

## Who's to blame?

Professor P. B. Checkland of the Department of Systems Engineering at Lancaster University, in his recent inaugural lecture, put forward the view that things that are technically possible have the habit of getting done. "The Concorde Project," he maintains, "goes ahead not because we want or need to get to New York in three hours, but because it is technologically possible to do so."

I think this needs qualification. For instance, it is technically possible to make a gold-plated lawnmower or a marble-topped motor-car, yet such products are unlikely to be produced because our culture simply does not induce the desire to own commodities of this sort among the people likely to afford them. But Professor Checkland's statement still very interestingly points to the fact that it is possible to build a model of what is likely to happen to technological innovations.

It is clear that these, like any other behavioural processes, do not simply occur at random, but in accordance with a pattern that it is the business of science to establish. This means that scientists and technologists cannot, as they are prone to do, blame industrialists and armaments manufacturers for the use to which their innovations are put.

Indeed, if it is possible to predict with any measure of probability what will be the fate of such innovations, then the innovators—assuming that they have access to this information—must take their share of responsibility for the resultant damage to society and its environment.

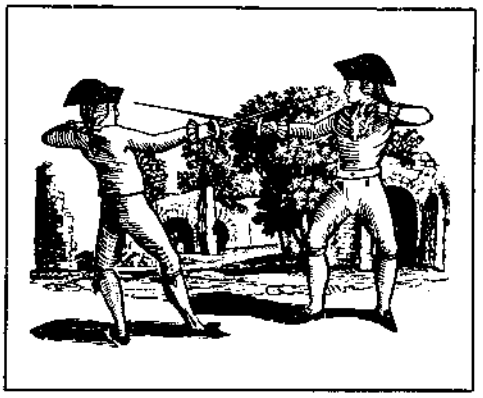
## Ships that pass in the night

Pollution means that some chemical is in the wrong place in the wrong concentration. *Chemistry in Britain*, Vol. 6, May 1970.

The chemical industry must bear ultimate responsibility for one particular type of environmental pollution. This is from chemicals which are synthesized for various legitimate purposes and which are only very slowly biodegradable, so that they remain in our environment for long periods. *Ibid.*

That such a process (the re-examination of old decisions to permit the use of various food additives, herbicides, etc.) is under way should not be regarded as a sign that strange chemicals now assault the environment to such a dangerous extent that extraordinary steps have to be taken to avoid trouble—it is equally fair to say that opportunities have now been provided that will ensure a safer environment. *Nature*, Vol. 226, April 25th, 1970.

Because improving the environment demands social and politieal leadership the government department charged with environmental improvement was asked to contribute to our presentation. Over a period of four months it proved impossible to produce a statement considered suitable for a publication serving the interests of chemists. *Chemistry in Britain*, Vol. 6, May 1970.



# Letters

## Subsidised Erosion

Sir,

I would like to clarify the question of the government subsidy on artificial fertilizers.

Farmyard manure is now becoming an embarrassment to some farmers because it is expensive to spread. They find it cheaper to use artificial fertilizers, whose price is reduced by a quarter to a third of the economic level by government subsidies. No such subsidy is paid on organic manures, which therefore become costly to use. The real snag here is that organic manures thus become pollutants instead of valuable means of maintaining fertility. Things are made worse because they are then replaced by artificial fertilizers which are more easily leached out of the ground.

Yours sincerely,

*K. Mellanby.*

The Nature Conservancy, Monks Wood Experimental Station, Huntingdon.

## Subsidised Deforestation

Sir,

At present, in the south-eastern counties, large tracts of coppice woodland are being cleared at the rate of an estimated 4,000 acres per year. The farmers receive a 30 per cent grant, plus a £12 per acre ploughing grant. In this way they change land value from £30 to £300 per acre. They get a return on the new land of some 15 per cent per annum, where formerly they received nothing.

All this comes about because the Forestry Commission have no interest in the indigenous hardwood, and have a marked preference for Spruce. All the land being treated in this way is in private hands, and I regret to say that farmers regard woodland as something worse than weed.

They don't appreciate the value of the transpiration which takes place through the leaves of trees. Later, they sometimes discover that their forbears left certain areas wooded to help with general drainage on difficult ground. Our forbears knew very well the value of elms to absorb excess underground water, and every tree had its end uses. In our part of the world huge flints are thrown up which can never be disposed of.

It is particularly tragic that this clearance should continue while this country imports £5,000,000 worth of timber and associated products every year, and when you see that our birch, sycamore, chestnut, ash, and even oak produce more growth per annum, and higher end-quality than any imported soft-wood species, one realizes the full enormity of this policy.

Yours sincerely,

*R. B. Poland.*

Fawkham Manor Farm, Fawkham, Dartford, Kent.

## Cost or Convenience

Sir,

Much publicity has been given recently to the plight of farmers and the difficulties that they are experiencing in trying to make an economic living out of agriculture in this country.

Prince Philip, in an interview on *24 Hours* recently on the subject of conservation, said that the land will have to be "exploited to the limit if he (the farmer) is going to make ends meet." This means that they will have to take advantage of every new technological development in order to extract the maximum return from each animal and each acre of land. The fact that over the last 15 years production and efficiency have increased to keep pace with steeply rising costs (but without increasing the return to the farmer) shows that farmers are capable of adapting in this way.

However, there is a serious danger, of which I am sure your readers are aware, from the increased use of pesticides, hormones, antibiotics, etc. and, quite rightly, legislation has been and is being passed to control their use. But this control is not and never could be effective internationally. As a result, countries with lower standards than ours have (to quote Prince Philip again) "an unfair commercial advantage".

Let me give two examples from my own experience as a sheep farmer.

1. I could save more lambs by using tetracyclins on my young stock, but this would have the effect of producing resistant bacteria which would remain in the flesh. Now tetracyclins are widely and effectively used as an additive for food preservation. The resistant bacteria could then cause damage out of all proportion to the benefit I had enjoyed, by allowing salmonella and other forms of food poisoning to result from the human consumption of the meat.

2. Sheep suffer badly during the summer months from blow-flies which lay their eggs in the flesh of the hindquarters. The eggs soon hatch into maggots which can, if untreated, completely devour the animal. Dieldrin proved very effective against this and was widely used, but it has now been banned as a residue was found to linger in the meat. Traces were then established in humans who had consumed it. The organic alternative treatments now available are less effective and more expensive.

If farming is to survive and prosper in this country and thereby contribute substantially to our economy, while at the same time providing clean food and a healthy environment for the population as a whole, then the consumer must be prepared to pay more for his food.

Yours sincerely,

*A. R. Hanbury-Tenison.*

Maidenwell, Cardinham, Cornwall.

## The Juggernauts of Lavenham

Sir,

Three headlines in a local paper recently focus attention on a situation in rural areas potentially more destructive than war-time bombs:

"Potholes get deeper but many roads will only get patched"

"Danger after crash"

"Driver buried as lorry crashed"

The villain of all three reports is not the Highway Authority fighting a losing battle to maintain all our roads on a limited budget; nor yet for that matter dare-devil drivers, but heavy traffic, particularly articulated container lorries, mainly from near-by docks.

The drivers of these lorries prefer the longer journey through narrow by-roads where they can keep moving, to the crawling frustrations of motorways specially constructed to take heavy traffic.

Our country roads were never intended to take the pounding they are getting today. Neither were the houses constructed to absorb the continual vibration set up by heavily laden lorries grinding through the narrow streets of villages unlucky enough to be on their route. Lavenham is one of these villages.

A medieval township which has survived the centuries almost intact, most of the houses are of timber construction with an average age of 500 years. A priceless heritage by any standard. Yet today the houses on the two streets used most by the lorries are in real danger of disintegration if the present traffic is allowed to continue. Heavier and bigger lorries could quite well be disastrous. Already, cracks in plinths and plaster are very evident. So are the blotchy patches on walls where loose plaster has been replaced. Window panes fall out. Crocks dance off shelves.

Speech is impossible for minutes at a time as the vehicles accelerate up the fairly steep streets—seven in a stream were counted a few days ago. The very floor boards surge underfoot with vibration and it is nothing unusual to see a lorry with a high load lift the gutters on some of the houses in Water Street as it hugs the pavement to avoid other vehicles.

Normal traffic is held up often as the huge lorries pass through, though the presence of other traffic does slow them up a bit, even if it is not less hazardous for the pedestrian who risks life and limb to cross the road sometimes. Clear streets are a direct invitation to greater speed—and noise—to which sleepless inhabitants can bear witness.

Time means money means speed means the other two headlines. An articulated lorry with a dangerous load jack-knifed across the road, blocking it for 10 hours, placing several houses -and lives--in jeopardy. Another hit a kerb and separated, the cab killing the driver. Yet another overturned spilling acid on the highway. Village streets are no less winding than country roads and any one of the disasters could have happened seconds earlier in a street, with dreadful results.

Whilst it is possible to sympathise with the drivers' need to deliver their goods as sooo as they can and realize too the need to keep the wheels of industry turning, it is senseless to allow the destruction of the countryside and its amenities as a sacrifice to the god of speed, Mammon and expediency. For most people the word *country* is synonymous with peace, quiet and beauty. So let it be.

Yours sincerely,

*Kitty Ranson.*

39, Market Place, Lavenham, Sudbury, Suffolk.

*cont. from page 14*

would cause sinkage and spontaneous combustion with controlled tipping, and raise the hydrochloric acid gas pollution problem for every refuse incinerator.

The question it raises for ratepayers is whether they can stop their Councils burning their money to pollute their environment, for incinerators need 10 times the capital investment and 6 times the running costs of a municipal compost plant of the Tollemache pulveriser type. One at Horley (Surrey) that cost £25,000 to handle refuse from 35,000 people is the easiest for Borough Engineers to visit near London.

It has a vertical shaft with hammers that wear at the rate of a shilling a ton, plus another shilling for the electric power to drive it.

But these machines, like all municipal composters, cannot break down plastics which tatter and yield under the hammers, so these, plus nylon—especially stockings and socks—are best screened out after decay, crushed into bales and used as solid filling material. Our greatest need in the field of refuse disposal is a Municipal Fertility Association of Local Authorities selling compost or sewage sludge, pooling funds for research and collective advertising to counter the propaganda of the chemical fertilizer industry. Meanwhile the saving on a 90 per cent smaller local government loan at 9½ per cent means a saving even if no compost is sold and merely makes the local tip last four times as long from the reduced bulk. Then grow potatoes on the filled tip, for the 16 ton an acre yields secured with Tollemache compost, are the best advertisement for farm sales.

There are many answers to the milk bottle problem but the easiest—of leaving the public its "pinta"—must be ruled out in this decimally Non-Permissive Society. We could ban PVC for milk bottles as Sweden has its fellow organochlorine compounds, and like the Swedes, use litre bottles in a brown, vitamin saving poly-olefine, which is more expensive but still reduces distribution costs. This would end the immediate incinerator problem but increase the troubles of controlled tippers and composters.

The ideal solution would be thin, non-returnable brown glass bottles nearer cylinders in shape, so that they would hold 0.75 of a litre, about a pint and a half, and would still fit the thousands of bottling machines without costly alterations, yet be heavy enough to stay upright on windy doorsteps in winter. These would be even worse dustbin fillers and airspace makers on controlled tips, but would melt perfectly in incinerators and powder easily in pulverisers.

The main PVC problem remains, as cobblers close down and shoes become increasingly expendable, as railway teacups, bathroom fittings, floor coverings and prepacks of almost everything build up millions of tons of potential hydrochloric acid gas in the pipeline of pollution. Banning this cheap and almost perfect plastic would have no effect for 20 years with so much already in circulation. When the right atmospheric conditions meet the right gas level and the hedges and gardens of some suburban valley are blasted like Runcorn and Widnes in the 1850's, we shall have to ban incinerators and force Councils to compost and save their rates. We may not have long to wait.

*cont. from page 28*

years, our growth problem becomes 20 times as serious.

But this cannot be true you say. I am playing with statistics. You are right. I am assuming 70 years life for today's baby at today's level of affluence, and such an assumption is absurd. If we continue population growth or rape of the resources, or both, IE will drop so drastically that by the year 2000 we may think the average Indian is fortunate.

So we should not worry about the hungry nations. The tragedy facing the US is greater and more imminent than theirs. India will be there after the US is gone. She will have colossal famines, but the land will survive and she will come back as she always has before.

*cont. from page 37*

unlikely for three reasons. One is that he hopes that the different groups will accept a loose identity within the Southern Sudan, so that the idea of statehood would not be superior to that of loyalty to one's people.

Another is that he would like the Southern Sudan to join the East African Community, where he feels it could greatly strengthen it. Obviously the Southern Sudanese have a greater affinity with, say, the Ugandans, than with the Arabs. Perhaps an informal grouping of Nilotics would be possible; it would certainly make more sense than the present ethnically-divisive situation.

The third reason is the desire not to impose alien ideas of political and social organizations, but to develop existing structures. Many African nations have made the mistake of seeing Western democracy, whether Marxist or capitalist, as the only key to modern nationhood, when their traditional systems could well have worked better. The Southern Sudanese hope to "grow" their state from the existing tribal polity.

Meanwhile, there are growing numbers of refugees outside the Sudan in urgent need of food and medical care. The Southern Sudan Association has recently been set up to help them, and also to provide scholarships for Southern Sudanese in exile. It hopes to enlist the co-operation of other charitable and religious bodies, and to draw their attention to a hitherto neglected part of the world.

*Robert Allen*

# obesity

## Slimcea Bread can help in the treatment of obesity.

An average person eats 38 ounces of bread a week: 8 slices each day. The difficulty of 'cutting out bread' is therefore obvious. To the psychological difficulties of giving up a food that is eaten at almost every meal is added the practical problems of finding sensible and sensibly priced alternatives to the protein, vitamins and minerals thus lost. Apart from supplying over 400 calories each day it is a vital source of protein, vitamin $B_1$, niacin, calcium and iron (amounting to 15-20% of the average total intake). The answer is not to give up bread but to eat as many slices of Slimcea as were formerly eaten of ordinary bread. Assuming no other changes, an average overweight person by merely changing to Slimcea would be better off by $11\frac{1}{2}$ lbs. of body weight in a year. In addition it will help to avoid the use of appetite suppressants, with their risk of dependency.

**Slimcea Bread...**
**Lower calorific value per slice.**
Slimcea has only 35 calories per slice against 51 calories per slice of equal volume of ordinary bread: a reduction of 31%. This is a real contribution to weight control since bread is eaten by volume rather than by weight.

**Higher protein value per slice.**
1.9 grms of protein per slice against 1.7 grms per slice of ordinary bread: a 12% increase.

**Delicious, Fresh Taste.**
Slimcea is real bread and is therefore no hardship as part of a long term diet (available in both white and brown).


*If you would like a free supply of eating programmes write to:*
Dr. A. J. Amos, OBE, FRIC, FRSH, The Laboratories, Dudden Hill Lane, Willesden, London, NW10