# The Ecologist

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

Vol. 1. No 2

August 1970

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Overcrowding and social tension - The farm drugs scandal

**Our diminishing resources** - The diseases of civilisation





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# The Ecologist

Vol. 1. No 2 August 1970

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# Editorial

# The biggest confidence trick of all time

Underlying all our relations with the so-called "developing nations" is the dogma that at all costs they must enjoy the benefits of affluence.

Few have questioned the desirability of this goal, still fewer its feasibility. Yet its desirability is highly questionable since the present disintegration of affluent societies may well be attributed to affluence itself rather than to any of its avoidable manifestations, while its total unfeasibility is demonstrable to anyone who knows how to count.

Let me make this clear. The developed countries are insatiable consumers. The USA, for instance, with roughly 6.5 per cent of the world's population, consumes more than a third of the world's power output (1,956.95 million metric tons of coal equivalent out of a world total of 5,614.35 million in 1967), and has nearly half of the world's motor cars (95,582,000 out of a world total of 214,120,000).

If we supposed that by some miracle the whole world achieved the US standard of living by the year 2000 (when world population will be around 7,000 million), this would mean a 35-fold increase in world energy consumption (to nearly 200,000 million tons), an 18-fold increase in the number of motor cars (to 3,500 million).

Fortunately, such world-wide affluence will never be achieved—for a number of obvious reasons. One is the amount of global pollution that would be generated.

Let us consider radioactive pollution. If the world's *per capita* output of nuclear-power attained that of Britain today it would be about 560 thousand megawatts, which is about 70 times the world's present total. Due to the terrifying toxicity of the many radioactive isotopes which would be let loose into the sea and air, some of which achieve concentrations of up to 100,000 in certain marine organisms, the effect on life and especially on sea-life, might well prove disastrous.

Indeed, according to Professor G. Polykarpov, "further radioactive contamination of the seas and oceans is inadmissible".

Nor would the world be able to support the amount of heat that would have to be generated to produce so many goods and services.

According to a report by the Committee for Environmental Information prepared for the Joint Congressional Committee on Atomic Energy in January 1970, if 7,000 million people reached the US standard of power consumption "the waste heat produced by the entire world's generating plants will reach about 370 million billion BTU. In one way or another, this waste heat will be carried away by the evaporation of water and will result in an increase of 1 per cent of the total water vapour present in the world's atmosphere each year ... this means that the rest of the world cannot match the US present electrical standard of living. The world will not contain the waste heat which the consumption of such massive quantities would require".

Dr Murrey Mitchell of the Environmental Science Sérvices Administration (ESSA) warns that increases in heat and carbon-dioxide in the atmosphere simply resulting from foreseen increases in power generation in the next decades threaten to melt the Antarctic ice cap, flooding most of the earth's coastal cities. A similar warning has recently been issued by the Smithsonian Institution. Fortunately, such cataclysms are unlikely to occur for the good reason that the natural resources needed to generate so much affluence are simply not available:

Hulett (*BioScience*) has calculated that present world food output would be capable of feeding about 1.2 billion people at present-day US standards. To feed 7 billion people at these standards requires a six-fold increase. Such an increase, save in the very short term and by using very doubtful expedients, is impossible.

The picture for non-renewable resources is very similar. 700 million people can use steel at the US rate, 900 million, fertilizers, 500 million, aluminium, and the chances of increasing production to satisfy so vast a demand are exceedingly slim.

As Preston Cloud shows in "Mined Out!", the world's mineral resources are running out fast. In the next 30 years we shall depend a great deal on recycled scrap metals. If 7,000 million people wanted to have the 1969 standard of living of the US, "the needed quantities of lead, zinc, and tin ... not to mention other metals, greatly exceed informed estimates of known, estimated, and inferred reserves". (Preston Cloud in a paper read to the American Association for the Advancement of Science, Boston, December 1969.) Indeed, the more we look into it, the more it is apparent that affluence is not only a temporary, but also a localized phenomenon.

There are no such things as underdeveloped countries, not even developing ones, because their development will be cut short, before they have proceeded very far, by a whole host of factors of which I have named but a few.

It is for this reason that our relationship with these countries is totally dishonest. We are methodically stamping out their religions, folk-lore, traditions and all other aspects of their culture that for millenia have determined the orderly pattern of their lives. (See *The last hunters of the Sahara.*) In exchange we offer them the brash, garish lures of a materialistic way of life that can never be theirs. They are indeed the victims of what must be the biggest confidence trick of all time.

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# The sardine syndrome

overcrowding and social tension by Claire and W. M. S. Russell

> What are the origins and causes of human aggression? Opinion seems to be divided between those who attribute it to stress caused largely by food shortages, and those who argue that it is innate. Claire and W. M. S. Russell point to a much more probable reason: it is stress of course, but stress caused by overcrowding.

"In 1900, a visitor from another sphere might reasonably have decided that man, as one met him in Europe or America, was a kindly, merciful and generous creature. In 1940 he might have decided, with an equal show of justice, that this creature was diabolically malignant. And yet it was the same creature under different conditions of stress." These words occur in The Shape of Things to Come, published (in 1933!) by H. G. Wells. For thousands of years, there have been two schools of thought about human aggression and its expression in violent crime, riot and war. Some people have said that human aggressiveness is human nature, an innate disposition in man. Other people, like Wells, have taken the view that human aggression is a response to intolerable frustrations, and that violence is a symptom of stresses in human societies and in their relations with their natural surroundings. The records of past history, right up to the middle of the present century, appear to favour this second view, that violence is a reaction to stress, notably the stress of shortage of food. Clear evidence for this connection can be found by studying the incidence and severity of public violence in many times and places, such as Imperial China, Japan in the 17th and 19th centuries, Tudor England, 18th century France, and medieval Europe from Britanny to Bohemia. By 1932, evidence of this kind had convinced most civilized people that human aggression is a response to stress, and not an innate and ineradicable taint. This was the verdict of the members of the American Psychological Association, replying in that year to a questionnaire, by a majority of 346 to 10.

#### Affluent aggression

But in the 1950's voices began to be heard again in favour of man's inherent aggressiveness. This change of opinion results from events in modern highly industrialized societies of W. Europe and N. America. These "affluent" societies have much higher national incomes than other nations, or than they themselves had in earlier periods. True, it has been estimated that nearly one-seventh of the British people, and more than one-quarter of the American people are living in serious poverty. Nevertheless, the affluent societies are genuinely affluent in one important sense. By comparison with Tudor England or Imperial China or modern India, most people in the affluent societies are free from really serious shortage of food. If violence is a response to stress, should not this real improvement have the effect of substantially reducing violence in these societies? What has actually happened is precisely the reverse. In England and Wales, between 1950 and 1960, the annual number of violent crimes per 100,000 people more than doubled. In the United States, between 1960 and 1967, violent crime increased nearly six times as fast as population. Does this mean that people are indeed inherently aggressive whatever their conditions?

At this point we can get new insight into the problem from studies of the simpler societies of monkeys (including apes), and especially from comparing their behaviour in the wild and in the zoo. By now we have accounts of some 15 species in the wild, at least eight of these same species in zoos or other close forms of confinement, and some species in a variety of different intermediate conditions. We find that differences between wild and zoo behaviour are common to all species studied, and amount to a total change or reversal of all aspects of social behaviour and social life. In monkeys living under completely relaxed conditions in the wild, quarrelling is always rare and violence is practically non-existent. In monkeys living under the stresses of an enclosure, quarrelling is frequent and violence appreciable, sometimes leading to serious wounds and death. This contrast applies to all the species studied: any monkey species in the zoo is more quarrelsome and violent than the same or other species in the wild. Hans Kummer made a direct comparison of hamadryas baboons living in the wild in Ethiopia with hamadryas baboons at the Zürich Zoo. He found that aggressive acts by males were 17.5 times as frequent in the zoo as in the wild, and that serious bite-wounds were commonplace in the zoo, though *never* occurring in the wild. This contrast seems to be typical for all monkey species studied.

#### Affluent monkeys

The zoo monkeys are clearly getting an ample food supply, and can be regarded, so to speak, as materially "affluent" societies. What they lack is space, since a band of monkeys in the wild normally roams an area of several square miles, whereas a zoo community must make do with an area of several hundred square yards. Hans Kummer found in the wild hamadryas baboons that such quarrelling as did occur was commonest in areas where cliff-ledges (and hence space for resting in safety from predators) were in short supply. Crowding is the crucial stress. Further confirmation of this comes from observations on rhesus monkeys by C. H. Southwick at the Calcutta Zoo and by Hilary and Martin Waterhouse at the Bristol Zoo. At Calcutta, halving the cage area for the same number of monkeys roughly doubled the amount of aggressive behaviour. At Bristol, halving the number of monkeys in the same enclosed area reduced the frequency of fights by 75 per cent.

The uniform peacefulness of wild monkey bands reflects the nature of their social organization. The forms of social structure and political control vary between monkey species. In the patriarchal democracy of the hamadryas baboons, leadership is dispersed among



Rhesus monkey adopting an aggressive posture

all experienced males; in cynocephalus baboons and rhesus monkeys, a small establishment of leading males controls the society; in Japanese monkeys, though male leaders generally control the movements of the band, a male can only become a leader if he is acceptable to the leading females who live at the core of the band. The one form never found in relaxed wild conditions is arbitrary dictatorship by a single individual. In the more oligarchic societies there is a sort of constitutional president but he does not differ sharply in rank from his aides, and owes his position entirely to the support of his male colleagues and, in Japanese monkeys, to the approval of the females. In a group of cynocephalus baboons observed in Nairobi Park, for instance, the leader could be driven away from a piece of food by a stronger baboon if both were some distance from the rest of the band. But normally, whenever an argument arose, the leader's authority was supreme, for he was always loyally supported by two colleagues, and a group of three can outrank any trouble-making individual. At Takahashi, a Japanese monkey male, individually capable of dominating any other male in the band, could never enter the leader class, for every time he approached the centre of the band, where the leaders live, he was driven out by the leading females. From these and other instances it appears that a highly aggressive male cannot expect to rise high in a band of monkeys under relaxed conditions. Since his position is owed to support by others and not brute strength, the leader does not appear much higher in rank than his supporters; on the other hand, he need not fear displacement as his physical powers decline. In chimpanzees and hamadryas baboons, elderly males are known to be respected; and in two Japanese monkey bands the top leader has been seen to retain his position to the end of his life, thanks to the active support of his leading colleagues.

#### Benevolence and rank

The basis of social rank among chimpanzees has recently been studied by Vernon Reynolds and Gillian Luscombe. The observations were made at a USAF base in New Mexico, and concerned a community of redundant chimponauts. These chimps had all been trained to work in space vehicles. As everyone knows, human astronauts have taken over their jobs. The apes were therefore gathered together in honourable retirement in a spacious enclosure of 30 acres at Holloman Base. They rapidly resynthesized a community similar in many ways to those Vernon Reynolds had observed in the wild in Uganda. In these relatively relaxed conditions, Reynolds and Luscombe made observations for six days on 34 individuals. Each individual was scored for the amount and kind of food he obtainIn monkeys living under the stresses of an enclosure, quarrelling is frequent and violence appreciable, sometimes leading to serious wounds and death.

ed. A clear-cut rank order emerged, with marked differences between highranking individuals, who ate plenty of their favourite fruits, and low-ranking chimps, who had to make do with monkey pellets.

Records were also made, for each individual, of all his social interactions with other individuals, that is every time he did something in relation to another individual. These interactions were classified into two groups: aggressive and friendly. Aggressive interactions included slaps, bites and a stand-up threat display which made the threatened individual take to flight. Friendly interactions included grooming, greeting, play and the like. When all the scores were compared it was found that the chimps of high rank, evidently the most self-assertive ones, were not the ones with the most aggressive behaviour, but those with most friendly contacts, the best-liked individuals. The most successful chimp of all had nine times as many friendly contacts as the average score. The chief way to win friends and influence people was apparently to perform a noisy but unaggressive display, quite different from the threat display; this cheerful hooting and banging about seemed to attract friendly attention and interest, and led to numerous friendly contacts and high rank and privileges as a result. When two or more bands of chimps meet in the wild at a fruit tree, which has just come into season, they engage in a regular beat session which may go on for 55 minutes, drumming on tree-roots and rushing about the trees. This may help to arrange ranks and priorities among chimps who do not know each other well. Clearly, under relaxed conditions, self-assertion and aggression are totally different things, expressed in posturally different displays. In a wild monkey band, aggression is not the way to social advancement.

#### Dictatorship in zoos

In the zoo, under sufficient crowding stress, dictatorship by a physically

powerful individual is a commonplace observation. In rhesus colonies observed by Michael Chance at Regent's Park and by Vernon Reynolds at Whipsnade, the top male was in each case an absolute dictator, of whom all other monkeys were terrified. In a group of chimpanzees in a small enclosure at Regent's Park, observed by Caroline Medawar, we can see the extreme contrast to the civilized community at Holloman Base. In this crowded group, the boss was a strong male with a positive dislike for personal friendly contacts: he would attack and viciously wound any of his subjects who made friendly approaches even to each other. In these conditions there has been a total reversal: high rank is now attained by brutal aggression and nothing else.

Between the two extremes, there are two intermediate situations. At Whipsnade, Reynolds drew up diagrams of the aggressive and friendly interrelations between each of the individuals in the colony. The chief male was found to be at the top of the aggressive hierarchy, liable to attack anyone below him, but also at the top of the friendly hierarchy, receiving grooming and friendly contact from many subordinates. In a community of rhesus monkeys at the Bristol Zoo, Hilary and Martin Waterhouse found two individuals at the top of the rank order in terms of food access and freedom of movement: one of these was at the top of an aggressive hierarchy, the other at the top of a friendly hierarchy. These two intermediate situations throw some light on the transition from a relaxed to a stressful society. Evidently, when a society is under sufficient stress, brute strength and ferocity take the place of friendly mutual support and responsible leadership.

It is no wonder the result is frequent quarrelling and not infrequent violence. A dictator monkey in a zoo colony, touchy about intrusion or disturbance in the confined space, is constantly liable to attack subordinates. He may suddenly rush upon a group of neighbours and scatter them-just as the police suddenly scattered a group of peaceful demonstrators in Lincoln Park, during the "police riot" in Chicago in the summer of 1968. In a study of 118 quarrels described by Reynolds among the rhesus colony at Whipsnade, we were able to identify a number of processes which in the wild make for peace, but which under the protracted stress of crowding actually spread, amplify, prolong and

Under relaxed conditions, self-assertion and aggression are totally different things. In a wild monkey band, aggression is not the way to social advancement.

intensify quarrels. A wild leader will repress a quarrel between two others by means of a mild threat; the zoo dictator will simply attack one of them as a punishment. In the wild, a monkey suffering momentary frustration from a superior may work off his feelings by redirecting resentment into a threat against some monkey of still lower rank, who can simply move away. In the crowded community, a monkey punished by the dictator will go off and attack somebody else by way of redirection, illustrating the observation of the great law reformer Sir Samuel Romilly, that "cruel punishment will have an inevitable tendency to produce cruelty in the people". When one monkey threatens, a neighbouring monkey will often threaten in the same direction, even if he cannot see the object of the first one's threat. In the wild, this automatic reaction ensures prompt support for the leader from his colleagues, who are always close to him, in suppressing, by threat and without violence, aggression by subordinates. In the zoo, this same reaction causes other monkeys to join in the quarrel on the side of the aggressor. By all these means, quarrels reverberate round the crowded society. Monkeys of low rank are liable to become the butts of redirection by all the others. This mass redirection can reduce an individual to the status of an outcast. This happened to a male at Whipsnade, who finally had to be removed when the others broke his arm in their unprovoked persecution of him.

#### Stress-induced aggression

We have now seen that rank criteria, social structure and a variety of social interactions all change completely under stress. When brute strength becomes the basis of social order, females and young, as the weakest members of the society, are the principal victims. In relaxed conditions in the wild, male leaders show the utmost chivalry towards females and young, and protect them instantly from even mild attacks by others. Under stress, the dictators of the zoo colonies are capable of savagely biting and even killing females and young. In a colony of hamadryas baboons at Regent's Park, observed in the 1920's by Sir Solly Zuckerman, eight out of 61 males died by violence, but 30 out of 33 females and five out of five babies were killed in this way.

Monkeys, in short, have two totally different kinds of social behaviour, "kindly and merciful" on the one hand, "diabolically malignant" on the other. Some social mechanisms, as we have seen, are actually designed to promote peace under relaxed conditions and violence under stressful conditions. Other mammals present a similar picture of reversal of social behaviour under stress, notably under crowding. The fundamental change is in parental behaviour, from a protective to a competitive attitude. For, as the Dutch zoologist Adriaan Kortlandt has shown, parental behaviour is the starting point of all other mammalian social behaviour. In its relaxed and positive and its stressful and negative forms, it is the origin of love and hate. The advantages of positive social behaviour are obvious: what could be the significance of the diabolically malignant behaviour under stress? Studies with rapidly breeding mammals, such as rats and voles, have shown that a population bred in a confined space, though supplied with unlimited food, will not exceed a certain density. As soon as the population density reaches a certain level, the reversal of behaviour begins, and the tension and violence and attacks on females and young have the effect of halting population growth and even reducing the population for some time. V. C. Wynne-Edwards has pointed out that if a population of animals only began to fight when its food supply was running short, that supply could be irretrievably depleted. By reacting to crowding, a population can be reduced in time to allow the food supply to recover. The effects of crowding and violence are not restricted to death by wounds. There are physiological effects on the females which impair reproduction for a couple of generations, and a disturbance of the machinery of immunity which renders the animals vulnerable to infectious disease, so that epidemics complete the crash of the population. The whole system of reversal of social behaviour can thus be seen as a means of response to a crisis in which population is in danger of outrunning resources. It may,



Tokyo's Underground employs official pushers to pack in the passengers

indeed, get out of hand and go too far; this may have happened to the red squirrel in Britain.

#### **Civilized mammals**

Under relaxed conditions, then, mammals are incredibly peaceful and, so to speak, civilized. Under population pressure, their societies are brutally unequal, cruel, tense and violent. Where man is concerned, we can make no such easy comparison. For man has probably never, or hardly ever, enjoyed completely relaxed conditions. Technological advance is the outcome of human intelligence, but it has always hit human societies as if it were an external force, since they have never recognized the need to regulate and allow for its effects. Every such advance, changing the relation between human societies and their natural surroundings and resources, has made possible an increase in population: every time, the increase has gone on without regulation, so that sooner or later population outstripped resources. As a result, man has been under virtually continuous population stress, and hence virtually continuous social inequality, tension and violence. Hence some people have supposed that these evils are the normal inherent lot or nature of man. But while all mammals are capable of fiendish cruelty under stress, man differs from them all in having an even more highly developed positive parental urge. This is clear from the long and increasing period of parental care in man, and from the unique social achievements of our species, with refinements of social welfare even for adults, all stemming from our parental behaviour. Even under frightful stresses, where almost all mammals would kill their young, many human beings continue to love and protect them at great sacrifice to themselves. It is not the violence in man's desperately stressful career that should astonish us, but the quality of human intelligence and human feeling in the most awful circumstances.

Nevertheless, under sufficient stress, a proportion of human beings do wound, kill, even eat their own children, and thoroughly mammalian atrocities do occur in man. We do not have human societies in totally relaxed conditions for comparison, as we do with monkeys; but we can compare human societies under greater or lesser degrees of stress, in different places and times. When we do so, we find striking differences, enough to suggest that, if we could eliminate population stresses altogether and forever, our societies could eventually be as free, friendly and peaceful as those of wild monkeys, and of course infinitely more creative. F. H. McClintock and others studied the incidence of violent crime in London in 1950, 1957, and 1960. They found violent crime at first concentrated in areas of dense, bad housing. As the British population crisis continued, other districts also became densely populated, and violent crime

By reacting to crowding well in advance of a population crisis, a population can be reduced in time to allow the food supply to recover.

spread to these, though it showed no sign of appearing in suburbs where housing was still good and population relatively sparse. At Newcastle, the city planning department recently studied various social and medical symptoms in different districts. The sharpest contrast was between the most crowded and least crowded third of the city. The most crowded third produced more than five times as many offences against the person, more than four times as many larcenies, seven times as many people on probation, three times as much juvenile delinquency, more than five times as many cases of neglect of children, five times as much venereal disease, and 43 per cent more prenatal deaths. In his Autobiography H. G. Wells thus described his life in a slum at Westbourne Park. "I looked, so to speak, through a hole in my life of some weeks more or less, into a sort of humanity coarser, beastlier and baser than anything I had ever known before . . . I think the peculiar unpleasantness of that episode lies in the fact that we were all too close together. We were as congested ... as zoo monkeys."

#### **Population crisis**

The settled civilized populations of mankind have generally had high normal death rates, of 3-4 per cent annually, but even higher birth rates of 3.5-5 per cent, resulting in a natural annual increase of up to 1 per cent. If this had been the whole story, it has been calculated that by now the world population would form "a sphere of living flesh, many thousand light years in diameter, expanding with a radial velocity many times faster than the speed of light". In real life, as opposed to the wonderland of mathematics, nothing of the kind can happen: indefinite natural increase is absurdly impossible, and either birthrates come down or death-rates go up. In fact, every time the human civilized populations seriously outran their resources, they entered a population crisis, marked by very acute social tensions, leading to extensive, unrestrained violence and stress, the collapse of the population under epidemics, and the decline and fall of many a civilization. These population cycles were out of phase in different regions; thus India succumbed to population crisis in the 18th century, China in the 19th, and hence the Europeans gained control in India a century earlier than they did in China. Europe was for long the least densely populated region of the civilized world, and most recent creative advances in technology and social organization were achieved in Europe during the precious respites between crises, when population was for a while in balance with resources. The current population crisis differs in two ways from previous ones: it is world-wide and it is marked by very low normal deathrates, making for explosive population growth.

A wild leader will repress a quarrel between two others by means of a mild threat; the zoo dictator will simply attack one of them as a punishment.

Chart by courtesy of New Society

If a population of animals only began to fight when its food supply was running short, that supply could be irretrievably depleted.

#### Our violent century

Our century is therefore exceptionally cruel and violent, and getting more so. Civilians, including women and children, made up five per cent of the dead in World War I, between 50 and 75 per cent of the dead in World War II and 84 per cent in Korea. According to Senator Edward Kennedy, quoted by The Times on December 3rd, 1969, more than 300,000 civilians had by then been killed in Vietnam since 1965. Even if we could tolerate the suffering and waste entailed by the population crisis response of social tension and violence, we can no longer afford it even for its old evolutionary function, since a world war with modern weapons, far from sparing our natural resources, would irretrievably damage them by its ecological effects. But we can avert all this. We can do what no animal can do. We can substitute voluntary birth control for involuntary death control, for what Paul Leyhausen has called "the old, cruel, methods by which Nature balanced our numbers". With our modern technological resources, and a reduced world population, we can find out how to create, for the first time, truly relaxed conditions for human societies. Everything we know of mammals and man suggests that, if we can do this, we can build a lasting, peaceful and creative civilization. We can choose whether our species is to be kindly, merciful and generous or diabolically malignant: for it is the same creature under different conditions of stress.

Note: this article is a shortened and updated version of a paper read on September 9th, 1969 at a Plenary Session of the International Ethological Conference at Rennes, Britanny.

If we could eliminate population stresses altogether, our societies could become as free, friendly and peaceful as those of wild monkeys, and infinitely more creative.



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# The farm drugs scandal

by Joanne Bower

The stress of overcrowding, unnatural conditions and lack of hygiene promotes disease on a wide scale—antibiotics have been used to keep it under control. Indeed, the growth of factoryfarming in the last decade or so has largely been made possible by the use of antibiotics, not only to cure disease in stock, but as blanket medication. They have also been found to act as growth promoters and therefore extra profitmakers. Ostensibly to keep animals healthy, this regular addition of drugs to their feed is now generally recognized as a substitute for good husbandry.

Apart from the ethical problems of keeping animals in conveyor-belt conditions, some doubt was felt about the wholesomeness of meat and eggs so produced. Already in 1959 the phenomenon of infective drug-resistance was established. A medical assessment of the position reads:

"The indiscriminate administration of antibiotics to livestock destined for the table has been employed in an attempt to protect the animals from sickness caused by the crude handling they receive under systems of intensive rearing. These animals harbour a variety of bacteria. Some of these germs develop a resistance to the antibiotics employed. They can pass their resistance on to other bacteria dangerous to man. The result is a rapidly increasing world population of germs which antibiotics will not touch. So serious has the problem become that a recent editorial in The New England Journal of Medicine made the claim that 'Unless drastic measures are taken, physicians may find themselves back in the pre-antibiotic Middle Ages in the treatment of infectious diseases'."

Drs Anderson and Lewis of the Enteric Reference Laboratory and Dr Williams Smith of the Animal Health Trust were also outspoken in their condemnation of the irresponsible use of antibiotics in agriculture, and especially The Swann Committee recognized that antibiotics fed to farm animals are a menace to our health. Why have its findings not been implemented?

in the calf industry. Calves intended for intensive rearing, collected at a few days old, are transported often for hundreds of miles, sometimes having passed through markets, picking up infection and becoming increasingly vulnerable through weakness and fright. Packets of antibiotics tied round their necks have not saved large numbers from succumbing to their rough handling.

#### Food poisoning

Antibiotics have also been used liberally in the broiler industry, where high density and a warm humid atmosphere provide ideal conditions for epidemics. Poultry are peculiarly susceptible to an enormous number of ailments, and it became necessary to send birds for slaughter "with their diseases" at an ever earlier age. An instance of the many food-poisoning organisms is Ecoli septicaemia, which produces a quantity of pus in the bird's body, which can be scraped away, leaving an apparently clean carcass. Marek's Disease-a form of cancer, precipitated by stresshas become the scourge of the industry. Poultry flock surveys conducted from Houghton Poultry Research Station in 1968 showed an incidence of 90-95 per cent of birds infected. Tumours can be cut out and here too the rest of the carcas may show no sign of disease.

Salmonella has become rife in both the calf and poultry industries, and outbreaks of food poisoning in the human population have been traced to these sources. Poultry in particular can harbour salmonella bacteria with no obvious signs of disease, but with potential danger to man. (This has been highlighted recently in warnings given to housewives. It could, however, reasonably be asked why the onus should be on the housewife not to poison her family, and not on the producer to supply healthy meat.)

The Ministry of Agriculture's laboratories at Weybridge showed that between 1957 and 1960 the percentage of tested strains of *E coli* bacteria—found in the gut of all humans and animals resistant to commonly used antibiotics, rose from 3.5 per cent to 63.2 per cent.

For years the warnings continued. A relatively modest provincial paper, the *Reading Evening Post* commissioned an enquiry from a young reporter, John Fielding, who unearthed a number of disquieting facts relating to danger to human health from the use of farm drugs. The *Post* called for swift Government control: "Is Our Food Being Poisoned? Must People Die Before the Minister Acts?" People did die. It was not for another two years that the Swann Committee was set up.

#### **Priority of profits**

A mass of evidence shows that the medical profession were fully aware of the dangers, and it seems impossible to believe that the Government could have remained in ignorance. But although individuals spoke out courageously, medical bodies seemed timorous of advocating any action which might interfere with profits. The immense pharmaceutical industry was now heavily involved: the Government was ladling out incentives to farmers to become more and more intensive; animal feed manufacturers with their "vertical integration" were beginning to dominate agriculture.

A joint committee of the Medical Research Council and Agricultural Research Council under the chairmanship of Lord Netherthorpe had recognized in



1962 that routine medication of animal feed with antibiotics should be confined to drugs with little or no therapeutic value, and which would not reduce the value of other drugs through infective drug-resistance. But it did not advocate immediate action because this "would deprive farmers of economic advanages".

As late as the Annual Conference of Public Health Officers in 1969, it was decided that although concern was felt at the evidence of transferable drugresistance in man caused by the use of antibiotics for animals "a total ban would jeopardize the farmers' livelihood".

Neither the medical bodies nor the Government committees seem to have taken into consideration the fact that the consumer—paying upwards of £300 millions a year in farm subsidies through taxation—had any right to protection or to freedom of choice. Profits must come first.

A parallel might be drawn with the Government's refusal to ban tobacco, in spite of its proved dangers, because of the revenue obtained from it. But those who buy tobacco know what they are getting. There is no means by which the consumer—or even the butcher for that matter—can know if meat has been treated with antibiotics.

#### The Swann Committee

The setting up of the Swann Committee was, as is usual with Government Committees, the result of public anxiety. By 1967 there was more than sufficient evidence to warrant new controls in the use of farm drugs. However, because the two previous committees—the Netherthorpe Committee in 1960 and later its Scientific Sub-Committee—had only been briefed to examine the use of antibiotics as animal feed supplements, and not as therapeutics, it was decided to set up yet another Committee with wider terms of reference.

Even the *Farmer and Stockbreeder* (September 12th, 1967) took the view that the Government was dragging its feet:

"Any year now a committee will be convened to consider names put forward to serve on the new antibiotics committee. Or will it be necessary first to have a committee to decide whether it is worth setting up a committee to decide who should serve on the antibiotics committee?" Neither did members of the medical profession pull their punches:

Dr Bernard Dixon (*New Scientist*, October 5th, 1967):

"Microbiologists have published a stream of facts and figures illustrating the growing seriousness of the situation. Those experts I have spoken to in the past fortnight are now staggered that further inquiry should be thought necessary.... The facts are that multiple infective resistance had been unambiguously described in 1965, that it has increased at an alarming rate in recent years, that the evidence for its association with the misuse of antibiotics in husbandry is compelling, that research workers in this field have issued repeated warnings. And that no action is to be taken."

Dr Donald Gould (New Statesman, January 5th, 1968) argued that the warnings of responsible experts who for years had urged the imposition of controls had been entirely ignored "save that their pleas have resulted in the establishment of totally ineffective 'committees of investigation'. The Government has done nothing. After all, a good deal of money was involved, one way and another. And who wants to antagonize the farmers?"

The Journal of Guy's Hospital on January 22nd, 1968 warned that unless

"... although individuals spoke out courageously, medical bodies seemed timorous of advocating any action which might interfere with profits."



urgent action was taken we might soon be back to square one in the fight against infection, and urged an immediate brake on irresponsible use of the former "wonder" drugs in the feed of farm animals and poultry to promote fattening and reduce disease; and on the use of antibiotics for preserving meat and other foods.

Some diffidence was, however, still noticeable. The *Medical News* of January 12th, 1968 reported :

"a curious reluctance on the part of bacteriologists to state any misgivings they may have. Several leading scientists approached by *Medical News* either declined to utter any controversial views about infective drug resistance or said a lot—and refused to be quoted."

By the time the Swann Committee was eventually set up (July 1968) the climate of opinion was favourable to a reform in our farming methods. It was now generally admitted that routine medication with antibiotics would not be necessary with good husbandry. As regards fattening, Swann found that, in fact, the growth rates of germ-free animals without antibiotics are at least equal to those attained in normally kept animals given antibiotics in their feed, and that, in any event, such growthpromotion is very variable. Swann suggested alternatives with no obvious danger to human health.

#### **Codes of practice**

The Swann Report was placed before Ministers shortly before the Codes of Practice for Livestock, drawn up by the Government's Farm Animal Welfare Advisory Committee, were debated in Parliament. These have been misleadingly referred to in the farming Press as "Brambell Codes". If, in fact, they had been based on such sections of the Brambell Report as dealt with space allowances, they might have gone some way to meet the Swann Committee's repeated recommendation that "deliberate modification of methods of husbandry ... is likely in the long term to be more effective and safer than any attempts to control disease with antibiotics".

The public, including Members of Parliament, had not seen the Swann Report when these Codes were discussed. During the debate Mrs Joyce Butler asked the then Minister of Agriculture why the House was considering the Codes without any knowledge of the Swann recommendations. Suppose the

Far

Swann Committee came out strongly on the subject of the relationship of ever closer stocking of birds and animals and the use of antibiotics on an even wider scale and their effects on human drugresistance? Mr Cledwyn Hughes replied that it would not be appropriate for him at that stage to comment on the findings of the Swann Committee, "but if it has the kind of bearing on the Codes which my hon. Friend has mentioned, we shall have to take very careful account of it in due course".

One is left wondering when the Minister would have found it appropriate for him to take such careful account, although he was already fully aware of the Swann proposals at that time. Meanwhile a million copies of the Codes have been distributed, containing recommended space allowances hardly likely to reduce stress or danger of infection, being admittedly those "below which good management becomes a decisive factor".

#### The Swann recommendations

The Swann Committee found that because of infective drug resistance the use of antibiotics in animal husbandry and veterinary medicine presented a hazard to human and animal health. ("Treatment may be made more difficult and the patient's life even imperilled because

In the slaughter room the birds are shackled upside down to the conveyor belt and move slowly towards the slaughterman ...



of antibiotic resistance. We accept that this has already happened and we have no doubt that it could do so again.") Such hazards could largely be avoided. The Committee's principal recommendation therefore is that antibiotics should be classified as "feed" or "therapeutic", and that only "feed" antibiotics should be available without prescription. The use of penicillin and the tetracyclines in animal feeds should be prohibited : certain other drugs now freely available should be obtainable only on prescription-but their use should not be limited. Alternative fattening agents are suggested.

In view of all the unease which had been expressed on the subject for many years, the Swann recommendations would not seem to approximate to the "drastic measures" called for by the New England Journal of Medicine in 1967. The Government announced immediately that it accepted "in general" the Committee's proposals for control and its main recommendations. Mr Cledwyn Hughes, ex-Minister of Agriculture, however, added :

"We must not make ourselves a nation of hypochondriacs about this, or a nation of non-meat-eaters."

Mr Richard Crossman, former Miniof Social Services. ster hastily announced that there would be no immediate ban on the three antibiotics specially mentioned in the Report:

"We feel we can give an interval to the manufacturers to use up their stocks and introduce new products. We are having consultations with the manufacturers to assess the time it will take. This report has broken new ground. We are able to take preventive action before the health risk has actually materialized."

It seems incredible that a responsible Minister involved with health could believe that the evidence in the Reportwhich even a young reporter on a provincial paper had been able to dig out three years previously-was breaking new ground, or that a health risk had not already materialized :

"The administration of antibiotics in ways at present permitted has already caused some difficulties in veterinary medicine and has caused harm to human health." (Swann, 8.14.)

The veterinary profession was not complacent. Dr P. D. Storie-Pugh, senior vice-president of the British Veterinary Association, speaking after a Council meeting in November 1969, said

that in the next few years there would be grave risks of serious outbreaks among human beings from known and unknown animal diseases. The controversy over salmonellosis would come to the boil in the next few months. The BVA had invited the BMA to discuss the present extent of this disease and control measures. The hon. secretary to the BVA, Mr P. N. Hull, added that salmonellosis was potentially a bigger killer than brucellosis in human beings "but unfortunately the medical profession don't view these two diseases with the same seriousness that we do."

However, by February 1970 the medical profession was taking notice. Dr Nick Evans, scientific editor of World Medicine, wrote in that Journal (February 24th):

"Infected calves and chickens now account for most cases of human food poisoning but a wary eye must be kept on several other foods. Pigs harbour the dangerous S. choleraesuis (highly invasive, and fatal in 20 per cent of human infections).... About 8 per cent of typhimiurium infections are invasive, requiring antibiotic treatment, and there is a very real danger that resistance will be transferred to more virulent strains like S. typhi and S. choleraesuis.

"The use of antibiotics against salmonellosis in the nation's livestock is

... the blood concentrates in their. heads, so that when their throats are finally cut, they bleed more rapidly.



Syndication

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Syndication

clearly a matter of running up a treadmill to stay in the same place. Only epidemiological measures can limit the organism's spread and at the same time release, man from an unpleasant and eminently unnecessary infection. The time to apply and enforce them is now." The same article warns that even fruit and vegetables are a risk when, as is often the case, they are grown on soil manured with infected slurry.

Nor is salmonellosis the only disease which can pass to man from livestock. Professor A. I. Betts has warned that a disease similar to infectious bronchitiswhich now affects all but a small minority of the national poultry flock-might occur in man. At a European Symposium on New Dangers of Disease transmitted by Food Animals in 1966, warnings were given of influenza hazards with the extreme virulence of fowl-plague, and of the possibility of degenerative diseases, atherosclerosis (coronary thrombosis), virus leukemia and others being transmissible to man. The Lancet of December 27th, 1969 contains a Paper by Michael Crawford of the Nuffield Institute of Comparative Medicine criticizing the "high energy" feeds used in intensive systems of husbandry. These produce large amounts of saturated and mono-unsaturated fats; whereas free-ranging creatures provide more protein and high quality structural fat. "The high saturated fat, low quality product appears specific to the modern intensive system." Prevention of atherosclerosis in man by supplying a proper balance of structural fat would be "surprisingly simple" but for modern methods of food technology.

The vital importance to our own health of keeping our food animals healthy would seem obvious. Yet the secretary of the Farm Animal Welfare Advisory Committee has said that there is no intention of revising the Codes of Recommendation for Livestock in accordance with the Swann recommendations.

### Attitude of the pharmaceutical industry

Where does the pharmaceutical industry stand in this matter?

In the Spring of 1968 letters to the Ministers of Health and Agriculture from the British Pharmaceutical Industry admitted that there was a "serious gap in our knowledge of where the true balance is to be struck between the benefits obtained from the use of these products (i.e. antibiotics) and the potential hazards involved". The Association promised all possible assistance to the Swann Committee and indeed provided much evidence.

Pfizer and Nevertheless. both Crookes Laboratories even at that time began to advocate antibiotics for mass medication in the broiler industry. Their "Broiler Programme" included treatment of the birds' drinking water with erythromycin and chloramphenicol, both drugs being commonly used in human and animal medicine. Chloramphenicol is the only really effective treatment for human typhoid: bacterial resistance to this drug could mean a typhoid epidemic against which we had no protection.

A public discussion on the subject of antibiotics in animal husbandry proposed by the Association of the British Pharmaceutical Industry had to be abandoned on the advice that its intentions were heavily loaded in favour of the Industry's viewpoint.

Shortly before the Swann Report was expected, a Report was issued by the "Office of Health Economics" (founded by the pharmaceutical industry and described in the Press as its "trumpet organization"). This announced that the health risk in the use of antibiotics in farming was small and largely hypo-

If you like your veal nice and white, the calf must move as little as possible during its lifetime and eat nothing but milk substitute, not forgetting the antibiotics of course.



Farmers

thetical, and that if farmers were to abandon the practice, food prices would increase. Members of the public who knew that a Government Report on the subject was expected might easily have mistaken this for the Swann Report itself. It is tempting to conclude that the Office of Health Economics Report was issued with the purpose of forestalling the Swann recommendations by reassuring the public as to health hazards and alarming them with threats of higher food prices.

Mr Keith Grainger, General Manager of Cyanamid of Great Britain (a subsidiary of the American giant) stated to a Press Conference before publication of the Swann Report:

"We accept that pressures exist on Government authorities to be ultracautious in this matter" and added that in his view there was no proved health hazard to humans arising from the use of antibiotics as additives to feed for farm animals or broiler chickens. He threatened a rise in the cost of meat and eggs if antibiotics were withdrawn.

After publication of the Report Mr Grainger told another Press Conference that rapid implementation of the Swann recommendations would not only preclude scientific dialogue, but would involve the dangerous principle that it is sufficient to suggest a hazard, fault or mere imperfection as a justification for prohibitive legislation. He believed a licensing system for feed manufacturers would be a more practical method of control.

Mr W. G. R. Weeks, lecturer in Agricultural Economics at Newcastle University, carried out a "special study" for the pharmaceutical companies and came up with the threat of an increase in costs to British farmers of £30 millions if the Swann proposals were implemented.

The Graham Cherry organization of public relations consultants also carried out a "special survey" for drug manufacturers and produced a figure of £37 millions. (These figures have been dismissed by Dr Williams Smith of the Animal Health Trust as alarmist.)

In January 1970 Cyanamid held a symposium for which the invitations (sent in plain envelopes) read:

"You are invited to a Symposium at the Royal Society of Medicine on the Implications of Infective Drug Resistance." There was no mention of Cyanamid, and a footnote read: "By courtesy of the Council of the Royal

Weekly

#### Society of Medicine."

A trifle misleading perhaps, and the New Scientist of January 22nd, 1970 gave its opinion that the Symposium itself "confirmed any suspicions this action might have created that Cyanamid were more concerned with providing opponents of Swann with a public platform, than with mounting a real debate".

There followed a Press conference to put the "case for a balanced scientific approach by governments for the control of human, animal and plant health products" arranged by the Graham Cherry Organization. No client's name was mentioned, but the speakers were two who had taken part in the Cyanamid Symposium and the invitation explained that they were concerned about "instant decisions by governments on such substances as antibiotics in animal feeding-stuffs, without full disclosure of the risks involved".

The Graham Cherry Organization, for Cyanamid, has since published a volume entitled "The Swann Report: Dialogue in the Press" containing its criticisms of Swann and also "a selection of recent press reports and comments" addressed to the public, the press, scientists, people in Westminster and Whitehall and the farming organizations.

"The stress of overcrowding, unnatural conditions and lack of hygiene promotes disease on a wide scale."



Out of 100 cuttings reproduced, 52 are straight reports of Cyanamid Press conferences, of statements by Mr Weekes who carried out the "special study", or based on other Press handouts from the Graham Cherry Organization. Of the rest, one article criticizing the Swann Report by T. R. L. Fraser, was evidently syndicated and is reproduced four times. Six letters to the Press are printed from farmers saying they cannot manage without drugs. The remaining cuttings are by no means all that have been printed on Swann. They do, however, contain a statement by the British Veterinary Association making it clear that a circular letter and questionnaire on the implications of Swann had been sent out by the Graham Cherry Organization without the knowledge or approval of the Association, which dissociated itself from the points of view expressed in the document. There is also a cutting from Farmers Weekly stating that the Press had been bombarded with anti-Swann literature, almost all of which had originated from the Graham Cherry Organization. Although most statements purported to be balanced scientific discussions, only one side of the coin had been exposed. The public should be made aware that this was the point of view of the trade and not a general consensus of opinion. Farmers Weekly concludes: "The Swann Committee recommendations are too important to be negated solely by the arguments of those with vested interests." It is to be hoped that these particular extracts will not be overlooked in the welter of cuttings inspired by the Graham Cherry handouts.

Mr Cledwyn Hughes, meanwhile, after his first fine careless rapture in accepting the main Swann proposals, told a Press Conference at which he was accompanied by Mr Richard Crossman, that he thought they could do all that was needed without new legislation: Orders in Council would be sufficient. Ministers were starting discussions with suppliers of animal feeds and the pharmaceutical industry.

A new clause introduced into the Report Stage of the Agriculture Bill by Mr Kitson on April 7th required Ministers to make regulations for the purpose of establishing a register of chemical substances which may not be used at sub-therapeutical levels in animal feeds. Mr T. Kitson said he realized the clause would be opposed by those with commercial interests in supplying

farmers with large quantities of antibiotics. Mr W. H. K. Baker reported that he had consulted an epidemiologist, a medical micro-biologist of international repute at present working in this country, who had said that without restriction on chloramphenicol and polymyxins man would be placed in particular danger, and that we must provide a substantial degree of safety for humans at once: "I would submit to the House that to neglect this eminent man's view would be the height of folly."

Mr Anthony Stodart, a farmer, urged that human health should override absolutely and utterly any economic advantage, no matter how great that economic advantage might be.

Mr James Hoy, for the Government, replied that they had in general accepted the Swann Committee's advice and hoped to put "some of its recommendations" into effect. Zinc Bacitracin had been freed for use as a feed antibiotic as from March 26th. The way was now clear to restrict the use of penicillin and the tetracyclines. Powers were already available to limit the use of chemicals in animal feeding-stuffs and "we are taking action following the report to meet the needs of most people". On this somewhat hazy assurance, the motion was withdrawn.

"... human health should override any economic advantage, no matter how great that economic advantage might be."



# **Bringing Order to Chaos**

A cybernetic approach to the study of societies and ecosystems

#### by Edward Goldsmith

In the first part of this article the author defined a "system"-a key concept of cybernetics-as an autonomous unit capable of adaptive behaviour. He then showed how societies and ecosystems could be regarded as specialized instances of a system. By determining what systems have in common he showed that it is possible to establish a general theory of behaviour, or a unified science, in terms of which all systems can be analysed. Thus, all systems are made up of interrelated parts, all have a basic structure, each of the parts must have an optimum value, systems are goal-seeking, and they tend towards increasing their stability or homeostasis. This is achieved by increasing complexity and order. In addition, all systems are governed by the law of economy and the parts are developed by differentiation and not by multiplication. Systems are also integral wholes in that none of their parts can be destroyed with impunity.

In this issue the author reviews the other characteristics of systems with special reference to societies and ecosystems.

#### Rejection

It is not surprising that systems which are sufficiently differentiated, such as biological organisms and societies, will tend to develop mechanisms which will enable them to exclude foreign bodies likely to menace their integrity. At the biological level such devices are known as rejection mechanisms. Experience with organ transplants has revealed that to suppress these mechanisms is to increase one hundredfold the patient's susceptibility to cancer, i.e. to the anarchic proliferation of cells. Mechanisms of this kind are essential at all levels of organization. Of the 3,000 simple societies so far examined by anthropologists, all appear to have laws of exogamy and endogamy. Marriage is forbidden within a restricted family circle, but also outside the cultural group, the object being to avoid cultural hybridization and hence the production of sub-systems that are differentiated parts neither of one system nor of another. What is today regarded as prejudice against people of different ethnic groups is a normal and necessary feature of human cultural behaviour, and is absent only among members of a cultural system already far along the road to distintegration. The notion of the universal brotherhood of man is therefore totally incompatible with the systemic approach to human cultural systems. It is as absurd as the notion that the cells making up a vast number of different biological organisms can be shuffled and still give rise to viable biological systems.

The imperialist position, whereby one ethnic group attempts to dominate and, if possible, absorb other groups, is also totally incompatible with a systemic approach. It contravenes the principles of optimum structure, self-regulation and systemic controls, as well as the essential principle of complexity or, in this case, cultural variety.

#### Feed-back development

We have seen that behaviour is goaldirected, in that, if conditions are optimum, it will tend towards increasing homeostasis. We have seen that it is explicable in terms of the interaction between the environment and the information contained in its cybernism.\* Each reaction is best regarded as selected by the environment from among all those that are cybernismically possible— (genetically possible in the case of a gene-pool, neurologically possible in the case of a brain and culturally possible in the case of a culture). It is in this way that the given parts of a system can influence the other parts qualitatively and quantitatively—a *sine qua non* for the maintenance of its balanced structure.

It is probable that an environmental demand for a given response that is not available at a given moment can, in time, determine its synthesis. This is usually disputed at the genetic level by those who consider that Darwinian natural selection (which is but an instance of feed-back development) tells the whole story. It is controversial whether it occurs during the immunizational process—yet another instance of feedback development. In the case of human day-to-day behaviour, its occurrence is incontestable. No one can deny man's capacity to improvise.

At the level of a human economy, the process of supply and demand, which is yet another instance of feedback development, undoubtedly involves improvisation.

In all these cases, the breakdown of the essential mechanism of feedback development can only lead to anarchic growth—growth that is not selected by the environment (in other words for which there is no environmental requirement), and which is therefore not specifically adapted to it. It must therefore constitute multiplication of parts, rather than differentiation, leading to eventual breakdown.

The establishment of systemic controls that prevent normal feedback development must bring about an imbalance in the system's basic structure. Since most human activity today consists in establishing more and more systemic controls in an even greater number of the different systems that are hierarchically organized to form our total ecosystem, it must follow that unintegrated parts are proliferating, leading thereby to chaos. An example is to be found in the field of education. If this process were allowed to occur normally, the correct ratio between the different specialists made available by the educational system, corresponding to the economic, social and ecological demand for them, would be maintained. As it is, we are producing a vast quantity

of young people with specialized knowledge in obscure branches of learning for whom there is unlikely to be any demand. In this way, we are simply creating unintegrated parts that must of necessity rebel against a system in which they have no place.

#### Transmission of information

Systems are differentiated in time as well as in space. Complexity increases temporally as well as spatially, and each generation that comes into being becomes specialized in dealing with slightly different environmental situations, separated from each other in time. These must be regarded as sub-systems, just like contemporaneous parts, and, like the latter, must be in possession of the same information that will enable them to act as temporally differentiated members of the same system. If the mechanism whereby this information is communicated from generation to generation breaks down, then the fourdimensional system must disintegrate.

At the cultural level, this means that for an individual to be capable of fulfilling his function as a member of a family, community and ecosystem, he must acquire during the course of his life the corresponding information. The most general information he will receive, that which will condition all the rest, is transmitted genetically. This will then be differentiated culturally by means of a number of steps, which must occur in the correct order, and at different social levels, just like any other developmental process.

The most general cultural information must be acquired from the family itself. Less general information must be obtained, at a slightly later date, from the community to which, during the latter part of its education, the child will be consigned.

When the family or the community disintegrate, this socialization process, which alone enables an individual to fulfil his correct systemic functions, will no longer occur. Instead, the individual will be submitted to a chaotic, unprogrammed barrage of asystemic information from such random sources as television personalities, journalists, pop singers, etc. Under these conditions, the individual will no longer acquire the kind of information that will enable him to fulfil his correct systemic functions. The family, community and ecosystem will clearly suffer, and will probably not be able to retain their essential structure, but will disintegrate still further.

In the light of this principle, we must revise the current view of education.

An "educated" man must be a different thing in different societies. A Hottentot imbued with the knowledge and sense of values required to fulfil the essential social and ecological functions of an Eskimo would make a very poor Hottentot. He would, in systemic terms, be uneducated—but so would a graduate of Oxford University with a First in PPE. Education is not simply the accumulation of random data. It is *functional*. Its role is, in broad terms, "systemization", i.e. the communication to a subsystem of that information which will enable it to fulfil its functions as a differentiated part of a system.

#### Self-regulation

A balanced system will be self-regulating. The only possible way in which a system can adapt to change is by building a model of its environment. This will enable it to interpret any situation and predict changes. Its action will then be the one most likely to increase its homeostasis in the light of these interpretations and predictions, and hence increase the efficacy of its reactions, so as to achieve ever greater homeostasis. A guided missile proceeds in precisely this manner as it finds its way towards its goal. It is also in these terms that the behaviour of biological organisms, stable societies and balanced ecosystems can be understood. It is only when systems cease to be stable that the self-regulating mechanisms break down. In such conditions, their survival can only be ensured by a principle external to the system, i.e. an asystemic control. A very simple society, such as an Australian aboriginal tribe, is totally self-regulating, just like a biological organism. It requires no chiefs, certainly no tyrants. Complex societies such as Switzerland, and most North European ones, are, or were, relatively stable and required little coercive government.

The total ecosystem, was also selfregulating so long as its balanced structure was not interfered with.

A self-regulating system is not free from constraints. It has just as many constraints as one controlled asystemically. The important thing is that each individual constraint is itself subjected to the set of constraints determining the behaviour of the system as a whole. This is precisely the difference between selfgovernment and dictatorship. Self-regulation at all levels of organization must be the ideal towards which we strive.

### Conditions under which a system will be self-regulating

It is essential to realize that a system must provide the ideal environment for its parts, since the only reason the parts were developed was so that they might fulfil specific differentiated functions within the system. Similarly, people are part of a family system, which is, in turn, part of a social system which in its turn is part of a vaster ecological one. One must therefore regard them as having been developed phylogenetically to fulfil specific functions within their family, society and ecosystem, and one must assume that it is in fulfilling these functions that they obtain maximum satisfaction.

For them to do this, they must be provided with appropriate information, and also with the correct environment, or rather, one whose characteristics are maintained within certain parameters.

When those conditions obtain, a subsystem will behave in that way which favours the survival or increased homeostasis of the system. If the system does not provide the appropriate environment, or if the information is not appropriate, then the sub-system will behave in a way which will tend to lead to the disintegration of the system.

Unfortunately, what constitutes a satisfactory environment for human beings has never been properly determined. One would have thought that this would be one of the principal goals of sociologists. However, they have not yet got round to thinking in these terms. Clearly, the external environment must have certain basic features such as the availability of food, water and air, but the presence of the physical necessities of life alone does not suffice to create a satisfactory environment. Man also needs a satisfactory social environment which involves the maintenance of the correct social structure. He needs a family, a small community, probably a larger one, and he certainly needs enemies. If he is not provided with them he tends to invent them. In this way, when the Comanche Indians were put on reservations they simply invented a host of evil spirits to replace the enemies of which they had been deprived.

Man has other requirements which his environment must also cater for. He has a sense of aesthetics. He cannot adapt readily to living in the grey, monotonous surroundings of our urban conglomerations. He cannot work up any enthusiasm for conserving an environment made up of chaotic complexes of concrete blocks or bleak fields mutilated by pylons, factories and housing estates. To create such an environment specifically for the purpose of increasing society's "standard of living" is to sacrifice its long-term stability in the interests of acquiring dubious shortterm benefits.

#### Asystemic control

When a system disintegrates, it loses its capacity for self-regulation. In such conditions, its maintenance can only be ensured by the application of some sort of external control.

Thus a doctor administers drugs to a body incapable of regulating itself; a surgeon intervenes when its basic structure has so far diverged from the optimum as to be incapable of selfreadjustment. Artificial fertilizers are added to the soil when the self-regulating mechanisms, which in a balanced ecosystem ensure nitrate-fixation, are no longer operative. Insecticides are sprayed over crops when natural biological controls cease to be effective.

At a social level, welfare, as unknown as it is unnecessary in a self-regulating society, becomes indispensable once the society has so disintegrated that people are no longer capable of looking after themselves. In the same way, coercive government of some kind becomes necessary when the cultural mechanisms, designed to ensure social self-regulation, have broken down. The choice in such societies is not between "democracy" and dictatorship but between chaos, thinly disguised as democracy, and dictatorship.

The trouble with all forms of asystemic control is that:

1. they are far less efficient than systemic ones, by virtue of the fact that they defy the law of economy (controls in optimum conditions being exercised at a lower level of organization);

2. they upset the optimum systemic structure, by allowing a pathological situation to persist;

3. the system adapts to them and becomes ever more dependent upon them. In fact, the more they are resorted to, the more they become necessary, and consequently the greater the difficulty involved in restoring a healthy situation. This is as true in the case of the use of drugs and of artificial fertilizers and insecticides as in that of welfare and dictatorship.

In each case, therefore, asystemic controls must be reduced to the minimum, i.e. applied to special cases only —deviants in a society—and their object should be simply to re-establish the proper functioning of the original selfregulating mechanisms.

#### Disintegration

By joining together to form a system, sub-systems become specialized and hence incapable of fulfilling by themselves all those separate functions needed to ensure their increased stability or homeostasis.

It is this dependence on each other that gives rise to the bonds that hold the system together. When the set of constraints ensuring specialization ceases to be operative, and all the parts begin to resemble each other more and more, the bonds will relax and the system will disintegrate. Any reduction in differentiation, like any reduction in the set of constraints associated with a given system, must, therefore involve a reduction in order, or a move towards "entropy", or disorder.

Thus in a simple ordered society there is a very clear division of labour among the members of a family. Certain functions are specifically fulfilled by the father, others by the mother, others by children of different age-groups. The breakdown of this differentiation of functions can only lead to the erosion of the bonds holding the family together and hence to an increase in social entropy or disorder. If a husband and wife have similar jobs, earn equal pay and are equally capable and willing to fulfil the household duties, then what is to hold them together? Clearly feminism is merely a symptom of the advanced disintegration of our society.

There is a variety of conditions in which disintegration is likely to occur. Thus a radical modification of the environment, to which the system will be incapable of adapting, would render its behaviour pattern redundant. Each response would no longer be selected by the environment. Feedback development would cease to occur, and differentiation would give way to multiplication of parts. The latter would cease to be specialized, would no longer be dependent upon each other, and systemic disintegration would be the outcome. This would also be likely to occur if the system's basic structure, or that of any of its essential parts, were interfered with in some way, so that it no longer had the optimum structure which would enable it to function as a self-regulating unit of behaviour.

#### Reintegration

Once a system has disintegrated, adaptive behaviour will only occur at the level of organization of its particular parts or sub-systems.

If the latter can adapt themselves to the disorder of their new environment,

then such a situation can persist until such time as environmental challenges induce the further development of the system. If they are not so adapted, i.e. if they depend for their survival on being subjected to a more ordered environment, i.e. that with which the now defunct system once provided them, then there will be an immediate tendency for them to re-create such a system, though the one that will emerge will tend to be better adapted to its changed environmental conditions. At a cultural level, individuals find it difficult to survive when deprived of that highly structured environment consisting of a family and a home, a community and a village, fields and forests, enemies and their strongholds, and unknown areas inhabited by dreadful supernatural creatures, i.e. an environment displaying the required distribution of order. In the absence of such an environment, they will be forced to seek short-term substitutes to satisfy those of which they have been deprived. These substitutes will include taking drugs, drinking, cheap entertainments, anything in fact that will render their unenviable lot slightly more tolerable. At the same time, they will be particularly susceptible to new doctrines that might enable them to re-establish new social structures, and hence that environment to which they have been adapted by millions of years of evolution. Thus, during periods of social disorder, cults, revolu-. tionary movements of one sort or another, usually of a "messianic" or "millenarist" nature, will proliferate. It is significant that there are 7,000 such movements in Africa at this moment. Such movements are best regarded as reintegrative.

To conclude, the adoption of a cybernetic approach to the study of societies and ecosystems must lead to a very different view of these systems—one in which "emotion", "wishful thinking", and other subjective elements are, to all intents and purposes, eliminated. Above all, it should permit the development of a model capable of representing the world we live in as a whole for the purpose of accurately predicting the effect on it of any local change regardless of the level of organization at which it occurs.

It is only in these conditions that science can be of use in guiding the direction of our societies and ecosystems.

<sup>\*</sup> Term coined by author to refer to any organization of information.

# The diseases of civilization

The declining health of urban man

#### by Robert Waller Editor of the Soil Association journal

According to the official figures, a middle-aged man can expect to live about three years longer than his counterpart in 1841. Over a period of more than a 100 years, this shows a negligible advance. In a paper given to the Royal Society of Health in 1967, Dr R. Logan, Director of the Medical Care Research Unit, summarized the hazards for middle-aged men as follows:

One in 4 will suffer from chronic bronchitis: 1 in 5 will develop coronary heart disease: 1 in 12 a peptic ulcer: 1 in 4 cancer, of which 1 in 30 will be cancer of the lung: 1 in 12 will be admitted to a general hospital each year: 1 in 300 will be admitted to a psychiatric hospital each year. A similar picture for women can be summarized by saying that 1 in 4 will be regularly attending a G.P. with a chronic disease: 1 in 8 will die of diabetes. Dr Logan also stated that sickness absence has doubled since the war. In their early sixties 13 per cent of men are incapacitated through illness.

Coronary heart disease; peptic ulcer; cancer; diabetes. A new pattern of disease is being observed in Western Europe. The infectious epidemic diseases lowered the expectation of life for everyone in the past. In this century they have been brought under control. How is it then that the expectation of life for the middle-aged has increased by such a meagre amount? The explanation is that the new diseases strike mainly in the second half of life: they are known as degenerative diseases. Doctors refer to the *twenty years abuse*, meaning we can abuse our natural good health for 20 years or so before the effects catch up on us, which brings us to the age of about 45. But it should also be noted with alarm that America reports an increase in cancer among children which not so long ago was unknown.

While these diseases continue to increase at their present rate, the expectation of life for those over 45 will fall. Must the second half have its particular forms of illness? Are we facing up to this problem?

Research done by Mr A. Elliot-Smith, formerly senior surgeon at the Radcliffe Hospital, Oxford, shows that there were only five cases of appendicitis at the hospital between 1895 and 1905. There are now over 500 cases every year. Stomach ulcers were not recorded before 1890. Yet in the last war 23,500 men were discharged from the army with them over a period of 30 months (1939-1941). These ulcers were not due to army life or army cooking; most of the recruits brought their ulcers with them. When Mr. Elliot-Smith examined the records of six separate London hospitals from 1925-1929, he found a dramatic rise in ulcers over this period.

Mr. Elliot-Smith had worked in Africa and had noticed among unsophisticated native peoples the absence of diseases most prevalent in this country. Back in Oxford, he undertook research to establish whether these diseases were newcomers or if they had always been present. He not only discovered that they were new, but that their incidence rose with the change in the national diet due to the new industrial processes of refining sugar and flour.

Several other doctors and surgeons who had worked among primitive peoples noted the same difference in the pattern of diseases and they all suspected that diet must play a part in causation of the *civilized* diseases.

For example, Surgeon Captain Cleave noticed that Africans who ate western food developed the new western diseases, while those who were still eating their traditional foods did not. This view has been supported by Mr D. P. Burkitt, a distinguished surgeon now of the Medical Research Council, celebrated for his work relating diseases to different regions of Africa. Cleave worked with a South African doctor, G. D. Campbell, comparing the hospital records in western food areas with those in less sophisticated ones: they found that the western diseases included far more than appendicitis and ulcers: they extended to diabetes, obesity, coronary thrombosis, dental decay, varicose veins, diverticulitis, constipation and several infections of the bowels probably related to constipation. Support for this view comes from many other medical authorities working in areas where traditional diets are being superseded by western diets.

The most obvious difference in diet between the two groups is that western



diets have white sugar and bread, processed, packaged and synthetic, while the older peasant diets are based on unrefined cereals, fruit and sugar. This is what is called wholefood by the diet reformers, since little or nothing has been removed from the grain and the sugar cane.

Cleave, Campbell and Painter (a surgeon at the Manor House Hospital, London) noticed that in wartime, when these refined foods were rationed and/ or the extraction of nutrients and bran from bread had been limited by law, these diseases declined, only to shoot up again when the restraints were removed. Today we eat 10 times more sugar per head than we did in the 18th century.

In the process of refining flour for white bread very little of the original nutritive value of the grain is left. It is said by some nutritionists that this does not matter because these nutrients can be obtained by eating a varied diet. On the other hand this means that we may have to eat too much to get adequate nutrition. Obesity due to overeating is also a disease of our time. More important, however, is that the bran, which is removed, should serve the function of stimulating the movement of the bowels. This may not be a nutritive function but it cures the white man's ailment of constipation at no cost. Recent experiments by Mr Painter at his hospital, where he has fed bran to all his patients, has had remarkable results in restoring their health. Mr Painter has succeeded in introducing wholemeal bread into the hospital diet.

It has been shown that food takes six to eight times longer to pass through the intestine in western countries than in parts of Africa and India, where the staple diet is wholefood.

#### The Saccharine Disease

Carbohydrate as starch is digested to, and absorbed as, sugar in the body. Refined flour is almost pure starch so we add it to our refined sugar consumption. Since the increasing consumption of carbohydrates and refined sugar can be so closely associated with the new diseases, Cleave and his collaborators have given a group of them one name, as described in their book *Diabetes*, *Coronary Thrombosis and the Saccharine Disease* (John Wright & Sons Ltd.),\* now going into its third edition. Saccharine rhymes with Rhine to distinguish it from the sweetener.

If a relationship has in fact been

established between dietary habits based upon excess of sugar (saccharine) in the body it should not be necessary to await an understanding of how this causes disease before attempting prevention.

As these diseases are the result of abstracting from the whole food, we are faced with a new outbreak of deficiency diseases. So one calls to mind the challenges faced by medical science in the past in curing such dietary deficiency diseases as scurvy, beriberi and rickets. The results were easily discernible and the diseases responded quickly to the correct treatment. The new kind of dietary deficiency disease caused by these concentrated incomplete foods builds up slowly over half a lifetime and then manifests itself in this wide variety of degenerative diseases both acute and chronic.

#### Sugar, fats or both?

Dr Hugh Sinclair of Magdalen College, Oxford, a nutritionist, has for a long time incriminated some animal fats as a major cause of degenerative diseases. He illustrates his argument with lung cancer. Lung cancer is now associated with smoking: but in Spain and Japan, where smoking is as common as in our own country, lung cancer hardly exists. So there must be another factor: Dr Sinclair believes it is the saturated fatty acids in animal fats.

There are two kinds of fatty acids, one essential-the unsaturated fatty acids-and one not essential, the saturated fatty acids. The essential ones are not made in the body and have to be taken in through food. They tend to be unstable in the air and turn rancid, so the manufacturers have found a means of changing their chemistry by saturating them. Here then we have another source of deficiency. A deficiency of essential fatty acids will weaken the membranes of our body cells, which serve to protect the cells from invasion and penetration by alien bodies likely to damage them.

Dr Sinclair has done experimental work which he claims shows that modern high energy feeding of pigs also destroys the essential fatty acids in their bodies. In a recent letter to *The Lancet* (27.12.69) he has been supported in this view by Dr Michael Crawford of the Nuffield Institute of Comparative Medicine. Crawford said: "People have always eaten some fat, but only the modern high-energy feed systems produce large amounts of saturated and mono-saturated short-chain fats." He goes on to argue that in modern factory farming methods "fat seems to replace functional tissue. We have examined 14 different wild herbivorous species, and have been unable to find any signs of such gross infiltration, which prompts the question of whether such lipid (fat) deposition is pathological."

This fat is largely inessential, and is not found on animals able to choose their own food by free-range grazing.

Crawford believes that simply to stop eating sugar is not enough: we need also to have the right amount of essential fatty acids in order to build up the arteries of our body with the proper structural constituents.

As Crawford says in his letter, an attempt at prevention by rebuilding the damaged arteries through the right diet should be simple enough. "But," he says, "from a practical standpoint it would be difficult in so far as it touches on almost every aspect of modern food technology."

We may add here that not only are modern agricultural feeding methods indicted, but the feeding of plants as well. For the plants on which we and animals feed are also fed by fertilizers and the modern practice is to concentrate these in the same way as flour and sugar are concentrated by extracting essential elements. This has been studied by Michael Blake in his book Concentrated Incomplete Fertilisers (Crosby Lockwood). There is no place here to discuss it but the principle is the same. Nitrogen is concentrated at the expense of other important plant nutrients which unbalances both the soil and the metabolism of the plant.

To sum up. What is alarming about the present health situation is that the rules of good health-fresh air, fresh food, adequate exercise and a temperate attitude of mind-which have been handed down from generation to generation-are being put out of reach of the individual who chooses to follow them. We are becoming aware of the dangers that arise from the pollution and contamination of the environment: but threatening as these are, they are no more dangerous than the changes in the composition of our food as a result of technological advances. In conservation year let us also pay attention to the conservation of the nutritional value of our diet.

\* Reviewed in the July issue of THE ECOLOGIST



#### Snow Leopard

Sir,

The swelling numbers of conservationists will be deeply shocked to read a report on the sale of rare animal skins which I noted in the Food and Raw Materials column of the Financial Times of March 12. This grisly trade in the coats of threatened species has become an abomination of which most thinking humans have become profoundly ashamed. I quite appreciate that the Financial Times' concern was solely to report a commercial transaction, but the clinical phraseology suitable for commodity columns makes singularly unpleasant reading when applied to that evolutionary masterpiece, the Snow Leopard, an animal universally admired for its rarity and its beauty. The "finished garment", the report explained, comprising four Snow Leopard skins at £340 each "would retail at around £3,000". It added that "almost as successful and confirming the importance of long-haired furs was the collection of Soviet Lynx which realised £70 per skin". What sort of people are engaged in this sort of business? What sort of journalists can be found to write such a column in language of this kind-and more remarkable still, what sort of women would want to be seen wearing a garment to create which so many noble and inoffensive animals have been murdered? The whole concept of destroying the great wild cats for status-wear is a grotesquism that should be legislated against without delay. It is incredible to think that the import of rare pelts is still permissible in 1970.

#### Yours sincerely,

John Aspinall. 44 Berkeley Square, London, W.1.

#### Alliance for (sane) Progress

Sir,

In wishing you every success may I welcome the *Ecologist* as an ally in the campaign to awaken and maintain concern over the challenge of our changing environment.

#### Yours sincerely,

Victor Head.

Assistant Editor, *The Field*, 8 Stratton Street, London, W.1.



Sir.

Having read about your new magazine the *Ecologist* in *The Sunday Times*, I am writing to tell you about an air pollution problem we have here.

There are two Phurnacite Plants producing smokeless fuel in Britain, and one of them is here-about half a mile from this town. If the country's demand for smokeless fuel continues to increase, I suppose it is not impossible that yet another plant might be built. In view of this possibility, I should like you in your magazine to draw attention to the amount of sulphurous fumes thrown out into the atmosphere by these plants. The inhabitants of this town are continually trying to get something done to regulate it, it is so bad. The children of the town, who all go to the new Comprehensive School very near the Phurnacite Plant, are continuously breathing fumes, which are definitely detrimental to their health. The local doctors have all noticed an increasing incidence in chest ailments among children in the three years since the school was built.

We would not like any other towns to suffer as we suffer from such fumes, just so that the rest of Britain can have smokeless fuel.

Yours sincerely.

Mrs J. Warlow. Glanpennar, Mountain Ash, Glamorgan.

#### **Conservation Party?**

Sir.

Today I bought a copy of the first issue of the *Ecologist*, which I had read about in today's *Times*. Many congratulations on producing this excellent and long-needed magazine. I wish it every success.

After all the hot air that blows over us every day from newspapers and television about the "necessity" for growth and expansion, and about the "over-riding importance of balancing the economy", it was indeed a relief to read so much commonsense about the real problems that face us.

Of course, the problems which you set out so clearly and graphically need to be tackled on a global scale. But I have little hope of their being tackled seriously, even in this country, until it is too late. Compulsory restrictions on the number of births, and the rigid controls necessary to restrict the ravages of industry and King Car would be looked on as undesirable interference with "personal liberty", and are therefore likely to remain political dynamite. The only hope I can see is that education—through magazines such as yours, for example—will make the electorate actually demand such restrictions.

Letters

Otherwise, is there *any* chance that either (or both) of our main political parties might start to treat overpopulation and conservation of the environment with the urgency and sense of purpose they deserve? There is precious little sign of this happening at the moment. Perhaps the time has now come for the formation of a new, crusading political party: the "Conservationists".

Yours sincerely,

D. L. Reynolds.

3a Queen Mary's Ave., Carshalton, Surrey.

#### **Unadaptive editor**?

Sir,

This morning, my newsagent persuaded me to buy a copy of your magazine on the basis that it was "proper smutty but no photos". I asked him the price, he said 4s., and then dealt at 2s. 6d. because it was the only copy he had sold.

On reading the paper, I soon found that I had been done. My lack of knowledge of modern terminology had led me to presume that ecology was just as likely to be a new vice as a new science.

It was not without interest, however, that I read the magazine. There was one article, unsigned, to propagate a return to the primitive order of man in the role of hunter gatherer as a solution to our problems. Later, there as an article on excessive population expansion.

Might I suggest that if man should compulsorily be returned to the role of hunter gatherer, then there is so little left to hunt or gather, that this would drastically solve the population question. However, judging by the portrait above the former article, I assume this to be the author, I would also suggest that this corpulent gentleman would be the first to perish under such a social order.

Yours sincerely,

D. H. Hume.

41, Bishopsgate, London, E.C.2.

The Editor refers our correspondent to the Comments section in this issue where our interest in Hunter-Gatherers is explained further.

#### **Oil Pollution**

Sir.

Oil pollution is bound to rise until all the local health authorities do something about it and notify the people that it is an offence to put dirty engine oils down the drains.

A leading oil company's retail manager wrote recently in a motor trade paper that 40 per cent of all engine lubrication oils was sold to do-it-yourself motorists. So where else, but down the drain or in the garden can dirty oil go?

Whichever place they put it, it has got to end up in our streams, canals, or rivers. Then everybody cries "pollution". What pollution costs us ratepayers I wouldn't like to imagine. Oil should be sold under licence the same way as petrol, but only by traders who can take the dirty oil back from the doit-yourself motorists and dispose of it in the right way.

If all waste oil was saved and collected by the reclaimed oil people for re-sale again it would also save the country money on extra imports (oil does not deteriorate). It would also save the ratepayers' money and we would be able to boat, swim and fish in our waterways.

Thirty years ago we could swim and catch fish in the Elstree Reservoir, also the Welsh Harp and our local canalways.

If the do-it-yourself motorist and the backstreet garages, who have not got a proper waste oil storage capacity and cannot dispose of it in the right manner, going on at the rate we are using oil now, then in a few years' time all our water will be polluted. This should be got home to the right authorities.

Approximately 20,000,000 gallons of lubricating oil are used in this country every year. 40 per cent of this goes down our drains which finds its way into our canals and rivers.

Yours sincerely,

G. F. Roochley. 115 Theobald Street, Borehamwood, Herts.

#### Spokesman for survival Sir,

I read with interest the whole of the first issue of the *Ecologist*. I have personally waited a long time for the arrival of such a magazine which will hopefully bring to the attention of the people of the world, the need for immediate, drastic and positive action to rectify the results of man's destructive progress. Without the use of a garish cover your magazine had sufficient impact to catch my eye as soon as I entered the shop.

I noted with great interest, the emphasis placed upon the population problem in this country, related, as it is, to the preservation of a stable ecosystem. This is in my opinion the basic cause of social, political, human and ecological problems in the world today, in that with the reconstruction of what might be termed a "sane optimum population level" our present problems of large scale would be avoided, and world sanity might once more be restored to those nations of the world that require it.

The *Ecologist* as a magazine will become the spokesman for the ecologically-aware. It is also to be hoped that you will not just rest here, but will continue to progress towards active participation in the problem of environmental conservation. It may be hoped that the birth of such a specialised magazine will excite the sort of interest generated in American Universities and portions of American middle-class society.

I wish every success to your new magazine, and hope that it will be as instrumental as possible in the fight towards the preservation of our future.

Yours sincerely,

Richard J. Thompson. 14 Brooklands Road, Hall Green, Birmingham.

# **The Fourth World**

How did you vote in the recent quinquennial debauch? Would it surprise you to hear that it doesn't matter? It wouldn't? Good! It could mean you have reached years of genuine discretion...

Whichever section of the Conservatives gets in at Westminster is a matter of near total inconsequence, for the quite simple reason that none of them has any central regard for the real problems . . .

These problems are surely not about capitalism or socialism, or about higher exports, trade union reform, student protests, increased production, and the rest of the rag bag...

We believe the real questions are about war . . . pollution . . . population . . . despoliation . . . and alienation . . .

We link these problems to one major question—that of size . . .

Most governments are doing horrible and evil things, not because politicians are more evil than the rest of us, but because they are no longer controlling events . . .

We believe their failure here is due simply to the fact that the mechanics of government plus the complex of social welfare, industry, commerce and other matters they try to oversee are all being conducted on too large a scale ...

So large that nobody can control them . . .

Remember how World War One dragged on when everyone wanted it to stop? Remember the Great Depression nobody wanted? Remember the Stalin and Hitler terrors which engulfed millions? Remember the nuclear arms race which no one wants? The inability of the U.S.A. to extricate itself from Vietnam?

We want a small scale of operations —like the renaissance city states which gave man so much glory, like modern Sweden and Switzerland—*small* countries which have abolished poverty and avoided wars for a century . . .

That's why we talk of The Fourth World—a world of thousands of smallscale countries which people can control and direct, not just four or five insane and uncontrollable political monsters...

This is the real field of 20th Century political radicalism. We see our job to explore, report and affirm in this light ...

Actually we have been doing it for more than four years, quietly, without backing, dependent almost entirely on the enthusiastic personal recommendation of our readers to their friends . . .

Readers such as Paul Goodman, Yehudi Menuin, Danilo Dolci, Joyaprakash Narayan, Dr E. F. Schumacher . . .

We like the *Ecologist*, it is saying something vital, new and original. Perhaps that's why the *Ecologist* likes us, and why it offered us this space to tell you about ourselves . . .

Please h shillings.	otfoot me a sample of Resurgence for the absurdly low price of four
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# Mined out!

Our diminishing mineral resources

#### by Preston Cloud

Professor of Biogeology, University of California.

The rapid deterioration of our environment, that we are experiencing today, can be attributed to two associated causes: the exponential growth of human populations, and their consumption and waste of the earth's material resources. Among these I include food, pure water, clean air, space, and nonrenewable minerals. However much informed estimates of these resources vary, they must all agree that there is some annual harvest of food that cannot be exceeded on a sustained basis, some maximal quantity of each mineral and chemical that can be extracted and kept in circulation.

Data available on the ultimately accessible and extractable reserves of most mineral resources are not yet good enough to say what the ultimate limits may be, but they do cast some sobering shadows.

It is axiomatic that nothing can expand infinitely on our finite spaceship earth. Mineral resources are finite, because, for all practical purposes, the formation and differentiation of the earth is complete. The useful elements available to us, moreover, comprise only a fraction of the total world-mass, and One fact of life conveniently forgotten by the proponents of growth is that the earth is finite, and there are limits to its resources. Minerals are vital to an industrial economy, and yet so committed are we to expansion that they are being squandered. One day they will run out and that day, as Preston Cloud demonstrates, is not far off. of this minute quantity, much has not been located, and much is unrecoverable by any known technology.

Copper will illustrate the problem. It is a metal which is neither very abundant nor in immediate jeopardy. Its abundance in the earth's crust averages about 55 parts per million, which is a lot of copper. However, of that amount, probably no more than a billion or two tons is recoverable, and of this about 210 million tons is represented by ore reserves not known. It will be difficult, therefore, even if we discover these and work lower grades, to increase copper production by as much as 10 times our present reserves. If we allow for increasing population and for expected end-ofcentury demands, it becomes clear that a limit must be reached within another couple of generations. The continuing availability of copper will then depend largely on the recycling of already mined metal. It is inevitable that the same must ultimately be true of all other metals.

#### No second crop

Mineral resources are products of millions of years of earth history, and different mineral deposits are localized Mines bear no second crop. As new discoveries decrease, there is only retreat to ever lower grades, imports, substitutes, synthetics, recycling and eventually, exhaustion.

in different geochemical provinces. Since new deposits do not form fast enough to replace those mined, they are nonrenewable. Mines bear no second crop. As new discoveries decrease, there is only retreat to ever lower grades, imports, substitutes, synthetics, recycling, and eventually, exhaustion.

No part of the earth is self-sufficient in all critical metals. North America, for instance, is rich in molybdenum but poor in tin, tungsten and manganese. Asia is rich in tin, tungsten, and manganese, but poor in molybdenum. Most of the world's essential chromium and gold comes from South Africa. Cuba and New Caledonia possess about half the world's known reserves of nickel. Most cobalt is in the Congo Republic, Cuba, New Caledonia and parts of Asia. The world's mercury supply is essentially limited to Spain, Italy, Yugoslavia, and parts of China and the USSR. The iron deposits of the world, basic to industrial development, are concentrated in particular old sedimentary belts of the continental cores.

As industrial nations use up their own supplies they turn increasingly to recycled metals and to foreign sources. Today all industrial nations except perhaps the USSR are net importers of most of the metals and ores on which their economy depends.

The United States, by far the world's largest consumer, although with only six per cent of its land area and people, depends increasingly on foreign sources. Among many other mineral commodities, it imports most of its manganese, chrome, cobalt, tin, and bauxite. It extensively supplements its lead, zinc, and tungsten from foreign sources. Its dependence on foreign petroleum, ironore, and copper grows annually. Except for bulk non-metallic materials like coal and phosphate, it is currently selfsufficient only in magnesium, molybdenum, and a few other metals. Even its readily accessible reserves of ordinary construction materials, like sand and gravel, are dwindling as the cities consume them and expand over them. Can such levels of consumption be extended

world-wide, or even long maintained in the US without population control?

At what point, moreover, does exportation of resources by developing countries begin to prejudice their prospects of eventual industrialization? What kind of social and political turmoil will arise when these nations discover that exportation has handicapped their chances for development? Is universal industrialization inevitable, impossible, or even desirable—and if not desirable how can its limitation be harmoniously achieved?

#### **Current reserves**

Considering the demands for resources and their finite supply, eventual depletion is probably inescapable. But what is the time scale and real magnitude of the problem, and what can we do to defer the final confrontation with it?

Unfortunately, reliable estimates of ultimate reserves for most minerals are not available. Economic factors, including mining, extractive technology, and transportation are key factors in establishing whether a particular type and grade of mineral concentrate at a particular place is or can be an ore. As we know also that new reserves will be discovered by geological exploration or be created by technological innovation, and that both population and per capita demands are bound to go on increasing for some time, we have to cope with many variables in estimating the lifetime of metals. These variables, however, tend to balance one another out, so that we can roughly estimate the apparent lifetimes of secure reserves for the 20 best-known commodities. Graphs of such lifetimes (see table) show that platinum, zinc, gold, and lead are in very short supply. Only 11 of the 20 worldlifetimes and four for the US persist beyond the end of the century. Present commercial deposits of silver, tin, uranium, natural gas, and crude oil will be pressing their limits by then. By the year 2042, which is only as far into the future as the invention of the airplane and the discovery of radioactivity are into the past, we can count on only eight of the 20 commodities for the world and maybe three for the USmolybdenum, perhaps iron, and coal (as well as, of course, magnesium, bromine and salt from the sea). Even if assured reserves could be tripled, or multiplied by 10, we would still be in trouble, for, in addition to the estimate that US requirements for metals and energy in the The United States, by far the world's largest consumer, although with only six per cent of its land area and people, depends increasingly on foreign sources.

year 2000 will be four and a half times present demands, world demands, if raised to the *per capita* level of the US, would then be about 30 times greater.

#### The future

What can be done to prolong the availability of the most critical resources?

One partial but often overestimated escape hatch is nuclear energy. The promises of breeder reactors and controlled nuclear fusion are threefold. First, they could provide almost "limitless" energy for the next few thousand years, permitting the "fossil fuels" (petroleum, coal, natural gas, tar sands, oil shales) to be conserved, as they should be, for the manufacture of petrochemicals, plastic and other synthetics, and for essential liquid fuels. Second, vastly increased cheap power will bring new non-commercial mineral resources to the market place by lowering the costs of transportation and beneficiation at the mine. Third, we could apply energy to extract dispersed metals from low-grade sources. Although records show little correlation between mineral production and energy input as such, the threat of resource scarcity requires that all possibilities be explored. Hence we should investigate the potentialities of nuclear fracturing of sparsely metalliferous rock in place. But this would create the problem of containing the radioactive wastes-of keeping them out of contact with humans and other organisms and out of the product. Thus the third promise of nuclear energydrastically lowering the grade of mineable rock-is a very uncertain quantity.

#### **Technological innovation**

Substitution and synthesis through technological innovation are other ways of stretching mineral supplies. Various metals can substitute for one another, and plastics for some metals. Aluminum already substitutes for copper in many roles, as copper and nickel now replace silver in coinage. Synthetic crystals come increasingly into use. Other substitutes can be created if price





It has happened before . . .

it can happen again.



Apparent lifetimes of known recoverable reserves at current mineable grades and rates of consumption.



#### Grim glut

The harvest of 1969 produced the greatest mass of wheat the world has ever known. This was due primarily to the chance occurrence of favourable weather in all the wheat countries, but in part to the influence of better practices and new strains in Mexico, India and Pakistan. Result—a massive surplus and a crash of world market prices.

One might think that this year the hungry people of the world will be well fed and able to produce a larger crop of children. But the world's wheat surplus will not go to feed hungry people. With a wheat glut and falling prices the exporter nations cannot afford to give their grain to starving people even if they want to. Wheat exports are a major part of the economy of Canada, Argentina and Australia. Only the US has been able to afford to give away grain.

The Canadian farmer is in serious trouble because of wheat prices. With \$65 million of last year's loans still unpaid, the Canadian government has increased its cash advances against unsold wheat to \$6,000 per farm. Obviously the Canadians must sell their wheat to the highest bidder and cut their losses. So it will go to feed animals to produce meat for Americans and Europeans.

Wheat is not a feed grain; feeding it exclusively leads to digestive problems in livestock. But with the surplus and with prices falling below those for corn, farm experts have now developed programmes to use up the wheat which the starving people cannot afford. Thus the *Farm Journal* for October says to feed wheat to cattle and in November to feed wheat to pigs. It also says that Canada plans to export grain surplus as beef. She brings in feeder cattle from the United States, fattens them on wheat, and sells them back to us.

We also have hungry people in the US, estimated at about 15 million. They are hungry for the same reason as are people in the rest of the world; they can less afford grain to eat than the affluent can afford it to feed to pigs.

The White House Conference on Food Nutrition and Health on November 29th, 1969, said that hunger in America is so widespread and serious that President Nixon should declare a state of emergency under the disaster relief act. They asked that such action be taken to provide funds to eliminate hunger in this nation in 1970 and poverty within the next few years.

Implementing these requests would demonstrate once again a strange paradox: you cannot eliminate hunger simply by feeding hungry people. When food is supplied to hungry people, they reproduce. Reproduction is as rapid as the level of nutritional intake will allow. They can outbreed the ability of this nation or any other to supply their food. We learned this with Public Law 480 with which we provided \$15 billion worth of food to the hungry nations. The result was a dramatic increase in the number of hungry people, lowering of per capita food consumption and general living conditions, and a decline in the efforts of these nations in trying to feed themselves. Recognizing this fact, an editorial in the February 1969, BioScience said "Because it creates a vicious cycle that compounds human suffering at a high rate, the provision of food to the malnourished population of the world that cannot or will not take very substantial measures to control their own reproductive rates is inhuman, immoral, and irresponsible."

The above statement is just as sound when applied to Americans as to Egyptians. To guarantee to feed all the descendants that the poor can produce is to make certain that we cannot uphold the guarantee. Not only will such a programme assure an ever-increasing proportion of people on welfare (according to Time the number in New York City alone doubled during Mayor Lindsay's first term) and the collapse of society. but it blots out the chances of the hungry ever attaining a decent standard of living. The more children in a family, the more the money required to raise them, and the less the chance of the family ever becoming self-sufficient.

It is time we faced our real responsibilities. Those who call for increased food production in the world are asking only that we make a grave problem still more serious. We must oppose any food distribution plan that is not tied to a rigid programme of compulsory birth control and a genuine effort to help the recipients break the poverty cycle.

#### (Mined out!-continued)

is not a consideration. But the production of plastics consumes petroleum and coal. Metals in general cannot be synthesized at temperatures attainable on a sustained and large scale outside exploding stars, and other elements have unique properties which exclude substitution. Substitution and synthesis must still be exploited to the limit, but we must recognize that they are insufficient, either alone or in combination with nuclear energy, to overcome the limitations of natural supply for ever.

A more promising means of extending the lifetime of resources is to improve the technology of new discovery. We must turn increasingly to geochemical methods that can assist in discovering ore deposits that lie beneath a cover of younger rocks or sediments including the array of now remotesensing devices that is becoming available for trial as a spin-off from the space programme.

Although major new mineral discoveries have been made in recent years, and will be made in the future, none of them means that we can relax the search for more. The discovery of a new, perhaps 10 billion barrel oil-field at Prudhoe Bay on the North Slope of Alaska, during the summer of 1968, is one of the increasingly rare discoveries of major new oil fields, of which probably few remain to be found—particularly outside of remote regions and the continental shelves.

#### **Ocean rescue?**

In considering the discovery of new sources of earth materials, we have focused so far on the land-surfaces of the earth. What about the sea? In 1964, it accounted for about 10 per cent of the value of minerals recovered. However, if the theory of sea-floor spreading is correct, the floor of the ocean beyond the continent slope will be a poor place to look for useful minerals. To consider as an important mineral resource the interesting but thinly dispersed manganese crusts and nodules of the deep sea floor is to risk falling into the sort of trap which led post-World War I Germany to imagine she might repay her war debts by extracting gold from sea water. The nickel, cobalt, and copper in these nodules continues to attract industrial interest, but their recovery and metallurgy pose problems of enormous magnitude. The best that can be said of them at this time, therefore, is that By the year 2042, which is only as far into the future as the invention of the airplane and the discovery of radioactivity are into the past, we can count on only eight of the 20 basic world commodities.

their potential remains to be evaluated.

Far more likely as a source of marine minerals are the submerged areas that belong geologically to the continents. Exploration for new mineral resources from the sea should be concentrated here. About 17 per cent of the world's petroleum and natural gas is now produced offshore and more will come. Other mineral products likely to be recovered from the sea floor in substantial quantities include heavy metal deposits formed on beaches and in streams along the coast. Submarine deposits will be limited to heavy products like gold, tin, and diamonds, and in general to depths of 130 metres or less. They will not go far towards solving the problem of other materials in short supply.

When other inescapable limitations are taken into account, moreover, it becomes apparent that the sea, although it must be a prime target for continued intensive research, offers no panacea for resource shortages.

#### Exodus?

It has been suggested that we may one day export people to other planets or import resources from them. However, even assuming that a habitable planet is available with accessible mineable resources, the impracticability of colonizing or of importing industrially significant quantities of materials from other planets is illustrated by a computation made by Garrett Hardin for the cost of colonizing the moon. He calculates that if four-fifths of the current GNP of the United States were devoted to that project it would take us a year to export one day's increase of world population at present growth rates. The import problem is of the same dimensions.

The facts reviewed here make it clear that there is no easy way out. But there is a way. We must limit populations, limit *per capita* consumption among the already affluent, and introduce sensible conservation measures, including the recycling of wastes and scrap and the recovery and storage of essential byproducts such as the helium in natural gas. And, of course, we must also accelerate geological research, exploration and the search for the technological innovations which will make it possible to recover and utilize larger fractions What kind of social and political turmoil will arise when aspiring nations discover that exportation has handicapped their chances for development?

of the earth's mineral resources with minimal harm to the environment.

Although we must continue to meet the inevitable demands of a growing world population, as well as increasing per capita consumption among the currently deprived, much of the metal that is now lost through dispersal and burial can be retrieved. The only inevitable losses are those from oxidation and friction, and even these can be limited by a determined policy to reduce waste and encourage recycling. Provident use of our resources, including our human resources, implies sensible economies in the use of materials and energy. We must recycle as much as practicable, and preserve for later use essential materials that are unwanted or deleterious byproducts of other operations.

There are at present few signs that the magnitude of the problem which will confront future generations has been recognized. Yet inaction on our part now may well ensure that the problem will not arise—for the future generations will not be around to face it.



# The last hunters of the Sahara

the Nemadi of Mauretania by Bruce Chatwin

Arguments about the nature of man have always been heavily influenced by our conceptions of hunter-gatherers. Now, many of our assumptions—for example about aggression—are being proved false as we look with less prejudiced eyes at the few hunter-gatherers that remain like the Nemadi of Mauretania. Thus it is a tragic irony that as we improve our understanding of their way of life, they are being forced to abandon it.

The innate quality of human nastiness has been a fashionable topic for Western intellectuals since their hopes for a better world failed to materialize after the Second World War. Archaeological discoveries of mutilated human skulls from the Lower Palaeolithic have been hailed with delight. One scientist, heralded as the "discoverer of Palaeolithic cannibalism", though flattered, considered himself, alone, unworthy of this honour.

Man, we are told to the point of exhaustion, is a territorial predator instinctively equipped to kill with a weapon. He lacks, Arthur Koestler says, "the built-in safety devices which prevent 'professional' carnivores from abusing their killing power to destroy fellow members of their own species". Any innate mechanism there might be for controlling this bloodlust was "bound to have been thrown out of gear with the innovation of weapons". The harmless vegetarian primate turned to homicide as a result of his new-found appetite for meat, So the Fall of Man is pushed back to the threshold of our humanity. In the manner of Aesop, animals are held up as models of rectitude, and the squalor of our behaviour compared unfavourably with theirs. Animal fables were a favourite literary exercise during the Hellenistic and Roman periods, and were gratefully received by those careworn but power-crazy autocrats who considered it their business to rule.

Faith in the inevitability of violence is a comfort, when one has to justify preemptive strikes against the intended violence of others. I write this on the day that President Nixon has found it fit to make a pre-emptive strike in Cambodia.

The prejudices of suburbia or government warrens have been projected on to Man the Hunter—the armed aggressive carnivore and originator of all our troubles. But a few hunters linger on in remote corners. They live at an illusory subsistence level, and eke out irregular supplies of meat with scavenged vegetable food. They are a real embarrassment. For, with exceptions that can be explained, the hunters are peaceful, healthy, sensible people in no way underdeveloped physically or mentally, and they enjoy a "right relationship" with their environment.

#### The ignoble savage

Many people wish they would fade away. They are dangerous for the Marxist; he believes in the perfectability of man, and an end to history, in a mechanized Valhalla of abundance for all. To the professional pessimist of the West they are a reproach, when he finds Rousseau's concept of the Noble Savage may not be so euphoric after all. He needs to excuse the peacefulness of the hunters, and so he says that they are "puny technically backward groups living under the dominance of aggressive neighbouring societies"1-a criterion that does not apply to Bushmen, Pygmies and other hunters despite efforts to make it so.

The search for the Ignoble Savage has been the preoccupation of many expensively equipped expeditions in recent years. The Ignoble Savage, locked in a primeval "State of War", is best found, some claim, in the tight mountain valleys of Western New Guinea. There, villages of gardeners butcher away in "an unending round of death and revenge", revealing to the satisfaction of many "the essential pristine state of man",<sup>2</sup> and performing very nicely in front of the Faith in the inevitability of violence is a comfort, when one has to justify pre-emptive strikes against the intended violence of others.

movie cameras. Furthermore the Willigiman-Wallalua—of whom I am talking —get rid of their frustrations in limited armed combats played, by prior arrangement, to a set of rules. The gardeners of New Guinea also suffer an incidence of peptic ulcers that would make a Manhattan physician's hair stand on end.

The archaeologist has no desire to preserve the hunter; for he might contaminate the flawless record of human violence revealed by his discipline. Archaeology, like the newspapers, is a catalogue of human aberrations laid out on a linear time scale. Anthropologists, concerned that they should not be accused of making moral judgements, have often been unwilling to give voice for fear that their programmes for field work might be interrupted, and until recently the few surviving hunters have had no champions other than a few oldfashioned sentimental conservationists, those much abused reactionaries against the inevitability of "progress". For whatever one may think of them, the break-up of the old colonial empires has been disastrous for "unprogressive" minorities. There is no place for them in nationalist states who labour under the stigma of technological incapacity. One such minority facing extinction are the Nemadi, the last hunters of the Sahara.

#### Witches and destitutes

The Nemadi, about 10 small bands of them (some 300 in all), survive on the western edge of the desert of El Djouf, the "Empty Quarter" of the Sahara, now divided between the Republics of Mauretania and Mali. They hunt oryx and addax antelopes with dogs, and return habitually to the line of wells that marks the medieval caravan route from Morocco to Timbuktu. There is, I believe, a very good case for the Nemadi being vestiges of mesolithic hunting peoples, who lived in the Sahara before the arrival of pastoralists from the east.

The Moorish and Arab nomads with whom they coexist regard the Nemadi as a caste, not as a separate ethnic group. Their very distinctive appearance belies this. They are white, remarkably white despite greater exposure to the sun than most Moors. Sometimes they have blue eyes. Their hair is straight and black. They are wide-shouldered, straightbacked and walk with long lilting strides. Their teeth are straight and white. The regular dentition of a woman thought to be reaching 100 is no mean achievement, and in sharp contrast to that of most town and oasis dwellers, whose teeth are well-decayed by 20. The women of the Nemadi, thin and handsome, are much in demand by, and freely given to, French soldiers and other visitors.

An American writer has said that "the Nemadi are amongst the most destitute people on earth".3 This in no way affects their self-esteem and they consider their way of life second to none. They have virtually no material culture, and would be totally invisible in the archaeological record. They make rough shelters of brushwood and use the occasional tent which they acquire from others. Till recently they dressed in antelope skins. Now they trade dried antelope meat for strips of Sudanese cotton, cooking pots and knives. They have been known to carry an antique firearm, but to me they denied that they ever hunted with one. They make their own water-skins. The antelope meat is called tichtar and is used, crumbled, to give a gamey flavour to couscous. The Moors eat it readily but ridicule the Nemadi for only eating rotting meat.

In Moorish society the Nemadi fall into the fifth category, the lowest of the low-"Ignorant irreligious thieves". They are nominally Muslims, but their professed religion is a facade that protects them from proselytizers. They have a frivolous disregard for religious practice, except when on the hunt, and cheerfully blame this on their own laziness. They observe no Muslim food taboos, and will eat wild boar if they get the chance. The Moors regard the Nemadi with horror tempered by uneasy caution, for they have the reputation of being practitioners of the black arts, an illusion the Nemadi do not dispel. There also persists the idea that the Nemadi are the rightful and original inhabitants of the land.

#### Masters of dogs

The name, Nemadi, probably derives from an expression in local dialects meaning "Master of Dogs"; some claim that they are the remains of the Numidians, well known to the Romans. They The prejudices of suburbia or government warrens have been projected onto Man the Hunter —the armed, aggressive carnivore and originator of all our troubles.

hunt only with dogs, and their use of the camel, which disqualified them in a recent symposium from being classed as proper hunters and gatherers, seems to be a recent development; the wells of the South Western Sahara have been drying up gradually; the antelopes and with them the Nemadi hunters have thus been squeezed further and further into the Djouf by pastoralists. The antelopes are now far beyond the reach of wells and would be unreachable without camels as water-carriers.

The dogs are small, swift and lean. They are well looked after and fed. The Moors ridicule the Nemadi for pampering unclean animals and for exchanging them as dowries. One pack leader is worth five camels. They are never called "dog" but "pupil".

The leading dog is called the "King of the Pack", and it is trained to fly at the animal's ear or muzzle and hang on while the other four go for the legs. When the hunter catches up, he lances the animal in one of three places, behind the shoulder, through the heart or through the flank protecting the liver. Before doing this, he finds time to wipe his hands, as a token of appeasement to the animal he is about to kill. The whole of the Nemadi's attitude to the antelope is one of reverent compassion. They are "friends" whose name must never be mentioned on the hunt. One observer reported that before dispatching an antelope the hunter makes the mark of a hand with fingers outsplayed on it; this practice immediately reminds one of wall paintings of the upper Palaeolithic and the customs of other hunters. It has not, however, been verified.

The gueimeur or Big Hunt is the event of the year; all spiritual as well as economic aspirations are vested in this hunt. It is an occasion for dancing, for the initiation of the younger members of the band, and generally to renew and reinvigorate the meaning of the society as a whole. Each stage of the journey, which resembles a pilgrimage, is marked by ceremonial, and follows a predetermined route based on precise knowledge of the movements of game and the availability of fodder. I was told that a *gueimeur* might continue up to 14 days march away from the town of Oualata, where I contacted them—a distance of over 200 miles.

The Swiss anthropologist, Jean Gabus, who went on the *gueimeur* with the same group in 1951 said that the bones of killed antelopes are never allowed to be defiled by dogs, but are reverently buried, a practice common to other hunting cultures, for the spirit of the dead animal is thought to reside in the skeleton.

#### Friends in crisis

This year the Nemadi are facing the crisis of their existence, though from their flashing smiles and spontaneous laughter one could not imagine this to be so. A government order actively prevents them from going to the gueimeur and has been in force now nine months. Each year the desiccating Sahara bites into the Sahel or Savannah belt, and waterholes marked on old maps have disappeared. Antelopes, already on the wane, become still scarcer when visitors come with telescopic sighted rifles and Land Rovers. Professor Monod, the greatest expert on the Western Sahara records that a party of six guns bagged 356 antelope in a week in the "fifties" -more than all the Nemadi kill in years, with no possibility of restocking.

Knowing their people to be notoriously fond of hunting and hopeful of rich tourists on safari, the Mauretanian government put a general ban on all hunting, and this is enforced as far as possible by provincial governors. The officials are sensible of the plight of the Nemadi, who are deprived of their means of sustenance. One considered the ban "inhuman", but they believe the position is hopeless. They have tried to turn them into good goat-keeping pastoralists, and turned over 1,000 goats last summer. The Nemadi saw this as an occasion for a magnificent display of dancing and feasting. All the goats have now been eaten. Their interest in animal husbandry is non-existent. They have nothing except for the charity of the locals, payment for their ocasional services as guides, a certain amount of vegetable food, such as berries and wild grains, the small Sahara melons that ripen in the barest sand, and seasonal hunts for truffles. Work or employment of any kind is out of the question. I suspect they rustle the herdsmen's goats. When I asked if this was so, there was

The archaeologist has no desire to preserve the hunter; for he might contaminate the flawless record of human violence revealed by his discipline.

an outburst of laughter, but such a situation cannot last indefinitely.

#### Crippled but consulted

At Oualata there were two Nemadi camps separated by a low hill with a tent pitched on its crest. There were 27 people in all. There were few infants, but each young woman had at least one child. One very old cripple manoeuvred himself about with his hands, but there was no suspicion that he was not considered a useful member of the band, and he was consulted on several occasions. The brother of the chief hunter was a fine-looking man in his thirties and had a club-foot. He walked with difficulty, but he too was fully integrated into the group.

I saw no evidence of malnutrition despite their difficulties, and the healthy clear-skinned children were in sharp contrast to the children of the town whowere suffering from malnutrition and had skin and eye diseases.

They harboured no great resentment against the governor, but this may have been because I was with a police officer. They said that there were still antelopes far away, 14 days off, "but the antelopes are no longer our friends". I asked Mahfould why the Nemadi would not keep goats and he replied effectively to the pointless question "If you give us a goat, we will kill it at once and make a big tam-tam". I bought several in the hope that they might last for some time. The herdsmen were horrified at the thought of good animals being wasted in this manner. The Nemadi sang and danced while we ate that night. There was a special dance they danced when they killed an antelope, but they couldn't dance it now.

My arrival attracted the attention of the inhabitant of the lonely tent on the hill. This was Lemina, photographed as an old woman in 1951. They said she was over ninety and were emphatic on this. She lived alone in her tent with two dogs and a cat. She walked unveiled through the acacia trees; and began to communicate with Mahfould in sign language. Reassured, she approached. She was tall and erect and plainly commanded a position of authority. Through Mahfould she thanked me for coming, and smiled an almost regal smile. The band were plainly awed by her.

Little is recorded of the kinship systems of the Nemadi. They are thought to be patrilineal and endogamous, but then no self-respecting member of Moorish society would consent to marry a Nemadi girl. They are considered too thin. Nemadi women are accepted as equal partners and offer themselves freely to strangers without the least jealousy on the part of their husbands. Perhaps the reticence of anthropologists and others on the subject can be explained by the presence of my two charming guides, both half-European, one aged 11, the other 18. The mother of the younger was very beautiful, and hardly looked more than 20 herself. Such are the temptations of life in the "field".

#### Mesolithic survival

This might explain the legends of their origins, as outcast Moors or Berbers, or even Phoenician or Christian sailors wrecked on the coast. If outcasts and fugitives have always been received into the Nemadi, this would not conflict with the plausible idea that they represent a survival of a mesolithic culture. It seems to be possible for a man to "become a

#### **Coming events**

1-8 August—Geological Conservation Course at Preston Montford field centre, Shrewsbury. Charge £14.10. Information from the Field Studies Council, Devereux Buildings, 9 Devereux Court, Strand, W.C.2.

5–12 August—Course in aquatic and marshland botany at Flatford Mill field centre East Bergholt, Colchester, Essex. Charge £14.10. Information from the Field Studies Council.

12–19 August—Course in the study of the flora of woodland habitats at Flatford Mill field centre, Colchester, Essex. Charge £14.10. Information from the Field Studies Council.

22–29 August—Course in the ecology of mammals and other vertebrates at Preston Montford field centre, Shrewsbury. Charge £14.10. Information from the Field Studies Council.

26 August-2 September—Conservation Course at Malham Tarnfield centre, Settle, Yorkshire. Charge £14.10. Information from the Field Studies Council. I saw no evidence of malnutrition, and the healthy, clear-skinned children were in sharp contrast to those of the town who suffer from malnutrition, skin and eye ailments.

Nemadi" but not for a woman.

Women are powerful in the Western Sahara. The ladies of Oualata today receive male visitors, unveiled, in their scarlet ochre and white painted courtyards. This practice shattered the Muslim sensibilities of Ib'n Battuta when he visited the town.

Even the Moors, who despise them, agree that the Nemadi are peaceful and gentle, despite their reputation as thieves. I know of only one record of a Nemadi killing another man—an immediate reaction to the wanton killing of a Nemadi by a Moor. They live among people who have for centuries known nothing but raid, counter-raid and blood-feuds. Little by little they have been eased into one of the least favourable environments in the world, and now they are actively prevented from leaving their traditional well to

26 August-2 September—Course in plant ecology of coast and estuary at Flatford Mill field centre, East Bergholt, Colchester, Essex. Charge £14.10. Information from the Field Studies Council.

29–30 August—Exhibition—"Conservation and Wildlife"—at Harlow Town Show, Essex. Information from Mr. A. F. Whybrow, Harlow Wildlife Society, 124 Lower Mead, Harlow, Essex.

5 September—Open day at Gromford Meadow nature reserve, Saxmundham, Suffolk. Information from the Suffolk Trust for Nature Conservation, Estates Department, County Hall, Ipswich, Suffolk.

16 September-14 October—Photographic Exhibition—"Man and Nature"—at City Museum, Bristol. Information from the Nature Conservancy, 19 Belgrave Square, London, S.W.1.

**18–21 September**—Annual Conference—"The five threats to the countryside"—at Nottingham University. Charge £5.10.–£8.10. Information from the Council for the Protection of Rural England, 4 Hobart Place, London, S.W.1.

hunt. The Moors think that the Nemadi are in a client relationship with them, and each group is formally attached to a family who "protect" them. The Nemadi do not put this view on the matter. All outsiders are "bad people" unless they prove it to the contrary. Their reaction to oppression has always been to flee to the desert and wait for better times.

#### Laughing out

When I left for the last time they all smiled brilliantly and flashed their white teeth. I asked them why they always laughed at the least source of amusement. "We always laugh," they said. "We are laughing very much today because there is meat," and they broke into a song about the foreigner who had brought meat. Their parting shot, relayed through my interpreter—"C'est la viande qui fait les beaux sourires." Presumably they will also die laughing.

#### References

<sup>1</sup> & <sup>a</sup> Derek Freeman "Human Aggression in Anthropological Perspective," in *The Natural History of Aggression*, eds. Carthy and Ebling, London, 1964, p. 112. <sup>a</sup>. Alfred G. Gerteiny, *Mauretania*, London, 1967. <sup>a</sup> Jean Gabus, "Contribution a l'Etude des Nemadi", in *Bulletin de la Société Suisse d'Anthropologie et d'Archaeologie*, 1951/2, pp. 49-83.

## The Soil Association

#### The quality of life

The Soil Association was founded to bring together those who care about the future of man's environment and the quality of life. Since 1946 it has been speaking out consistently against the indiscriminate use of persistent pesticides, the abuse of artificial fertilizers and the damage man is inflicting on the world in which he must live.

Its members receive a quarterly Journal and monthly newspaper, as well as lists of books, booklets and pamphlets which they may buy by mail order, many of them published by the Association. It holds conferences, sends lecturers to all parts of Britain and aims to create a body of opinion informed on environmental issues.

It is supported by the subscriptions and donations of over 4,000 members living in some 70 countries.

A warm welcome awaits you from an Association which shares your concern. Write for details of membership to The Secretary, The Soil Association, Walnut Tree Manor, Haughley, Stowmarket, Suffolk IP14 3RS.



#### **Noisy spring**

The story began in The Observer on March 29th, with "Operation Hades", on the effects of the herbicides spraved by the US Air Force on four million acres of Vietnam, including babies born with thalidomide-type deformities. The main chemicals were 2-4-D, our commonest selective lawn weedkiller, and 2-4-5-T. a total killer for the toughest weeds. On April 3rd, the Daily Telegraph reported that the Forestry Commission had pledged themselves not to use 2-4-5-T on Isle of Wight beauty spots, because, on March 20th, before any Press publicity, the local Labour Party had appealed for a ban, citing the risk to forestry workers, visitors and wild life.

On April 5th, the *Observer* followed with "The Drops of Death That Fell from the Sky" on what happened at Globe, Arizona when these herbicides were used to clear chaparral bushes. The aerial spraying began five years ago and the people of Globe blame the herbicides for a range of ailments among women and scores of deformed births among animals, wild and tame. Ever since the spraying began, a herd of goats in the area has produced kids, 60 per cent of which are deformed or born dead with cystic kidneys or enlarged livers.

Mrs McKusick, an ornithologist working for the National Park Service kept records quoted in the article: "Between May 15th and 28th, 1966, 11 brown towhee finches were found in our yard unable to fly, eat, drink, or stand upright. They had eyes discharging or swollen shut. All died within three days. In 1967 a change in bird population was quite noticeable. No towhees, no resident cardinals, jays, or tangers. In 1968, after spraying, the leaves fell from the trees in our garden and were eaten by geese and chickens which became sick immediately. A peacock was found paralyzed with feet clenched like fists."

It was not until April 19th that the

Sunday Times solved the mystery of why the local Labour Party, not a Conservation Society, had demanded the ban, with a massive article entitled: "The Weedkiller that Harms More than Weeds Alone". It began with the mysterious death of Rusty, an Alsatian owned by an artist (who was sketching in the New Forest in August 1969 and let his dog roam into 2-4-5-T-sprayed undergrowth), and went on to the 1970 deaths of a retriever and a boxer in the same circumstances in the Isle of Wight. Here the Forestry Commission had sprayed 700 acres with 2-4-5-T and apart from the dogs, many small birds were found flapping about blind, like the towhee finches of Globe, Arizona.

Neither dogs nor birds stirred the Labour Party to action, but complaints from forestry workers of skin rashes, boils and acne after exposure to the spray, and headaches, nausea and unsteadiness when respirators were not worn. Ministry regulations insist that these should be used and the trouble arose from a shortage of protective clothing. Yet the many brands of weedkiller containing 2-4-5-T sold to gardeners have only "AVOID contact with eyes, skin and clothing. If any gets on the skin, wash it off with soap and water" on the labels. Nothing about the risk of breathing the spray, the need for plastic suits and facemasks, or the danger to cats, dogs and birds.\*

Experiments with mice at the American National Cancer Research Institute have established the abnormality-causing effect of 2-4-5-T, but it is claimed that this is from dioxin, an impurity present only as a trace in the British herbicide, in use for 22 years. With the zest for explaining away the gnat, and hoping that the short memory of the public will hide the camel, that is characteristic of scientific spokesmen for commercial and official bodies, the defence has concentrated on this aspect.

The Guardian report on the Forestry Commission announcement on April 21st stressed the dioxin angle, and so did the Daily Telegraph's "Halt on Weedkiller's Use After Genetic Fears", ignoring the dead dogs, the forestry workers, the birds of Globe and the Isle of Wight, and the water buffaloes, cattle, pigs, chickens, ducks and wild life of Vietnam, killed, crippled or blinded by contact. Since 1967, the US has sprayed 14 million tons of herbicides on Vietnam, compared with our Forestry Commission's modest 50 tons on Britain. Finally, on April 30th, the New Scientist summed up with a leader, "Herbicidal Witch-Hunt" including the following sentences: "Until last week the blame was laid on a commercial impurity, but the latest American research reportedly shows teratogenic results in mice after massive doses of virtually pure 2-4-5-T. Consequently, the American Government has restricted its use, the Forestry Commission has suspended spraying operations and the Minister of Agriculture has referred it back to his Pesticides Advisory Committee.

"The scientific grounds for these decisions are minimal and the whole affair will cause glee among those who regard popular concern about environmental issues as inevitably irresponsible, emotional and ill-informed."

The phrase "witch-hunt"—employed recently also for the ban on cyclamates —is used emotively to convey a picture of defenceless chemical manufacturers hounded by Rachel Carson-enflamed mobs, or grilled by the Senator Mc-Carthys of the Royal Society for the Protection of Birds. It is, like "emotional", "ill-informed" and "irresponsible", a term of abuse for the Science Correspondents and journalists of serious periodicals when what they write is inconvenient to Authority, official, commercial or scientific.

If it had not been for their first and most courageous "witch-hunt", Authority would have suppressed the fact that nuclear weapons produce fallout. Then, without the pressure of public opinion, there would have been no Test Ban, and testing would have continued until the human abnormality rate rose to the levels produced by herbicides in Vietnam (or higher) and the bone cancer rate from Strontium 90 to a large fraction of the lung cancer figure. The main protection for the people of this world, which is one world because it shares a single atmosphere and seven adjoining seas, lies in the courage of those who are prepared to risk offending the advertisers and report the truth however awkward it may be. Without them the world is in real danger from those who explain away the unforeseen until it is too late.

\* A leaflet "Weedkillers without worry" on safe weed control for gardeners is obtainable free for a stamped addressed envelope from The Henry Doubleday Reseach Association, Bocking, Braintree, Essex.



#### **Oil reserves**

Known oil reserves are running out, announced Robert O. Anderson, Chairman of Atlantic Richfield Co. at the first annual conference on Industry and Environment in June. He is quoted in the *New York Journal of Commerce* as claiming that "10 years from now, Venezuelan reserves will be sufficient for another year only. Alaska north slope reserves will be adequate for two years, and the reserve of the Norwegian sector of the North Sea will last five months, based on present consumption".

His answer to the problem was to increase production elsewhere, though he admitted that simultaneously corporations must provide more leadership to minimise pollution.

#### The pink and the black

Emphysema, once a fairly rare lung disease, has increased five hundred per cent in the city of New York in the last ten years. The incidence of bronchitis deaths has risen two hundred per cent. Both figures are attributable to everincreasing air pollution. A medical examiner there is quoted in *Rodale's Environment Action Bulletin* as saying, "On the autopsy table it's unmistakable. The person who spent his life in the Adirondaks has nice pink lungs. The city dweller's are black as coal".

#### A worm a day . . .

According to Rodale's Environment Action Bulletin during a recent hearing on pesticides at the Lehigh County Court House, Allentown, Pennsylvania, Dr Francis Trembley, a Lehigh University ecologist, asked the pest control board to recognise the fact that DDT will "step up the heart rate and eventually cause death by heart failure." He warned that the DDT levels now accumulating in plankton were capable of destroying all life in the oceans, and pointed out that contact with hard pesticides during use is not the most serious problem. Far more damaging, or even fatal, is the ingesting of foods contaminated by DDT residues. When a farmer stated that pesticides are necessary because apples with worms are not marketable, Dr Trembley answered, "Eating a worm is perfectly harmless. Ingesting DDT is fatal".

#### Successful ecology action

Housewives in Canada have been boycotting detergents with a high phosphate content. The result is most encouraging according to the Toronto Globe and Mail, and sales of high-phosphate detergents have dropped. According to a survey made last month by Mary Jukes, who writes the Globe and Mail's "Shopping Basket" feature, three out of four shoppers have switched to low-phosphate brands of soap flakes and washing soda. Tide (43.5 per cent phosphate content), one of the biggest sellers until the phosphate flap, is taking the biggest beating, retailers report. The manager of one A & P store says his weekly order of Tide has dropped from 6 cases to 11. The assistant manager of a Dominion store agrees: "That about describes our drop in our sale of Tidefrom about 5 cases a week to 11." How have the manufacturers responded?-by reducing the price of highphosphate detergents. It looks as if the battle will be a bitter one.

#### **Chlorinated** soup

Eddie Albert, movie and TV star, has become a crusader for a clean environment, according to the New York *National Enquirer*. In a recent talk, he said: "The Mississippi and the Missouri have become nothing but open sewers. In those rivers you will find no end to the germs. In fact, they have signs 'Don't eat your lunch near the water'. We are really drinking—you and I—chlorinated soup of dead bacteria now that has probably been through a dozen toilets."

#### Under fifty monkey-eating eagles

Feedback

The total population of the monkeyeating eagle of the Philippines is about 36 birds, certainly less than 50. This is the verdict of Dr Rodolfo E. Gonzales (Oryx) after his WWF-aided investigation on Mindanao Island (the eagle's only home) last year. The causes are the usual ones-deforestation, slash and burn cultivation and firearms. Deforestation is proceeding at the rate of one hectare every three minutes, depriving the forest-dwelling eagle of its habitat. "No mountain today seems high or remote enough to escape human invasion." In addition the eagle faces "severe persecution by an expanding, well-armed and uncaring human population".

#### Cancer increase in Zoo

Air pollutants have been suspected of causing a number of pathologies in man, including cancer. There is now evidence that indicates air pollution may be a factor in increased lung cancer rates in animals in the Philadelphia Zoological Garden.

Dr Robert L. Snyder, director of the zoo's Penrose Research Laboratory, claims in *Science News* that lung cancer rates have increased significantly among zoo animals that stay out of doors during all of their lifetimes. The increased rate is particularly pronounced among waterfowl, but was also detected in lions, otters, skunks and other animals.

Autopsy records have been kept for waterfowl since 1901. During the period 1901–1935, there was only one lung cancer death, but there were 13 in the period 1936–1970.

Although the total number of waterfowl during the two periods was different, Dr Snyder says statistical analysis shows the increase to be significant.

Dr Snyder speculates that particulate pollutants fall to the bottom of ponds

where waterfowl feed. He says particular carcinogens are specific for particular tissues and the one for lung cancer could be introduced orally.

#### Learning to love dirt

Experiments are being conducted at Beltsville, Maryland, where plants are being subjected to various forms of artificial pollution, in an attempt to make them adapt genetically.

Air pollution is said to cost American agriculture \$500 million annually in plant losses, according to the *Houston Post*, and studies show that it may stunt the growth of some crops by up to 50 per cent.

Rather than find ways of reducing the pollution, heads-in-the-sand scientists are trying to breed new plants specially adapted to thrive in polluted air.

#### Is the end of X-rays in sight?

The long-term dangers of diagnostic X-rays are becoming ever more evident. Drs Tamplin and Goffman of the Atomic Energy Authority claim that one rad of radiation is likely to increase chances of cancer by approximately 1 per cent, and much more in children. Since one radiographic picture is between two to three rads and they are used with total abandon by the average radiologist, it is not difficult to work out the effects of indiscriminate use of diagnostic X-rays on the population as a whole. It is a relief to learn of the development of new diagnostic techniques such as infra-red systems.

Pulse reports that Autonetics, part of the American Rockwell, have developed a new thermography apparatus 10 times more sensitive than apparatus currently available. "It is clear that earlier diagnosis, possible by more sensitive apparatus, will beneficially influence treatment and prognosis. Indeed, it is claimed that it has already been possible to detect a cancer a year before it would be apparent to the surgeon. The best X-ray technique available cannot do better than this."

#### Dangers of nitrogen dioxide

Evidence that Nitrogen Dioxide at levels sometimes found in urban areas can cause lung damage was reported by Drs K. H. Kilburn and A. R. Dowell, researchers at the Environmental Medicine division at Duke University Medical School, Durham, N.C. At levels higher than 7 ppm pulmonary edema was produced in dogs. At levels of 3 to 7 ppm there was "severe damage to certain cell membranes in the lung, the first step towards pulmonary edema". (Pulmonary edema is the collection of fluid in the lung by the rupture of certain cells. The fluid interferes with breathing and if bad enough, can cause death.)

Kilburn and Dowell pointed out however, that since the air in most urban areas contains more contaminate than just nitrogen dioxide "these undoubtedly must aggravate the problem". Nitrogen dioxide gets into the air from car exhausts, from a number of industrial processes and from cigarettes.

Dr Kilburn reported that a smoker may breathe from a 100 to 400 ppm of nitrogen dioxide while puffing. He warned that chain smokers could be expected to receive lung damage similar to that found in the laboratory tests. (*The Plain Dealer*, Cleveland, Ohio.)

#### Swing low, sweet charity

It was reported in the Daily Mirror that Royal Air Force fighter jets on training flights in Northumberland roar so low that an outraged mother, Mrs Anne Wrangham, of Harehope Hall, Wooperton, claimed her two young sons came home with earache from the noise. Startled sheep, according to local farmers, have been seen to leap nearly their own height, and some have lost lambs because of the exercises. Protest letters sent by Alnwick and Glendale rural councils, Northumberland, have gone to the Ministry of Defence, whose official answer was that every effort is being made to reduce low-flying noise.

Aware of the difficulty in reducing aircraft noise, I telephoned the Ministry of Defence to determine exactly what "every effort" means. I was put through to the Public Relations Officer who said: "Training is kept to a minimum, is strictly controlled, each flight is authorized in writing and is no lower than required. There are several areas in the UK for low flying. All are rural and sparsely populated." Apparently members in "sparse" populations are regarded as having less rights than members of dense populations, a principle not unlike that of the human sacrifice made to placate gods on behalf of a nation.

"Yes, but what about your efforts to

reduce the noise?" I persisted.

"It is kept to a strict minimum," he said.

"Would it be correct, then, to say that no changes are contemplated in low flying over Northumberland or anywhere else?"

There was a pause. "Yes," he said, "I suppose you could say that."

#### Company care

The story behind Minamata disease, one of pollution's most horrifying spinoffs began in the early fifties when 44 people died and 70 more were crippled for life in a Japanese fishing village. It was made public recently at the International Symposium on Environmental Disruption in the Modern World in Tokyo, which was reported in the *Medical News-Tribune*.

In 1952 the Japan Nitrogen Company started to mass produce organic synthetic products and dump its untreated waste in Minamata Bay. A year later people in the village began suffering from an unknown disease, whose symptoms included ataxia, difficulty in seeing, hearing and speaking, involuntary movements, dysphagia and mental disturbances.

A medical study group from Kumamoto University was set up, which discovered that all the victims had been eating large quantities of fish from the bay. Cats, birds and other fish-eating animals were also affected. Clinical symptoms suggested that the disease was caused by poisoning. Attention was turned on the Japan Nitrogen Company, who reacted by refusing to divulge the list of chemicals used in their manufacturing process. But the investigators found high concentrates of manganese, zinc, lead, mercury and other metals near the factory's drains in the bay and a link was suggested.

In February 1957 fishing was banned in Minamata Bay and for a while there were no new victims of the disease. But the people of Minamata, who depended on fish for food, went hungry. A recommendation for compensation had been rejected by local and central governments alike. Ignoring the ban, the villagers began to catch and eat fish from the bay again. Of the 29 who subsequently went down with Minamata disease, this time 14 died.

The search for the cause of the disease continued. In July 1959 the study group produced evidence to show that organic mercury poisoning was to blame and pointed the finger at the Japan Nitrogen Company, who immediately fought back with hired scientists to try and disprove the investigators' claims. But when the company changed its dumping ground from the bay to the estuary of the Minamata River, the mercury content of shellfish in that area shot up and 16 cases of the disease were reported from nearby villages.

In November 1959, 3,000 enraged fishermen stormed the company but were driven off by the police and their leaders penalised. Finally, although it did not officially recognize that it was responsible for the disease, the company agreed to make token compensation. Adult victims of Minamata disease received £100 each and children £30.

The payment was made on condition that, even when it was proven that the disease resulted directly from effluent discharge from the plant, the fishermen would not ask for further compensation. Conclusive evidence against the company came out immediately after an agreement had been signed by the fishermen.

Since there is no cure for Minamata disease, and as the mud in the bay is still full of mercury to this day, the ban on fishing continues. There have been no more outbreaks in Minamata, but in 1964, further north in Niigata City, the same disease turned up and claimed 30 victims of whom six died. It took the Japanese government two years to recognize officially that Minamata disease and Niigata City disease shared the same cause.

#### More mercury

In the USA recently, Patrick J. Lucey, Democratic candidate for the Governorship of Wisconsin, declared that the Department of Natural Resources should outlaw the discharge of all mercury into all waterways in the State. His request was based on the extensive mercury pollution of the Wisconsin river. Recently a 35-mile stretch of the river was ordered closed to fishing. Lucey said the tests show that as much as 30 lbs of mercury are entering the river daily from unknown sources. (*Mil-waukee Sentinel.*)

#### A taste of things to come

New York had its blackout—London has just had its tube breakdown. 200,000 Londoners were stranded for an hour in 300 trains in the sweltering heat as six of the eight lines of London's Underground system were paralysed at the height of the rush-hour. Women fainted, panic-stricken passengers broke windows in a frantic effort to get more air and 6,000 passengers abandoned trains in tunnels on the Central and Northern lines to walk along the tracks to the nearest stations and fresh air. This once more accentuates the vulnerability of our technological age, as the machinery required to maintain ever larger populations in ever denser urban areas becomes increasingly more elaborate, so we can expect an ever greater number of such incidents.

#### Radioactive pollution of the seas

The Atomic Energy Commission has recently asked permission to increase by four times its discharges of radioactive waste into the Irish Channel at Windscale. This is a very alarming thought, as the radioisotopes contained in such waste are by far the most toxic substances ever known.

Even if these wastes are within currently accepted levels, they can still be extremely dangerous. Professor Polykarpov in his "Radio-ecology of aquatic organisms" writes that their concentration in certain marine organisms are from 10,000 to 100,000 for the commoner radioactive materials. Dr Lowenstein of the Radioactive Research Center of the University of California Medical Center has observed that oysters gathered 250 miles away from the nuclear reactor at Hanford, Washington, contained 200,000 times more radioactive zinc than the surrounding ocean. What is particularly frightening is that most of these isotopes have extremely long half-lives (30 years for instance for Strontium 90) which means that this waste simply tends to accumulate. Very little work has been done on the biological effects of low doses of radiation. When we do find out, according to Dr Lowenstein, "it will be too late to do anything about it".

What we do know is that the younger the organism the more sensitive it is to radiation. Professor Polykarpov stresses that sea life is particularly vulnerable since 40–90 per cent of all plankton, fish eggs and larvae are concentrated in the top 5 cm. of sea water. This is the largest and most productive biomass in the world and all other forms of sea life depend on it. He states unequivocally that further contamination of sea water is inadmissable.

Dr Lowenstein feels the same way. He said to the San Francisco Chronicle "... the situation, with which we are now confronted, where every living thing on the land, in the air and on and under the sea, is being poisoned with radioactive wastes because some decision-makers, in some countries, have decided that the people must have atomic bombs and atomic power, regardless of the consequences to the environment". To the fore of the mounting campaign against radioactive pollution of the seas is the newly formed Oceanic Society whose address is 680, Beach Street, San Francisco.



"Over here, quick ! A very rare specimen of industrial waste !"



#### Content to breathe . . .

The sceptic and the sluggard in us all unite when faced with evidence of some threat to the environment. Our two stock responses are, "There's no proof" and "There's plenty of time". They comfort us in our inaction until enough people suddenly die to make us change our mind.

Our concern for clean air provides us with a textbook example. As early as the 13th century people grumbled about London's smoke, and by the 17th century these mutterings had changed to warnings, when Thomas Sydenham in particular wrote of their dangers to health. These warnings were repeated by many others, so that in 1854 Sir John Simon could write that "at no distant period" smoke from domestic chimneys would be controlled.

Just under 100 years later, in December 1952, a week of dense fog combined with unusually severe air pollution ended in the deaths of 3,500 to 4,000 people in the Greater London area. This was three times the number that might be expected for the time of year, the main causes of death being bronchitis, pneumonia and tuberculosis. Although most of the people who died were old, the number of people under 45 dying from these diseases was also three times greater.

They did not die in vain. In 1956 the Clean Air Act was passed, which empowered local authorities to establish



smokeless zones; and the 1968 Act in turn empowered Government to require them to do so. Wherever smokeless zones have been imposed the results have been dramatic. For the first time it has become worth-while to clean London's public buildings, and the variety of birds that visit its parks, and of plants that can be grown in them, has been considerably increased.

This is progress indeed, although the establishment of smokeless zones throughout the country has now suffered the ludicrous setback of a shortage of smokeless fuels. Nevertheless, the quality of the air we breathe is still cause for concern, and thus the recent publication of *Air Pollution and Health*, a report for the Royal College of Physicians, is especially welcome.

The report reminds us that "Britain has the highest death rate in the world from chronic lung disease in middleaged men". Of all such diseases, the major cause of disablement and death is bronchitis, and because of it over 30 million working days are lost each year, at an estimated annual cost (in terms of medical care and lost production) of about £65 million.

There is no doubt that high levels of air pollution affect people suffering from diseases of the heart or lungs, but the report is cautious about the exact effects of current levels. There is a close correlation between smoke and sulphur dioxide pollution and mortality from bronchitis: in a number of studies it was shown that "after density of population and domestic overcrowding were taken into account, the rates for premature death and disablement and for absence from work because of bronchitis were highest among those working in the most polluted areas". But many other factors have to be taken into account. Cigarette smokers, for example, are three times as likely to suffer from chronic bronchitis as non-smokers-though twice as many

of them have the disease in the dirtiest areas than in the cleanest. And air pollution is merely one of the many perils of urban life: although the report could not demonstrate the precise role of air pollution, it proved that life is much safer in the country. After allowing for age, sex, social class, and tobacco smoking, one nation-wide survey showed that bronchitis is "twice as frequent in large towns as in the rural areas of Britain".

Reports

This difference between town and country is exactly reflected in the death rate from lung cancer. It has been calculated that "if the death rate from lung cancer for a symptomless nonsmoker is taken as the irreducible minimum, the risk of death from the disease would be about doubled for a man living in an urban area, but increased twenty-fold if he smoked more than 20 cigarettes a day". Again, this may or may not be due to air pollution; in Norway, where pollution is much lower, there are also "substantial differences between urban and rural death rates from lung cancer".

The report drew attention to the effects of contaminated air on children, pointing out that disabling diseases suffered later in life may have their origins in childhood; and that "the death rates from respiratory disease in children are higher in England and Wales than elsewhere in North West Europe, and double the rates in Scandinavian countries". The usual differences between town and country are evident, and the report repeats its reluctance to indict air pollution as the *only* urban factor.

A factor it is, however, and an important one. What can we do about it? When it gets down to recommendations, the report is disappointing, for all but two of them are for further research. The two pleas for action recommend strict enforcement of legislation against unnecessary smoke from badly serviced diesel engines; and vigorous implementation of the Clean Air Acts. Both are undoubtedly important, and hopefully the latter will spur the Government into meeting one of the promises of its election manifesto: that it will set "clearly defined aims and target-dates for the achievement of cleaner air". I suggest a smokeless Britain by 1975.

The Clean Air Acts apply only to smoke, however, and do not concern themselves with other major pollutants of the air such as sulphur dioxide. Coal, coke, most of the solid smokeless fuels, and the heavier grade oils used in central-heating installations (but not the small domestic ones), all contain sulphur. Practically all of it goes up the chimney as sulphur dioxide, 5 per cent of which may be oxidised to sulphuric acid. Sulphur dioxide is present in the air of large urban areas, like London, in much greater amounts and concentrations than is smoke. It isn't very good for us. A certain amount escapes through tall chimneys and is easily dispersed. Where it goes nobody knows, though the Swedes claim they receive some of it. But enough stays with us (each year the total discharge is over six million tons) to make early action imperative. It is illogical to legislate against smoke, and to leave sulphur dioxide alone, when it is a matter for speculation which is the more dangerous.

Technically, we could reduce the sulphur content of fuel oil to below 1 per cent, which would cut the total discharge of sulphur dioxide by about 20 per cent. Or we could extract the sulphur from the effluent gases—and use it. The latter alternative would be an expensive way of getting sulphur (though a rise in world prices could make it economic), and with the former, fuel oil prices could go up by about 5d. But the social and environmental costs of doing nothing are much greater.

It is here that we should have had a less timid statement from the report. It is very difficult to pin a disease on any one pollutant, and so far it has also proved impossible to establish the *relative* importance of smoke and sulphur dioxide. Besides, other pollutants, such as carbon monoxide and the oxides of nitrogen, could be dangerous to health, either by themselves or combined with the two major ones. So the report concludes that there is no evidence to justify "recommendations on 'air quality standards' for any one pollutant *in isolation from the others*". There is no doubt, however, that the chronic lung diseases alone are an expensive burden on the nation, and that contaminated air plays an important part in their origins and development.

Because we cannot establish precise threshold limits for each pollutant does not mean that we shouldn't lower the overall level of air pollution. There is enough evidence that we should. Enough evidence, but no proof. But what proof do we need before we dip into our pockets? Surely not another 3,500 to 4,000 deaths?

Robert Allen

#### **Requiem for a ferryman**



No one knows what killed Bernard Carroll. He died in a fire; the inquest found he had been burned to death. But no one knows how the fire started, or what caused it.

He was 24 years old and he lived in Partington, in Cheshire. He worked as a ferryman at Cadishead, a few miles from Manchester, rowing passengers back and forth across the Manchester Ship Canal.

Early on the morning of April 14th the air was still and a mist hung over the water. The police were out, investigating complaints they had received from people in Partington who said they had smelled gas. One policeman was standing on the jetty beside the canal. There was a boat in mid-stream which seemed to be in trouble. It carried a group of men who all appeared to be groggy. One of them looked as though he was unconscious. He was leaning backwards out of the boat. They were having trouble steering and the boat was drifting. It was just after 7.15 when the policeman saw Mr Carroll jump into another boat and row out to help. He got to within 20 or 30 yards of them when it burst into flames. The fire spread rapidly, engulfing Mr Carroll's boat. In all it spread 1,600 yards along the canal. Mr Carroll died, five men are in hospital and three were not found. No one knows what happened.

The obvious line of enquiry was that vapour had escaped from some installation on the canal side and had been trapped close to the surface of the water. The first suspect was Shell Chemicals, which has a plant about a mile from the scene of the fire. A Dutch-owned tanker had been loading Prolysis gas at the time of the fire but no positive link could be established. Is it possible that vapour had drifted a mile over the surface and along the bank, causing people to complain to the police of a smell of gas, and that the men in the drifting boat, overcome by the fumes, had inadvertently ignited them? Had someone struck a match to light a cigarette? The Chief Pollution Officer of the Mersey and Weaver River Authority said he was satisfied that the fire had been caused by none of the regular pollutants discharged into the canal.

Every day the canal receives, in addition to the contents of the rivers which flow into it, 90 million gallons of sewage and 180 million of trade effluent.

Is this a case of a watercourse which bursts into flames spontaneously? If it is, there is a precedent, so Manchester will not be able to claim the dubious distinction of a "first". The river Cuyahoga, which flows through Cleveland, Ohio, has the honour of being the world's first area of water to be classed officially as a fire hazard. It does burst into flames. On one occasion it came close to burning the bridges which have the temerity to span it.

If pollution is severe enough it is possible for gases to bubble up from the mud on the bottom. Particularly if there is a temperature inversion, layers of volatile gas may be trapped close to the surface. The Manchester Ship Canal fire may have been caused by a leakage from the loading of the tanker, and it may not. The River Authority may be perfectly correct in saying that none of the known pollutants could cause fire, but how certain can anyone be about the chemical reactions which may take place between the large number of inorganic and organic materials which meet at random in the water? 22 firms discharge effluent into the canal and this may mean far more than 22 different substances.

The remedy in this situation is difficult. All the factories discharging into the waterway, and all the local authorities releasing sewage, must treat their effluent to such a standard that when taken together the total pollution of the water is within acceptable limits. This is not the same thing as demanding that a single factory clean its effluent when there are few other factories using the same water. The factories beside the canal may have to treat their effluent to a much higher standard. The treatment of effluent costs money, and the cleaner the effluent, the more it costs. If it costs £X to remove 90 per cent of a pollutant, it may cost £2X to remove 95 per cent, £3X to remove 97 per cent, £4X to remove 98 per cent, and it may not be possible to remove 99 per cent at all. Thus, one factory may be able to discharge its effluent at a cost of £X, because it has a river all to itself, while a rival, engaged in the same business, may have to pay £3X simply because it happens to be sited in a heavily industrialized area. If one more factory is opened beside the common waterway, all the factories beside it may have to increase their effluent treatment costs to accommodate the newcomer. For this reason it may be necessary in the short term to subsidize the treatment of industrial effluent in certain cases, just to protect industries from unfair competition. In the long term polluters must bear the cost of cleaning their own effluent. If this means that some of the factories beside the Manchester Ship Canal have to close and move elsewhere, this may be no bad thing.

Even when firms are aware of the dangers of pollution and are conscientious about the treatment of their wastes, accidents can and do happen. The Stanton Ironworks, in Derbyshire, was fined £100 after pleading guilty at Ilkeston Magistrates Court on April 30th to discharging cyanide into the Erewash Canal. The spokesman for the Trent River Authority said samples of the water had shown pollution at more than 115 times the level permitted. The effect on fish life was considerable. According to the firm, a pump failure had given trouble two months before the offence, but in this case they could only assume a freak chain of chemical reactions had resulted in the formation of cvanide.

It is not only the villains we must watch, it is the freaks as well. The fire on the Manchester Ship Canal may have been caused by a leakage, or it may have been caused by a freak chemical reaction. As always, we are left with the question, who pays? In this case it is only too clear who paid. Bernard Carroll paid for it, with his life.

Michael Allaby

#### The dirty deep

Pollution of the ocean has now spread wide and deep. The April 1970, issue of *Biological Conservation* carries a letter from Thor Heyerdahl, the Norwegian explorer, describing pollution which his papyrus raft-ship, the Ra, discovered far out at sea.

The Ra first encountered polluted sea off the coast of Mauretania. The crew believed the oil through which they sailed might be caused by an oil tanker cleaning out its tanks ahead of them, but two days later and a hundred miles to the south-west, similar pollution was found. "Brownish to pitch-black lumps of tar-like or asphalt-like material of the size of fine gravel" were floating at, or just below, the surface. Similar particulate pollution was met with the next afternoon, but now some of the particles were larger and the water itself was discoloured. The crew had the impression of "being inside a harbour amidst the outlet of city sewers".

Further pollution was found on June 30th in mid-Atlantic, and again on July 15th, some 600 miles east of the Lesser Antilles. It took two days to sail through this patch and some of the particles were eroded or pitted and occasionally they had small barnacles or algae growing on them.

The voyage of the Ra lasted 52 days. For six of them the raft was sailing through visibly polluted water in midocean, as well as close to both east and west continental shores. "Whatever be the cause," says Heyerdahl, "this pollution is so widespread that it calls for a planned investigation and explanation."



But perhaps the most disturbing example of ocean pollution comes from an item in *New Scientist*, April 16th, which was quoted in *The Veterinary Record*, May 2nd. The deepest-living vertebrate ever found has been recovered from a depth of nearly five miles in the Puerto Rico trench. It was a fish  $6\frac{1}{2}$  inches long and it was collected along with empty paint cans, fruit juice cans, beer can lids, pieces of old aluminium, empty bottles and torch batteries.

Michael Allaby

#### Ecology Action in Britain— The Conservation Corps

On April 22nd, all over the United States, there were demonstrations and teach-ins drawing attention to man's deteriorating environment. Earth Day, as it was called, attracted little notice in this country, but on that same day a ceremony took place in London which illustrated what British young people can achieve by direct action towards improving the world they live in. On April 22nd, the Conservation Corps became an independent body, run by its own charitable trust, The British Trust for Conservation Volunteers Ltd.

The story of the Conservation Corps begins 11 years ago, in 1959. The Council for Nature knew that there were many young people who were eager for an opportunity to work in and for the countryside. It appointed Brigadier E. F. E. Armstrong to bring together as many of them as he could and put them to work. Within weeks a party was out at work and in its first year the Conservation Corps, as it was called, worked over 1,000 man-days.

The lower age limit for volunteers was set at 16. The majority are older than this, their average age is around 20. Many, but not all, are students, or still at school. Some are graduates in the biological sciences. Those who are in full-time employment come from all walks of life. Because such a high proportion of its members are still receiving full-time education, the Corps has always organized its programme to fit in with theirs. Based in London, tasks have been held at weekends within a radius that can be reached conveniently in the time available. During the school and university vacations there are longer, residential tasks, further away.

At the present time the fully paid-up membership of the Corps is around 1,600, but this figure is misleading; the full list of groups that have participated contains over 80 names and represents something like 10,000 individuals. Each full member, and each group, receives a regular newsletter and a list of forthcoming tasks. Would-be volunteers use this list to select the tasks, and the sites, which most attract them, and apply to be included in the party. They are then sent more detailed information about the site, the kind of work they will be doing, and instructions for finding their way there.

The work is hard and the conditions may be severe. A party of 20 once worked on a mountain site for a fortnight during which 20 inches of rain, sleet and snow fell. I have visited volunteers living under canvas in a snowy January while they worked to clear a small river of overhanging vegetation. But, knowing this, they still come.

The Corps has rarely advertised for volunteers because it fears such a rush of applicants that its administrative staff would not be able to cope. In any case funds have never been sufficient to provide all the tools, equipment and transport that a major expansion would require. Nevertheless, during its 11 years, the Corps has worked more than 51,000 man-days in over 1,000 tasks on 208 different sites. The work itself varies widely from site to site. Among the projected residential tasks for 1970, for example, there is the planting of marram grass to hold together sand dunes at Braunton Burrows in North Devon, the surveying of a nature reserve in Kirkcudbrightshire, the construction of a path, steps and fence in a nature reserve in Monmouthshire, repairs to Iron Age fortifications in Hampshire, the maintenance of nature trails on Beinn Eighe in Ross and Cromarty, digging firebreaks around remote experimental plots in Sutherland, ditch digging in a deer sanctuary in Lancashire and woodland management in Warwickshire. Altogether there will be 47 residential tasks this year and there were 40 weekend tasks between March and July alone. In 1967 two volunteers called at the Soil Association's headquarters in Suffolk. Officials of the Association learned that the Corps was in financial difficulties and also that volunteers had never before worked on farm land. An approach was made to the Jack and Mary Pye Trust which resulted in money being made available to prevent the Corps from collapse. It achieved more, because the Association suggested that an experimental programme be started to bring the Corps on to its own farms and from there on to farms elsewhere. Under modern farming conditions it is often difficult, if not impossible, for the farmer to find the labour or the money to maintain the many areas of natural habitat, important to wildlife and often of scientific interest. This is one major reason for the disappearance of so many of our hedges and trees.

The Soil Association joined forces with the Council for Nature, and the responsibility for the day-to-day running of the Corps was taken over by a management committee whose members were drawn equally from the Council and the Association.

The publicity which attended the launching of this operation brought applications for more places than could be found, and so a course was arranged for would-be volunteers. A small party spent several days at the Nature Conservancy's Monks Wood Experimental Station, visited several Corps sites in East Anglia and saw Operation Habitat Rescue in action. They listened to lectures and watched practical demonstrations.

Operation Habitat Rescue ended in 1969 by a decision of the management committee to drop the title. By that time tasks on farms were a routine part of the Corps' work. But there are dangers. Voluntary labour must never be confused with cheap, or free labour. Applications from private landowners are subjected to careful examination. The work done must have a strong conservation element and there must be some assurance that a continuing management policy will guarantee that conservation of parts of the area will be valuable. There is little point, from the conservationists' point of view, in laying and maintaining a hedge as a suitable habitat for birds and animals if the owner is planning to spray an insecticide close to it, or to clear out the bottom of the hedge. There is even less point if next year he is liable to change his policy and remove the hedge altogether. Again, the Corps' organizers must be satisfied that if the work were not done by their volunteers it would not be done at all, and a site would be lost.

The Conservation Corps is unique,

not only in Britain, but probably in the world. Visitors from overseas come to study its organization and to see it at work. It is a nation-wide voluntary organization which provides practical assistance to landowners in the conservation of nature, and at the same time provides education in the techniques of conservation. The educational aspect of its work has always been important and now it is hoped to introduce a Certificate of Proficiency in conservation which will demand theoretical knowledge as well as skill in the field.

The demand from young people to work in the countryside may be expected to grow, especially if the American Environmental protest movement infects British universities, as it is beginning to do already. The Corps wants to expand, now has the necessary administration, knows the work is there and has the labour. All that is required is money. It must not fail. The principal guest speaker at the launching ceremony was Jack Longland, a director of education and a mountaineer. He described it as "one of our most important contributions to European Conservation Year 1970". He went on to appeal for support and said "the Conservation Corps will amply earn that support because it operates at the point at which concern for our environment is married with the belief that no society can be healthy which does not offer rich and varied opportunities for service to the community".

Michael Allaby

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land.



# Why primitive peoples ?

Why does the *Ecologist*, a magazine which is essentially concerned with the social and environmental ills of the modern world, interest itself in the socalled primitive peoples?

The cynic may be forgiven for answering that this is all that can be expected from environmentalists, since in their sentimental opposition to "technology", "growth" and "progress", they are more than likely to hanker after the good old days when we were all hunter-gatherers.

Certainly, we feel things were a little easier then; but there are three much better reasons why it is important that primitive peoples be discussed.

Firstly, primitive peoples, whether hunter-gatherers, slash-and-burn cultivators or pastoralists, are under intense pressure to change their ways and join (or participate more fully in) the economy of the countries in which they find themselves. This is not new of course: but what is unusual is the intensity of this pressure, and the speed of the cultural changes which follow. The result tends to be disillusion with the particular culture, and subsequently social disintegration-all in the names of "development" and "civilization": a civilization which increasingly is being questioned from within for the poverty of its values and for its blinkered disregard for the medium-term.

Secondly, as was pointed out in our first issue (p. 41), the hunting-gathering way of life has been man's most persistent and successful adaptation to date. It is as if we were once a climax species living in equilibrium with our habitat (as the few remaining hunter-gatherers do to this day), but have since become a pioneer species—doomed to so modify our environment, through increasingly intensive agriculture and ever more sophisticated technology, that we can no longer adapt to the changes we provoke. There may be time for us to mend our ways, in which case huntergatherers deserve another, closer, less patronising look than they have been given hitherto.

This brings us to our third reason. Briefly, the causes of the environmental crisis are: exponential population increase, exponential consumption of nonrenewable resources, and the growing demand for a "better" standard of living in terms of goods and services. These factors generate more and more waste (hence pollution) and increasingly hasty and violent exploitation of the environment. Behind all this is our system of values, the panoply of our expectations and ideals. Obviously something is wrong with them and they must be changed. Before they can be changed, however, we would be wise to examine alternative value systems: among others, those of "primitive" peoples.

We cannot go back, but if we are to go forward with any confidence, we should try to learn from the many cultures very different from our own, but no less experienced at living life on planet earth.



After the fall of the Han Dynasty, China passed through an unstable century known as the period of the Warring States, during which it was divided into a number of independent countries often at war with each other. Foremost among these was the Kingdom of Wei, which for a long time was run by a powerful king who called himself the "Emperor" Tsao Tsao, for he claimed to hold sway over the whole of China. His Prime Minister, Ki Leang, was a wise and good man bent above all on preserving peace and on bestowing its benefits on a civilized community.

Comments

One day he went off on a journey, but he was not gone more than a few days before a messenger informed him that the Emperor had suddenly decided to invade the neighbouring kingdom of Han Tan. Ki Leang immediately hastened to the capital by the quickest possible route. When he was ushered into the Emperor's presence, he told the following story:

"Your Majesty, today, as I reached the city walls, I saw a coach taking the North road towards Min-Li. It was undoubtedly the most beautiful coach I have ever seen, made of ebony and studded with semi-precious stones that were wrought into patterns of a delicacy that only our master craftsmen are capable of achieving. It shone in the glow of the rising sun like some strange apparition from the world of spirits. But as impressive as the coach, Your Majesty, were the horses to which it was harnessed: six magnificent white stallions, tall and elegant animals with beautifully moulded bodies. And I stopped short in my tracks, entranced by this magnificent spectacle, when all of a sudden the coach drew to a halt.

"Its occupant was a man of distinction who spoke as one accustomed to being regarded with the utmost respect. He leaned out of the window and asked me the distance to the City of Chou. I replied, 'The City of Chou is 200 miles to the South, but you are heading in the opposite direction.' The traveller did not seem in the least bit perturbed by this and said, 'That is of no importanceyou see, I have the finest horses in all China.' I repeated 'But Chou is to the South, and you are heading Northwards.' 'Yes,' replied the traveller, still unperturbed, 'but my coachman is the most skilful in all the Kingdom of Wei.' 'I have no doubt,' I answered, 'but you are still heading in the opposite direction." 'Ah,' answered the traveller with the same lack of concern, 'But I have unlimited supplies for the longest possible journey.' 'The finer be your horses,' I replied, 'the more skilful be your coachmen and the more abundant be your supplies, by taking the North Road, they can only serve to widen the distance between you and the City of Chou, which is to the South.' "

Then turning to the Emperor Tsao-Tsao, he said, "Your Majesty, since the beginning of your reign, your only goal has been to further the happiness and welfare of the Chinese people. If you decide to go to war with the people of Han Tan, the greater the army that you mobilize for this purpose, the more brilliant your Generals, the more abundant your supplies, the *further* will you be from your goal. It is like going to Chou by the North road."

There is a moral to this tale. The whole of our civilization is geared to the achievement of "progress". Is it not possible that our notion of "progress" is totally false, and that all the scientific ingenuity, technical skills, and human effort that are going into this undertaking might be misdirected? Might we not be going to Chou by the North road?

#### Puny penalties for river pollution

A Derbyshire firm of bleachers and dyers was convicted recently of four offences of discharging effluent into a river and polluting it. The case is interesting. Over a year ago, the Trent River Authority brought eight charges against the firm. Local magistrates ruled that there was no case to answer. The Authority appealed to the High Court, which decided that there was a case and ordered the magistrates to look at it again. Does this suggest an unwillingness on the part of the local court to convict? At all events, four of the summonses were dropped by the Authority and the firm pleaded guilty to the remaining four. It was fined £10 for each offence, £40 in all.

It was stated in court that the firm

had been negotiating for seven years about plant to treat its effluent and that this would cost between £35,000 and £40,000. The local authority had been asked to accept the effluent but this would mean modifications to the sewerage system which would cost £200,000.

The Rivers (Prevention of Pollution) Act became law in 1961. For the past nine years it has been an offence to discharge untreated effluent which pollutes water. It seems the Derbyshire firm waited two years before beginning to consider a change in its methods and has spent the subsequent seven years debating the pros and cons. One may be forgiven for doubting its sincerity. The point is, of course, that so long as the penalties remain low it is cheaper to break the law. This firm has been disposing of its wastes for less than £5 a year. On purely economic grounds it is better from the firm's point of view to spread the cost of effluent treatment among the community than bear the whole of it. So, unless the firm can be persuaded to install a treatment plant, it looks as though the ratepayers of a small country town will have to fork out £200,000 if they are to save their river. If the polluted water which travels via the Derwent to the Trent is abstracted at any point for domestic use it will have to be purified and so the cost will fall on the ratepayer anyway.

Many large industrial organizations take the pollution problem seriously and are willing to try to solve it, but they need protection from less responsible competitors who can seize an unfair advantage by passing on to the public a part of their production costs. If the Derbyshire firm is to be made to install plant it must become clear that breaking the law is more expensive than observing it.

Almost all of Britain's inland water is now polluted to some extent and new pollutants may appear at any time and with distressing rapidity. Relatively unknown chemicals which are harmless in themselves may react with other substances. The result is unpredictable. In the view of the Institution of Water Engineers there is now a serious danger to our tap water from this source.

One of the most intractable pollutants, which can and does pollute tap water is not, strictly speaking, a pollutant at all. Plant nutrients, nitrates from sewage and fertiliser run-off from farm land, and phosphates from sewage and detergents, over-stimulate plant growth. The plants die and de-oxygenate the water as they decompose, so killing the fish and, eventually, the bacteria which decompose organic matter.

At the present time nitrates and phosphates are not removed during water purification. In small concentration they are harmless, but nitrates are converted to nitrites by microflora in the intestines of small babies. Adults are not usually affected. At more than about 50 parts per million, nitrites can cause methaemoglobinaemia, a condition which can prove fatal. Levels in Britain are monitored constantly and in the Suffolk Stour, which is heavily abstracted for domestic use, they have been well above 20 parts per million. There is a danger in lowland areas that heavy applications of nitrogenous fertilizer may be washed out by a sudden rainstorm. In America levels as high as 45 parts per million have been recorded in the Kaskaskia River, in Illinois.

The Labour Government put the quality of inland water high on its list of priorities. The voluntary organizations also rate it high. The Committee for Environmental Conservation (CoEnCo to its friends) was formed last year to coordinate the activities of the hundreds of bodies in the conservation and amenity fields. On particular issues it will be able to speak on behalf of the members of all of them.

A Sunday Times opinion poll suggests that CoEnCo has its priorities right. 35 per cent of the sample said river pollution was the most serious environmental problem facing us. It came second only to overcrowding and overpopulation (47 per cent). 57 per cent said they would pay higher taxes to improve the environment. These findings agree with those of a similar survey which was conducted in Sweden.

The last government promised to amend the scale of penalties to "bring them into line with the realities of modern life". Let us hope the present one will take action soon.





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

#### Nuclear nemesis

THE PERILS OF THE PEACEFUL ATOM by Richard Curtis and Elizabeth Hogan, Gollancz, London, 1970, 52s.

#### THE CARELESS ATOM

by Sheldon Novick, Houghton Mifflin Co., Boston, 1969, UK price, 56s.

"The most deadly, the most dangerous process that man has ever conceived," these startling words, pronounced by two United States Supreme Court Justices, William Douglas and Hugo Black, to describe the workings of a nuclear reactor, are quoted in both books. These share one essential aim; to put across the authors' concern for the future should the atomic energy programme continue to develop along its present lines.

After emerging from the initial abject despair into which the books plunged me, I decided to find out what nuclear scientists themselves felt.

If I expected to find them fearful and apprehensive at what they had unleashed upon us I was very much mistaken. Certainly they were all sensibly concerned about radiation hazards and were determined that the quantities of radio-nuclides released into the environment should be kept to a minimum (economics dictates how low this minimum should be), but, as for any future dangers to humanity—they hardly seemed to exist.

The pundits left me with a nagging doubt that perhaps Curtis, Hogan and Novick were not so far off the mark-and that unless we were very careful now we should find ourselves in an irremediable position, with our very existence threatened. For one thing many of these scientists-perhaps to justify themselves-have an obsession with such vague concepts as "progress" and the gross national product, and without energy, they point out, the first will not proceed and the other will not grow (see Atom April 1970)in other words the developing nations will remain backward unless they can be supplied with energy. Here the scientist with his rational thinking leaves me cold: it's no secret that the industrial nations take more than the lion's share of the world's definitely limited resources (including uranium 235) and that while they get richer the developing countries with their swelling populations get poorer. (See Science Journal June 1970.)

But if I dissent from the nuclear energy programme on the grounds that I do not believe in the viability of economic growth with its concomitant reliance on increased power production, I also dissent from it on the grounds that the authors of these frightening books may indeed be right.

Basically the books concern themselves with the safety of reactors—both in theory and in fact; with radiation hazards; and with insurance of public safety. The facts as they present them indicate that nuclear reactors are neither entirely safe nor reliable and that in the future, as they get bigger and bigger until they are some 10 to 12 times the size of those in operation today, they are likely to be less safe and less reliable.

Sheldon Novick begins his book with an account of an early reactor—the NRX reactor at Chalk River, Ontario—which went critical in 1952, releasing high levels of radio-activity into the water and atmosphere.

This disaster was followed by another—a few years later in 1957—at the Windscale number one pile, when the reactor core was totally destroyed, releasing a large quantity of radioactivity into the atmosphere.

While they admit these incidents have occurred, nuclear scientists are at pains to point out that the technology is continually advancing and with it a knowledge of how to make the reactor safer. Indeed, the Central Electricity Generating Board in the United Kingdom has eight commercial nuclear power stations supplying the national grid system and seven of these reactors have been in operation for nearly a decade without any nuclear incident. Not that there haven't been problems; a recent HMSO report compiled by the Select Committee on Science and Technology points out that all the Magnox reactors have had to suffer a loss of output because of corrosion caused by the hot coolant gases; and, "the prospects", says the report, "for restoring the affected reactors to full power do not appear to be good".

When a power company in the USA proposes to build a nuclear reactor it must first submit its plans to the Atomic Energy Commission. At the same time it must indicate what it conceives to be the "maximum credible accident" as well as the hypothetical accident in which all the safety devices fail.

In October 1966 the Enrico Fermi Fast Breeder Reactor at Lagoona Beach near Detroit went critical after being plagued by mishaps of one sort or another, and had to be "scrammed" by thrusting six safety rods into the very core of the reactor. The great gnawing fear was that the fuel rods containing enriched uranium might have melted and a sufficient quantity of uranium-235 might have collected together in one spot to form a critical mass if jarred. The resulting runaway chain reaction could undoubtedly generate enough energy to trigger off an explosion large enough to rupture the containment structure.

Books

For the next month nuclear experts very carefully analysed what had happened inside the reactor. Apparently a zirconium plate cover added as an afterthought to make the reactor safer, had come adrift because of poor quality rivets and had blocked the flow of coolant. Fortunately fears of a secondary chain-reaction were not realized.

But how close to the "maximum credible accident" had this incident come? According to Novick the actual incident was not only "incredible", it might have been far worse.

A breeder reactor is a very special kind of reactor, for in theory it generates as much fuel as it consumes. This it does by converting non-fissionable uranium-238 to fissionable plutonium which can then be extracted and used in another reactor. Uranium-238 is in fact plentiful, but it only converts into plutonium when it is bombarded with neutrons, and these neutrons stem from the fissioning of a much rarer naturally occurring uranium, isotope-uranium-235.

Nearly all the present-day reactors are consumer reactors in that they do not breed fissionable material, and if they continue to consume uranium-235 in ever-increasing quantities as the trend suggests, Glenn Seaborg, who is chairman of the AEC, predicts that 40,000 tons per year of refined uranium will be needed by 1980. Serious shortages may come about in the not too distant future, especially of the cheaper priced uranium. The most obvious thing to do is to accelerate the breeder reactor programme.

What about safety? As the authors of both books point out, no breeder reactor has yet proven itself safe; indeed over and above the accidents at the Fermi reactor and at Windscale no. 1 pile—both breeders the Hallam breeder in Nebraska had to be closed down because of a lifetime of difficulties with the sodium coolant system.

Dr Edward Teller—the father of the H-bomb and a man not renowned for moderation—has himself expressed more than caution on the question of the breeder reactor. "In order for a fast breeder to work economically in a sufficiently big powerproducing unit it probably needs quite a bit more than one ton of plutonium. I do not like the hazard involved," he says. "If you put together two tons of plutonium in a breeder one-tenth of 1 per cent could become critical."

Of course it is almost impossible to gauge how much radioactive material might escape, for most of it would be in particulate form, yet the AEC tried, and in the Brookhaven Report, otherwise known as "Wash-740", attempted to predict what would happen should a 100,000 to 200,000 KW reactor release its inventory of 400 million curies of radioactive substances. This staggering quantity—equivalent to that released in a bomb 190 times more powerful than that dropped over Hiroshima—in fact would have accumulated in the reactor core after some 180 days of operation.

The commission assumed for the sake of pessimism that the disaster (considered a nigh impossible event) would occur under poor weather conditions when there was a temperature inversion which prevented the radioactive discharge from escaping upwards into the atmosphere. If the cloud hung over a city within 30 miles of the reactor, 3,400 would be killed, 43,000 would be injured and the damage to property could be in the range of 7 million dollars.

The AEC has since carried out an updated study but has not divulged the results. Nevertheless, on account of the reactors being considerably larger it admits "the theoretically calculated damages would not be less and under some circumstances would be substantially more than the consequences reported in the earlier study".

But not all accidents are in reactors, and

between 1960 and 1963 of 223 requests for AEC special emergency teams 40 per cent involved transportation accidents. Sometimes a little radioactive waste gets released, and of course it all adds up. Perhaps the most horrifying thought is for how long the radioactive wastes stored in stainless steel tanks can be maintained in their underground repositories without accident. The tanks are seething with highly radioactive wastes and must be kept cool to prevent them from bursting. The wastes will be dangerous for hundreds of years. As Dr L. P. Hatch of the Brookhaven National Laboratory has said, "if we were to go on for 50 years in the Atomic power industry and find that we had reached an impasse, that we had been doing the wrong thing with our wastes and we would like to reconsider the disposal methods it would be entirely too late because the problem would exist and nothing could be done to change the fact for the next, say, 600 or 1,000 years ....".

Although the individual releases of radionuclides may not add up to much, the real concern of the authors of both books is that they are gradually building up as a whole to a level where one day they may cause serious and conspicuous effects. As Novick says "the environment which supports us has only a limited capacity for radiation and that capacity can only be used once". A hundred years or so of an ever-expanding nuclear programme is bound to have repercussions.

Thermal pollution is another problem that seems to have been somewhat underrated by nuclear scientists. They have tended if anything to look at short-term effects and have capitalized on trivial benefits such as large prawns. Yet with the demand for energy doubling every 10 years in the United States it can be easily calculated that if the supply meets the demand by 1980 one-sixth of all the available fresh water in the United States will be necessary for cooling. And in a dry summer one-third of the water may have to be used. Indeed, say Curtis and Hogan, at the present rate of growth of the industry "it is conceivable that some rivers might reach their boiling point by 1980 and evaporate by the year 2010".

Perhaps I might add to this disturbing prospect; Professor LaMont C. Cole of Cornell University supported by Caleb A. Smith (*BioScience* 1970 vol. 20 page 72) has assessed that if energy production continues at its present rate throughout the world the earth will be uninhabitable in 130 years. Could he possibly be right?

Curtis and Hogan, and to some extent Novick, appear to be somewhat committed to the idea of increasing energy production and to the concept of "progress". They have both looked at various means by which power might safely be produced. It seems from the facts that scientists, politicians and industrialists should look very seriously at what they are doing-for it may well be that any significant increase in energy consumption may not be safe by any criterion. And if it is not safe then I suggest we should begin for once to question the entire basis of our technological world and the very Peter Bunyard concept of progress.

## ECOLOGY CONSERVATION EKISTICS



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#### **Eco-action**

THE ENVIRONMENTAL HANDBOOK a Ballantine/Friends of the Earth Book, edited by Garrett de Bell, Ballantine Books Inc., 95 cents.

In America, April 22nd, 1970, was Earth Day. At any other time in the history of this planet, Earth Day would suggest a celebration to the gods to ensure the success of another year's harvests. April 22nd, 1970, was not like that.

It was a day of protest, a day when people demonstrated in the streets to draw attention to what we and they have done to the earth, what we are doing and the likely result if we continue. It was a protest against the over-use of the automobile and the ugliness, pollution, ill-health and accidents it causes, against the effluents with which we poison the air, water and soil, against the chemicals which we pour indiscriminately into the environment with little testing and less regard for their long-term effects.

The environmental protest movement is growing apace. It has infiltrated the civil rights movement. In America it is now politically hot and we may expect it to become so in Britain within the next few years. It appears to be new, but I suspect its roots can be traced at least to the beginnings of the popular movement against nuclear weapons in the fifties. In its early days CND campaigned against atmospheric nuclear testing on the ground that fallout released into the environment mutagenic substances whose effect was unpredictable. Leading world scientists of the calibre of Pauling, Rotblatt and Einstein supported this view, but for each of their warnings governments produced other scientists who assured us that fallout was harmless and that levels of residual radioactivity were well within safe limits. Their tune changed only when the completion of a test programme brought weapons development to a point where atmospheric testing was no longer of prime importance. Some of us learned cynicism early!

The Environmental Handbook was produced as background reading for Earth Day. Its editor, Garrett de Bell, is a biologist from Stanford University, who dropped out of his studies for a doctoral degree at Berkeley in order to devote himself full-time to ecological problems. He has gathered together an impressive list of contributors. Most of America's leading writers on ecological problems are there: René Dubos, Paul R. Ehrlich, Lewis Mumford and John W. Gardner, former Secretary of Health, Education and Welfare, all contribute articles, along with other professors, journalists and the organizers of several of the voluntary groups.

The Handbook is divided into sections. The first, and largest, is called *The Meaning* of *Ecology*. It is here that one writer after another points out the inevitable consequences of an ever-expanding population. They are seldom shrill and what might have been a heavy and unrelieved catalogue of doom is broken from time to time by an unsentimental nostalgia for a past that was better, as when, for example, Kenneth Brower describes the love of wild places and the creatures that inhabit them which he inherited from his father, a noted conservationist; and by wit like that of Dr Ehrlich, whose Eco-Catastrophe! sets out a scenario for the environment 10 years from now. He is splendidly ironic about the likely collapse of the Green Revolution, America's plan for world food production based on high-yielding cereals, and the Soviet contribution of a newer and better pesticide, Thanodrin. His purpose is deadly serious, however. He has based his predictions on incidents and trends which appeared before 1970 and he has projected them for only 10 years. He sees the complete and final death of the oceans by 1979. Sometimes the truth is so grim there is little we can do but laugh at it.

The general view is that our problems will not be solved until we have learned to curb population growth and have abandoned the myth of an economy that grows for ever. In a sense it is the GNP which is the villain of the piece. The absurdity is obvious; the picture of nations working frantically to export to one another more and more of the fruits of their technologies, manufactured from dwindling resources and with mounting pollution, is so ridiculous we may well agree with those who suggest it's about time economists were taught some economics.

The second and third sections of the Handbook are devoted to *Eco-tactics*. They contain suggestions for those who wish to make their concern felt and effective. Although they apply primarily to America, many could be useful here. As pesticides are banned, for

Institute of Biology Symposium Number 19 THE OPTIMUM POPULATION FOR BRITAIN

#### Edited by L. R. Taylor /

March 1970, xxiv + 182 pp., 35s. (£1.75)

"The optimum population for Britain has already been exceeded."

This is the opinion of 90% of the scientists attending the latest Institute of Biology symposium in London.

What led a group of responsible people to draw such an extreme conclusion? This book gives the facts behind the startling opinions of 14 experts who contributed to the symposium.

It covers the growth phenomenon, the price of pollution, the limitations of our resources, the dilemma of abortion and many other topics that Britons can no longer afford to ignore.

An excellent tool for social scientists and others professionally concerned with future population growth, this book will also be of value to the lay reader who wants to form an intelligent opinion on the question of population. Institute of Biology Symposium Number 18 Biology Symposium Number 18 Biology & Ethiopy & Ethiopy Edited by F. J. Ebling 1969, xxx + 146 pp., 40s. (£2.00) Population control, contraception and abortion, homosexuality, organ transplantation, the survival and reproduction of the unfit, biological warfare, the social responsibilities of scientists:— sixteen scientists consider the ethical problems arising from man's social and technological development.

Is there an objective standard by which ethical codes can be judged? What is the relation between moral guilt and guilt in its psychological and legal senses? These and related issues are discussed by several biologists with a psychologist, a psychiatrist, a criminal lawyer and a transplant surgeon.



ACADEMIC PRESS, LONDON & NEW YORK Berkeley Square House, Berkeley Square, London W1X 6BA, England 111 Fifth Avenue, New York, N.Y. 10003, USA example, volunteers could arrange for the collection of unused stocks and could then exert pressure on the authorities for their safe disposal (they must be incinerated in a special furnace at very high temperatures). We could buy only those Christmas trees that have roots, and then plant them in prearranged sites. When shopping we remove unnecessary packaging, particularly nondegradable packaging, and leave it behind us in the store, explaining our action to the assistant. There are many suggestions of this kind, as well as for educational projects for schools. There are descriptions of successful projects, including the Ecology Food Store, in Cambridge, Mass., which sells only organically grown food wrapped in re-cyclable containers, degradable soaps and hand-made goods manufactured from recycled materials.

There is then a long list of organizations the reader may join. This alone, since the book has been produced by one of the groups named, shows the extent to which voluntary groups are working together, rather than competing for members and funds.

As America leads the world in the creation of environmental problems, so it leads, too, in voluntary action to solve them. The Environmental Handbook is lively, unstuffy, and packed with information and ideas. I look forward to a British edition. Meanwhile, for 95 cents its 350-odd pages are unbeatable value. When you have finished with it make sure it is recycled!

Michael Allaby

#### Cancer crusade

#### MAN AGAINST CANCER: RESEARCH AND PROGRESS

by Bernard Glemser, The Bodley Head, 45s.

Cancer research is variously regarded as "a noble but dull and unrewarding pursuit", as "too complex for anyone not working in the field to understand" and as "an expensive exercise that has been achieving little or nothing during recent years". Moreover, most so-called popular books on the subject fail to provide a more satisfactory image of the subject. This book by an experienced and successful novelist does so handsomely.

Accompanied by his wife and armed with a tape-recorder, Glemser set off to interview scientists in research institutes and hospitals in countries scattered around the globe. From these interviews he has pieced together a series of exciting adventure stories that depict man using all his wits to solve problems closely bound up with the very mystery of life itself. Some of the all too easily overlooked triumphs of cancer research are highlighted, and the hopes, fears, prejudices and conflicting views of the scientists are presented in a way that the layman can understand and which grips his interest.

One story concerns a form of cancer most commonly seen in children in certain parts of Africa. The disease was discovered by Denis Burkitt, a surgeon originally from Northern Ireland, during the early 1960s, and this has proved to be a landmark in cancer research. Firstly, it is likely to be the first type of human cancer that is shown to be due to infection with a virus-possibly the Epstein-Barr virus. A complex variety of relationships between man and this virus suggests that infection may occur anywhere in the world, and is usually unmarked by illness of any kind. Uncommonly, infection manifests itself as glandular fever (infectious mononucleosis), and very rarely as Burkitt's African lymphoma. Concurrent infection with malaria may be the factor which favours lymphoma development in those infected in Africa, since the geographical areas in which African lymphoma occurs more or less coincide with those in which malaria is endemic. The striking response of some patients with Burkitt's lymphoma to treatment with anticancer drugs focused attention on the possibility that the body can sometimes reject a few remaining cancer cells by an immunological mechanism provided that most of the cancer has been destroyed by other means such as surgery or chemotherapy.

The history of cancer research—albeit slightly biased because it is history as perceived by a novelist who is American—is the basis of a lively second chapter. Since this was written, another page of history has turned with a serious cut-back of Government funds for cancer research in the United States. This is a source of immense frustration for many top scientists in the field, but good may come of it if it leads to acceptance that, even when money is more plentiful, problems should be tackled on the basis of

Wilderness and Plenty



### BBC 1969 REITH LECTURES Dr F. Fraser Darling

The 1969 Reith Lectures by Dr. Frank Fraser Darling, Vice-President of the Conservation Foundation, were immediately recognised as a major contribution to the growing public debate on world pollution and over-population.

Dr. Fraser Darling leads on from an analysis of man's relation to his physical surroundings to describe the ways in which the environment has been exploited, contaminated and devastated under the pressure of advancing technology. He pleads for a planned conservation policy as the only means by which we can avoid destroying the delicate natural balance and making our planet uninhabitable.





priorities. One hopes that the concept of the crash programme which entails the simultaneous investigation of every combination and permutation of possibility at the same time, has gone for good.

Cancer presents a galaxy of problems and not, as some people imagine, just a single problem. Special problems are associated with particular places, occupations, customs and habits. During the past decade, research on causation and prevention in relation to these special problems has been particularly rewarding and provides Glemser with material for his chapter entitled "Of people and places", "A new kingdom of medicine" (about the discovery of a fascinating new class of chemical carcinogens, the nitrosamines, capable of causing cancer at almost any site in the body), "The case of the depraved turkeys" (about the discovery of aflatoxin, a powerful carcinogen, in ground nuts) and "The case of the tumorous trout" (about the liver cancers that develop in trout fed a diet contaminated with aflatoxin).

In places the book is moving, without being sentimental. The fact that cancer is not a common cause of death in India means only that tuberculosis and other infectious diseases take their own heavy toll. And whilst one reads the account of Glemser's experiences in India, the terrible question pushes itself forward—"What sense does cancer research make against the tragic scene of uncontrolled overpopulation in that part of the world?"

Francis Roe

#### A cybernetics primer

#### CYBERNETICS SIMPLIFIED

by A. Porter, pp. 159, English Universities Press, 1969, Hardback edition 35s., Softback edition 22s.

This book is based on a series of lectures given to intelligent sixth formers and the author aims to present the principles of Cybernetics with the minimum of mathematics and specialized jargon. In certain respects Cybernetics Simplified achieves this objective admirably; it provides a commendably lucid and concise account of feedback and servo-mechanism theory which, by dint of ample illustrations and well chosen examples, leads the reader painlessly towards the quite subtle truths of stability, optimality, etc. Further, it gives a very fair picture of "measurement" as the word is understood in engineering and the allied disciplines. If the review were primarily addressed to students or practitioners of physical science, I should stop at this point; just saying "a good semi-popular book on a real but narrow aspect of Cybernetics".

But the greater part of modern Cybernetics is concerned with systems of a much less restricted type; the systems encountered in the cognitive, behavioural, social and biological sciences. A proper study of these systems calls for a much more sophisticated framework than that required in the analysis of servomechanisms and other artifacts. The sophistication in question is philosophical (structural if you prefer it) and even an elementary text is positively misleading if it fails to outline the appropriate way of thinking.

Cybernetics Simplified does not do so and in so far as natural systems are considered (notably in Chapter 7 on learning), the book is open to serious criticism. The last two decades of cybernetic work in this area are summarized between pages 147 and 150. Moreover, though Utley's and Grey Walter's research of the 1950s is briefly reported, all of the other pioneering work is completely omitted (for example, there is no mention of Ashby, McCulloch or Waddington; their words or their discoveries).

If Cybernetics is interpreted as a sort of generalized control engineering, then these cautionary comments are irrelevant or even petulant. If it is interpreted as a science of organization and control that underlies ecology and the like, then they are quite important.

In summary, the book is an excellent primer on Cybernetics in the narrow sense. Its qualities in this respect are unquestionable and outweigh its shortcomings as a text about Cybernetics in the broader sense.

Gordon Pask

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