The Ecologist

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

Vol. 1. No. 5

November 1970

4s (20p)

Fertility or pollution? The choice before us . Can science be reformed?

The life and death of the Great Plains . Does Nigeria exist?





Let's come clean.

Despite smokeless zones and all the 'whiter than white' promises of the last 25 years, Britain is still a dirty place.

Sheets that are dizzily white when they're hung out need another dip by the time they're dry. Not surprising that a new word has gone into the dictionaries. Smog.

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and more of our cities change over to Natural Gas their sorry climates will lift and lighten.

Houses, offices, shops, factories will become cleaner, as well as warmer and better run.

This is more than a promise.

It is a prediction. Natural High Speed Gas is a truly smokeless fuel.

A fuel for civilized people. Use Natural Gas-the civilised fuel.

The Ecologist

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... he's a compulsive buyer, thrives on additives and industrial waste, doesn't need a home or a family, has no sense of aesthetics, and is completely sterile, which means, gentlemen, that the market for this outstanding new product is entirely yours ...

Editorial

Science: redefine or abolish it?

The scientist is under attack. His image is deteriorating fast. No more do we see a benevolent sage whose infinite wisdom is leading to man's conquest of nature, to the elimination of disease, poverty, misery and everything else that afflicts us. Instead, to more and more, he has become an ogre, who, to satisfy his own curiosity and the growth-mania of his employers, is concocting vile poisons that are bound to get us all in the end.

This new image is not undeserved. There is a lot wrong with modern science. For instance, it is divided up into a host of little watertight boxes—each labelled: chemistry, ergonomics, pesticide-science etc. whereas the biosphere is simply not cut up this way. On the contrary, its parts are so closely interconnected, that looked at separately they are as meaningless as is a carburettor to a man who has never heard of a motorcar.

This means that scientists not only understand very little *outside* their own little boxes, but not that much *inside* them either. Also, their lack of interest in the biosphere as a whole means that they must remain ignorant of its general principles, of the foundations on which their little boxes are built.

Take Pesticide Science. It is based on four assumptions. The first is that there actually are such things as "pests". But what, in fact, is a "pest"?

Bugs like leaf worms and boll weevils, birds like sparrows and wood-pigeons, mammals like wolves and foxes, even people like Tasmanian Aborigines and South African Bushmen, have at various times been labelled "pests" and so they have been poisoned, shot and, when possible, exterminated.

What do these biologically very different animals have in common? Mainly, it would seem, that they are all presumptious enough to eat food that could otherwise be eaten by us.

It is essential to realize, however, that they do lots of other things as well. Countless millions of years of evolution did not occur simply to provide Western Man with minor irritants. Each fulfils a multitude of essential functions in our biosphere. Each is an essential environmental constituent to myriad other forms of life—and this we totally ignore when we classify them as "pests".

This leads to the second assumption; that exterminating "pests" leads to increased food supply.

Pesticides concentrate as they go up the food chain—and at the top are the wretched predators, so they are the first to get killed. This can only lead to a proliferation of their prey. Thus killing crocodiles in African rivers has led to the proliferation of inedible barbel that have practically wiped out the very edible tilapia. Killing off hawks and ospreys in Britain and elsewhere has led to a population explosion among sparrows, while killing off ladybirds in Norfolk has resulted in today's plague of aphids.

It must be apparent that by killing off predators, pesticides are actually creating pests—not the odd one, but epidemics of them. This is why they were abandoned in many parts of Malaysia (see Man-made Plagues, The Ecologist Vol. 1. No. 4) and more recently in the Canete Valley of Peru.

This is also why in different parts of the world predators are being re-introduced; otters to control fish in Polish rivers, birds to control insects in Spain, and soon birds of prey to control seagulls in Guernsey.

But there are other reasons why pesticides can't increase food supply: they cannot discriminate (as do predators) between target and non-target species. But the latter account for 99.5 per cent of all living things. So getting rid of the 0.5 per cent that we classify as "pests" is expensive, in terms of animal life.

Unfortunately too, many of these lives fall into another category: food. Thus as a result of pesticides and other pollutants, haddock catches in the U.S. declined from 50,000 tons a year in 1963 to an estimated 10,000 tons in 1969. Fishing, which is Iceland's only industry declined by 80 per cent in 1968 apparently as the result of DDT poisoning of herrings in the North Sea.

Thus, to increase short-term yields of one type of food we are drastically reducing long-term yields of another.

Also we must not forget a basic ecological principle: stability is achieved by increasing complexity. But we aim at achieving the simplest possible ecosystem; one consisting of us and our crops to the exclusion of all other forms of life. We simply cannot get away with it. We must pay the cost: plagues, epidemics, and less food in the long run.

This leads to the third assumption; that it is, in fact, possible to eliminate "pests". Mammals and birds may be quite easy to kill off, not so insects. They produce so many generations in such a short time that they can adapt genetically to any new chemical, and probably faster than scientists can produce them. Though, in spite of all warnings, we are using ever greater amounts of pesticides, there are more insect species today (see *Environment*, April 1970) than ever before, while over 200 of these have already developed resistance to chemicals. So it looks as if we are fighting a losing battle.

And now to the final assumption: that we can tolerate the ever higher amounts of toxic substances we are subjected to.

It is on the basis of their effect on laboratory animals that chemicals are judged safe or unsafe to humans. We know that pesticides kill off animals in the wild. Why shouldn't this provide equal evidence?

Things that are toxic to all other mammals whether in the wild or in the laboratory, must certainly poison us too. As Wayne Davis points out, "One of the lessons of modern molecular biology is that basic life processes are essentially the same in all organisms."

Scientists are constantly refusing to accept conclusions apparent to most people, on the grounds that they are not supported by sufficient "evidence".

So let me give them a dose of their own medicine. I challenge any of them to provide evidence to justify these four fundamental assumptions.

If they can't, then they will have to admit that Pesticide Science is based on false premises, as are many other disciplines—economics to name but one.

This would reveal that specialists are incapable of examining the basic principles on which hinges the very validity of the work they are doing.

In which case, to what extent can this work be regarded as scientific?

Either it isn't, in which case science should be redefined, or it is, in which case it should be abolished.

Living with Gorillas

Part One by John Aspinall

With the continued uncontrolled expansion of the human species, there is little chance that anything will be left of the natural habitat of the larger mammals. Twelve years ago John Aspinall, a unique figure, gambler, traveller, naturalist and ardent conservationist set up breeding colonies of some of the most imperilled species. tigers, gorillas and clouded leopards. In this way he hopes to contribute to their survival. In this, the first of a series, he tells of his experience with one of the few gorilla colonies in captivity.

At a time when the limitations of our own species have become ominously clear to most thinking men, it could be profitable to take a glance at our closest

relatives among the mammalia-the great anthropoid apes, the Gorilla, Chimpanzee and Orang-Utang. From the classic studies of Schaller, Fossey and Goodall it becomes clear that the first two species have achieved a complex level of social behaviour combined with a dominant role in their habitat without any signs of resultant environmental deterioration. The gravamen of the charge levelled at mankind by today's ecologists is that the so-called progress made by us since the discovery of fire has been at the expense of the earth's finite capital resources and is therefore, from the evolutionary standpoint, not progress at all but-regress. Indeed it will probably take the planet millions of years to recover from the human experience and it is a tragic irony that during the countdown to the ecocatastrophe, the period that we are living in now, many "innocent" species will be swept away. Among these will almost certainly be the great apes.

Twelve years ago I set out to form self-perpetuating colonies of gorillas and chimpanzees at Howletts near Canterbury. Well aware, even at that date, of the extreme pressure on the wild remnants of both species I was already preconditioned to the "oasis" mentality. It was my wish that Howletts might prove to be a sanctuary of some beleaguered mammals and so enable them to survive the ecological blizzards of our own epoch. In this article I shall confine myself to some of my experiences with the Lowland Gorilla.

At the age of about 12 I met the great ape in Ballantyne's absurd book The Gorilla Hunters and later I saw his image on the screen in King Kong. I can remember discounting even then the stories of the ape's innate ferocity and insatiable libido. For years I collected every available book on gorillas but they were a disappointing miscellany: mostly the narratives of trophy or specimen hunters and interspersed, for the most part, with photographs of the cadavers of huge sag-jawed males, hand-hoisted to give them the grizzly appearance of life. However, even in these dim works the mystic allure of the gorilla came through for me in no uncertain terms. It became my particular ambition to have gorillas as my friends and a special dream to win the confidence and trust of a fully grown male.

In '58 for the first time I found myself in a position to procure my first gorilla. I met Heini Demmer, the animal catcher, when he delivered Chi-Chi, the giant panda, to the London Zoo and he told me he would supply me with approximately eight gorillas over the following four years—all of them infants.

The colony today, in hierarchical order:

-				-
	Name & Sex	Age	Weight	Arrived
1	Gugis (m)	12 yrs.	375 lb.	1959
2	Shamba (f)	13 yrs.	320 lb.	1959
3	Mouila (f)	10 yrs.	205 lb.	1960
4	Baby Doll (f)	9 yrs.	240 lb.	1961
5	Ju Ju (f)	8 yrs.	160 lb.	1962
6	Mumba (m)	$4\frac{1}{2}$ yrs.	85 lb.	1968
7	Djoum (m)	2 yrs.	44 lb.	1969
8	Mushie (f)	1-2 yrs.	28 lb.	1969

In '67 Howletts experienced its worst disaster, we lost the following three gorillas from an invasion of the strongoloides parasite:

Kulu (m)	11	VIS	325 lb.	1961
Moundou (f)	7	yrs.	140 lb.	1960
Dingi (f)	6	yrs.	120 lb.	1960

After this setback, which was due to a diagnostic failure, I decided to employ the services of a full-time veterinary surgeon and there have been no further losses to date.

In the wild state gorillas live in large bands or super-families of perhaps 10 to 30 individuals and so it became necessary to build the colony step by step and to integrate and assimilate each new arrival into the existing group. At the moment, the six large apes run together and the two infants who have been with us for a year are being introduced gradually. This is done by habituating them to one adult at a time, a slow but sure progress which enables them eventually to secure a place in the hierarchy; albeit in the case of motherless infants —the lowest one.

Gorilla babies usually arrive in poor condition and suffering from the stress of a prolonged journey. The only hope of keeping them alive is to have available a foster mother who will love them as much and care for them as diligently as she would her own offspring. In this respect I was lucky to have the services of my mother-in-law Dorothy Hastings and her mother "Granny Coode". These two inspired women devoted all their time to nurturing the gorilla children and without their help the colony could scarcely have survived.

Imprintation and mother-transfer are essential for infant survival in captivity but present quite an obstacle when the difficult process of integration begins. Schaller believes that in their natural state the juveniles stay with their mother, or at least retain a special relationship with her, until the age of seven or more. We found that circumstances forced us to feed the infants into the group between the ages of 2 or 3. Though physical contact is maintained by us until adulthood—and after in the case of females—the animals (none the less) then become orientated towards their own kind.

This system has not worked out to perfection, as one of the females-Baby Doll-has never fully adjusted herself to the social structure of the Howletts gorilla clan. She remains the "odd girl out" and keeps aloof from her companions for long periods, particularly during her monthly oestrus when she sulks alone. Her position in the hierarchy is a comparatively low one and not commensurate with her weight, strength and intelligence. This is probably because she is less able to call on friends in the case of a quarrel. Baby Doll, however, is the favourite of all the keepers owing to her extraordinary personality. She is the only female who dares to thump Gugis on the back and the only one who will wrestle with him with any appearance of enjoyment. I play every weekend with all the gorillas, except Gugis, and though Baby Doll is the roughest to handle she is also the most playful and amusing. I think she could be low on her hormone count and certainly she shows many boyish characteristics. Her genitalia are underdeveloped and her breasts vestigial. Gugis, who has copulated with all the other adult females, has never shown any sexual interest in Baby Doll. When she is in oestrus she sometimes "presents" to one of the keepers or to me. Alas! We cannot satisfy her demands.

Baby Doll is the only gorilla who is unafraid of strange phenomena such as noisy toys and other devices that gorilla keepers use to drive the apes indoors on cold nights or to force them out of their sleeping quarters at cleaning time. When Baby Doll herself is in possession of a squeaky toy she relishes the advantages this gives her over the others. Gugis, Shamba and Mouila will give way before her, evincing signs of alarm and even repugnance. When the toy is eventually misplaced or removed by the keepers we have never witnessed any evidence of vindictive behaviour on the part of her seniors. The concept of revenge seems alien to the gorilla.



The author with Gugis.



Above: A gorilla walk. Below: A botanical "teach-in".



f/m	Species	Breeding record
4/5	Lowland Gorilla	(one foetus '69)
2/2	Chimpanzee	1/0 '70
3/4	Siberian Tigers	(reach breeding age 71/72)
7/10	Indian Tigers	12 Howletts born (3/3 this year)
1/4	Clouded Leopard	0/3 born this year Howletts (first ever G.B.)
3/3	Black Capped Capucine monkey	2/1 Howletts born (1/1 this year)
2/2	Wooley Monkeys	-
1/3	Cinnamon Capuchin monkey	4
2/4	Ratels or Honey Badgers	-
2/2	American Bison	1/1 Howletts born (1/0 this year)
3/2	Przewalskis Horse	(arrived this year)
6/8	Nilghai	All Howletts born (3/3 this year)
10/13	Axis Deer	20 Howletts born (6 this year)
1/1	Sambar Deer	1 born Howletts
1/1	Black Buck	1 born Howletts
11/13	Wild Boar	21 Howletts born (11 this year)
2/2	Brazilian Tapir	(recent arrivals)
3/4	Timber Wolf	-
2/3	Two Wattled Carsowarius	(recent arrivals)
50	Jungle Fowl	-
30	Guinea Fowl	-
5	Peacocks	

18 different species with a total of 147 specimens. 79 were born at Howletts.

The subtleties of hierarchical structure are probably more easily observed in captivity than in the wild and possibly the extra tensions that are built up and exaggerated by confinement tend to expose these with a greater clarity. The dominant role of the male is adumbrated at a very early age by his overt concern for the safety of his companions. Upon his massive silver back will fall the burden and responsibility of group defence and Djoum even at the age of two responds to outside threats which leave Mushie unconcerned. When we used to take the colony for gorilla walks through the park Gugis and Kulu acted as protectors and outriders.

An indication of their erstwhile position in the faunal scale of the African rain forests was the confident manner with which the half-grown apes would drive away any bison, nilghai and horses that happened to be in their path. This is confirmed by field observers who have seen gorillas disperse red buffalo and even elephant from forest clearings where they wished to forage undisturbed. I sometimes took a half-grown Indian tiger on rambles with the gorillas and if he clawed the smaller ones too severely Gugis would pound him on the

back until he desisted. I think it can safely be said that until the advent of firearms the gorilla was a veritable overlord. In the climax ecosystem of the tropical forest he had achieved primacy. He feared none but the hunting tribes and with these he held his own for tens of thousands of years. The adult gorilla male who has succeeded to the patriarchy of a band is usually a stable and benevolent leader. Gorillas have developed an extraordinary capacity to neutralise any over-weening, intrafamilial exertion of power. An infant or juvenile that is threatened by a large male or female is immediately assisted by the remainder of the clan-whatever the cause. This re-active response is, I am glad to say, extended to include their human friends. I used to wrestle with Gugis until 18 months ago and Shamba on these occasions never left my side. Whenever Gugis stepped out of line she admonished him with a series of threatening coughs, and if his horse-play became too violent or if I cried in pain the whole clan would drive him away with a cacophony of barks and screams.

Since the colony was founded, no gorilla has inflicted a serious injury on another, which emphasises their fundamental good nature and powers of restraint; particularly if you take into account the artificially cramped conditions which they have to endure.

Dian Fossev who studied Mountain Gorillas in Ruanda for three years maintains that each family takes on the characteristics of the dominant male or "silver-back". The two leaders of the Howletts colony developed very different personalities. Kulu was more "honest" and predictable than Gugis and inspired less fear than his successor. He was a natural leader and the group seemed happier under his regime. When he died in '67 Gugis was too young to succeed and during the interregnum Shamba filled the gap. In natural conditions I doubt whether Gugis would ever have become a clan overlord as the females do not wholly trust him and this lack of confidence, during the last six months, has inhibited copulation. A year ago Gugis covered Shamba, Mouila and Ju Ju regularly when they came into oestrus but since then he has added another 60 lb. of musculature and become curiously unsettled in his temperament. This could be because of the tensions built by "cares of state" and certainly he is the most active gorilla for his size,

I am sure, in all Europe.

Specialists in zoo animals like Demmer, Chipperfield and Van Den Brink who have seen him in the last few months have been astounded by his extraordinary display behaviour, triggered, as always, by strangers entering the servicing corridor adjacent to his own enclosure. This strip of territory he regards as a sort of no-man's land and to enter it-a definite threat. His reaction is, to the uninitiated, quite frightening. He is well aware when visitors are approaching and disappears out of sight into his sleeping-den to brood. The guests then enter the corridor to watch the colony at close quarters, enjoying the unsual spectacle of seven gorillas climbing, playing and wrestling together; none of the females, of course, showing any concern at the proximity of the foreigners. A few minutes later Gugis comes out with a rush, hurling his body against the weld-mesh or giving it a shattering blow with his elbow and knuckles. During one of these exhibitions he assumes the offensive posture, flexing his shoulder muscles and mobilising his whole frame for action. These moves are accompanied by a marked withdrawal of the lips, signifying annoyance, and a conspicuous raising of his body hair making him appear larger than ever. The intruders are met by a prolonged stare followed by "bluff charges". Sometimes the displacement activities that ethologists love to describe can be seen on these occasions. Gugis will try and impress the spectators with his awesome strength. He may fling around a log or a lorry tyre or smash a branch to pieces in his hands . . . the message always gets home.

Julian Huxley once wrote that man can only feel humble in the presence of a great male gorilla and I have never met a man who did not. Sometimes people ask what would happen if I went into his cage and played with him. The answer is probably-nothing. Two years ago when Gugis was approaching 300 lb. I found the going very tough indeed. I never got badly hurt but his play was not getting any gentler as I had hoped as his strength increased with age. At certain times I began to feel a subtle change in his attitude towards me. Since he was 10 months old we had enjoyed a profound relationship. I cannot doubt his love for me, any more than I can question my love for him. When I was the father and he the child there were no problems, but in late adolescence he

sometimes became unpredictable and his wrestling began to show signs of illhumour. I decided that to go on playing with him every weekend was a poorish gamble as I might unwittingly get involved in a hierarchical squabble.

I have high hopes that Mumba and Djoum will prove to be more selfassured than Gugis and be willing to accept me when they are adults. My optimism is based on the big difference in the personality and character of gorillas, which, by all accounts, is just as pronounced as with us.

We have had considerable breeding successes at Howletts, the details of which are listed on p. 6. The Siberian Tigers, Przewalskis Wild Horse and Brazilian Tapirs have not been with us long enough to breed but we are confident that colonies of these three species will be established. We have failed so with the Cinnamon Capucin far monkey, Wooley monkeys, Honey Badgers and Timber Wolves. The gorilla Monila delivered a 6 months foetus June '69 and we hope for better results when the band move into its new "Gorillarium" of 110,000 cubic feet in 2 months time. It will be equipped with brachiating paths, chutes, trapezes, rope ladders, a heated swimming pool and a huge drum. These contraptions will help dispel the boredom so difficult to counteract in confinement. Unlike his cousin Homo the gorilla only breeds in optimum conditions. The rate of regeneration in world zoos is pitifully inadequate: No more than an average 11 births per annum from a population of approximately 300 apes.

In his last redoubts in the shrinking forests of Central Africa the noblest of the humanoids is fighting his last battle —a losing one. When I was in the South Cameroun gorilla country I discovered that the great males only managed to get one hunter for every twenty gorillas killed. He is slaughtered ruthlessly for protein and his courage and strength are almost useless against firearms. The forest tribes are careless of his fate and the urbanised, deculturised ruling cliques of the Central African republics are ashamed of his very existence!

Those few people who know the gorilla well cannot bear the thought of his passing. He is the embodiment of Rousseau's dream of the "noble savage". Magnificent in his selfpossession, heroic in his pride and strength he yet remains the gentlest of the anthropoids.



Gugis showing interest.



Above: Shamba laughing. Below: Gugis enjoying a sow thistle.





Lawrence Hills presents a practical plan to ensure at once the fertility of the soil and the cleanliness of our rivers. We consider it imperative that this plan receive the attention that it deserves, and to this end, we are sending an off-print of this article to all M.P.'s and Local Authorities

Today, and every day, 37 million gallons of untreated sewage flow down the Tyne, carrying bacterial contamination five miles out to sea. The Tees has 500 separate outlets pouring filth into it; the Severn takes raw sewage from 40 per cent of the people of Wales; and every major estuary in Britain except the Solway Firth is heavily polluted. There are 148 local authorities discharging raw sewage into the sea and 200 seaside resorts where visitors can go paddling or swimming in visibly contaminated water.

These facts and more are in the report of the Working Party on Sewage Disposal under the Chairmanship of Mrs Lena Jeger MP published in August 1970 (1). Like most Working Parties, it recommends modest and cautious proposals, for its Members hope that their endeavours to gather the facts before they change for the worse, will not be entirely wasted. Yet even if every recommendation is carried out, we shall still have stinking beaches and waste our fertility in poisoning our rivers and the sea. Caution is not enough when we must deal with problems that will double themselves in twenty years and cost five times as much to solve.

The *daily* flow of sewage in Britain is 3,100 million gallons, or 60 gallons a day for everyone, from babies to pensioners. We average 31 gallons a day each for personal needs, 11 for w.c. flushing, 11 for baths and washing, 3 for laundry, 3 for cleaning and dishwashing, $1\frac{1}{2}$ for garden watering, a gallon for cooking and drinking, and half a gallon for car washing. The other 29 is our share of industrial demands, from 160 tons of water to make a ton of paper to 400 for a ton of synthetic rubber.

Before all this water flows through our sewers, it must be pumped from the wells that go down to our falling water table, drawn from our rivers and collected behind dams that drown villages and nature reserves from Devon to Wales and the Lake District. If we ever average even three baths a week, or (the Water Engineer's Nightmare) our lemming-like youth takes to a cult of daily cold baths, we shall be driven to costly desalination of seawater as though we were a desert oil sheikdom. Yet Britain is not dry. Just wasteful, greedy and short-sighted.

Australia's example

In Melbourne the entire 99.9 million gallons of sewage a day from 1,778,000 people is used to irrigate 28,809 acres of pasture, lowering the cost of sewage disposal to 5/10 a year per citizen (our average is 25/-) and gaining environmental advantages that make this mighty farm a greater wonder than Sydney's bridge or opera house.

The Werribee delta is so flat that the sewage can run by gravity, sinking easily through this vast filter and drawing air down to the roots of the grass and plant life which thrives on the foods and organic matter left by the constant liquid manuring.

This makes heavy stocking (even by Australian standards) possible, and in 1969 52,356 sheep and 5,363 beef cattle, were sold from this area, not to mention milk and wool sales. The experiment began in 1893, and after 77 years of success there is still no sign of the disaster from the accumulation of toxic minerals, especially zinc, predicted by the chemical fertilizer industry.

Melbourne's problem is that so much of their 18.93 inches of rain falls in winter. The surplus has to be run out to sea with the storm water, to avoid swamping the pastures with more sewage and water than they can take. In August 1970 there were protests at the few weeks of coastal pollution at St. Kilda, while Britain suffers all the year from sewage served raw on her beaches.

Rickmansworth pioneering

Our winters are longer and wetter than Australia's and we can rarely irrigate using both effluent and sewage. But two Drainage Authorities, West Hertfordshire and Middle Lee have been spraying a liquid sludge on farm lands for over 14 years, with the same lack of toxic metal trouble as Melbourne, and an increase in productivity almost as great.

In 1967-68, the road tankers of the

8



West Hertfordshire Main Drainage Authority distributed 37 million gallons of their "Hydig" liquid sludge, which has no smell and looks like thin tar, within a 40 mile radius of their pioneer plant at Rickmansworth. There are now about 15 other authorities using this process and steadily surrounding themselves with satisfied farmers. (2).

These are not "Muck and Mystery" men. They have given up chemical fertilizers (but not lime) because it is cheaper and requires less labour to use free fertility sprayed on their pastures from tankers, than to buy subsidized chemicals and spread these themselves. It costs the Authorities between 30/and 50/- a thousand gallons to give their sludge away, which is cheaper than spending up to £50 a ton to dry and bag it, to sell at £5. It is cheaper than drying and burning or dumping in the sea and it puts the plant foods and humus back on the land where they belong.

Without fertilizers

Mr S. Reid of Iver, Bucks, has farmed for 10 years without fertilizers on 85 acres of sandy land over gravel, sludged at the rate of 10,000 gallons an acre of Hydig three or four times a year. This allows stocking at the incredible rate of three beasts of varied ages an acre. He buys 405 day-old calves, suckles them on nurse cows and sells them as fat bullocks, beating the factory farming "zero grazing" system on lower labour costs and capital investment. His nine acres of market garden crops and five on mangolds rotate round the farm, to cash the fertility build up from the sludge

and the heavy stocking. He carts no dung and his cow pats are spread by fast harrowing.

The sludge, which is concentrated, unlike Melbourne's, is 4.4 per cent dry matter which holds 6.8 per cent nitrogen, 4.7 per cent phosphorus and 0.15 per cent potash. This makes it an ideal grassland fertilizer although it needs skill to balance the grazing mouths and stop the grass racing ahead on the nitrogen, otherwise the clover enjoying the phosphorus would be swamped. In 1966 the local NAAS took soil samples and found high fertility and no build up of toxic metals. Tests in 1969 showed that Hydig contained no organo-chlorine compounds.

Modern detergents break down, releasing phosphorus that grows unwanted algae in rivers but good grass and clover on the land. This fast grass system fits not only beef cattle, but dairy cows and sheep, with kale, cabbage, grain and potatoes on the break with heavy liming every 4-5 years. The Hertfordshire Institute of Agriculture, experimenting with Middle Lee liquid sludge, found that grain yields were equal to the best grown with chemical fertilizer, but the crops were about seven times less likely to "go down". Yields were far better from liquid sludge, than the same sludge dried, because half the nitrogen and phosphorus escaped in drying. (3).

Agriculture is our largest and most efficient industry, but a survey by the National Agricultural Advisory Service shows that this efficiency has been at the expense of the soil. Constant grain crops ever since the 1950's, combine-harvested and treated with chemical fertilizers and selective weedkillers have brought the humus down from the recommended 8 per cent to 3 per cent.

Some land will take this greedy farming, suffering only disease and a buildup of those weed grasses that dodge the killers, but the wet seasons of 1968 and 1969 showed up the damage on the clays. The only way back to humus is through mixed farming and fewer fertilizers. Expanding the liquid sludge system could save our heavy land without bankrupting farmers squeezed between fixed prices, rising costs and well-earned wage increases.

Nitrate dangers

Ever since 1968 Professor Barry Commoner of Washington University has been warning of the dangers of nitrate fertilizers which can be changed to poisonous nitrites by bacteria present in babies' digestions. Infants have died from this in the USA and now water from wells in North Lincolnshire has started the symptoms in Britain (*Observer* August 30th 1970) in circumstances that fix the blame firmly on the fertilizers.

High levels of nitrate also reduce the oxygen-carrying capacity of a baby's blood, starving the brain dangerously. For three months the Lincolnshire wells have been above the World Health Organization's nitrate danger limit. Mothers are now supplied with bottled water from safe areas, but excess nitrate can be found in tinned carrot and spinach baby foods, grown on heavily fertilized land. But constant tests, however, are made by the makers, and the risk is low.

Plants take up their nitrogen as nitrates in small quantities by bacteria that break down manure, by clover root bacteria and still more by others that live free in the soil, feeding on humus and gathering nitrogen from the air. Modern agriculture bypasses the bacteria with ready-made nitrates, especially nitrochalk, nitrate of soda and increasingly liquid ammonia squirted into the soil.

The NFU and the ICI would regard any suggestion of using less nitrate as motor manufacturers would the idea of making small slow cars to cut road casualties. Here again, liquid sludge could be the answer. Only a little of its nitrogen is nitrate, the rest needs bacterial action to release it slowly, so it starts grass and grain off fast before its nitrate can wash away and the rest is unlocked through the months. It pays better to apply free dressings, that are *used* by crops and soil, than to buy nitrates which wash away and become poison for babies or feed useless algae in rivers.

Liquid sludge

Over half our 5,000 odd sewage treatment plants use this heated digestion process, which makes the best and richest liquid sludge, odourless and safe, but the most costly to dry as fertilizer. The process involves three weeks anaerobic fermentation at 90° F, killing pathogenic bacteria and weedseeds, and producing methane gas. The giant Upper Tame Main Drainage Authority at Birmingham uses this to generate power, saving £35,000 a year in electricity to drive their machinery and sludge pumps.

The oxygen grabbing ability of effluent is known as "biological oxygen demand" or "BOD" and the maximum approved level is 20 milligrames per litre. The effluent from West Herts and Middle Lee is about 5 mg/1 BOD, which is safe for fish, swimming and even drinking. Out of 30,190,000 gallons of sewage a day entering the West Herts' works, only 144,000 gallons a day is concentrated Hydig sprayed on farms, the rest must flow into the river as clear and colourless effluent. If it did not the river would dry, and there would be nothing for the Authority downstream to pump into the Water Works, purify and share out for the 60 gallon a day personal needs of its citizens.

The pollution problem inland stems from the 60 per cent of Authorities whose effluent does not even reach the 20 mg/1 standard, and even this figure depends on dilution by river water, half of which may already consist of equally bad effluent. When the springs that feed the river dry up, there is nothing to dilute effluent, fish die and the river stinks.

Everyone who comes into this country starts putting the load on the sewage works from the day they arrive. It is easy to plan hospitals, schools, community centres and art galleries for an expanding city, but until the new sewage works is in action, or the extensions completed, the overload must go into the river, as higher BOD effluent or direct discharge.

Only the Borough Engineer knows where the load is heaviest, but if the problem is sludge disposal, or the space and cost of new drying beds or burners, there is a quick answer. There is now at least one firm of contractors who will provide a tanker fleet, sell the service to farmers and build up a liquid sludge disposal circle on a three year contract. No capital investment or loan sanction is necessary, and immediate action will cut the overload for less than the consultants fee for a new sewage works which may take years to build.

One designed with storage capacity to run tankers on a five day week (keeping them off the roads at weekends), and with sludge beds only for emergencies, would cost 20 per cent less and occupy 30 per cent less space than an orthodox plant. Before the money is spent on tankers, take on a contractor and have a look at the costs, for it may well pay to leave him to handle the local farmers.

It is essential that the sludge should be below the Ministry of Agriculture toxic metals safety standard of not more than 100 p.p.m. nickel, 750 p.p.m. copper, 1,500 p.p.m. chromium and 1,500 p.p.m. zinc. If there is more, it is a question of tracing down which local industry is releasing toxic waste and demanding that they install an extraction plant. Councils have far more power against industrial pollution than they used to, but the first act of any Government that did not merely pay lip-service to pollution control would be to make the maximum fine for discharge into rivers and sewers £100,000. It is cheaper for firms like the one guilty of releasing cyanide into the river Chelmer and killing all the fish, to pay the present £50 fine than to purify their wastes.

Seaside stench

Today seaside resorts have a choice.

They can spend £2-3 million on long outfall pipes that take their untreated sewage too far out to wash ashore. Here it will produce pollution effects that include mighty crops of seaweed, and large fish dying slowly from eating the polythene bags and other plastic and rubber refuse which the pipe disgorges. Or they can buy a heated digestion plant for half the money, and send their sludge to grow good grass and lucerne instead of seaweed.

Seaside resorts, with visitors doubling the summer population just when the land needs both water and fertility, could be the greatest gainers by tanker sludge disposal. Here a campaign by ratepayers whose livings depend on visitors, could have considerable effect. Especially since a treatment plant is half the price of a long outfall.

It is the Councils of towns along the stinking Tyne and Tees and the foul estuaries of England who will fight for their freedom from pollution.

Fertility for filth

There are about 4 million people along the estuaries and 6 million including visitors in seaside towns whose untreated sewage goes straight into rivers or the sea. However much we improve the rest of the country, we need new sewage plants for 10 million citizens. How much is that going to cost?

If they lived in communities of half a million each, that would mean only 20 heated digestion plants at $£3\frac{1}{2}$ million each, or £70 million, which is about the Government share of the development costs of a new aircraft engine for a plane that never gets built. The costs go up as the number goes down until a plant to serve 250 people would cost £45 for each of them. Average the cost at £30, and the total is £300 million, rather less than a fifth of the cost of the Concorde.

The prestige of being the first country to take serious action against pollution, and the export potential involved, would be vastly greater than the dubious kudos derived from our half of the Concorde. The lead in civil engineering and the development of short cuts and improvements in both the digested sludge and tanker systems from the experience of building a thousand sewage treatment works of all sizes, would give Britain the type of commanding position she once enjoyed as railway and bridge builder to the world.

Very few people will ever afford to

fly at twice the speed of sound, but everyone needs a share in a sewage system. If ever the underdeveloped countries develop as far as W.C.s and weekly bathnights, the world will face its mightiest pollution problem, not only in finding the water but in getting rid of it.

If we export the methods of the wasteful West and turn the Ganges, Nile and Zambesi into Tynes, Rhines or Seines, we shall exhaust the rock phospate of the other mineral fertilizer deposits of the world in a generation, by pouring out fertility to pollute faraway beaches and even the farthest seas. The challenge of the Seventies is not Space but Sewage.

Figuring the figures

The Working Party calculated that in the annual million tons of dry matter in our sludge, there is only 26,500 tons of nitrogen, 14,000 tons of phosphorus and 3,300 of potash, which is barely 4.5 per cent of our consumption of chemical fertilizers and therefore not worth considering as an alternative.

This figure is based on the average analysis of dried sludges of 2.4 per cent nitrogen, 1.3 per cent phosphorus and 0.3 per cent potash, but tanker sludge holds rather more than twice as much of the first two. It does not include the sewage from the 10 million people whose contributions go direct into the seas and estuaries, so it should be 20 per cent higher. A corrected estimate would be nearer 75,600 nitrogen and 33,600 phosphorus and 5,000 tons potash.

Still more important it ignores the 25 p.p.m. each of nitrogen and phosphorus in the 30,000 million gallons of effluent which flows down to the sea every day through our polluted rivers. This adds up to 3,348 tons a day, or over a million tons a year.

America's "Melbourne" is the Nittany Valley, where Pennsylvania State University has experimented with irrigation by sewage effluent, using farmlands as filters to raise the water table and save fertility from bleeding to waste down every river, while the wheels give out under the load of America's extravagance.

Their system does not need flat land, just effluent piped like a normal water supply and spray irrigators that jerk their tall plumes over so much of the world's croplands. The control plots, with normal chemical fertilizer and wellwater irrigation, have produced 2¹/₄ tons of lucerne hay an acre. Those with an inch a week of effluent water (44,800 gallons an acre) and no fertilizer have given double the yield. Maize has yielded 114 bushes an acre, against 63.30 with fertilizer and oats 80.10 compared with 45.20. The most striking of all was the doubled height and 83 per cent increase in girth for young oak trees in a plantation irrigated with 2-4 inches of effluent a week for five years.



750 gallon Hydig liquid sludge tanker.

What the government must do

If Britain is to face the challenge of the 1970's, we do not need satellites in orbit but experimental sewage plants along the South Coast. So little has been spent on research on the environmental aspects of sewage sludge and effluent that the £3 million our Space Research programme costs would be enough to take it right ahead.

The first step would cost little. The programme should begin with a Ministry of Housing and Local Government circular announcing: (1) A complete ban on new outfalls into sea or estuaries, and no loan sanction for replacement outlets costing more than sewage treatment plants. (2) No loan sanction for other than heated digestion sewage plants. (3) No loan sanction for sludge burning incinerators or dumping vessels. (4) Easy loan sanction for new heated digestion plants, for conversions for existing plants, and storage tanks and other equipment necessary for the tanker sludge system.

If the Ministry can encourage air pollution by granting an easy sanction for refuse incinerators, surely they can do the same to reduce pollution by sewage?

The Ministry of Agriculture and Fisheries could suggest that sludge ponds should be used by farmers to store "offpeak liquid" in winter so they can spray it in spring, and the small tankers they use, should rank for grants as farm improvements. These are given for tower silos with effluent that causes serious river pollution; why not for liquid sludge equipment to reduce it?

In the next Price Review the Ministry could abolish the Fertilizer Subsidy on nitrogen and phosphorus, while keeping it on lime, saving about £20 million a year and ending the present unfair competition between subsidized fertilizer made with imported raw materials and home produced sludge and municipal composts. An alternative would be to pay the subsidy also on the plant foods in sludges and composts, to allow competition on equal terms, with a higher rate for liquid sludges because of their greater environmental advantages.

The argument constantly used against this suggestion is that it would involve paying farmers a subsidy on selling their manure heaps to each other. The proposal has never been to subsidize organic manure only to pay the subsidy to those Councils and Drainage Authorities whose sludges reach Ministry standards of quality on plant foods and toxic metals, and whose effluent is under 20 mg/1 BOD.

The new estuary and seaside treatment plants replacing the outfalls responsible for gross pollution would need grants from the Ministry of Housing and Local Government, like the improvements grants given to householders for adding the baths and lavatories responsible for so much of the overload. The cost would be considerable, for it is only rather more than half the cost of introducing decimal currency, and though it must be met from taxation, the public would gain an obvious improvement not merely an inconvenience.

It will be said that the first step should be a campaign to educate the public to the need for increased rates and taxation to pay for measures against pollution. Those who plead for education usually plead for inaction. We need instead a militant conservation body to educate our Councils and our Government to the need for doing what can be done cheaply and easily now, before *our* money is invested in creating further waste and pollution when it could so easily buy fertility and cleaner rivers and seas.

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Grass feeds the ox: the ox nourishes man: man dies and goes to grass again; and so the tide of life, with everlasting repetition, in continuous circles, moves endlessly on and upward . . .

John James Ingalls in The Kansas Magazine (1872)

The North American prairies once sustained a vast and complex pyramid of life. The 50 million bison, 400 million prairie dogs and 30,000 Plains Indians were some of the elements in its differentiated fabric. Lorus and Margery Milne illustrate their interdependence and how the land now deprived of them is aesthetically toneless and biologically impoverished.

More people appreciate green grass than are aware of the microscopic algae in a pond. "Of all plants the grasses are the most important to man. All our breadstuffs—corn, wheat, oats, rye, barley—and rice and sugar cane are grasses." On dry land they take the place of algae and support a tremendous wealth of life.

When the Pilgrim Fathers landed in New England, a pyramid of life based on grass had long shown remarkable stability on the prairies well beyond territory seen by white men. From northern Mexico to the environs of Lake Winnipeg, from the foothills of the Rocky Mountains to the western slopes of the Appalachians stretched great grasslands: tall-grass prairies to the east, and short-grass towards the setting sun. These were home to about 30,000 Plains Indians, whose way of life depended almost completely upon the wandering herds of bison and of prong-horn antelopes.

Only on the plains of south central Africa has man found a like concentration of large herbivores—such a wealth of animal life based on grass. Fifty million head of bison in an average year seems to be a conservative estimate for the total number, the sum of all the thousands of separate herds. Pronghorns probably were as numerous.

Pyramid of Life

On the American prairies of those days, the grama grass and buffalo grass formed the green base to the terrestrial pyramid of life. On them fed bison and pronghorns, prairie dogs and mice and grasshoppers, the equivalents of the many kinds of minnows in a pond. And preying on the land herbivores, as game fish do on forage types, were smaller numbers of wolves, coyotes, foxes, badgers, grizzly bears, hawks, owls, eagles, rattlesnakes, and 30,000 Indians. These meat-eaters took their grass nourishment at second hand.

West of the Appalachians, where two centuries ago the bison and pronghorns criss-crossed the Great Plains, other grasses now grow in field after cultivated field. On straight paved highways we whisk today between expanses of Indian corn or Caucasian wheat. For hundreds of miles docile cattle are restrained by flimsy roadside fences that erstwhile herds of bison would have shouldered through and pronghorns would have leaped at a bound. Bison country of yesteryear is all modern wheatfields and ranch lands. Grasses cover it, often in dense stands. But many of them are Old World grasses. They support a far different pyramid of life, with man at the top.

With only 30,000 Indians, the Great Plains reached a reasonable state of balance. The area's capital wealth, the low vegetation, varied somewhat from year to year according to the amount of rain. Yet it sustained the herds as they grazed their way or battled with predators. Captain William Clark, exploring the West in 1804 on the famed Lewis and Clark Expedition, shrewdly recognized this competition in its true role: "I observe near all large gangues of Buffalow wolves and when the Buffalow move those animals follow, and feed on those that are killed by accident or those that are too pore or fat to keep up with the gangue."

The grass on one hand and the wolves on the other gave the wandering herds of herbivores a social organization and put a premium on proper numbers. A herd could be too big, or too small, or somewhere in between. If its membership surpassed a certain size, the combined need for food exceeded the supply. At first the pace of the grazing herd might quicken, leaving infirm individuals to trail behind—food for following packs of hungry wolves. Soon, however, an oversize herd divided. Then the grazing speed of each fragment could be more leisurely.



Stalking buffalo under wolf-skin.

Too small a herd could not defend itself from a concerted attack by predators. When the group consists of a dozen or fewer, neither bison nor pronghorns seem able to form a compact circle, facing outward. The young cannot cower at the centre, protected by their elders. Instead, the herds will panic and stampede, allowing wolves and coyotes to pick off the immature, then the slowest adults, and finally the last of the little group.

Prairie dogs

So long as bison and antelope still roamed the Great Plains, that level treeless land resembled a closely pastured meadow pocked by the almost endless "towns" of black-tailed prairie dogs. Probably more than 400 millions of these burrowing rodents foraged among the drought-resistant vegetation. Sometimes these dike-encircled doorways were spaced a mere four feet apart. Oftener, each home lay as much as 30 ft. from the nearest neighbour.

No doubt the bison and antelope were more cautious than domesticated animals when stepping through the domain of prairie dogs. Cows and sheep tend to stumble carelessly into the burrows and sprain or break a leg. Prairie dogs make no attempt to conceal these holes. Instead, the black-tails regularly cut off every plant over six inches high within as much as a hundred feet of home. They gain in this way a clear view in which to detect any approaching enemy.

A hundred feet is about as far as a black-tailed prairie dog will venture

from home. Any bush or clump of grass beyond that distance then becomes a hiding place for wolf or fox, coyote or bobcat, sometimes even for a golden eagle. From this fact comes the paradox that prairie dogs depend for success upon repeated returns of big grazers such as bison—their competitors for forage. Bison knock down the distant vegetation. Without bison, it is easier for the predators to approach unseen, and prairie-dog numbers shrink in spite of abundant food.

The grasses sustain prairie dogs without limiting their numbers. Instead, the burrowers are held in check by warmblooded enemies and by rattlesnakes, which slither into their burrows, seizing young and old alike. Badgers dig out prairie dogs. Black-footed weasels follow them into their tunnels. Burrowing owls and other birds of prey take a toll. Larger carnivorous mammals lie in wait. Directly or indirectly the grasses can feed all these forms of life.

The Plains Indians

Indirectly the grasses used to nourish and clothe and warm the Indians of the plains. These men preyed on bison for meat and hides. They built modest camp-fires of dry buffalo chips, as the great grasslands afforded little else that would burn well. Yet the Indians could not greatly damage either the range or the meat supply upon which they depended. They made no attempt to domesticate the bison, to settle in any one place as "home". Until the white man brought horses and firearms to America, the Indians followed the herds. In retrospect, it is impossible not to admire the balance of nature into which the Plains Indians fitted. They lived at peace with their environment, even if not always among themselves. Their livelihood did no significant harm to the land on which they lived. Only the great climatic changes such as brought and banished the Ice Ages, seemed likely to affect the western ranges.

To this scene came Europeans who prided themselves on their knowledge, their wisdom, their religious certainties, their tools, their weapons. They had no idea of relationships among land, plants, and animals. They could not know that, with their superior weapons, they would almost exterminate both the Plains Indians and the bison in barely a century.

The Indians had to go. They would not adopt white man's ways and respect the boundaries of property.

The bison had to go, for much the same reason. According to the proceedings and Debates of the Forty-third Congress, in the *Congressional Record*, Volume II: "They [the bison] eat the grass. They trample upon the plains upon which our settlers desire to herd their cattle and their sheep.... They destroy that pasture. They are as uncivilised as the Indians."

Particularly the bison had to go, for with bison available, the Plains Indians maintained their independence against all comers. It became a matter of starving the Indians into becoming "civilized" by destroying their food resources. The Great Plains have never recovered from the change. Without bison or antelope or Indians, the prairie dogs might have been expected to disappear. But the stockmen moved in too quickly. They shot and trapped the predatory birds and mammals that had kept the prairie dogs in check. And their livestock trimmed the vegetation more closely than ever the bison and antelope had done.

Certainly the prairie dogs thrived under the new conditions. Stockmen cursed them, particularly when domestic animals broke their legs in burrow openings and died on the open plains. Soon reliable estimates appeared: 32 prairie dogs ate as much forage as a sheep; 256 prairie dogs took the grass needed to feed a cow. With strychninepoisoned grain and later with generators of lethal gasses, the ranchers did their best to eliminate prairie dogs. Today few of their "towns" remain outside of wildlife sanctuaries and national parks.

The speed of this change can be seen in Kansas, where the burrowers occupied about two million acres in 1903. By the spring of 1957, prairie dogs could be found on only 57,045 acres. And of these, a fourth were schedeuled for elimination during 1957. The rest were expected to go by 1960 and damage by prairie dogs would be only a memory.

Too high a price

Few people have questioned whether the ideal sought by man demands too high a price. The landowner strives for something unknown in the natural world: a yield of 100 per cent. Each farmer feels justified in protecting his crops, in begrudging any measurable loss of production through animal interference. He wants to take the place of the bison, the antelope, the prairie dogs, the grasshoppers and other insects that fed on prairie plants. Man or his domestic livestock must be the only animals to harvest the Great Plains.

Towards this end, the farmers and stockmen have eliminated the bison and most antelope in the wilds. Prairie dogs have become almost as rare. The big predators—wolves, coyotes, foxes, bobcats—are practically gone from the plains. The insects remain.

Prairie dogs used to chase grasshoppers, and the larger predators also kept the edge off hunger by eating insects. Now grasshoppers and other insects thrive—unless the landowner takes the place of insect-eaters also. This is part of his cost in harvesting the total yield from plants.



Prairie dog.

Often we forget the contrast between man's one-crop fields and nature's endless variety. One crop is the ultimate in imbalance, and must be defended constantly. We overlook, too, how many animals do both good and bad to man. The prairie dog's taste for foliage conflicts with our interests, but its liking for grasshoppers is a help. Nor is it easy to realize how small an area is home to many native animals. If man removes as weeds all except his crop plants, creatures with no special liking for the economic vegetation may eat it rather than travel to remote supplies of more palatable kinds. Other animals are driven off, upsetting still more the complex balance of undisturbed prairie.

Natural allies

Perhaps we tend to overlook our natural allies through unfamiliarity with modern situations where a true balance can be found. One of these, was discovered not on a prairie but in California's avocado orchards. So perfect is biological control in this cropland that each year less than one per cent of the total avocado acreage needs pest control treatment. Yet insect enemies are present, unnoticed although ready to attack. An experiment tried near San Diego proved how quickly they can respond to opportunity.

For a period of eighty-four days, entomologists removed by hand every helpful parasitic and predatory animal they could find in one portion of a single tree. Within this trial period, caterpillars of one kind multiplied so rapidly that, to save the leaves, it was necessary to destroy the insects one by one. Two other avocado enemies thrived until it seemed that similar action might have to be taken against them. Still other mites and scale insects increased phenomenally. But all of this change occurred only in the experimental portion of the tree. Other branches of the same avocado and other trees in the same grove presented no pest problem. Man's natural allies there continued their efficient control at no cost to the growers.

On prairie ranch land, a balance can be reached if livestock are managed carefully. Prairie dogs cease to be a menace if a good cover of grass is present—neither too much nor too little. Too much grass is a sign of failure to utilize the land economically for cattle, although under-use of this kind can displace prairie dogs entirely. Too little grass leads to more prairie dogs, and often they are blamed unfairly for the barren ground produced by over-grazing by man's animals.

Fortunately, the ranchers are coming to understand the land they supervise. Some of them now recognize an obligation both to leave it in better condition than they found it, and to retain for the future the aesthetic value to be seen in native plants and animals. As this philosophy spreads, so too will a place for a few bison and prairie dogs. With the land once more in balance, man's own economy will also be in order.

Reprinted from The Balance of Nature by L. J. & M. Milnes, Macdonald, London.

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.



Most of the mice who get lung cancer do not smoke—they are smoked *at* as non-smokers are in air liners, cinemas, restaurants, and in every public room but the library on passenger ships. Perhaps the heaviest smokers of all are Councils who burn at least 50,000 tons of dead leaves from street trees every year, for the billowing white bonfire smoke, which heralds the autumn season, contains 70 parts per million of cancer-causing benzpyrenes, against 0.2 p.p.m. for tobacco. (1)

This is why the big tobacco companies do not sell herbal cigarettes. The composition of herbs is very much the same as that of dead leaves and garden rubbish, and cigarettes with 350 times the benzpyrenes, even without nicotine and associated tars, would shoot the rate up to a conclusive figure. There never has been a herbal cigarette nice enough for sufficient people to become forty-aday-men and show in the statistics.

With 28,000 deaths from lung cancer a year the odds increase that your neighbour on either side will be one of these statistics in the next five years, and the odds are even higher that you will live next door to a chronic bronchitis case or an asthma sufferer, especially a child. The files of the Henry Doubleday Research Association hold dozens of heartrending letters from retired people in the country driven indoors by bonfire smoke, and every suburban road is full of sufferers from chain bonfire smokers.

Heavy bonfires smoking is habit rather than horticulture and gardening addicts bitterly resent the protests of their neighbours, insisting that burning is the only way to get rid of their rubbish. Smokeless zones restrict coal fires which smoke above roof level, but not the Englishman's right to choke his neighbours with bonfire smoke blowing straight in their faces. Many councils even campaign for ratepayers to "Burn Your Rubbish and Save Your Rates", which produces the worst air pollution of all. The slow burning bonfire of weeds and lawnmowings is bad enough, but the metal basket type incinerator which makes it easy to burn paper, plastic and kitchen wastes including bones, is even worse.

In San Francisco, Los Angeles and many other American cities, these incinerators are prohibited because of the smog they produce when there are temperature inversions. These usually happen at dusk, bringing chimney smoke down into the streets and spreading bonfire smoke flat at lung level. A warm weekend with every gardener tidying and burning, leaving his fire to smoulder, followed by nights hot enough for open windows, but cooling later to bring the fumes down can bring misery to many people, though to the chain bonfire smoker it is the nostalgic scent of autumn.

Keen gardeners can easily spend as much on chemical fertilisers and peat to replace the plant foods and humus they have sent up in smoke as moderate smokers spend on cigarettes. For you smoke bonfires for your own pleasure, not necessity, and it saves money to give up your personal share of air pollution from the estimated 300,000 tons of garden rubbish burnt every year in Britain today.

The alternative to bonfires is making compost with your rubbish, and leafmould with dead leaves. The Henry Doubleday Research Association has worked out simple methods that do not involve the smells or fly risk that chemically minded gardeners associate with compost heaps. These are described in "Give Up Smoking Bonfires" (2) which is designed to fold into a rate demand. So far 460,000 of these have been sent out by Councils, for Medical Officers of Health are aware of the bonfire problem, and are willing to persuade the Town Hall clerks to co-operate in the only measure against air pollution that costs the ratepayers nothing. With enough donations the Association could have this leaflet sent to every household in Britain, but the scheme must stop at the half million mark when funds run out.

Councils are willing to help others persuade the public, but the ratepayers' problem is to persuade their Councils not only to abate the nuisance of their own leaf-burning bonfires in parks, open spaces and dumps, but to stop wasting their most saleable asset. Toronto is the only city in the Commonwealth that makes Municipal leafmould to sell and save the rates. Leafmould wholesales at £10 a ton, and the labour cost and capital investment in converting dead leaves that must be swept away into a saleable commodity is trifling compared with making municipal compost which is far inferior as humus.

Leafmould and peat both contain about twice as much nitrogen as farmyard manure. Their value lies in their moisture retaining and mechanical action as well as their slow release of plant foods. Once head gardeners would only buy oak or beech leafmould because this had more tannin and lasted longer in the soil, and the reason why nurserymen and gardeners now use peat only, is because good leafmould is unobtainable.

Street trees are mainly planes, chestnuts and maples. In Toronto their leaves are stacked behind chainlink fencing in odd corners, for six months decay. Then a mobile shredder, costing about £300 in Britain, is towed round by a Council lorry with two men to feed it, and the shredding speeds up even the slowest rotted leaves like plane and chestnut so the whole accumulation can be sold for lawn dressing, mulching between shrubs, potting soil and digging in to humus-hungry gardens before next autumn's harvest arrives. Land in cities is too expensive for rows of heaps maturing like wine as at Kew, where leafmould has been used in preference to peat for more than a century, but any Council with room to burn leaves has room to make leafmould.

What of the chain bonfire smoker, about to light up again though he has just put one out, arguing desperately in defence of his addiction?

He insists that raspberry and fruit tree prunings, yew, privet and holly hedge trimmings and brussels sprout stems that harbour meally cabbage aphide, *must be burnt*. Of course they can, but the total in any garden of really unconpostable waste is very small compared with the mountains of leaves, mowings and weeds that the 52 bonfires a year man gathers and smokes till his neighbours choke and his soil is starved of the humus he wastes. It is the *heavy* bonfire smoker who should give up his expensive and unhealthy habit for the benefit of himself and others.

 [&]quot;Cancer and Atmospheric Pollution" by Professor F. C. Pybus, M.S., F.R.C.S. Medical Proceedings Vol. 10 No. 12, June 13th 1964.

⁽²⁾ Free for a long, stamped addressed envelope from The Henry Doubleday Research Association, Bocking, Braintree, Essex.



Scientists are coming under increasing attack. To many they are doing more harm than good. Why is this so? Can science be reformed in such a way that it can contribute to the long-term benefit of mankind? The author argues that this could be so if the different disciplines into which it is at present divided were integrated into a single unified science, but such a task requires a new methodology and a new theory of knowledge.

Can man survive science? As it is at present organised, the answer is most certainly no. Many criticisms can be levelled at scientists but undoubtedly the most serious is that they are so specialised they do not know the effects of what they are doing on anything outside their own tiny field of study.

For instance, nuclear physicists, geared to harnessing the energy of the atom do not know the effects of the radiation emitted during this process on biological organisms. Economists geared to the task of increasing "wealth" are quite oblivious of its effects on our physical and social environment. And so it is with all of them. Their specialised knowledge of a minute aspect of our biosphere and their total ignorance of any of its myriad other aspects, condemns them to waste their talents in devising what are at best gimmicks of little long-term value and at worst Frankenstein-like monsters capable of wreaking varying degrees of havoc on our already ravaged biosphere.

It must not be forgotten that when there is a finite possibility that something will happen it is only a question of time before it does. Monsters such as hydrogen bombs, and viruses against which we have no natural controls, and that are capable of destroying most life on this planet, are already at the disposal of would-be aggressors.

In the meantime, scientists are methodically providing governments and industrialists with knowledge to permit the further short-term expansion of our species, increasing thereby the global pollution of the air, seas, rivers and soil by the countless by-products of agriculture and industry.

In this way they are rendering possible those processes that will eventually transform our biosphere into a biological desert capable of supporting only the most rudimentary forms of life.

What is science all about?

To understand why scientists are doing so much harm and to suggest how this could be remedied, we must first of all determine what science is all about.

Most people would say that science consists in building up knowledge. But what is knowledge? Philosophers consider it is their job to answer this question and an important branch of Philosophy, Epistemology or the Theory of Knowledge, is devoted to this task. Unfortunately its conclusions are far from convincing, mainly because it has such little contact with the disciplines whose generalities it seeks to establish.

Most modern epistemologists are empiricists of one sort or another—i.e. they consider that knowledge is built up by "observation" as opposed to thinking.

Professor Ayer is one of the best known empiricists, and in his latest book he defines knowledge as information that is "true", that we know to be "true" and that we have reason to know to be "true".

As I shall show during the course of this article, this corresponds to no concept that can be of any use in a scientific context, what it does correspond to however, is the way the word "knowledge" is currently used in the English language.

Oxford linguistic philosophy

This is consistent with the methods of so-called Oxford Linguistic Philosophy at present in vogue in our Universities, which naively assumes that current English usage (as opposed to Chinese or Basque) can provide information on the functioning of our biosphere instead of on the culture or "personality" of the people who devised it, as Benjamin Lee Whorf showed in the studies of the languages and cultures of the Hopi, Shawnee and Navaho Indians. A language is more than a means of communication: it embodies a complete world-view or "model" of the world peculiar to the Society that evolved it, providing an ideal medium for its formulation.

How do scientists choose their terms?

Such a model is very different from that which scientists attempt to build. For the latter's purposes, a very different language is required, one that will provide the model with appropriate functional units.

Indeed, for a scientist to build a model making use of classifications designed for totally different purposes, is very much like an engineer building a motorcar out of odd bits and pieces lying about his back-yard which were designed for a totally different machine, such as a typewriter or lawn-mower.

The linguistic units of a scientific model must be designed specifically for the function they are to fulfil within a specific model—as is the case with Physics, the most advanced scientific discipline. The atom for instance or the quantum are not terms inherited from our cultural past, nor for that matter do they correspond to observable things as they should do if physicists were to be strict empiricists. They were invented, or more correctly, postulated, to fulfil specific roles in an emergent model of "matter".

Thus there is no reason why we should use the term "knowledge" as it is used today—nor in fact why we should use it at all.

What is information?

Instead, let us regard scientists as building up information, a more general term than knowledge. We can talk of the information contained within a genepool, the nucleus of a cell, a brain or a computer.

These are not vague analogies but specialised instances of the same principle.

Mainly as a result of the work of Shannon and Weaver, communication engineers now use the term in a very precise and measurable way. The information value of a message corresponds to its improbability vis-a-vis the receiver.

We can talk of the information contained within a gene-pool, the nucleus of a cell, a brain or a computer. These are not vague analogies but specialised instances of the same principle.

If the message is limited to a certain number of words, clearly all platitudes must be eliminated, and only those things which the receiver is least likely to know, i.e. the most improbable ones, must be mentioned. This notion of information is fine for communications purposes, but it won't do for our purposes.

To explain what is wrong with it one must look more closely into the behaviour of scientists and other forms of life —in fact at behaviour in general. It is essential to understand in this respect that scientists are not unique. They are not doing anything that other people and even other forms of life are not doing. All require information. Without it they could not adapt to their respective environments.

The difference is that scientists are building up more information than they strictly require to ensure man's adaptation—information that some people think enables man to control his environment.

To understand the nature of the information that scientists are building up, one must not regard it on its own but as a specific instance of a more general principle.

Information in a behavioural context

If we do this, we find that other natural systems do not just accumulate information as empiricists assume they do, they organize it. Data must not be confounded with information. The two are very different. Data is detected. "transducted" or translated into the informational medium or language of the brain and then organized into information. This process is what we normally call "perception", though empiricists seem to ignore the last two steps and insist on regarding it as a simple mechanical process rather like taking a photograph, instead of a complicated organizational one. It is essential to realise that it is the brain, not the eye, that is transforming data into information and that the brain is really doing the perceiving. Perception is the interpretation of data, and it is for this reason that people tend to see very different things and that perception is in fact so subjective.

The measurement of information

If information is a type of organization, then it can be measured in terms of its departure from "entropy", a concept originally developed in thermodynamics, which corresponds to a state of total disorder or disorganization such as the primeval dust, where each particle is separate and disassociated. As "order" or "negative-entropy" builds up, the particles will organise themselves into ever more complex associations. Since, in accordance with the second law of thermodynamics entropy is the most probable situation, improbability must increase as we move away from it.

It is in this way that information is measured in communications theory.

Unfortunately this concept of information is not quite sufficient for our purposes. It does not take into account, among other things, the reason why particles join together or why information is built up.

Goal-directedness

The most important and least recognized feature of the behaviour of natural systems, including that of scientists, is that it is goal-directed, or "purposive". This thesis is often referred to as "teleology". It is considered heretical by modern philosophers, mainly because it appears to imply the activity of a little spirit, the so-called "ghost in the machine", and also because of its "deterministic" implications. Today these objections are simply not relevant. How a system is controlled so as to keep it moving in the right direction is explained by the fast growing discipline of Cybernetics without recourse to little spirits,

It is essential to realise that it is the brain, not the eye, that is transforming data into information.

while the fact that all scientific predictions can do no more than state probable developments on the basis of an imperfect model of the system involved, must dispel all possible notions of "determinism".

Stability

What is the goal towards which behaviour tends? The answer is "homeostasis" or stability, which is the same as saying that behaviour occurs to avoid change, or more precisely to reduce it to the minimum necessary to ensure adaptation to the environment.

This can be done in two ways; either by modifying the environment in such a way that changes are reduced to a minimum, i.e. by building a house, introducing central heating etc.; or alternatively by increasing one's capacity for dealing with change, i.e. by building up more and more information on which to base predictions that will permit ever more accurate responses.



I have done it, Smith . . . I've created a new biochemical weapon.

Prediction

Prediction must be the sole object of building up information, and the capacity of biological organisms to achieve it is quite outstanding.

Thus the development of an embryo in the womb is the result of a long series of carefully programmed moves, each one of which must take place in just the right environmental conditions. This means that the correct sequence of environmental conditions can be predicted.

If I can pick up a cup of tea, it is because at each stage in the seemingly simple, but in fact highly complex sequence of steps, I am unconsciously making predictions which are being monitored in such a way that each little error in the path my hand is taking is duly corrected.

More spectacular is the predictive ability of baobabs and certain cactuses. These possess countless little pores, which they fill with water when a drought is expected. Since the more water they store the slower is their metabolism, they must store as little as will see them through the drought, which is what they succeed in doing, so much so that it is possible to predict the duration of any drought from the amount of water in their pores.

Scientists are attempting to do just this, except that rather than achieve optimum accuracy they are after the maximum; otherwise they make their predictions by using exactly the same methods.

Behaviour based on a model

The first person to describe this method was Kenneth Clark in 1952. He suggested that organisms possessed in their brains a little model of their environment. Every action would be regarded as based on the interpretation of the situation to which a response was required in the light of their particular model. This meant that there was no such thing as trial-and-error learning. If a rat found its way through a maze, it was not as a result of a series of random moves, but of a careful succession of moves each one of which appeared at the time to be the most likely to lead to success on the basis of the rat's model, as modified by the experience of each successive move.

The scientist learns in just the same way by continually monitoring his model.

His predictions like the rat's will never be "true", in the sense of "absolutely certain" for two obvious reasons:

The number of factors influencing the ever-changing situations are infinite, while he can only take into account a finite number of them and there must be a time-lag between the detection of the relevant data and their interpretation, during which time the situation may well have changed.

Structure of the model

If a model is to represent our biosphere or any part of it, it must clearly reflect its structure.

The biosphere is in fact a single behavioural process, made up of a vast hierarchical organization of sub-processes and sub-sub-processes. All have a number of basic features in common. Thus they proceed from the general to the particular, in accordance with a series of steps that must occur in the right order, and these steps are cumulative and serve to differentiate functions previously fulfilled in a more general manner. Clearly the information organized to form a model must reflect this hierarchical structure.

The importance of generalities

In any hierarchical process, the generalities are those that apply to all of its parts. Take an army. The general issues the most general instructions which are then differentiated and further differentiated at each echelon. One cannot explain the behaviour of the whole army in terms of these instructions as at each echelon further information is added in order to adapt them to local exigencies—nevertheless they are by far the most important instructions issued, and to try and understand the behaviour of an army without reference to them would be a pretty hopeless task.

In fact one can say that the more important the instructions the more general they must be, and if one had to build a model using a limited number of variables, their degree of generality must clearly be a major consideration.

Parameters

The object of a model is not to provide a faithful reproduction of a situation, but rather the representation of it which is necessary for specific behavioural purposes, i.e. it must be more like a map than a photograph. Behaviour is required to prevent change, from which it must follow that the model must represent those aspects of the situation which are most threatened with change. If the system is adaptive (and it will not have survived if it isn't) then it will have developed the means of counteracting expected changes.

In this way the dials on the dashboard of a motor car provide a model of those basic aspects of the behaviour of a car that are likely to suffer change—change that can be counteracted by the driver with the assistance of a garage hand.

Similarly a doctor's model of the human body will use such variables as blood-pressure and body temperature, because a change in their value will affect the body as a whole, i.e. they are important, because such a change is quite likely to occur, and because the doctor knows what action to take to counteract it, at least in theory. On the other hand, a model using such variables as the size of the lobe of the ear and the length of the big-toe would clearly not be of much use to him.

The maximum values for each of these variables within which the system can function properly, can be referred to as its parameters.

It is clear that if we wish to build a finite model of a system, it must represent its most important parameters and those most likely to be affected by environmental change.

Information value of the model

The information value of a model reflects its capacity to give rise to the most accurate prediction of the most serious deviations from the systems most important parameters. In other words it must correspond to its ability to interpret messages with a high information value. Such a model must display the following qualities:

- -an optimum degree of order
- -an optimum complexity

-an optimum rate of interpretingdata Let us look at each of these in turn.

Order

"Order" is the influence of the whole over the parts for a given number of parts and a given rate. The greater the order, the greater must be the degree of differentiation and the greater must be the limitation of choice.

This means that the higher the order displayed by a model the more limited the number of ways in which a message can be interpreted. If a model displays sufficient order there is only one possible behavioural response compatible with it, and if the variables have been correctly chosen, this response will be the adaptive one, i.e. that making for maximum homeostasis.

Such is the case with the model of basic physical behaviour built by modern physics: each problem has only one possible answer (in terms of the model). Such is unfortunately not the case with sociology where different specialists consider themselves quite free to provide different solutions to the same problem, a situation which they even rationalise as being desirable in order to further the "free exchange of ideas".

Complexity

Complexity must not be confounded with size or number of parts. Information is not simply accumulated. It is organized. It is not the number of parts that is desirable but the variety. The latter term is, in fact, often used instead of complexity. It is not satisfactory, however, because it implies that *any* variety is useful and this is not so.

Whereas by increasing order one increases the precision with which one can respond to a given environmental situation, by increasing complexity one increases the number of different environmental situations to which an adaptive response is possible.

What is important is that the information permitting these responses must be graduated in accordance with the probability of its being required. A gene-pool, like a brain, does not contain superfluous information or surplus capacity as many scientists affirm. Every item is justified on the basis of the probability that it might conceivably be used, even if it turns out not to be. By reducing this information one is simplifying the informational system and thereby increasing its vulnerability to environmental changes.

Rate

By increasing the rate of interpretation, one is increasing the rate at which a system can adapt to a changing situation. For this reason, a cultural model as used by human societies and modified by the experience of each generation is more adaptive than a mainly genetically determined one, as used by ant societies for instance.

Information value of a message

The information value of a message must clearly be measured in terms of the modification of the model brought about by its interpretation.

Consciousness and alertness are clearly nothing more than physiological states favouring the detection of data with high information value.

If it brought about no such change, it would be irrelevant to the behaviour pattern of the system involved and would simply be ignored. The higher the change, on the other hand, the more relevant it would be, and the greater the effort that the system would make to detect, transduct and organize it.

Consciousness and alertness are clearly nothing more than physiological states favouring the detection of data with high information value.

Building up information

How is information built up? Empiricists maintain that information is built up by a process they call "induction", i.e. by observing more and more instances of the same thing. Thus generalities are built up from particularities, but not vice versa. If this is so, why bother to accumulate information? Indeed if one knows nothing about a subject one must proceed by observation. The more one knows about it, however, the more it is possible to predict development without having to depend on observations. Thus one can teach an earthworm to find its way through a maze, but only after a large number of experiences. A rat on the other hand, will learn more quickly, and a man quicker still, because as we ascend the "ladder of life" the nervous system becomes more centralized, and the brain grows so as to contain an even more impressive organization of information. In this way the capacity to deduct particularities from generalities is correspondingly increased.

The same is true as a science progresses. As Professor Elsasser writes:

"the ideal of classical concepts of scientific analysis is to eliminate ultimately all inductive elements and to reduce the description of predictions to pure deduction from general laws, together with the set of parameters characterizing the system in question".

The sort of deduction we are interested in, however, is not simply deduction from a single general law, but from a hierarchical organization of such laws, i.e. from the model as a whole. Indeed, we believe something to be the case, not because it can be verified empirically, as empiricists would have it, nor because it can be deducted from a general law, but because it is the conclusion that is most consistent with the model as a whole. This must be our most basic epistemological principle.

Relationships between the parts

Induction, according to the empiricists allows one to establish cause and effect relationships.

By "cause" they appear to mean the event that "triggered-off" the situation they wish to explain.

Thus if a mother-hen chases a dog away from her chicks, this action must be explained in terms of the stimulus, i.e. the sight of a dog menacing her chicks.

Unfortunately, there are a very large number of possible relationships between the different parts of a model, and a model that takes into account only a single relationship is far too simple to have any predictive value.

Thus the mother-hen chases away the dog so as to ensure the survival of her species, so as to exert a curb on dog populations by limiting their food supply, and because hens have an inborn fear of dogs. All must be regarded as "causes" if the latter term is to have any useful meaning.

To regard only one such relationship as valid, as do Empiricists, is extremely naive, yet it is consistent with the thesis that information can only be built up by induction.



Besides, to use information about the future to build up information about the present or the past—as we are doing in several of these instances—implies goaldirectedness or teleology, which, as we have seen, Empiricists regard as a major heresy.

Connections between the parts

It must be clear that if interpretations and predictions are made on the basis of all the possible relationships that can be established between the different parts of a dynamic or four-dimensional model, then these must be closely connected to each other. It is a truism of ecology that our biosphere is a single integrated system. It can only be so, since it came into being as a single behavioural process, displaying all those qualities that characterize behavioural processes in general.

From this it follows that it can only be represented by a single model, and one whose parts are closely interrelated so that all possible relationships between them can be clearly established.

The present divisions of science

At present science is divided into a host of separate disciplines each of which has developed its own terminology and its own method. There is clearly no way of establishing a connection between them, hence the miserable failure of multi-disciplinary research.

These disciplines are only capable of dealing with behavioural processes in laboratory conditions away from the influence of those countless factors that specialists are simply not trained to take into account. To compensate, the predictions they make are taken as being true "other things being equal". Yet there is no reason whatsoever for supposing that they will be equal.

We have seen that the variables left out of a model should be those that are either trivial or extremely unlikely to be affected by environmental change, i.e. that we can establish scientifically as being likely to remain equal. This is a long way from implying as scientists do today that they will remain equal simply because they lack the ability to predict the way they are likely to change, and the effect of such a change on the situation they are studying. If we adopt the former method, the most basic generalities of a process will nearly always be left out, for they are so firmly established that they would be exceedingly unlikely to change. They would, in fact, simply be taken for granted.

Thus, under ideal conditions, a sociologist would take for granted all the information that we possess on the atomic, chemical and biological structure of the societies he was studying and simply concentrate on their cultural organization.

In the same way, a sergeant in dealing with his section will not repeat the orders issued by the army commander to his divisional commanders—he will simply take them for granted.

This does not mean that his men are exempt from these general instructions any more than a society is exempt from the laws governing the behaviour of the atoms, molecules and cells that comprise it.

Unfortunately however, modern sociologists behave as if they were not subject to these laws, not because they have considered the question but simply because they have no means of examining it.

If science were unified, specialized disciplines would continue to exist but since the terminologies used by each one of them would be related to those used by all the others and to that of the unified science as a whole, it would be possible to study them in the light of such general principles, which would only be taken into account if a change in their application could be predicted.

Choice of other variables

What is true for the choice of the gen-

eralities of the model must be true for that of its other variables.

The different relationships obtaining between the parts of the biosphere that must be taken into account in our model cannot be confined to any spatial or temporal or spatio-temporal sector of it.

To establish these relationships, our model must be able to represent the biosphere as a whole.

Only in this way can the variables be chosen in accordance with their relevance, i.e. their importance and susceptibility to change, rather than arbitrarily, i.e. because they happen to form part of the subject matter of a conventional field of study.

Conclusion

It is only in terms of a unified science, capable of describing the biosphere as a whole that it is possible to understand any of its differentiated parts. Such a science would have the following qualities:

1 Its different parts would be so connected that it would display the necessary degree of order.

2 It would have the requisite complexity, i.e. would be made up of a sufficiently varied organization of information.

3 It would permit the correct choice of variables.

4 It would permit the establishment of that multitude of different "causal" relationships that are required to ensure the correct interpretation of any signal and predict the corresponding change.

The development of such a science would permit scientists to understand the full implications for the biosphere of the specialized work they may be undertaking, and prevent them, if they have any feeling of responsibility to the world they live in, from pursuing their present fatal course.

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Ecotechnics

by Arthur Puffett

Meaningful start by ALCOA

In December 1969, the Aluminium Company of America (ALCOA) formed an Environmental Controls Division. The objectives of this Division are to control sources of pollution by making available, through licencing agreements, know-how and methods for safely limiting contaminants affecting air, water and land.

The first major contribution of the Division has been in eradicating the pollution problems peculiar to the production and fabrication of primary aluminium. ALCOA mines and refines bauxite, the ore of aluminium, and then further processes the resulting aluminium oxide (alumina) into chemicals, metallic aluminium and a host of fabricated products.

Aluminium production takes place in carbon-lined electrolytic cells called "pots". Fumes from these pots contain several gases and fine particles of fluorides, which in high concentrations may damage vegetation, or animals which feed on the vegetation. The traditional method of removing effluents has been to use water scrubbers and electrostatic precipitators. Although quite efficient, this method has a decided disadvantage in that the water used for cleaning has to be treated before being discharged.

In the new system, gases from smelting pots are collected and then passed through a bed of alumina, which absorbs the gaseous flouride and other particles. Any remaining particulate matter is trapped on cloth filter bags, leaving only cleaned air to be returned to the pots. The whole system operates completely dry, leaving no liquid waste for treatment or disposal.

This method not only removes potential contaminants, but operating under a closed system it also conserves scarce fluorspar minerals which are essential to the smelting process. Already operating on a number of ALCOA's own smelters, it was recently announced that the first recycling plant had been sold to a



This bag collector at Alcoa's Badin (N.C.) smelting works acts like a giant vacuum sweeper to draw exhaust gas from smelting pots.

competitor, Anaconda, who will use it on a new smelter in Kentucky.

An interesting economic fact also emerges from ALCOA; in the two latest potrooms to have been built, some 12.5 per cent of the total capital was spent in fume control and recovery equipment.

Destroying waste efficiently

The complete destruction of waste without smoke, soot or fly-ash requires heat, time and oxygen. Designed to satisfy these criteria, portable incinerators manufactured by Brulé Waste Control Ltd., 39 Jermyn St., London, S.W.1., are in use with companies and local authorities throughout the UK.

Originally intended for supermarkets and similar companies producing large quantities of waste, the incinerators have discovered a ready market with rural councils, who are finding it increasingly difficult and costly to find adequate tipping facilities.

The Brulé range of incinerators, which are refractory-lined and fully insulated, cater for refuse capacities of between 50lb (20Kg) and one ton (1000Kg) per hour, reducing waste to 1/500 of its original volume. They are designed to incinerate all solid waste, wet or dry.

A semi-parabolic arch absorbs, retains and reflects heat back to the charge bed as a concentrated beam of high-temperature radiation. The arch turns the expanding gases in a circular clockwise motion within the burning chamber, mixing combustion air entering the chamber from beneath the grate with the hot gas released from the charge. Under typical burning conditions, the mixture will revolve three and one-half times in the first combustion chamber, before entering the second-stage chamber.

The function of the second chamber is to complete the combustion cycle. The partially burned gases are exposed to new oxygen which burns up the smoke and odour they contain. This chamber also collects incombustible particles which would otherwise pass up the chimney.

A third-stage chamber continues after-burning, eliminating fly-ash and completing the collection of incombustible particles. The resulting "clean" gases then pass up a refractory-lined stack, the only visible sign being a slight heat haze around the exit.

Part of the problem

The problem of exhaust emissions from vehicles in the USA is slowly being tackled, although new solutions often give birth to new hazards. The omission of lead from petrol reduces the octane rating, which in turn leads to less power. Larger engines are needed to compensate for the power loss, and the engines are made to run hotter to burn more gases before they are emitted. More heat results in a less efficient cooling system and so the problems multiply.

A number of interesting devices aimed at reducing pollutants are now in an advanced stage of development, and until an acceptable alternative to the internal combustion engine emerges, these will have to suffice.

Texaco Inc. has developed a filter which will remove a significant amount of lead and other solid particles from car exhaust gases. The use of lead in petrol causes other anti-pollution devices such as catalytic silencers and manifold reactors to lose effectiveness in a relatively short time. Texaco claim that their lead filter, used in a car system combined with one of the other pollution control agents, would enable the lead to be removed before reaching the other filters. This would result in a virtually clean exhaust gas.

The lead filter uses a patented method called the "Leak Alumina" process, named after its inventor, Dr. R. J. Leak. The process uses stainless steel wool coated with alumina to provide a large surface area and a very durable structure. This increases the ability of the filter to trap lead and other particles.

Designed in various shapes to replace standard silencers, the filter is being offered for licencing and for evaluation with emission control devices designed to reduce the oxides of nitrogen, unburned hydrocarbons and carbon monoxide.



by Jimoh Omo-Fadaka

"The bastion of parliamentary democracy in Africa", "Africa's showpiece", "Africa's most stable regime". These proud accolades greeted the birth of an independent Nigeria on November 1st 1960. Six years later the country fell apart. Why?

To answer this question we must first realize that Nigeria is composed of many different peoples, who, previous to British domination, were organized into separate states. Each of these has developed its own distinct cultural pattern and corresponding system of government. Each has its own history, tradition, heroes. Each observes its own religious practices, celebrates its own feasts and cherishes its own ideals. Though these different cultural patterns have been variously affected by British domination, their foundations are still intact and they remain nearly as distinct from each other as they were originally. Let us take a brief look at the main Nigerian societies.

The Yoruba

The Yorubas in the West, a closelyknit society, number about 10 million. Their traditions, still very much alive, dominate daily life and there is throughout Yoruba society the highest respect for age and experience.

The family is polygamous. This does not mean that women occupy a subsidiary position. On the contrary, they are very independent. In all African societies there is a clear division of labour between men and women and among the Yoruba the women are traders. With the increasing importance of trade they do very well indeed and some have beBiafra has vanished from the headlines and projected maps of continental Africa, yet the elementary political principle which was ignored and ultimately sparked off a bloody civil war is as true today as it ever was. Diverse cultures do not coexist happily in one state unless the union is voluntary and the will to make a success of it is strong. Stories filtering through of neglect and discrimination in Iboland make the future of Nigerian unity look even bleaker, if that were possible. Jimoh Omo-Fadaka stresses here the poor exchange many African tribes have made in permitting a centralised, corrupt and bloodless Westminster model to supplant local tribal democracy based on participation and the traditional sense of communal duty and mutual responsibility.

come exceedingly rich. The men do not take part in trade. By tradition they have always been farmers. The Yorubas are divided into tribal groups each headed by a chief. In pre-colonial days, their king or *Oba* never ruled without the advice and consent of his chiefs. As in most traditional African kingdoms, the Oba could be removed from power if he lost the confidence of his subjects. When this happened he was simply presented with a gift of parrot's eggs, signifying that he should commit suicide. And he did.

It was on this pattern of government that the British grafted their system of indirect rule. The colonial power knew nothing of Yoruba traditions. The king was regarded as an autocrat and legislation was introduced to preserve what were thought to be his perogatives. As a result, his power no longer depended on the decisions of his chiefs. Though in the short term this may have made the Yoruba people easier to control, in the long term it had precisely the opposite effect. The king was no longer part of the body politic, he was above it. But the Yorubas had no tradition of autocratic rule and opposition rapidly grew against it. At the same time, the advent of politics in the western sense led to the formation of political parties operating through local councils, and as their influence has grown, so that of the Oba has waned.

Religiously the Yorubas are "still pagan". This would lead people to suppose that they are savages living in a state of anarchy. Nothing could be further from the truth. It simply means that the Yoruba still practise their traditional tribal religion. This centres round "ancestor-worship" which Jomo Kenyatta prefers to call "communion with ancestors". Indeed, the ancestors are not Gods worshipped in a western manner, they are regarded as members of the tribe who have simply graduated to a sort of senior age-grade. It is often said that an African society is composed not only of the living, but also of the dead and the yet unborn. This confers on it a high degree of continuity and stability. Another of the essential features of such a religion is that it is indistinguishable from the rest of the society's culture. It is only in a western-type religion that a rigid distinction is made between the temporal and the religious. Among the Yorubas, as among the ancient Greeks and Romans, religion colours all behaviour, permeating and motivating every social act. It is this that confers such great authority on their customary laws and permits the high ethical standards of conduct that are so often absent in so-called advanced societies.

The Binis

In the mid-west, Benin is the dominant influence. The Binis and their neighbours, the Ishans, Afenmais, Agbors and Urhobos have much in common and speak a similar language. These groups together number about 2 million. Once a powerful empire, the kingdom of Benin was first described by the mediaeval Arab traveller Ibn Battuta. Dutch travellers in the 17th century reported an advanced civilisation and described the splendours of the royal court. But in 1897, a British ex-



Fulani horsemen.

pedition defeated the Binis and burnt their city to the ground.

Benin is best known abroad for its art. Its bronzes, the work of a special caste of smiths, are justly renowned for the extraordinary quality of their craftsmanship. They express the vigour of Benin religion and its traditions of kingship. The ruler, or Oba descends from a long line of distinguished kings. He rules through his prime minister the Iyasere who is appointed for life, and the chiefs, who can be dismissed if they no longer retain the Oba's confidence. Culturally attuned to living in a centralised society of this sort, the Binis' system works fairly well because they are naturally law-abiding. Foreigners often find them difficult to understand. They seem remote and elusive; but behind this facade they are a kind and gentle people.

The British imposed their system of indirect rule on this traditional system of government. However, neither foreign interference nor the growth of political parties has in any way affected the power and authority of the Oba. This may be due to the religious aura that surrounds him. Like the Pharoahs of ancient Egypt, the kings of the Shilluks and those of the Ashanti, the Oba of Benin is a divine king. To understand the role of a divine king it is important to understand the principle of "dynamism", which is common to many traditional religions and which involves the belief in what is called mana among the Polynesians or muntu among the Bantu people. This is an undefined force that resides in every person, family, clan and tribe. It is the goal of each man to increase his stock of this force as it will

confer on him the strength, skill and all the other qualities needed for his success. To obtain it he must obey the customary law, and partake in certain festivals. On the other hand, by breaking the law and in particular by breaking taboos his stock is correspondingly diminished.

In a centralised state such as Benin most of the society's *muntu* resides in the person of the king himself. If the

A nation cannot be created by the edict of a politician any more than by the pen of a lawyer. It can only be the product of slow and gradual evolution.

king fails to obey the law or breaks a taboo not only will his personal stock of muntu be diminished but so will that of the society as a whole. Thus the king's behaviour is the prime concern of all the people. Most of the national feasts are designed to renew the king's muntu. If this shows any sign of diminishing, he must be immediately replaced by a more vigorous successor-hence the custom of killing the king, common to many ancient civilizations which Sir James Frazer described in the Golden Bough. In such conditions, nothing save the disintegration of the society's culture can reduce the prestige and influence of the king.

Among the neighbours of the Binis are the Itsekiris. Their language is similar to that of the Yoruba while their customs are closer to those of the Binis. The western Ibos live in the Asaba and Aboh divisions as the Ijaws who have intermarried with Ibo-speaking people and adopted Bini customs. Their religion is pagan though they have been subjected to many Western influences.

The Ibos in the eastern region make up 70 per cent of its 121 million inhabitants. Unlike the Yorubas, Binis and Hausa-Fulanis, the Ibos have neither Obas nor chiefs and though they have little political unity they are linked by strong cultural and religious ties. It may be thought that this lack of political unity may be a definite disadvantage. In the west, a large unified state is considered essential to the happiness and security of its inhabitants. It is this sad illusion that is causing so much trouble in Africa as in all "developing countries" that have temporarily fallen under the spell of western views and values.

If such people were to examine the life of the Ibos they would be rapidly disillusioned. The latter have never developed any effective political unit bigger than the village because they simply do not need one. A village has the ideal population for a sound democratic society—no more people than can know each other by sight.

An Ibo village is run in a most democratic way. Practically every male villager takes part in the running of its affairs. There is a complex system of age grades—each responsible for fulfilling specific tasks within the community, and for taking corresponding decisions. The most important of these are taken by the council presided over by senior men who held office by virtue of their age, ability and prestige. It is



difficult to imagine a more democratic system of government nor one in which governmental abuses are less likely to occur.

In the west today, more and more people, especially the young, are demanding the sort of participation in government and freedom from arbitrary interference which is an Ibo's birthright.

The British found it difficult to deal with democratic societies of this sort. It was much easier to handle individuals rather than whole communities. It was for this reason that they nominated "warrant chiefs" who could be easily integrated into the system of indirect rule. Needless to say this experiment was a dismal failure. The very notion of a chief was alien to Ibo tradition. Certainly they would not accept chiefs nominated by a foreign power. Recently the Ibos have had to appoint chiefs as delegates to the House of Chiefs of the Regional Legislature. Needless to say, however, their status is more that of a delegate than of a chief.

Ibo culture is geared to a trading economy. Always an active and ambitious people, commercial success is highly regarded. This is clearly one of the reasons why they have done so well in the modern world.

The non-Ibo minorities in the region are the Ibibios, most of whom live in Calabar, the Ijaws, the Efiks, the Ogonis. They have much in common with the Ibos with whom they have intermarried a great deal.

More than half of the inhabitants of the eastern region, both Ibos and non-Ibos are Roman Catholics. This religion has taken a far stronger hold and exerts a much stronger influence on their lives than does Protestantism on the inhabitants of the west and mid-west regions.

The Moslem north

The Hausa-Fulani make up 70 per cent of the 29 million people of the northern region. Their society is feudal and authoritarian. The peasants, most of whom live in villages, are ruled by Emirs through their prime ministers, the Madakis. A great deal of importance is attached to tradition and respect for the elders and chiefs, though the latters' authority depends in the final resort on support from the Emir. The Hausa-Fulani are Moslems, and Islamic law pervades every aspect of their society, providing a powerful bond to hold together the different tribes and to differentiate them from their neighbours. The British allowed the Emirs to continue as before though subject to British control, and in return promised not to interfere with their authority nor with the Moslem religion and way of life. Islam is a very exclusive religion. Its adepts are taught to regard infidels as enemies, with whom there can only be cooperation for tactical reasons. Nationalism has always been very strong in the north and led to the creation of the Northern People's Congress.

The remaining 30 per cent of the population of the Northern Region are non-Moslems. They are the Tivs, Nupes, and Igalas, the Idomas and the Yorubaspeaking peoples of Kabba and Ilorin. Then there are the Kanuris of Bornu. Of these diverse peoples, about 5 per cent are Christians, the rest pagan. Though still organized in small tribal units, they have been more receptive to western education and way of life than the closely knit Hausa-Fulanis.

Lugard's folly

It was these divergent ethnic groups that were called upon in 1914 to share the same administrative system and merge themselves in the new, totally artificial state of Nigeria. Lord Lugard laboured under no illusions. He admitted that his task was to "unify administrations not peoples" and insisted on retaining the separate identities of the south and north. Even then, both the Northerners and the Southerners expressed their opposition to the shot-gun wedding of two so totally incompatible cultures. The British, however, succeeded in keeping antagonism within bounds.

In spite of this, the North threatened to secede in 1953 and the West in 1959, while in 1967, the East actually did so and proclaimed the Republic of Biafra. During the civil war that followed, the mid-west also seceded, calling herself the Republic of Benin. It was crushed three months later, but it took three years of bitter and cruel fighting to bring the Biafrans back into the fold.

At independence, Nigeria had not become a society or a nation, nor is it yet. It has remained an assemblage of totally distinct nations. It is noteworthy that of the few statesmen who gave Biafra recognition, two were by far the continent's most intellectually distinguished— Kaunda of Zambia and Nyerere of Tanzania. Nyerere, as a historian and political theorist, stressed that Biafra had all the qualities of nationhood which Nigeria, as a political entity, so con-



Five Benin heads in brass and bronze.

1 and 2 Heads of the late period 18th to mid-19th century.

3 Head of the middle period 17th to early 18th century.

4 Benin head of the early period about AD 1500.

5 One of the best known Ife heads 13th to 14th century.

spicuously lacked.

What lessons can we draw from the Nigerian experience?

Parliaments and peoples

Parliamentary Government is only possible among people who are ready to compromise. For this to be possible they must have many things in common. More precisely, they must agree on a number of fundamental questionsthose commonly accepted verities which they regard as so important that they are willing to fight for them. They must only differ on less important issues, those on which they are ready to compromise. In an ideal situation, political parties are nothing more than alternative governments as has often been the case in Great Britain. When a gulf divides them, as was the case between the Nazis and the Communists in the Weimar Republic, parliamentary government can only provide a stage for struggles that must eventually come out into the open and tear the structure apart.

Such is undoubtedly the case when political parties correspond to ethnic groups separated from each other by religion, language and tradition. In a word, Nigeria, except perhaps in the mid-western region. Thus the Northern People's Congress was predominantly Hausa-Fulani and was led by the feudal Moslem leader Sir Ahmadu Bello, Sardauna of Sokoto and Premier of the Northern Region. The National Council of Nigerian Citizens, the ruling party in the East, was largely Ibo. Hopes of unity hinged on the Federal elections of December 1964. It was expected that a Northern dominated coalition Government would take over. Unfortunately, the Western-dominated Action Group refused to cooperate.

When the Northerners saw that their position was threatened by the forthcoming election, they simply abandoned the facade of democratic government. Intimidation was openly resorted to. In the North, southern opponents of the Northern People's Congress were denied the right to hold meetings, resulting in arrests for unlawful assembly and sedition. As a result of such tactics, almost all the party's candidates were returned unopposed.

Even in the regional elections we find the same thing happening. In the Western Regional election, there was only the flimsiest facade of democracy. The then Premier, Chief Ladoke Akintola boasted that whether the people voted for his party or not it would still be returned to power, and indeed it was.

All this could not have occurred in a traditional African society. Tradition and public opinion are without any doubt the only really effective forces preventing corruption and other abuses of power.

But there is no tradition common to all the different ethnic groups that make up Nigeria, nor is there a single organized force of public opinion. In their absence, only the fear of legal redress (absent in this case) could enforce behaviour tending to the common good.

The military coups

It was in order to put an end to these malpractices that some young Ibo Army officers attempted to overthrow the Government in January 1966. Six months later a Northern-inspired military coup brought General Gowon into power. This led to the massacre of about 30,000 easterners in the North. Two million others fled to seek refuge in their homeland. This was the prelude to the civil war.

It is now over. The Yorubas and midwesterners are reluctant allies of the Hausas, to the extent that it is possible to be allied to a nation that is so much larger and more powerful. In fact, the question is how long they will accept Hausa domination? Meanwhile the Ibos have been subdued, but is there any reason to suppose that they are less antagonistic to the North than they were before? On the contrary. They have suffered a great deal, made tremendous sacrifices, all this cannot be forgotten overnight.

Meanwhile, how has General Gowon attempted to consolidate his domains? He has divided it into twelve artificial states that do not correspond to the natural ethnic divisions of Nigeria. For example, the people of Kabba and Ilorin in the North are Yorubas. They have been included in Kwara State. They do not want to be part of the Northern Region with whose inhabitants they have nothing in common. The Yorubas of Lagos want to be part of the Western Region and do not want to be isolated to constitute the Federal capital. Port Harcourt, which is an Ibo town, has been merged with the Rivers state in the East.

This cannot constitute a stable situation. As chief Awolowo admits: "Nearly all the states will pass through a period of internal disharmony, instability and





Nigeria's twelve key regions, Gowon's botched prescription for peace.

Ethnic overlap in Nigeria's new regions.

turmoil until they finally disintegrate."

There can be no stable society that does not take into account the fact that the loyalty of any Nigerian is first to the ethnic group, next to his region of origin and only finally to the Federation.

In this sense, Nigeria has never really existed as a nation, a fact that is recognized by many of Nigeria's leading politicians.

In 1947, Sir Abubakar Tafawa Balewa, later first Prime Minister of the Federation declared: "Since amalgamation of the north and southern provinces in 1914, Nigeria has existed as one country only on paper."

Chief Awolowo stated that Nigeria was "a mere geographical expression; at best an agglomeration of tribal nations. There is as much difference between them as there is between Germans, Russians and Turks, for instance".

Sir Ahmadu Bello told a group of southern Nigerian students in London before independence that he would rather be called the Sardauna of Sokoto than the Prime Minister of Nigeria, which is another way of saying that Nigeria did not exist. He went further to say that if Southerners wanted the cooperation of the north they should follow the teachings of the prophet Mohammed.

General Gowon himself, on assuming office, stated in his broadcast speech of August 1st, 1966, that "putting all considerations to test, political, economic as well as social, the basis of unity is not there".

In 1969, during the civil war, Chief Awolowo, who is Vice-Chairman of the Federal Executive Council under the Gowon regime wrote that "There is no such thing as a Nigerian nation anyhow" and that "The so-called common Nigerian nationality is a veneer and a facade".

In 1953, he opposed the move to separate Lagos, a Yorubaland, from the west and make it the Federal Capital. He still does. He challenged the then Colonial Secretary "to deny that the people of Western Region have the right to self-determination, and are free to decide whether or not they will remain in the proposed federation".

Separate in cooperation

Indeed no one national group cherishes the idea of being ruled by the other. What they desire most is to find a formula for living together in a polyethnic society. The only way to do this is for the different national groups to be allowed to develop separately without fear of political domination of one section by the other. There is no way of removing this fear other than by granting them complete political autonomy. Once this fear is removed, full economic, social and cultural cooperation could well lead to that unity which has eluded the country so far.

A nation cannot be created by the edict of a politician any more than by the pen of a lawyer. It can only be the product of slow and gradual evolution. Even if it could, it is plain common sense that the most lasting associations must be those freely entered into rather than those enforced from a position of strength. Not until this essential and inescapable fact is understood is peace likely to be restored to our strife-ridden continent.



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"We're all Keynesians now" an economic advisor to LBJ was once quoted as saying in *Time*. The economics of John Maynard Keynes took over long ago: now individuals, businesses, universities, city, state, and federal governments operate ever increasingly on deficit financing.

Briefly the system is this: a businessman needing to expand has two choices. He can save money until he can pay for expansion or he can borrow. In an expanding economy his business expansion itself generates enough additional income to more than pay off the loan. Thus the owner gets richer sooner by borrowing. This Keynesian system was accepted because it worked.

It cannot work for much longer. Keynes' system requires an expanding population, an ever increasing per capita income, and a Gross National Product growth of 4 to 5 per cent per year. Only if the earth and its natural resources were expanding at a rate of 4 to 5 per cent per year could this system continue unchanged. But the Kennicott Copper Corporation, for example, cannot expand at this rate any longer because copper is getting scarce. And each population increase means *your* share gets that much smaller.

We are over the top now and ready to start down the slide. Our productivity (output per man hour), which had been increasing steadily, at about 3.2 per cent per year since World War II started falling during the first half of 1969 (*Time*, October 17, p. 96). With our balance of payment problems getting more severe this means trouble. Consumer credit (personal debt, exclusive of mortgage loans), has now reached \$116 billion, twice the amount of 1962. Some economists have expressed alarm about this steep rise in consumer credit. To service such debts one's personal income must continue to rise. But real income, that is, actual purchasing power, is now falling for the first time since the last Great Depression.

Meanwhile bankruptcies have been climbing at rates that cause doubling in 10 years, e.g. 91,000 in 1958 to 197,000 in 1968. Many have expressed alarm over this trend. But if you think it's bad now, wait until they start rolling in next year. As real income declines those who are up to their ears in debt will have to file bankruptcies.

Personal bankruptcy saves the individual: it is the merchant who loses. And the merchants are in debt too. They cannot survive a flood of personal bankruptcies. They depend on your credit payments to keep them above water. Imagine, gentlemen, a row of dominos. Personal bankruptcy—merchants go under—banks fail—economy collapses.

So you think it won't happen next year? You may be right. Many things could be done to postpone it. Bringing troops home from Vietnam would help. Get troops out of Europe, too. Devalue the dollar. Cancel ABM and SST. The ultra-conservatives have been spending us to death. Liberals spend less money but for useful purposes.

A civilization is comparable to a living organism. Its longevity is a function of its metabolism. The higher the metabolism (degree of affluence), the shorter the life. Keynesian economics has allowed the US an affluent but shortened lifespan. We have now run our course.

This thesis is based upon sound principles. The laws of ecology are simply correlaries of the laws of thermodynamics, and they cannot be repealed by legislative action or manipulation of the economy. The day of reckoning can be postponed, but someday soon we must pay the piper.

To survive we must have a revision of our economic system. Neither the number of cars, the economy, the human population, nor anything else can expand at an exponential rate in a finite world indefinitely. We must face this fact now. The crisis is here. So I call upon my friends in the square building across the street to design for us a new system of economics based upon the realities of today's world. It must be a stable economy for a stable population. Economic growth is no longer progress.



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Reports

"Taken for granted"

Report of the Working Party on Sewage Disposal to the Minister of Housing and Local Government.

The working party composed of a mixture of lay and technical members and with Mrs Lena Jeger as chairman, has in a remarkably short time produced a detailed and eminently sensible report about a complex and nowadays emotive subject. It should be compulsory reading for everyone genuinely interested in the environment.

Demand for clean water and the discharge of effluent to rivers is continually growing and it would seem that the reasonable way to prevent water shortage is to re-use effluents. This means that the standards of quality for effluent must increase in the future and the only way to achieve this is to ensure that considerably more money be spent on sewage treatment, and that treatment works be built in advance of the urban development they serve, rather than vice-versa. At present the importance of water quality is almost ignored when water conservation proposals are considered. This urgently requires correction. There should be a new central body dealing in an advisory capacity with all aspects of our water resources. River authorities should be replaced by authorities responsible for a complete integration of sewerage and water functions and having in addition power to control discharges to the sea within three miles of the coast. There should be an increase in the amount of research undertaken into the subject and better training for the staffs of river authorities and sewage works. The main conclusions as to the reason for the present unsatisfactory condition of many of the rivers close to populated areas is that there are far too many small sewerage authorities of insufficient size to provide a service of the standard required and not nearly enough money.

The recommendations could with the utmost advantage be acted upon today,

but the question is when can they reasonably be expected to be adopted? Many of the legal, technical, administrative and financial aspects of this subject need vast improvements because the volumes of effluents discharged to rivers in our over-crowded isle will double in the next 30 years. Yet even if an immediate start were made on initiating the appropriate legislation, it would probably be at least four years before this would come to fruition and then a further five years before any new or extended treatment plants could be constructed. Although our methods of purifying waste and controlling water quality are already very advanced, the use and re-use of relatively small rivers by such a heavily populated island makes it essential that we keep well ahead in this field. If we don't, we shall simply not have enough water.

While the report accurately pinpoints the main sources of pollution and offers the most sensible remedies, the working party has not fully appreciated how critical and complex water quality matters could become in the future, unless scientific control occupies a more important place in water resource management. This can no longer be regarded as synonymous with the transport and storing of water-the quality of the water is now the paramount consideration. The report suggests that the national body for planning water should deal jointly with both quality and quantity but this does not go far enough because future industrial and agricultural developments are likely to result in water problems of such complexity that a separate specialized body responsible for quality control is essential. The problems caused by the biologically stable detergents a few years ago, causing rivers to foam, were a relatively harmless warning of how a synthetic chemical with far more serious consequences might find its way into our water supply.

The report emphasises how re-use of water resources will of necessity become more common in the future, but it does not stress the change in attitude of responsible authorities needed to ensure that such a delicate problem be properly controlled. At present the relatively small force of scientists employed in various aspects of water, finds it a fulltime job to keep up with today's problems and usually has insufficient opportunity for applying its knowledge to foreseeing and preparing for the problems of tomorrow.

More comment could usefully have been made in the report about industrial and residential development. Although liaison between water and planning authorities on day to day matters already takes place, there is almost no liaison between the water authorities of an area and the long-term planning bodies. As a result, when long-term plans are prepared for a particular region, little thought is given to the possible effect of doubling or even trebling the quantity of effluent discharged into its rivers. The recent Strategic Plan for the South East explicitly stated that it aimed at safeguarding natural water resources. Yet nowhere did it provide the slightest evidence that the planners had considered how they would be affected by the inevitably vast increase in the volume of effluent.

Water is now one of the most important factors to consider when development takes place. Its availability must decide whether an industry can develop in an area. Doubling the volume of sewage effluent to a river might ruin the water supply of a far larger population than that which discharged the effluent. The Jeger Committee could usefully have pressed for a much greater involvement of water interests in the long-term planning proposals for an area.

In considering pollution of the sea the Jeger working party received many reports of polluted beaches. They came down strongly in favour of the construction of long sea outfall that would discharge macerated sewage far out to sea. Why however did they not add weight to their arguments by naming the beaches which have been the subject of complaints? So long as they remain anonymous, public opinion cannot force the authorities to take the necessary action. If a seaside resort were named and required to install notice boards saying "Keep off the Beach—Polluted", the pollution would be removed very promptly.

The problem of oil pollution of beaches, however, is hardly mentioned. The working party may have considered it outside their terms of reference. Nevertheless it is so important that it deserves a fuller comment. The broader River Catchment Authorities which the Report suggests should look after all matters concerned with the rivers, estuaries and the sea, would be in a much stronger position than existing bodies, to deal with oil pollution problems. They would employ biologists who could determine what were the ecologically soundest means of fighting oil spills and technically trained personnel to supervise and to implement their decisions.

The Jeger Report, therefore, will clearly play an important role in determining the course of water-management policy and is also sufficiently controversial to lead to much useful discussion and debate.

Ronald Toms

... and not a drop to drink

Report on the Unesco World Water Balance Symposium, Reading, Berks, 1970.

The people of Chile have been critically short of water since 1968. The absence of rain in its normal measure for the past five years has left rivers dry, underground reserves uncharged, reservoirs almost empty and landscapes parched. For the population of Chile the long, seemingly endless "official drought" has served as a harsh reminder of the vital importance and fundamental nature of water to life. The nation's agricultural output, already stagnating at the start of the drought, has now slumped further, adding to the country's chronic inflation and other economic problems. Without rain from above not only do rivers and wells dry up; sources of foreign exchange also wither.

The helpless plight of his country was described out-of-session by the Chilean delegate to the UNESCO Symposium on World Water Balance held at Reading in July. In some places it was reported that the only source of water was from melting glaciers. In an effort to alleviate the hardship of certain desert communities near the foothills of the Andes, the government has undertaken a programme to accelerate the melting of glaciers by spraying them with a film of hydrocarbon. The resulting alteration in albedo meant that the ice trapped more solar energy (by reflecting less) and thus



By the way, are you aware the river is said to be thoroughly polluted?

melted more rapidly. Such glacier "mining" techniques are not peculiar to Chile (Russia is also experimenting in this area) but conditions in that country provide a superficial justification for such tests. However, there was little doubt in the opinions of the impartial, but thirst-quenched delegates, that such tests were verging on the irresponsible. One ecologically conscious speaker stated that water supplies should be trucked-in to the thirsty villages despite the cost, until the nation's petrol stock was depleted rather than tamper with nature's icy fingers.

Indeed, glaciers do melt slowly, such is the time-honoured tradition of the global water-cycle. On average, water in glaciers, which interestingly represents 78 per cent of the globe's fresh water stock, stays locked up in icy isolation for some 8,600 years. Any attempt, therefore, to increase the melt rate for a glacier is a one-way business. The destruction ('mining' is a euphemism) of glaciers in this manner interacts with the surrounding region's micro-climate and in turn affects the regeneration of the glacier up-valley. No-one knows exactly what will happen if a glacier is entirely obliterated, but hydrologists at Reading were of the opinion that, like sleeping dogs, glaciers were best left well alone, a view that the thirsty inhabitants of the Andean foothills might find hard to accept. Of course, glaciers were only one of the subjects discussed at this meeting, but the example of Chile did serve to point out the sort of delicate water problem that can arise.

On a global scale it appears that there is more than ample fresh water available for all man's requirements but unfortunately most of it is in the wrong place. Consequently regional shortages alternate with regional floods and man is constantly engaged in battle with surface water.

Some 97.5 per cent of the world's water is in the oceans and it is denied us by reason of its on average 3.5 per cent salinity. Total land waters almost make up the difference: about one thousandth of one per cent of all water in the atmosphere.

Of the amount of water on the land (as opposed to in the ocean) one per cent is in a free liquid state on the surface and 21 per cent is underground. As already mentioned, the great bulk is frozen.

Division of surface waters is on the basis of 63 per cent in lakes; 34 per cent

in the top soil and about one per cent in rivers. This is perhaps a rather surprising statistic but even more surprising is the fact that twice as much water as all the rivers is contained in the world's biomass—in the bodies of all the animals that inhabit our globe.

That mankind's unbridled proliferation on this planet is having unsavoury consequences is only too well known. But ways of predicting the consequences of any large scale interference with nature are still in their infancy. However, one speaker at the symposium did describe research work being financed by the US government to develop a computer model of the hydrosphere so that the remarkably complex movement of water in all its manifold states could be more accurately predicted. Early results of the work are promising and suggest that human modifications of the globe over the coming decades (such as the large-scale movements of water planned in Russia from the wet north to the dry south) could be simulated and then probable effects carefully examined before they were in fact undertaken.

Without doubt the most sobering paper delivered at the meeting was one entitled *The influence of Man on the Hydrological Cycle* by H. C. Pereira of the United Kingdom. Divorced from the scientific fantasy that permeates so many specialist papers, this one dwelt on an important aspect of community life on this planet.

Man's greatest influence on the hydrological cycle has been by accident rather than by design. Throughout his history he has interfered with the land on which he lives to grow crops, to build shelter or to carry on his business. With the advent of the industrial revolution the process escalated to the point that man lost sight of nature and was so taken up with his own achievements that he failed to notice his rank abuse of the planetary life cycle. Only in recent times have the warning signs of floods, pollution, salinisation and famine been seen and identified.

While the developed countries can buy time by spending the appropriate sums on pollution control and intensifying agriculture, the plight of the underdeveloped countries is a serious cause for concern.

With no progress in widescale contraception the increase in world population could be 3,000 million in the next 30 years. According to the speaker, some 80 per cent of the new mouths will be born to the poorer 'half' of the world. And that means they will have to scratch a living for themselves from an even poorer land.

To survive, they will have to cut down remaining forests, for more agricultural land. This will lead to changes in the run-off characteristics of the area. The rains will come and wash down the slopes, taking with them the fertile topsoil carefully yet ignorantly tilled by peasant farmers. In short we can foresee further watershed destruction and land erosion. And eroded land is wasted land that can only be salvaged with immense difficulty.

And the danger is not only from the pick-age farmer. The illiterate but proud owner of a foreign-aid tractor can destroy watershed at an even greater rate. A slide showed one such example where the witless farmer had ploughed his land downslope. He had simply not been instructed in contour-cultivation. Doubtless later in the year, after the rainy season, he puzzled for a few moments why his land had been shaved of so much rich topsoil. Further down the valley, unseen, the local dam would silt up far more rapidly than if the farmer were still using traditional techniques.

As Pereira said, technical aid is not enough. Political leaders in the emergent nations must be encouraged to appreciate the important issues of national development. Foreign aid should only be distributed in packages related to the long-term needs of the nation. Medicine and education, so readily acceptable, should only be provided as part of a package-deal incorporating measures to protect soil and water resources. These would in the long term be far more valuable than skyscrapers and jet aircraft; guns or sleek motor-cars.

David Howard

War in the swamps of the Nile

"As the curtain is not iron but grass, it will not withstand a concerted effort of the African people to lift it." (From the *Grass Curtain*—June 1970)

The Southern Sudan Association was formed in London in March 1970 by a group to let the world know about a forgotten war, about tribes being subjected to systematic genocide, about refugees fleeing across the borders of the Sudan into neighbouring states. It is hard to get away from propaganda, for judgement to remain impartial. The Arab block accepts the view of Khartoum, namely that in the Southern Sudan today there are merely bands of rebels who must be overcome by force lest they threaten the solidarity of the state. Nimeiry's government has proclaimed "Autonomy for the South and set up a Ministry for Southern Affairs headed by a communist Southerner. What more do the Southerners want?

Perhaps the answer can be found in *Republican Order No. 4* issued by the Khartoum Government in April 1970:

"Military Tribunals will hear the offences committed under this Order.

"1 Anyone who commits, participates, abets or encourages by any means the committing of any act which is seditious against the socialist political system of the State will be punished by death and his property confiscated.

"2 Anyone who conspires with or contacts a foreign state or who works for it to perform any hostile act against the Revolution will be punished by death and his property confiscated.

"3 Any smuggler of any major agricultural crop or animal wealth will be punished by death and the confiscation of property. Any smuggler of any Sudanese currency with the purpose of undermining confidence in it, will be punished likewise.

"4 Any public official who misappropriates any public money will be punished with death or life imprisonment. "5 Any strike or stoppage of work or collective walk-out which aims at harming the national economy, will be punished by death or life imprisonment.

"6 Anyone who carries weapons or arms will be punished by death and the confiscation of property.

"7 Rumour-mongers according to the Order will receive maximum jail sentences of 10 years and a maximum fine of £10,000, or both.

"8 The Order also declares that anyone who possesses any seditious printed, taped or written material against the Revolution will be imprisoned for a maximum term of 10 years, or fined at a maximum sum of £2,000 or be punished by both.

"9 Punishment under the Republican Order No. 4 will not be applied against anyone who reports to the authorities any intended offence stated in the order."

The Revolution referred to is the May 1969 coup d'état, when the Northern Arab army took over the government in

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Khartoum. Since then human rights have been forgotten whilst the laws quoted above speak for themselves.

What is difficult to understand is why in the first place a state of war exists in Southern Sudan today. For 14 years the negroes of the South have been fighting the Muslim Arabs of the North. Successive governments in Khartoum have promised freedom to the South. Instead, the towns have been flooded with Arab army garrisons, cattle and villages in the countryside have been bombed, and the educated Southern elite have until recently been dismissed from government posts, killed or driven into exile.

During this time 1 million may have died in the South. Certainly half that number are refugees living in temporary camps in the Congo, Central African Republic, Uganda, Kenya and Ethiopia, without proper food, medicine or education. What is worse is that all of this has happened because we, the British, abandoned the Sudan, making no provision for the protection of a large minority group.

Whilst African states stand sympathetically aside and the OAU pontificates against separatism, the Southern Sudanese leaders, despite the part that tribalism has played in their internal struggles, have formed and equipped an army, the *Anya-Nya*, and have organized administrative and judiciary systems. The bush is outside the control of the military from Khartoum. Only the few large towns in the South such as Juba, Wau, Malakal, etc., are ruled by the Arabs. Despite tribalism and the natural tendency for freedom movements to be split by dissension between their leaders, some form of concerted action against the occupying forces has been possible. The danger is that outside forces may exploit the situation in the Southern Sudan for their own interests. The United States could well wish for the establishment of a buffer state against the increasing tendency of Arab nations to employ Russian advisers. Israel might not be altogether unhappy at the opening up of a second front. France could well wish for a friendly neighbour to support the government in Chad. And so, unless we are careful, the Southern Sudan could become another Biafra embroiled in the Middle Eastern situation.

On the other hand, the dangers of action are perhaps only matched by the dangers of laissez-faire. This could lead to the abandonment of what is left of the cultural heritage of the Southern nations. Names and customs of tribes well known to anthropologists, such as the Nuer, Dinka, Anuak, Azande, etc., would be lost forever. Their languages would be replaced by Arabic, their religions by the Muslim faith. Even those recently converted to Christianity would lose the freedom of choice. Previously these peoples had come to terms with their environment. They lived in the swamps and forests, unmolested by so-



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called civilization. They even withstood their enemies with the traditional spears. Now the enemy carries machine guns, and Russian built MIG's bomb villages and cattle. Refugees flee from the invading forces with the result that the grazing for cattle is less than adequate in the restricted areas in which the tribes are driven. Suddenly the environment becomes overwhelming and lack of knowledge of an encroaching modern world, makes resistance almost (but not quite) impossible. The Nuer and the Dinka of the Upper Nile Province in Southern Sudan do not need to worry about water pollution, save for the sight of the occasional bodies of their dead comrades floating by. Nor is the air befouled by smoke, save for the burning of fires made with cow-dung to keep off the mosquitoes. Nor are the crops damaged by herbicides. Instead, once grown, they are burned by the troops. A way of life-even total existence-is threatened by this ruthless extermination of a large minority group. Can we really allow genocide to take place in the name of non-intervention and the inviolability fledgling national of unities?

B. H. MacDermot

Agriculture, forestry and land management

The report of the Advisory Committee on Agriculture, Forestry and Land Management, to be presented to the third Countryside in 1970 Conference, is a disappointing bromide. They remit: "To consider how the countryside can best be cared for, improved and utilized to the maximum extent for the benefit of all." Must the countryside be "cared for" like a poor relation, "improved" like a wayward child, "utilized to the maximum extent" which implies exploitation and "for the benefit of all", including those who have no interest in its conservation?

The patronizing terms of reference damned the report before it was written. Maybe the committee, dominated by senior and thus tired spokesmen of farming, forestry and landowing interests made the best of a bad job. Its sterility of thought could have been avoided by the inclusion of an independent mind: Nan Fairbrother New Lives, New Landscapes comes to mind, or John Weller, Modern Agriculture and Rural Planning, or Paul Cheshire, who has upset the land-owning and landusing establishment in recent BBC programmes.

"Countryside" is a new term not yet, surprisingly enough, in the dictionaries (and there is precious little about "conservation", the new catchword, either). Thus, it might not be too late to attempt a definition as "traditionally farmed land". As long as a new concept lacks an agreed definition it is free currency, for people to use as they will and to their own advantage. To the farmer countryside is land used for food production, to the townsman it is space for recreation, to the planner, traveller or developer it is a space between. The best hope for the countryside is to let it be!

The advisory committee fudges all the main issues, in its attempt at emasculated compromise. No one must be offended. Hardly a word about the main pressures: the relentless drive to increased farm income by increased farm output (the clever treadmill imposed on innocent farmers by governments and farm suppliers), the exponential increase of population, leisure and mobility, and material living-standards. Nothing about the apparent need to ease marginal land out of agriculture (implicit in our entry into Europe), or the massive (£20 million a year) social subsidies to hill farming. Very little about the deleterious effects of modern agricultural techniques on livestock, soil structure, fertility, wildlife, scenery and access. Only platitudes about the very real conflict between sheep and conifers on the hills and uplands of northern and western Britain.

However, on the credit side, there is a vague plea that rural amenities should be paid for, with no suggestions as to the mechanics of this redistribution of personal or government expenditure. Farmers are subsidized, the public gets the countryside for free; cheap food, cheap amenities. But this means we get exploited and exploiting farmers. Before we think of conservation subsidies we must consider to what extent present agricultural subsidies are anti-conservationist. Not just anti-wildlife or antiamenity, but against long-term farming interests, which must be concerned with stock, crops and soil, assuming we cannot alter the climate! But if there are acknowledged social subsidies for farming or forestry there must be public control, planning controls. There could be a sharp division between "economic" farming, which should be able to find its own market, and "amenity" farming, which has to be supported by the public through taxes or tolls. Traditional mixed farming is good for the scenery, good in the fight against pollution (spreading the muck back on the land), and probably good on production-per-acre standards. There is a strong case for subsidizing organic farming, although this should pay the farmer, and the conservationist, in the long run.

We need food and timber produced from the land: these are highly subsidized necessities. We also need space for recreation, scenery, natural history studies, solitude; free luxuries. We need services such as housing, communications, water, industry, land uses for which we pay indirectly. Land is finite, its uses infinite; our understanding of the economies of multiple use is in its infancy. A countryside balance sheet should be a high priority for the Countryside in 1970 movement.

J. H. Goodland

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peat and build your barns of brick. Well. I am ready to let you cut down wood as you need it, but why destroy the forests? The Russian forests are going down under the axe. Millions of trees are perishing, the homes of wild animals and birds are being laid waste, the rivers are dwindling and drying up, wonderful scenery is disappearing never to return: and all because lazy man has not the sense to stoop down and pick up the fuel from the ground. One must be an unreflecting savage to burn this beauty in one's stove, to destroy what we cannot create. Man is endowed with reason and creative force to increase what has been given to him : but hitherto he has not created but destroyed. There are fewer and fewer forests, the rivers are drving up, the wild creatures are becoming extinct, the climate is ruined, and every day the earth is growing poorer and more hideous-there you are looking at me with irony, and all I say seems to you not serious andperhaps I really am a crank. But when I walk by the peasants' woods which I have saved from cutting down, or when I hear the rustling of the young copse planted by my own hands, I realize that the climate is to some extent in my power, and that if in a thousand years man is to be happy I too shall have had some small hand in it. When I plant a birch tree and see it growing green and swaying in the wind my soul is filled with pride, and I... make the most extensive plans for the future; I don't think of myself as a crank at such times, but believe that I am being of immense service to humanity immense!"

from Uncle Vanya, by Anton Chekhov

Cultural adaptation in nonhuman animals

Though cultural adaptation undoubtedly plays a much smaller part in the behaviour of animals than of man, to suppose that it is a negligible factor would be quite contrary to the evidence. The fact that the young of many species are subjected to quite a long period of parental tutelage points to the fact that information is conveyed "culturally" and not just genetically from one generation to the next. The extent to which this occurs varies with each species.

Thus Haldane remarks (in Culture and the Evolution of Man, Ashley Montagu Ed.) that whereas the blackbird has no cultural tradition, since males brought up in isolation will sing a perfect song, the skylark and chaffinch on the other hand must learn theirs. Reared in isolation, the skylark's song is apparently unrecognizable, and that of the chaffinch very imperfect. Thorpe has even noted different dialects among chaffinches. He found that he could recognize five different local chaffinch dialects in Great Britain. The chaffinches of the Azores, on the other hand, "sing a dialect differing from any of the British dialects far more than they differ from one another".

If their song is learned, as it appears to be, and if different groups use different dialects, it is clear that we can talk quite legitimately of the transmission of cultural matter from one generation to the next. Haldane also points out that there are examples among animal societies of the transmission of material objects from one generation to another. A good example is that of the agricultural ant *atta* which "transmits pieces of the fungus rhozites which they cultivate. Each piece is carried in a special cavity near the mouth and deposited in the new fungus garden".

Comments

Haldane cites Kuo (1938) whose experiments showed that cats would not generally kill mice or rats unless taught to do so by their parents.

There is a growing literature on the subject of social deprivation, among the higher mammals in particular, which tends to confirm that its victims seem incapable of fulfilling many of the necessary functions that make up their behaviour pattern. Harlow (in Social Deprivation in Monkeys, Scientific American, November 1962) shows that infant monkeys, deprived of a mother, will, in later life, be incapable of a normal sex life. Mason shows that the essential features of social organization were lacking among a group of socially deprived rhesus monkeys, whereas in a control group, a hierarchy was well established, and bickering and fighting were thereby reduced to a minimum. This was not the case among the isolates, who were continually fighting, and who resented any interference with their personal sovereignty. Mason concludes his study thus: "Our results emphasize the fundamental importance of the socialization process in the life of the nonhuman primates. Some writers distinguish human development from that of the nonhuman primates by the presence in man of a social heritage which supplements and modifies that based on biology alone. Without denying the many important psychobiological differences which separate monkey and man, we see that for both, the full development of their biological potentialities requires the stimulus and direction of social forces."

Cultural innovation also appears to be a feature of nonhuman primate societies. Haskins shows (in Ants and Men) how the Argentine ant *iridiomyr*- *mex humilis* abandoned an agricultural life in fayour of one permitting him to exploit the vast food potential of human habitations.

Haldane refers to the "invention" among the great tits of opening milk bottles that are on human doorsteps, which, having become common in England, has now spread to Holland; whether, as Haldane remarks: "... by cultural diffusion or by independent invention, we know not."

Clearly to study the behaviour of nonhuman animals without reference to their culture is as vain a pursuit as to try to understand culture as a specifically human attribute.



Five days—ecofiction

For years, farmers, scientists, and estate agents had deplored the slow, but steady rise in the world's water level. By 1986, much of Holland had been flooded out, the treasures of Venice were underwater, and fish swam across the area once known as the fens.

The melting of the polar ice-caps had been brought on by a rise in global temperatures due to an elevation of the carbon dioxide content in the atmosphere. This in turn had been caused simply by the use of too much power.

But in the struggle to maintain a "civilized standard of living", as the Prime Minister put it in a TV speech from New Chequers (atop Mount Snowdon), these facts were ignored. After all, employment had to be maintained. The TUC joined a consortium of oil companies, the National Coal Board, and politicians of all kinds to place compulsory D-notices on any article critical of the government's power policy, which had not changed since the late '50s. We were still (slowly) going nuclear, and "steps" were being taken to ensure that the public was "adequately protected" from radiation hazards. After the Anglesey reactor had jammed, melted, and spewed its contents into the river Severn, armies of

civil servants were needed to obtain signatures to the Official Secrets Act from all the inhabitants of the Severn Estuary.

It was a group of students who first demonstrated the full extent of the crisis of the water levels, and by that time, it was very late indeed. Their calculations proved that Mount Everest would be submerged sometime early in the spring of 1987. The Professor of Oceanography at their university refused, at first, to believe the results, and suggested an independent enquiry. For his procrastination, he was eventually lynched by an outraged mob. (Rumours that he died muttering "bloody students, no sense of rigour" are apocryphal.)

Be that as it may, the facts had become evident to everyone by November 17 when the UN convened behind closed doors on the 85th storey of the Empire State building in New York to consider the problem. All minutes of the meetings were secret. In fact research in oceanography had been classified as the first act of the conference. (This was unnecessary, since all the competent oceanographers had long since become ardent mountaineers, and few had left forwarding addresses.)

It took the UN until December 24th to develop a programme of action. After agreeing to build an enormous tower in the Rocky Mountains, and proceeding thence to "supervise its construction", squabbling broke out among the delegates. The main point of difference seemed to lie in who was to make the announcement. When it was decided that the Pope should act as speaker, many members walked out (climbed higher) in disgust.

The Pope's Christmas blessing was watched in all areas where TV sets and power were still available. "Fellow Christians," he began, "Jews, Moslems, Buddhists, and all you atheists out there, the judgement of the Father is upon us. Go to church, pray, make your peace with God and your neighbour. Prepare to meet your maker. For in seven days, the whole world will be under water...."

The story of those final days is grim. Some people simply gave up, others tried to cram the maximum amount of pleasure into their remaining hours. More than a few took hideous revenge on the few politicians they could find.

But the vast majority remained glued to their TV sets, watching, in living colour, the drowning of their world, waiting endlessly, hopelessly for a reprieve. BBC programmers suffered nervous breakdowns under the strain at a hitherto unknown rate, as they churned out hour after hour of disaster.

Speakers were at a great premium, so much so that on December 27, someone had the idea of interviewing the Atlas IV computer recently erected on top of Ben Nevis. It introduced itself with aplomb, and gave a precise and unemotional analysis of the situation. Later, the director general of the BBC asked it, "What can we do?"

Atlas churned the remark over in its circuits for a second before replying. "You have five days to learn how to live under water."

The study of government

In the average English university, Government is studied almost exclusively in terms of the workings of political institutions. However, there are many societies that do not have any political institutions at all. It is possible, in fact, that the majority of societies ever developed by man fall into this category. As Lowie writes (in Primitive Society): "... it should be noted that the legislative function in most primitive communities seems strangely curtailed when compared with that exercised in the more complex civilizations. All the exigencies of normal social intercourse are covered by customary law, and the business of such governmental machinery as exists is rather to exact obedience to traditional usage than to create new precedents."

Indeed, in such societies, as is shown by Lucy Mair (in Primitive Government), nothing can be found to correspond to our notion of government. There are no kings, presidents, or even chiefs, no courts of law, prisons or police force. The closest approximation to a political institution is the council of elders that occasionally gathers to discuss important issues. It is for this reason that the Australian aboriginal tribe has often been referred to as a "gerontocracy", or as a government by the old men-a title that can aptly be applied to most simple, ordered societies. The only possible objection to the use of such a term is that the role of the elders is in fact simply to interpret the tribal traditions and customary laws that are handed down from generation to generation, any deviation from which is severely punished by the ancestral spirits. In a sense, therefore, such a society might easily be referred to as a

"necrocracy"—or as government by the dead.

A society of this sort usually displays a very high degree of order. The absence of formal institutions, rather than giving rise to the permissiveness that we would expect, is in fact associated with firm discipline and the strictest possible adherence to the tribal code of ethics. Behaviour which, in a disordered society, could only be exacted at the cost of brutal coercion, is with them ensured by the force of public opinion, the sanction of the elders, and the fear of the ancestral spirits.

In more advanced societies, we find the same principle obtaining in a less extreme form. Thus, in ordered societies where public opinion plays an important role, the need for strong government, and in particular, dictators, is correspondingly reduced. Conversely, in those disordered societies where public opinion plays but a small part, we find that the absence of the most authoritarian government, linked to an all-pervasive and coercive bureaucracy, inevitably leads to lawlessness and mob-rule.

A cross-cultural study of societies would undoubtedly reveal that political institutions play only a subsidiary role among the mechanisms of social control that have been developed by human societies. It would also reveal that the study of Government *in vacuo* is a vain and fruitless pursuit.



Paradise Lost

Few people in the world today have got a tougher job than Mrs Indira Ghandi. She is faced with increasingly hostile neighbours, mounting secessionist pressure in many states, ever more congested and disorderly cities, uncontrolled population growth and the growing threat of widespread famine.

Take a look at population densities: New York, with a population density of 76,176 per square mile in Manhattan in 1950 was considered by many as uninhabitable. In Delhi, in the same year,

population was twice as dense, while in one section of Bombay there were 1,873,904 people per square mile. Between 7 and 60 per cent of the population of the large Indian cities are considered to be living in slum conditions. By our standards this figure would be vastly higher. In Calcutta it is particularly bad : about 75 per cent, and according to Clinard (in Slums and Community Development) anything up to a million people have no shelter at all. They simply live on the pavements, and survive as best they can. But their lot is euphoric compared to what it will be in 30 years' time.

By then the population of Calcutta is expected to increase to between 35 and 66 million, that of Delhi to between 17.8 and 33 million, that of Bombay to between 11.9 and 22 million.

There is little hope that the economy will have developed fast enough to provide them with employment. Nor that the basic necessities of life will be provided for them. As Clinard writes, "... The problem of accommodation in Indian cities almost defies imagination." By then the total population of India will have reached something like 1 billion people. The possibility of there being enough food to go round is exceedingly slim as Michael Allaby showed in The Green Revolution-Social Boomerang (Ecologist 1970 Vol. 1, No. 3). The conclusion is inescapable: India is faced with starvation and social breakdown.

What has led to this nightmarish situation? Only population growth can be indicted. And this is mainly the result of Western interference in the form of modern medicine, urbanization, and all the other manifestations of Progress.

We like to think that before we brought Indians the benefits of Western civilisation their lives were "short, nasty and brutish", to use the consecrated phrase. Ctesias, Athenian ambassador to Persia, disillusions us on this score. He writes of India that "the pleasantness of the country excels all others, being watered in every place by many rivers so that the land yields every year a double crop; and by that means is so rich and so abounds with plenty of all things necessary for the sustenance of man's life, that it supplies the inhabitants continuously with such things as make them excessively rich, inasmuch that it was never known that there was ever any famine amongst them; the climate being so happy and favourable; and upon that account, likewise there is an incredible number of elephants which for courage and strength of body far excel those of Africa. Moreover, the country abounds in gold, silver, brass and iron, and precious stones of all sorts, both for profit and pleasure."

Another paradise lost

Before the coming of civilisation, the Indians of the North-West Coast who inhabited what is now the urban wilderness around Seattle and Portland were beset by a terrible problem: how to get rid of surplus food resources. Their relatively high level of civilisation was, in the words of William Drucker (Indians of the Northwest Coast), "due largely to the amazing wealth of the natural resources of their area. From the sea and rivers, fish-five species of Pacific salmon, halibut, cod, herring, smelt, and the famous clachen or 'candlefish' (this last so rich in oil that a dried one with a wick threaded through it burns like a candle), and other species too numerous to mention-could be taken in abundance. Some of these fish appeared only seasonally, but were easy to preserve. The sea also provided a tremendous quantity of edible mollusks; "when the tide goes out the table is set", as the saying goes. More spectacular was the marine game: hair seal, sea lion, sea otter, porpoise, and even whale. On shore, land game too abounded. Vegetable foods were less plentiful, although many species of wild berries were abundant in their season. In other words, the bounty of nature provided that which in most other parts of the world man must supply for himself through agriculture and stock raising: a surplus of foodstuffs so great that even a dense population had an abundance of leisure to devote to the improvement and elaboration of its cultural heritage."

Fortunately, they devised a means of solving their problem : an elaborate system of feasts or potlatches in which rival chiefs vied with each other in the bravado and recklessness with which they destroyed their possessions: vast quantities of blankets, canoes, and highly valued engraved copper discs called coppers. To engage in such a competition and to come out the victor became the height of a young man's ambition. In this way the society was provided with an essential goal structure, without which it would surely have disintegrated. Such are the resources of cultural adaptation. (See Ruth Benedict, Patterns of Culture.)

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Waiting for evidence

At least two-thirds of the local councils in Britain which pipe sewage into the sea do not treat it in any way. Although most of them make sure it is piped at least a mile offshore, unusual tide or wind conditions can wash it back to the beach. Dr Kit Pedlar, chief scientific adviser to the Doomwatch team reports: "Water which has been contaminated by sewage can carry many diseases-such as typhoid, polio, hepatitis and dysentery. It is time for an up-to-date examination of the dangers in the sea." But Dr Brendan Moore, chairman of the Medical Research Council committee which compiled the 11-year-old "no health risks" report still claims: "I stand by the findings. There is no evidence that points to disease being caused by sea bathing in sewage." (Our italics) Daily Mirror

Junk drunk

Dr Andrew Porteous, a lecturer at the University of Glasgow believes he has the answer to the ever-mounting garbage problem. "Turn it into alcohol", he suggests. Dr Porteous' process works by hydrolizing cellulose, a major constituent of domestic wastes which, with additional processing, will yield ethyl alcohol. How? Boiled with hydrochloric acid, cellulose is converted fairly simply into sugar. The sugar can be reprocessed by fermentation into alcohol which has a great many uses in manufacturing processes.

Environment Action Bulletin

Oil drain

Used engine oil poured down drains by do-it-yourself motorists who service their own cars, is causing a pollution problem in the Thames according to a report issued in September by the London Boroughs Association. Gullies near lock-up garages have been found full of oil which finds its way into the river. Car washing, which results in dirt, oil and detergents running into drains, is also causing a problem, but accidental over-filling of oil storage tanks is one of the worst polluters. A working party of the Association of London Borough Engineers and Surveyors has recommended that oil interceptors or filters should be fitted at all parking and garage areas where cars might be serviced. Daily Telegraph

Charles' last laugh

The sea at St Kilda, Melbourne, whose mayor described the Prince of Wales as a "crank" over pollution, is unfit for bathing, according to an independent survey. Presenting the results of the survey to the St Kilda Council, Councillor Van Trayling declared that they completely vindicated the Prince and convicted Mayor James Duggan of irresponsibility in attacking him. **Birmingham** Post

Dangerous dining New Yorkers with heart and respiratory ailments should avoid dining at sidewalk cafes where pollution is more than

double that of indoor restaurants, Deputy Air Resources Commissioner Fred C. Hart has announced. Outdoor cafes also expose customers to about 20 per cent more carbon monoxide in high traffic areas. He suggested owners voluntarily enclose their cafes to shut out particulate pollution. The city's Consumer Affairs Department has been pushing owners in the opposite direction by strictly enforcing the law requiring the cafes to be open-air during the summer months. "But let me add for perspective" Mr Hart said, "that pollution is a threat to New Yorkers wherever they are. Already this year we have had 62 days on which the pollution levels were in the unhealthy Daily News, New York range.

h Gained on the roundabout . . . The Nixon administration believes chances have improved for congressional passage of the controversial anti-pollution tax on lead in gasolines. An official said he viewed congressional chances of passage as 50-50. He based his view on questioning members of the House Ways and Means Committee who must act on the plan after hearings. UPI. Washington

... and lost on the swings A study this year by the US Bureau of Mines concludes that lead-free gasoline emissions have a higher potential to produce eye-irritating smog. This is a blow to the simplifiers who believed that removing the lead was all that was required to clean up car exhausts. In fact, some scientists studying the new fuels have discovered increased engine wear, and, apart from the smog effect, a rise in the quantity of cancer-causing agents in exhaust gases. To make up for the absence of tetraethyl lead, refineries have boosted the aromatics content. Burning these in the engine produces substances which researchers at the Sloan-Kettering Institute in New York found caused cancer to rise.

The Detroit Free Press

Н **Clean air car race**

A car powered by an engine using unleaded petrol has been declared the overall winner of the transcontinental US clean air car race. It was entered by Wayne State University, Detroit and beat 32 other low-pollution vehicles, including some powered by electric, turbine, steam or hybrid engines.

The Times

Priorities

Bedevilled by inflation, President Nixon's Administration has cut back on programmes of environmental,

scientific and social significance. \$204 million are budgeted for urban mass transportation \$106 million for air pollution control and \$85 million for consumer protection. However, a staggering \$290 million has been allocated to a single production project— America's supersonic airliner.

Sierra Club, National News Report

Scrap the superjet

Richard Garwin, a science adviser who has served three Presidents urged Congress today to write off the proposed supersonic transport plane as a flying white elephant. President Nixon has claimed that producing the fastest commercial aircraft on the market is vital to the national interest and economy of the US. However, testifying before a Senate Appropriations subcommittee, Garwin and other witnesses charged that a faster-than-sound commercial airliner would be uneconomical since the required noisesuppression equipment would make the plane too expensive to operate.

Daily News, New York

Cost of the clean-up

Despite all the alarming rhetoric voiced in the last year since ecology and the environmental crisis became household words, very few in either business or government seem willing to face up to the huge expense involved-until they have worked out how to pass it on to the consumer voter in higher prices and taxes. The \$106 million air and the \$1 billion water appropriations schedules for 1971 are a drop in the bucket. A private group study estimates it will cost over \$70 billion in 5 years to carry out an initial clean-up. A Harvard University report several years ago put the antipollution cost, by the year 2000, at \$275 trillion. Such an Utopian scope can only be compared with the figure once cited of how much it would cost to clean up our decayed cities-\$3 trillion.

Some businessmen find it hard to get the message. At a recent meeting of the Canadian-American Commission on pollution in the Great Lakes, the Canadians stuck up stoutly for fifty per cent rights equal with the Americans to pour pollution (sic) into Lakes Erie and Ontario because of major industrial expansion in southern Canada.

The Plain Dealer, Cleveland, Ohio

C Pollution bonds

"The people of Massachusetts have made it clear that they have had enough of polluted waterways", declared Governor Sargent, authorising a bond issue of \$250 million for water pollution control and sewage treatment projects. He also signed legislation authorising a \$25 million bond issue for low interest to private industry for the construction of water pollution control facilities. The Boston Globe

Meat-packers lament

American meat-packers are worried. One Los Angeles packer laments: "Meat today is not up to the texture of meat as we've known it over the years. We took it up with government inspectors and they say that soft, musty meat had no harmful effects. But you wonder. ... " The source of their discontent is DES, short for diethylstilbestrol, an artificial hormone used to fatten beef cattle. It is fed to an estimated 75 per cent of the 40 million cattle slaughtered annually in the United States. However, it is a carcinogenic compound, that is, it is capable of causing malignant growths in animals. No residues of DES are allowed in meat reaching the customer. But an official concedes: "I don't see how you can keep it all out."

Environment Action Bulletin

Fur seal protest

This year the Interior Department's building in Washington has been picketed by people demanding an end to the fur seal industry in the Pribilof Islands, Reporting this, Audubon comments that while there could be a cause for this on humanitarian grounds, there cannot possibly be one on biological or conservation grounds. Protected by a convention since 1911, the almost extinct seals now number an estimated one and a half million. Control is now considered necessary as the summer food supply is limited and overcrowded rookeries lead to disease, parasites and fatal injuries. The Pribilof fur seals are, in fact, the perfect example of what conservationists mean by harvesting a wild animal population on a sustained yield basis. This is what conservation is about. Orvx

Canada protects her coasts

The ecological implications of oil development in Alaska are occupying both the Canadian and US governments. Canada is concerned about the proposal to run a year-round service of ice-breaking supertankers to carry the oil round her dangerous north coast to the eastern American ports, and the Government proposes to create a 100mile pollution-control zone covering all northern waters. All ships operating within 100 miles of the Canadian shore would be subject to Canadian regulations to protect the environment. (The USA has protested.) The all-too-real possibility of a disaster in these dangerous ice-bound waters is described as "a nightmare thought" by Boyce Richardson, of the Montreal Star, writing in the Guardian; any wreck on the scale of operations proposed would make the Torrey Canyon disaster look puny. Accidents are anyhow more likely in such dangerous waters, and the coldness of the water would make the damage almost permanent. Oryx

The coming cold

Any repetition of last winter's troubles with Britain's giant 500 MW electrical generators will inevitably mean power cuts again. Despite a massive programme of summer repairs, the Central Electricity Generating Board will still be on a capacity knife-edge for the next seven months. In theory it will have a safety margin of 15 per cent. But this margin assumes that peak demand will be up by only 4 per cent on last year. The total demand for electricity, however, is rising by over 6 per cent a year. The Times

Blackouts

Five years after the notorious blackout of November 1965, New York and New England continue to be vulnerable to blackouts, or at least brownouts. Voltage cutbacks have already occurred this summer and electrical generating capacity is stretched dangerously thin throughout the East, as well as Chicago, Minneapolis-St Paul and St Louis. More than 24 minor blackouts occurred in the first three months of 1970 alone, normally a period of light demand. Those who require uninterrupted power-hospitals, airports, water systems, computer terminals, police and fire departments have been

installing emergency power generators at a record pace. The problem is that utilities, accustomed to satisfying power needs growing at the manageable rate of 3 per cent a year, have seen demand triple for the past two years. Industrial expansion and a proliferation of air conditioners, colour television sets, washers and drvers and a host of other gadgets promoted by the utilities themselves have placed unprecedented demands on power lines. Conservationists, clean-air advocates and the worst peacetime shortage of fuels in the nation's history hamper the utilities in their bid to increase generating capacity. Natural gas and lowsulphur coal are in short supply while nuclear reactors have failed to develop as rapidly as expected, partly because of fears of radioactive pollution of the air and thermal pollution of lakes and rivers. According to the industry, it will be 5 to 10 years before power supply and demand can be put back into balance. But Glenn Seaborg, chairman of the Atomic Energy Commission estimates the US will require six times as much generating capacity by the year 2000 as it needs today.

18

Philadelphia Daily News

Cadmium

The latest metal to come under the pollution spotlight is cadmium, which may well equal mercury in its detrimental effects on life in air, water and land environments. Dr Henry Schroeder of Dartmouth College Medical School claims that cadmium has long been suspected of being harmful to man and that scientists should also take a close look at the spread of beryllium and antimony. *Mining Journal*

Exploded dream

The American has betrayed his own dream of a new world centred on equality and progress according to Professor J. W. Watson of Edinburgh University. The country expanded so rapidly that its original base is virtually destroyed. It has killed off 85 per cent of its wild life, 80 per cent of its forests, used up 65 per cent of its lead and zinc, 60 per cent of its high-grade iron ore and ruined one acre of soil out of every 10 beyond repair.

The Times

LU Clean cars

General Motors Corporation is planning to make some cars pollution-free by 1973 and to convert all cars by 1974, it is reported from Detroit. The new anti-pollution systems might add £31 to the price of each car.

Some of the new cars will use electronic fuel injection, others will have a carburettor designed for precise control of fuel entering the engine. All cars will have converters to change exhaust gas to carbon dioxide and water vapour. Daily Telegraph

Dawning of the age of Cancer Various forms of cancer have been found in clams, oysters and scallops taken from polluted waters off Rhode Island and Massachusetts by scientists, Drs Paul Yevich and Marcia Barry of the National Marine Water Quality Laboratory in West Kingston.

"How the pollution gave these animals the diseases and what the diseases mean, we haven't the faintest idea," said Yevich. New York Post

L Venice

The Italian Government has at last announced its intention to go ahead with a comprehensive plan for saving Venice. The recent elevation in status of the city-it has become capital of the new Veneto Region-has highlighted the need to attend to the serious dangers to which the city is exposed from the waters and pollution of the atmosphere. Work by the National Council for Research is producing meteorological and oceanographic information which will enable more accurate forecasts to be made of the dangers of high waters. The Times

Anti-pollution gets teeth

Tough anti-air-pollution legislation was advanced in the autumn by a US Senate Sub-committee. Senator Muskie, subcommittee chairman, said it would establish national air quality standards and compel that they be achieved in all regions of the nation within five and a half years after enactment. States would be required to implement the national standards and ensure deadlines were kept. State plans could include traffic control, automobile bans, emission controls, land use regulations. The car industry would be compelled to expedite a "clean engine" by 1975, five years earlier than recommended by Mr Nixon's administration. The Health, Education and Welfare secretary

would be empowered to issue orders to abate pollution emissions, subpoena records, enforce entry, seek civil fines up to \$10,000 and criminal penalties up to \$50,000 or two years imprisonment for wilful second convictions. Private lawsuits to enforce standards would be permitted and the Federal government would be prohibited to contract with any firm violating the new laws. *The Boston Globe*

CH Responsibility of scientists All scientists should undertake "not to conceal from the public any information about the general nature of their research and the dangerous uses to which it might be put". This resolution, after a seven-hour impromptu teach-in

devoted to self-criticism, was carried by a ginger group of scientific rebels, members of the British Society for Social Responsibility in Science, at Durham in the course of the British Association's meetings there in September. The Association was attacked for its complacency and relations between the BSSR and the BA establishment, already considerably strained, may soon develop into a legal confrontation. The Guardian

Successful can disposal Operation in California



Kaiser Aluminum & Chemical Corporation have started a scheme in California for the recycling of aluminium cans called the Can Disposal Operation (Can D.O.). Any person can collect cans and take them to one of 11 collection centres where they will receive 10 cents per pound for them. A company spokesman pointed out some of the advantages of the scheme. "Can D.O. will assist in controlling litter; its recycling aspect can help provide an answer to solid waste disposal; it will help conserve natural resources; and it affords civic and charitable organizations an opportunity to raise funds." The Can D.O. programme has now been in operation for four months. In one month alone over 3 million cans were collected.

CD Fountain of health no longer

Madrid's ancient Fountain of Health, frequented by people with liver and digestion problems has been closed by pollution, and according to the city's authorities it may never be re-opened. It was said that the pollutants have been caused by "residual waters coming from the sewage system".

The Evening Bulletin

Fined a million

Chevron Oil company has been fined a total of 1 million dollars for massive oil pollution of the Gulf of Mexico.

On 500 separate counts Chevron was charged with failing to install and maintain storm chokes and safety shut off devices on 90 offshore oilwells in the Gulf southeast of New Orleans. Every day of violation was taken as a separate offence in the indictment.

The indictment came after a cluster of wild wells had spewed thousands of barrels of oil into the Gulf 30 miles from the shore. At one point during the spill, one of the worst of its kind on records, crude oil was pouring into the Gulf at a rate of 1,000 barrels a day, feeding a 52 square-mile slick.

After the explosion which started the wells off on their polluting spree seven weeks elapsed before they had all been capped. The flow of oil was finally halted by pumping tons of mud down into the wells and cutting off the flow at its source.

Chevron, owned by Standard Oil of California, did not contest 500 of the 900 counts in the case. The remaining 400 were dropped.

The New York Times **"Baby boom" to bring 9 m more** A "baby boom" between now and the end of the century has been predicted by the Registrar General who estimates that births in England and Wales will number over a million annually by the year 2001 against 815,000 last year.

The basic reason for the projected rise in the number of births, since

fertility is constant and family size is expected to fall slightly from 2.5 to 2.4 children, is the rising number of women of child-bearing age.

It is thought that the population of England and Wales, nearly 49 million last year, will increase by 9,700,000 by the year 2001. Daily Telegraph

Children in flats suffer

A warning that children living in highrise flats may suffer because of the way of life imposed on them was given by the National Society for the Prevention of Cruelty to Children in a recent report.

There were definite indications of an effect on the child in his early years, "and there is a strong possibility of resultant behavioural difficulty in many instances," said the NSPCC.

Over half of the parents interviewed said they were lonely and 80 per cent would have preferred to live in a house. The report concluded that housing in flats of families with young children is "restrictive, undesirable and productive of a good deal of human discomfort if not suffering".

Evening News

OK, so you've read all about pollution. Now what are you going to do about it?

For a start, you can join the Conservation Society.

Pollution is only one head of the hydra. Others are disappearance of raw materials, extinction of wildlife, ruin of our heritage and countryside, urban sprawl, overcrowding, lack of essential services, pressure on individual freedom — the list is endless.

The quality of life — indeed its very existence — is threatened.

The Conservation Society believes that the root cause is to be found in soaring world population combined with a demand by each person for more and more material goods. This is produc-

For a membership application form and more information, write, mentioning The Ecologist and enclosing a 4d. stamp to:

ing a greed for output which the earth's limited resources must be increasingly plundered to satisfy.

The Conservation Society is working through education, research, and lobbying of the government to halt the trend. We desperately need more members to help us.



S. G. Lawrence, Hon. Secretary, 21 Hanyards Lane, Cuffley, Potters Bar, Herts. Do it today: whoever you are, whatever you do, we need you. This is everybody's problem.

President: Yehudi Menuhin, Esq., Hon. KBE. Past Presidents: Dr. Edwin Brooks, MP. The Rt. Hon. the Lord Ritchie-Calder, CBE, MA.



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



Already too many

THE OPTIMUM POPULATION FOR BRITAIN: Symposium of the Institute of Biology No. 19. Edited by L. R. Taylor, Academic Press, London, 1970. 35s.

How many people can this small group of islands sustain? This is clearly a difficult question to answer, but it is essential that we do so soon.

As A. I. N. Houghton says, "Population increase in Britain is thought of as something to be provided for, not something to be stopped".

This attitude is an archaic one. If we must plan our future—which is essential if we are to survive—then we must clearly be able to plan the number of people who will share it, and to do this we must know how many these should be.

The Conference on the Optimum Population for Britain organized by the Institute of Biology attempts to do this.

The Proceedings are edited by L. R. Taylor who writes an excellent introduction. He realizes that one of the most important factors affecting the optimum population of this country is the world-food situation. Even if world agriculture "is theoretically capable of doubling its production: there seems much doubt if it will do so in time to meet demand", he writes. Symptomatic of this is India's annual imports of cereals from North America which increased from 4 to 14 million tons between 1961–6.

The Agricultural Research Council accepts that we in Britain must be able to produce at least twice as much food by the year 2000. Taylor is, I am certain, very optimistic in suggesting that this can be achieved. Like many of the participants in this conference, he displays an almost child-like confidence in science and technology.

Nevertheless he admits the difficulty in increasing our standard of living any further. He is also worried by the ethical problems involved: factory farming, the flow of food from the poorer countries to the richer ones, the ever-increasing destruction of wild-life. He asks "Is the whole country going to become a mass-production factory for human life?".

A number of interesting papers follow: G. W. Cooks of the Lawes Agricultural Trust tries to determine the "carrying capacity of the land" in the year 2000.

He seriously considers that we shall be able to feed our inflated population by further intensifying agriculture, and by introducing better strains of hybrid wheat. His optimism does not appear justified by the data that he furnishes. At Rothamsted, it has been possible to achieve wheat yields of more than 55 cwt/acre—nearly double present average yields. There is however, a big difference between what can be achieved experimentally and what can be obtained under normal conditions. After all it is chimeric to expect that human error, inefficiency and other factors limiting output, i.e. droughts, plagues etc., can be eliminated.

Yields which have increased from 20 cwt/ acre in 1948 to 33.5 cwt/acre in 1964 are now beginning to fall off. In 1968 for instance they were back to 29 cwt/acre. Also yield increases are achieved at considerable cost. Nitrogen fertilizer input has gone up for instance from 60 elements in 1939 to 748 in 1968.

Thus we are obtaining diminishing, if not negative, returns for this particular input as we might well be for others; such as machinery and pesticides.

Besides the input of land will be falling: we have already lost 400,000 acres of the best agricultural land to urbanization in the last ten years, and this process is going on unimpeded. Dr. Mellanby attempts to evaluate the costs of pollution-control. He is particularly concerned with pollution arising from modern agriculture and suggests that it would be "cheaper, in both money and amenity to continue to import much of our food, and to try to pay for this by industrial processes, the pollution from which may be easier to control".

Books

Quite apart from the ethical problem of foisting agricultural-pollution on other countries, Dr. Mellanby seems oblivious of the growing world-food shortage and of its inevitable effects on Britain's economy. His conclusion illustrates the lack of communication between specialists in different disciplines.

G. P. Hawthorn of the University of Essex states that we have neither the need nor the capacity to calculate an optimum population, and leaves one to wonder why he accepted to take part in the conference.

A. J. Boreham of the Ministry of Technology thinks that population increase is on the whole a good thing as it contributes towards achieving what he regards as the objectives of society:

- -the highest possible level of income
- -the highest possible rate of growth
- -price stability
- -a balance of payments

There are all too many specialists who are seemingly oblivious of any consideration outside those which they have been specifically trained to take into account.

Today's Japan answers almost perfectly to his description of an ideal worth striving for. It is a hell on earth; one hundred million people in a tiny island suffocating in their own waste products.

D. E. C. Eversley of the University of Sussex is another "tunnel-thinker".

He considers that the only factors relevant to determining an optimum population are: population size, availability of natural resources, the state of technology and the direction and quantity of foreign trade.

He concludes that it is by no means proved that "high population growth always prevents economic growth": thereby intimating that Britain is still underpopulated.

Up till now as Rattray-Taylor notes, everybody has avoided the "thorny problem of actually defining an optimum population for this country".

Dr. M. R. Freeman of the Memorial University of Newfoundland remedies this deficiency. He says, "The concept refers to a human group within the size range required for the suitable expression of a normative pattern of social organization and for the adequate realization of certain internalized cultural goals; such a population will normally become stabilized below the biological carrying capacity of the environment".

Professor Paul Ehrlich of Stanford University proposes a definition of overpopulation as "the situation where numbers are pressing on human values". Clearly we have reached this point. It is naive to count on technology to solve all the problems arising from overpopulation. "About the only thing that would do any good would be to repeal the laws of Thermodynamics." "Perhaps", he suggests "we should work very hard on Congress and Parliament to do that."

Ehrlich's approach is global and makes nearly everybody else appear parochial. He points to the increasing instability of the world we live in. For instance, large-scale wars are now very likely. We have increased deserts in the last sixty years from 10 to 25 per cent of the earth's land surface. There will be a growing water shortage and wars will soon be fought over water supplies.

The World's stock of minerals such as iron, chromium, copper, tin etc., is dwindling fast.

"The U.S. alone plans to use up virtually all of the non-Communist world reserves of these metals before 2000."

How can Britain maintain her economy under these conditions? The answer is that she cannot.

"If current trends continue, by the year 2000 the U.K. will simply be a group of impoverished islands inhabited by some 70 million hungry people, of little concern to the other 5 to 7 billion people of a sick world." It is difficult not to share the same conclusion.

The participants in the symposium set off from very different premises and could not really be expected to cooperate in a joint effort at working out a model of Britain permitting the calculation of its optimum population. It is not surprising that no such calculation is offered.

What the conference accomplished was to point out in Freeman's words "the divergent and irreconcilable points of view [that] typify the alarmist biologists on the one hand, and the confident laissez-faire social scientists on the other".

The latter still cherish a naive belief in man's ability to control nature and bend it with the help of "omnipotent science" to suit his requirements.

As Taylor remarks, quoting Bansden: "Science can do much, but it cannot work miracles: it cannot produce something from nothing and cannot take out of the system more than it puts into it." In other words it cannot repeal the laws of thermodynamics, and to discuss what is an optimum population for this country, or any other, with people who do not understand this basic fact can produce little of value.

Edward Goldsmith

Mugs of the world unite!

TECHNOPOLIS: SOCIAL CONTROL OF THE USES OF SCIENCE by Nigel Calder, MacGibbon & Kee. 45s. Nigel Calder warns us of the dangers inherent in a technological society. He describes development which could change radically not only our way of life, but more disturbingly, our systems of government. He quotes Bertrand Russell who said, back in 1954, "the man who wishes to preserve sanity in a dangerous world should summon in his own mind a parliament of fears, in which each in turn is voted absurd by all the others". *Technopolis* summons a formidable parliament.

The warning is timely, according to Mr. Calder. Science and technology are not concerned with moral issues, they simply explore ideas and suggest innovations. The use to which they are put is a matter for social and political decision. The American Association for the Advancement of Science produced a booklet. "The Integrity of Science", in 1964, which was devoted to this. Persistent pesticides illustrate the point. Scientists can monitor levels of residues and can estimate the amounts that would be immediately dangerous. They can tell us little about long-term effects of subacute doses, but they can point out that where harmful substances are accumulating there can be no "safe limit". Do we use them or not? The decision must depend on an evaluation of the likely benefits weighed against the likely cost. It is not a scientific decision.

Mr. Calder devotes considerable space to the implications of a national and, eventually, a world computer. This he sees as the most significant innovation which is likely in the near future. Into it would be fed data on every citizen together with such a mass of information that everyone could obtain from it anything at all. It could be used as a notebook, it could advise the housewife on prices as she planned her shopping, it could contain all the world's literature, it could provide education and entertainment. The uses to which it is put depend on people. It could fall into the hands of those who would establish a political dictatorship, or it could be of great benefit. I confess I do not find it attractive in either aspect and I would question the value of it at all. Does more necessarily mean better? Mr. Calder says, for example, "that in the well-educated, leisured world of the future the system will have to accommodate vast and possibly desirable outpourings of amateur literature and works of art". What does this mean? The mind boggles.

Is this the world of the future? Will we all live, as Mr. Calder seems to believe, in a super de-luxe, chrome-plated world, liberated from the need to earn a living, with the whole of the world's culture on tap, in our own living rooms? Will the new electronics enable us to participate in the running of our country as never before, with referenda and consultation with the people before any important decision is taken? Will every last mother's son of us have a Ph.D. and rockets strapped to our backs for personal air travel door to door?

The forecasting of the future is the latest scientific parlour game. It is a bit like astrology, though probably less accurate. You take as many factors as you can think of, relate them one to another, project forward in time and, hey presto! The Future. Mr. Calder says the difficulty is people. At every stage they will be required to choose one path to the promised land or another and they will choose irrationally and emotionally. This suggests scientists are not irrational or emotional, which seems to dehumanise them. Anyway, who decides what factors are to be considered and on what basis?

Mr. Calder has played this game himself in his The Environment Game and he quotes himself here. He sees a world in which "automation had eliminated the conventional systems of economic reward". It took account of "man's biological nature as a hunter. The result was a compound scheme, involving: 1. factory production of food and abolition of agriculture; 2. redistribution of the population evenly over the globe by land and sea, in compact towns where the most advanced technologies would be available; 3. restoration of the remainder of the environment to something like natural conditions; and 4. invention of an elaborate gamekeeping system that would provide the principal 'occupations' for humans, as scientists and hunters."

There is a trap and Mr. Calder falls into it. Indeed, I suspect he has never been out of it. He assumes that there will be more and more technology and that it will serve a permanently expanding economy, so that we will all go on getting richer and richer. The only problems are those of ensuring proper, democratic control of the system. The result is wishful thinking of the most audacious kind.

What about the factors he leaves out? What about a world population that doubles every 37 years? What about the dwindling resources on which the whole structure depends? Where is the power to come from? He mentions a Royal Dutch/Shell group forecast that by 1985 petroleum will provide 59 per cent of the world's power and that by the end of the century the world's energy consumption will have increased fourfold. He admits that supplying this demand may be difficult in the long run, but for the moment, he says, with oil shales and tar sands, there is plenty to be going on with. Estimates that I have heard give us 70 to 80 years (most optimistic) down to 30 to 50 years (most pessimistic) before the world's petroleum runs out. Already prices have risen because of the expense of finding new sources. How well will Mr. Calder's world run in the 21st century without petrol, petrochemicals or lubricants to oil the wheels?

Again, he seems to believe that synthetic and simulated foods will solve the world food problem, but this shows a lack of understanding of nutrition. It will be a long time before a complete food can be synthesized safely, because of the substances of nutritional importance that have not yet been identified. He is so confident of his factory foods that he would wind up agriculture. On economic grounds alone this would be foolish, because the cheapest way of managing the land to provide the amenity he would like is to farm it. What does he think would happen if it were simply abandoned? It would not turn into a pleasant park, but would revert to its original climax vegetation; dense impenetrable forest. The wild life we are all to hunt would not return because dense forest does not provide a good habitat, except around its edge, and anyway most of the animals are extinct already or soon will be.

We are told that there are two kinds of people. Those who are cautious and conservation-minded, and those who favour the "technological fix" in the belief that there is no problem technology can create which it cannot also cure. Little space is wasted on "the Cassandras", such as Barry Commoner, and although Mr. Calder promises to discuss both types it is only the "technological fixers" whose point of view is expounded. He advises us, very sensibly, to oppose everything, but then we learn that the aim of this opposition is only to ensure full discussion, not to stop or even to impede "progress", which must go on at all costs.

Mr. Calder's main contribution to learning may be his naming of the two psychological types as "Mugs" (short for mugwumps) and "Zealots". Mugs value scepticism, prudence, inconoclasm and non-conformity. They are liberal, idealistic democrats. Zealots are the opposite. They are strong men who value patriotism rather than internationalism, boldness rather than education. This list of comparative attitudes seemed to me to come down so heavily on the side of the Mugs that it was with great reluctance that I was forced to the view that Mr. Calder himself must be a Zealot. Therefore the mote must be in my own eye. I am obviously a Mug of somewhat extreme Muggish views. Thank you, Mr. Calder, thank you.

Let me, then, state briefly the Mug side

of the argument. Industry, which is based on the processing of non-renewable raw materials, will run out. Technology exists to exert control over the environment and over societies (hence the controversy over the good or evil applications). The more that outside control is applied to a previously stable ecosystem the more it will take over natural functions within the system and so the greater the degree of control that will become necessary. This will lead to ecological, or social, instability.

The view that technology can solve the problems it creates is naive: it will aggravate them. International control over the uses and abuses of the environment is clearly necessary, but there is grave danger in centralisation and the world computer is the last word in centralisation. Centralised states require complex communications systems which are vulnerable and government by consensus will override the wishes of minorities. Mr. Calder believes greater and better communications will enable minorities to express their views. So it may, but he offers little hope that they will be able to live as they wish. What if they want to disconnect themselves from the computer?

As a Mug I believe we should learn to be less dependent on technology, not more. Let technology produce the jam, but not the bread and butter.

Technopolis contains a great deal of information about technological development, about the history of technology, and it has

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an excellent bibliography. It may be that in the immediate short term Mr. Calder has identified the problems accurately. For this reason the book is valuable and worth reading. In the long, and even medium term, a large pinch of salt may be advisable: by then the problems are likely to be very different. *Michael Allaby*

Too much of a bad thing

NITRATE IN SOIL, PLANTS AND ANIMALS by Harry Walters. A pamphlet reprinted from the Journal of the Soil Association, Volume 16. Blackfriars Press Ltd., Leicester, 1970.

"Baby D.M. became cyanosed at the age of nine days, soon after discharge from hospital. Artificial food was being given, and the water used was from a borehole on the farm in Makapanstad...north of Pretoria.... An analysis of the borehole water showed the presence of excessive nitrates (304ppm)..."

This case quoted by Steyn ten years ago reminds us of an old, but growing, problem; too much nitrate. Today vast quantities of simple compounds of nitrogen combined with oxygen are being injected artificially into the environment. Oxides of nitrogen pollute the air and nitrates assault the soil.

In the United States, chemical fertilizer, much of which is nitrate or forms nitrate rapidly in the soil, is used at the 7 million ton/year level, and the result of a 14 fold

POLLUTIONS THE WORLD CRISIS

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The drugs Epidemic

Rt. Hon. WILLIAM DEEDES M.P.

Here is the first authoritative guide to this massive social problem. William Deedes, a former Cabinet Minister, Daily Telegraph journalist and Vice-Chairman of the Institute for the Study of Drug Dependence, sorts out fact from prejudice, explains the medical evidence and the present state of the law. Essential reading for all young people, parents and teachers who are affected by this desperately urgent problem.

35/-

increase over the past 25 years. The aim is better agriculture but the suspected consequences are rather different. They range from the deoxygenation and death of rivers and lakes, following the overgrowth and subsequent death of vast quantities of algae in waters excessively enriched with agricultural nutrients, to direct threats to human health. Further research is clearly needed to assess these and other effects fully, and it is in this context that Harry Walters' 22 page pamphlet illuminates a major area of present knowledge. Harry Walters, Consultant Associate Lecturer in the Department of Applied Biology and Food Science at Borough Polytechnic and Consultant to the Soil Association discusses the impact of nitrate on soil and the chemical's subsequent uptake by plants and eventually by animals and by man. He discusses the area he has chosen in great detail, backing his review with nearly 200 references to the literature. Of necessity this is not an overall review of nitrate pollution, but of one part of the story.

Concerning the soil itself, Walters tells us that the efficiency of uptake of nitrate by the plant depends on soil structure—"essentially, the more aerated and resilient they (soil structure) are, the more favourable the conditions for nutrient transport from soil to roots physically, chemically and microbiologically".

Such conditions are undermined by the blind use of nitrate fertilizer, for this while sustaining crop growth, fails to rebuild humus and so soil structure deteriorates.

It is generally agreed, Walters states, that when the nitrate composition of soil is not excessive and when soil structure is well supplied with humus and organic matter, growing plants take up nitrogen steadily and progressively and the nitrate content of the plant remains quite low (0.005–0.05 per cent nitrate-nitrogen), although exceptional circumstances may boost this to toxic levels. Such circumstances include drought, the absence of sunlight or of certain trace elements such as moybdenum, or following the sublethal use of such herbicides as 2, 4–D.

But a far commoner cause of high plant nitrate levels (0.1–1 per cent nitrate-nitrogen) is the intensive use of synthetic nitrogen fertilizers, and Walters is able to quote a number of examples of livestock poisoning associated with nitrate in plants. He tells us that the significance of plant nitrate is not new. It has been known since the 1930's.

Nitrates are dangerous because they are easily transformed into toxic nitrite. This has been observed to take place rapidly when pig-feed is mixed with high nitrate water and Phillips has reported that fresh spinach with an initial nitrate content of 2314ppm showed complete conversion to nitrite after 21 days refrigerator storage. The conversion of nitrate to nitrite and also to toxic hydroxylamine occurs by microbial action in the rumen of the cow.

Human babies in the first weeks of life are especially susceptible to nitrate poisoning. One reason is that the upper gastrointestinal tract of infants normally supports bacteria which rapidly reduce nitrate to nitrite. Walters gives much information concerning the effect of nitrate on farm animals. The presence of readily oxidisable substances such as sugars, in animal feedstuffs tends to offset

the effect of nitrate. Thus beet crops, and especially their leaves tend to accumulate nitrate but, this constitutes little danger to livestock. Some nitrate is normally taken in by the animal in fodder and this is rapidly and harmlessly reduced to ammonia but where excess nitrate is taken there is the danger that nitrite will also be formed in substantial quantity. In animals, nitratenitrite poisoning has been found to diminish thyroid and adrenal gland function and to lower Vitamin A and E levels. High nitrate levels in water for livestock may result in loss of milk production, vitamin A deficiency thyroid disturbances, reproductive difficulties and abortions.

But what of man? Walter cites an instance of the poisoning of children in Germany due to the consumption of high nitrate spinach and then goes on to say, "A number of other such special cases have been reported. No other published work in this field was located by the author.... concerning the effect of intake (of nitrate) at levels which do not cause clearly discernable food nitrate-derived poisoning. This is only to be expected since... only now are workers becoming more fully aware of this potential problem and its possible concomitant effects in relation to haematological, endocrine and nutritional imbalances..."

Here and elsewhere much research is needed. For example there is the suggestion this year by Lijinsky and Epstein that cancer may be caused by the chemical formation in the gut of carcinogenic nitrosamines derived from nitrites and certain secondary amines which are present in the diet. Nitrites and nitrates are used as preservatives for meat and fish and concentrations of nitrosamines have been observed in nitrite preserved fishmeal, Walters reports.

But nitrate's saddest effect is on young babies, in whose bodies it so readily forms nitrite. Nitrite reacts with the haemoglobin of blood, cutting down its oxygen carrying potential. The condition called methaemoglobinaemia may lead to cyanosis (when 20-25 per cent of the haemoglobin is so changed) and death (at the 70 per cent level). WHO has warned that water containing more than 10ppm nitrate-nitrogen should not be used in the preparation of baby food. The U.S. public health authorities place the same nitrate concentration limit on potable water. At least one Minnesota town's water supply has exceeded this limit and has had to be replaced. From 1947 to 1950, Minnesota reported 139 cases of methaemoglobinaemia including 14 deaths caused by nitrate in farm well water.

Turning to foodstuffs, nitrate rich vegetables constitute a risk for infants. Spinach is particularly to blame here. A number of cases of methaemoglobinaemia have occurred in Europe. One report on a number of commercial baby-foods shows that, of the samples examined, spinach contained an average of 1373ppm nitrate. In 1966, Simon recommended that spinach should not be given to infants in the first three months of life. This all underlines one point. It is that nitrate, if it is used at all, must be used with considerable care and foresight. In this context, Harry Walters' review is a much needed source of information. Eric S. Albone

Ecologue

Creeping on us

The snore of a tanker filters through grey smog oil settles on sullen seas blackness under darkness.

A cold morning mist clears on a white form wings flapping thrashing in everslowing panic.

An icy sea fondles tirelessly its warm-blooded treasure sucking a bedraggled head drooping wearily into its watered grave. A streaked black object washes ashore on a black surf chuckling as it trickles back leaving a form decaying.

Oil settles on sleeping sands clinging to a golden skin softly raping.

Karl Mackie





Ecology action

Sir,

"'The Army of Misfortune'. Why should we always think of this as meaning 'The Others'?" (Dag Hammarskjöld in Markings.)

It is everywhere apparent that the difficulty with many conservation projects is to convince the majority that they are necessary and involve everyone if they are to succeed. For too long there has been an isolation of the conservationist. This summer in Swansea a breakthrough was made.

Sixteen young men and women from seven countries joined the local people in a common goal—the success of European Conservation Year. They were members of an international Quaker work camp and worked a 40 hour week. Their task was to continue forestry and conservation projects for the Lower Swansea Valley Project. Within three weeks they not only completed the work asked of them but also created a revolution in thinking about conservation in the local area.

Why is more not done on these lines? The young are willing to help. All that is required now is projects and practical help for the work camps organisations. This is a unique method both of promoting international cooperation and to further a public respect for conservation.

Yours sincerely,

James G. Strachan. 44 Gerard Road, Barnes, London SW13.

On the level

Sir,

In the second issue of your excellent and long-needed journal, you cite the frequently quoted possibility that increased burning of fossil fuels may create conditions which could lead to partial melting of the Polar Ice Caps with a consequent rise in sea level, disastrous for many "low-level" cities.

It is not so frequently quoted, but equally likely, that any increase in sea levels must lead to a redistribution of Earth's crustal stresses, leading to earthquakes of an order of magnitude greater than any previously recorded. In support of this, it is known that some newly created dams have become epicentres for earth tremors where such activity was previously unknown. Furthermore, the very recent earthquake in the Khorassan province of Persia, following on from another a few years ago, seems to point to unlooked-for effects from the raising of the level of the Caspian Sea for hydro-electric schemes.

Yours sincerely,

R. J. Hartless. 5 High View, Hitchin, Herts.

Divide and conquer

Sir,

Mr G. F. Roochley of Herts suggested in his letter the idea that one should recover waste oil from do-it-yourself mechanics for reprocessing because "oil does not deteriorate". This is untrue, for the molecular structure of the lubricating oil is broken down by the heat and friction found in the internal combustion engine. The waste oils from garages are usually burnt. Although it might be an idea to use it as heating fuel, I am not sure whether this would be an economical proposition, or even whether the composition of waste lubricating oils might give off more fumes when burnt than the proper stuff.

Another comment that struck me from amid the welter of information in your magazine, was that although many, if not all your subscribers, tell of the awful pollution we daily are subjected to, none really have an alternative solution. If we cleanse our effluent to a greater degree, what shall we do with the waste we have extracted from the effluent?* If we put it in the ground, it will still find its way to our rivers, and we are back where we started from. If we burn it, it goes into the atmosphere etc. If we sink it in the sea, the plankton etc., will be adversely affected.

After reading your magazine from end to end, I had the distinct impression that the problem of man living in his environment was insurmountable. There are so many different problems to solve that one doesn't know where to start. Everyone has his own "hangup". This might encourage the bureaucrats and uninformed laity to follow the doctrine of "Divide and Conquer". As long as there are so many arguing about so much there is no concerted effort over just one item. Let us organize ourselves into one group to attack one problem at a time, remembering always that no problem stands alone and that it will take many years before the efforts directed towards one problem bear fruit.

Letters

Yours sincerely,

R. M. G. McNaught. East Neuk, Parsonage Road, Galashiels.

Fuel and conservation

Sir,

I hope that Preston Cloud's factual article on the world's finite mineral resources will be followed by an equally authoritative article on the politics and economics of the problem, and the world statesmanship that is needed.

Coal's leading place in the League Table (*The Ecologist*, Vol. 1, No. 2, p. 27) surely merits a special mention. Here is an industry that has been in sad decline, is now recovering, and is faced with enormous responsibilities both for the supply of energy and the provision of feedstock for the chemical industry (especially oils and plastics). The steel industries of the world still depend on coking coal, for which there is no substitute.

Yet the oil and natural gas industries seem hell-bent on exploiting their meagre reserves in as short a time as possible. The nuclear generation of electricity also presents some awkward conservation problems.

It is prime cheek of the Gas Council to advertise in your journal, cashing in on the anti-pollution bandwagon. They're the most obvious anti-conservationists of the lot! Someone should take the steam out of their advertising, which has been condemned by the profession. Natural gas is killing gas coke: hence the rescinding of smokeless zones, a major setback to European Conservation Year in Britain. Big Business is fighting back. Only this morning, with an ECY circular, I had apologies from the Central Electricity Generating Board and Shell. In the next few days I am bound to receive similar excuses from the Concorde people, Tio Tinto or British Leyland.

At the same time, we must all have sympathy with your correspondent from Mountain Ash, one of Britain's most devastated areas, suffering from fumes from the Phurnacite plant. There, virtually smokeless dry steam coal is bonded with pitch, baked with fumes given off, and concerted into a most popular clean fuel. A similar problem exists in the Midlands, where bituminous fuel is rendered smokeless (to the detriment of residents and the advantage of the rest of the country). Similar problems are faced by residents near motorways, airports, or industry.

^{*}See Fertility or Pollution in this issue. As you point out, all our problems are interrelated. We feel that what is required is a new philosophy that will colour all our relationships with our social and physical environment. Ed.

I suggest a fuel conservation tax, which would be levied on the fuel and power industries in relation to the rate of exploitation of known non-renewable reserves.

Yours sincerely,

J. H. Goodland.

Down House, Pyleigh, Taunton, Somerset.

I agree that in any overall plan to solve our problems, an energy tax should play a preponderant role. Ed.

In defence of the short term

Sir,

I have read with interest and enjoyment the first issue of *The Ecologist* and as both a farmer and student of economics would like to comment on some of the implications in your leading article, and certain other articles.

The general message in the first issue appears to be that man must concentrate much more on the longer term than the shorter term aspects of life. While obviously agreeing with this sentiment, I find myself critical of the apparent surprise shown in your magazine that man should be so preoccupied with the short term. Surely by the nature of democratic society and the short term accountability of government to electorate, the emphasis must of necessity be on short term planning, with only lip service paid to longer term problems.

In effect, the essence of your comments is that this process should be altered so that the views of an educated elite, i.e. ecologists, scientists, agriculturalists and the medical profession, should be more forcefully applied, either through the electorate via education or through the government by means presumably of statutory bodies: that this might be more successful in achieving a change of emphasis towards longer term planning with respect to man and his environment is debatable. What, however, is less contentious is the fact that further controls will obviously impose greater constraint upon the individual members of society, and owing to the longer term nature of the plans there is bound to be considerable loss of personal liberty.

While personally of the opinion that the larger and more complex the society the more inevitable it is that greater overall planning and control is necessary, I do not find it at all surprising that man should individually and collectively shy away from control and discipline of the long term approach and concentrate on the short term.

It would indeed be an interesting debate to develop as to what long term gains would be bought at the price of the short term loss of freedom. It seems likely, however, that such an argument should be couched in the terms of possible gains rather than the negative approach that if controls are not exercised then disaster will occur. Despite the obvious difficulties ahead in terms of population increase, poor nutrition and pollution problems of all kinds, it is well to remember that these problems can only be tackled from a position of economic strength, which itself is likely to have been built with rather less emphasis on the longer term approach.

In short, collective man appears in the

past to have acted in the main with scant regard for the long term, only reacting to the problems created when the stimuli were overwhelmingly strong. For many reasons I find this a thoroughly understandable performance, and while endorsing the need for better education with respect to man and his environment, feel that man is right in treating with apprehension any form of long term planning and control, despite any personal opinions to the contrary.

Yours sincerely,

J. P. Mulligan.

Cinderhill Farm, Mayfield, Sussex.

Primitive societies have built-in cultural controls that ensure that behaviour tends towards their long-term interests. It is in this sense that such societies are stable. Fd

Make your presence known

Sir,

I have for the first time read *The Ecologist* and found it a proficient and frightening documentation of the perilous state of our world. What disappointed me was my own ignorance of the actual position. Yet I fear that the general public knows even less than I: it is time they were fully, and forcefully, informed. This will not be achieved, however, by such a ludicrously cliqueish attitude as, for example, the Conservation Corps', fleeing publicity "because it fears...that its administrative staff would not be able to cope" It is rather difficult to support an organization when one does not know of its existence. Let's waken up.

Yours sincerely,

John M. McAulev.

64 Barshaw Road, Glasgow SW2, Scotland.

Dumping of nerve gas

Sir.

The recent dumping of the Nerve Gas containers in the Atlantic must raise some conjecture as to whether this was in fact the best means of disposing it.

Conservationists will, in particular, be dismayed this year, just when efforts were, and are being made to contain pollution in various forms, because it would seem that pollution is rather on the increase than decrease. It has also been suggested that the gas could have been neutralized by a chemical, which may perhaps have proved a safer method.

The fact must remain that details of other alternatives were not made public, and as this operation was of international importance, it might be advisable to set up a commission under the auspices of the United Nations, for example, should any future occasion arise of similar character, where highly dangerous substances have to be eliminated.

Yours sincerely,

H. H. Dennis.

31 Oldstead Road, Bromley, BR1 5RN.

Passing the buck?

Sir.

s a lavman I fo

As a layman I found your articles of great interest, but would like to make the following comment: Individual members of our society are competitive in nature and therefore strive to emulate and indeed surpass each other in both the quantity of material possessions and living space. I feel that there is little hope in attempting to convert those of us who already form part of this society, but believe instead that the greatest possible emphasis should be placed upon convincing our children of the value of maintaining and indeed improving our environment.

I believe that this training should commence as early as possible, perhaps at Primary School, and should be achieved by specially written books and field kits in keeping with modern teaching methods.

I understand that there is currently available in Sweden a field kit that children can use in order to determine quite simply, various aspects of the quality of our environment. It should be possible to devise a similar kit at low cost for children to use in this country. Might it also be a useful idea to incorporate in the pages of *The Ecologist* a simply written section which would be understood by very much younger people than the journal is currently aimed at?

Yours sincerely,

N. C. Hammerton. Brandon/Systems Press Ltd., 79-80 Blackfriars Road, London, S.E.1.

Prospective sacrilege

Sir,

It was with considerable dismay and apprehension that I read a report in the *Financial Times* on September 1st concerning possible mineral mining in North and Mid-West Wales by several interested companies.

The main interest seems to lie in a particularly beautiful and unspoilt region known as the Harlech Dome and special interest is being taken in the upper Mawddach valley "with a view to mining by open-cast methods the entire mountainside". A pit just over a square smile would be excavated.

Prospecting is also being considered in several other places in Merioneth and adjoining counties, mostly it appears by foreign companies in their search for zinc, lead, copper, uranium, etc.

The idea of all this taking place in a National Park and on top of the oil threat to Cardigan Bay makes a mockery of Conservation Year.

One hopes the N. Welsh will realise their most lucrative industry to date is tourism, which would certainly fall off if they allow their lovely land to become scarred by slag heaps and pits, as it has in the South.

Mineral mining can only be a very short term project. Beautiful unspoilt scenery is fast becoming a rare and precious commodity, with long term returns.

I would like to use this opportunity to congratulate you on your excellent and timely magazine. I wish you all success.

Yours sincerely, Mrs Marcia Hughes.

11 Spinney Close, Hurstpierpoint, Sussex.

A scheme for mapping the distribution of seaweeds

Sir,

Our present knowledge of the distribution of even the commonest species of seaweed is extremely scanty. This is of course particularly true of the underwater flora. It is essential to know where seaweeds occur if we are to assess the rate and extent of marine pollution. Moreover, seaweeds are also an important resource and many are utilized commercially.

To fill this gap in our knowledge the British Phycological Society in collaboration with the Biological Records Centre have just launched a scheme to map the distribution of seaweeds around the British Isles. The first stage in the scheme is the collection of large numbers of records. The source of these records will be the recording cards sent in by collectors.

If you would like to participate in this project as a collector, recording cards are available free of charge from the undersigned.

Yours sincerely,

Dr T. A. Norton. Department of Botany, The University, Glasgow, W.2.

Cumulative poisons

Sir,

Congratulations to *The Ecologist* for exposing the sad story of Mrs. Butler's bill. Perhaps we would do well to remember that vast fortunes have been made out of pesticides, so there is an obvious vested interest in maintaining their sale.

Classifying compounds according to their killing power is not so simple as appears at first sight. Even derris (which comes from pyrethrum) is pretty toxic to fish and the hormone weed killer 2,4D, which appears to have no ill effects on land animals, is also toxic to water creatures. Moreover, spray that gets accidentally carried by the wind may damage plants one has no wish to destroy. Indeed, anyone polluting a river with 2,4D may be prosecuted.

Misunderstanding might also arise over red and yellow markings. Malathion (BST, Malthon) is the most common organo-phosphorous compound on sale to the general public and the dose needed to kill a human being happens to be less for this compound than for the organo-chlorines such as DDT, BHC and dieldrin. In many ways malathion is preferable to an organochlorine because it disintegrates rapidly and is not accumulated in the soil. In contrast, BHC (Lindane) may be retained in the soil for seven years after crops have been sprayed, Fortunately the even more persistent dieldrin is no longer on sale to gardeners.

It is all very well for the experts to say that few people have died of organochlorine poisoning but, since our health service is concerned only with the really sick, I fail to see how anyone can be sure that we are not all suffering liver damage due to eating small quantities of organochlorines over long periods. Most of us already have a fair amount of these chemicals stored in the fatty tissues of our bodies.

1 tried to assess the danger of compounds

at present on sale to the general public from a survey at my local gardening shop. Warnings are certainly given about keeping the stuff away from children and pets, of washing hands etc., after using the chemical and in some cases not gathering fruit or vegetables for so many days after treatment. However, this hardly conveys to the man-in-the-street the truly poisonous nature of these compounds. All goods stated the chemicals contained but only in the case of some of "Boot's" preparations was the amount also given. I used this information to calculate how much of various preparations a child weighing two stone would have to eat in order to stand a fifty-fifty chance of being killed.

The slug bait metaldehyde is not so poisonous to mammals as many other pesticides and the two stone child would have to consume eleven ounces of pellets, an event that does not seem to be very likely. In contrast, the weed killer for nettles commonly contains 2,4.5T. The child would only have to swallow one teaspoonful of the liquid as sold in the shops to be poisoned: even an experimental sip could do considerable harm. A spray for fruit trees contained both DDT and BHC and two teaspoons of this would poison the child. A less dangerous spray for greenfly contained malathion: here half a cup full would be dangerous. I think these figures, which do not take account of the danger from the cumulative effect of small doses, speak for themselves.

Yours sincerely, Peggy Ellis. 64 Blenheim Road, Caversham, Reading, Berkshire.

What the Canary told the Miner

We all know how the canary served man honourably in the bad old days of coal mining. Many of us will also recall that it was a relatively sudden and disastrous decline in breeding success among peregrine falcons that warned us, back in the 1950's, about the build-up of the chlorinated hydrocarbon pesticides in the food-chain.

A study of wildlife is perhaps the best early warning system we've got about impending pollution dangers. Professor Wynne-Edwards made this very point at a recent Royal Society symposium.

Any reader of *The Ecologist*, therefore, should also read ANIMALS, the international wildlife magazine. (In fact, the editor of *The Ecologist* has himself been reading it since 1963.) We are seriously concerned with all aspects of animal life—from conservation to ecology to animal behaviour; from bird-watching to butterfly-collecting (though we don't encourage the latter these days).

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Coming events

2-4 November—The Countryside in 1970— Welsh Conference—at the Grand Hotel, Llandudno. Information from Conference Secretariat, The Countryside in 1970 Committee for Wales, Graig Lwyd, 134 Penrhos Road, Bangor, Caernarvonshire.

2-6 November—International Congress on Industrial Waste Water, Stockholm. Information from secretary of the Congress, Drottning Kristinas vag 47, S-11428, Stockholm, Sweden.

6-8 November—Liberal Party Conference— "Pollution of our Environment"—at the Alexandra National Hotel, 330 Seven Sisters Road, N.4. Information from Mrs. S. Robson, 31 Chester Terrace, Regents Park, N.W.1.

7–8 November—Residential field course on Conservation at Rogate Field Centre, Sussex. Information from Mrs. P. Small, London Natural History Society, 13 Woodfield Crescent Ealing, W.5.

12 November—Sessional meeting of the Institute of Landscape Architects at Nash House auditorium, 6.30–8. Information from Miss A. Dale, I.L.A., 12 Carlton House Terrace, S.W.1. 14 November—Exhibition—"Science around us"—at the College of St. Mark and St. John King's Road, Chelsea, S.W.10. Information from School Natural Science Society, 2 Bramley Mansions, Berrylands Road, Surbiton, Surrey.

14 November—Annual General Meeting of the Conservation Society at Caxton Hall, St. James Park, London SW1. Information from S. G. Lawrence, 21 Hanyards Lane, Cuffley, Potters Bar, Herts.

17–18 November—Second International Congress of the World Wildlife Fund—"All life on Earth"—at the Royal Garden Hotel, London, W.8. Information from World Wildlife Fund, 7 Plumtree Court, London, E.C.4.

18 November—Autumn meeting of the Institute of Public Cleansing at Olympia. Information from Institute of Public Cleansing, 28 Portland Place, W.1.

19 November—Meeting of the Operational Research Society. Information from Operational Research Society Ltd., 62 Cannon Street, London, E.C.4.

26 November—Soil Association Farmers' Conference. Information from Soil Association, Walnut Tree Manor, Haughley, Stowmarket, Suffolk.

Classified Adverts

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