

The

Ecologist

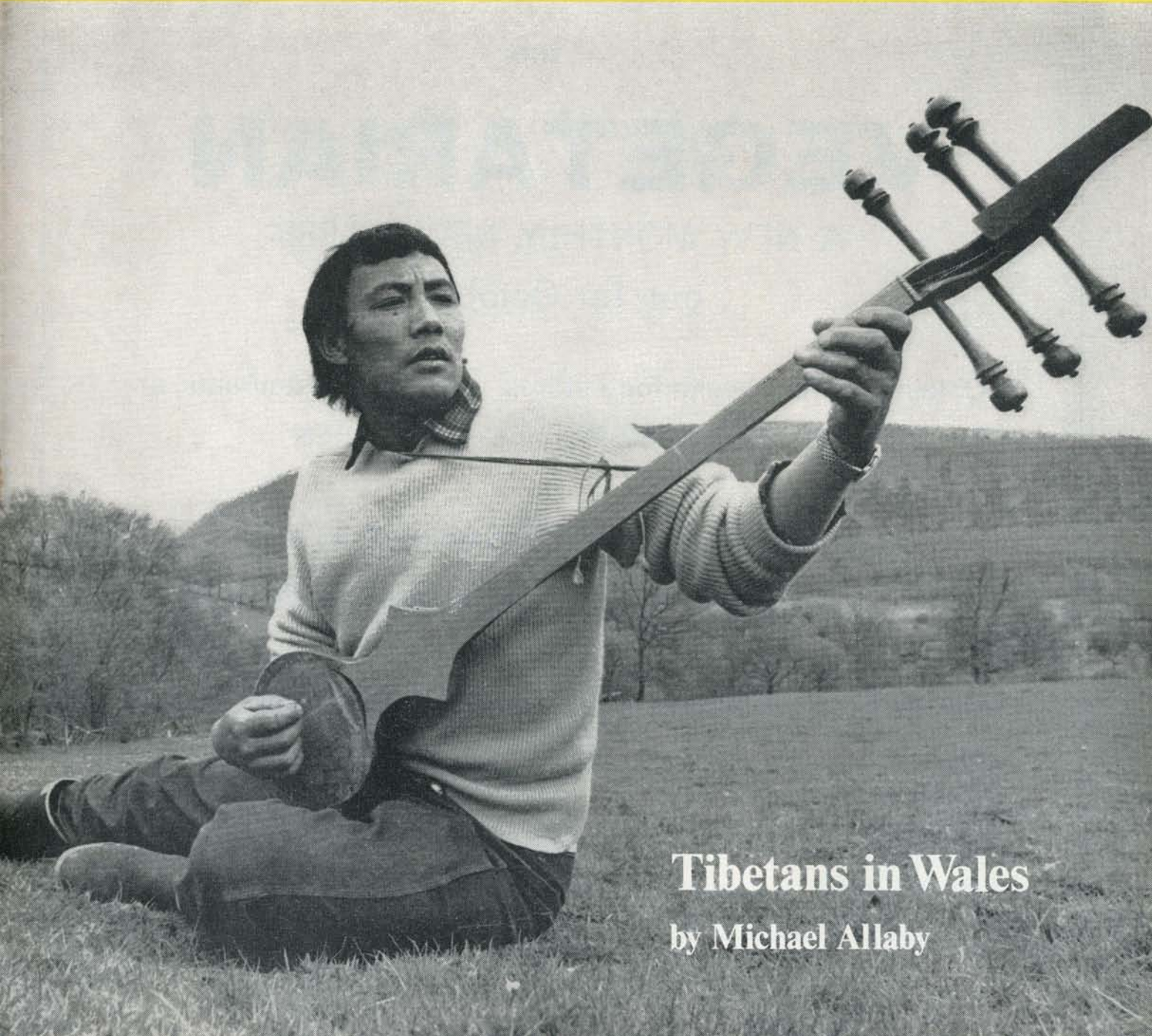
Man and the environment ■ The Quality of life ■ Pollution ■ Conservation

Vol. 1. No. 15

September 1971

The cost of pollution ■ German moves to protect the environment

Politics of pollution ■ Eating our way to the grave



Tibetans in Wales

by Michael Allaby

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in the environment

in the food we eat

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The Ecologist

Vol. 1. No. 15 September 1971

Editorial *Chickanowski's chicken*

3

Feature articles

Edward Goldsmith	The cost of pollution	4
Richard Warner	German moves to protect the environment	9
David N. Leff	Politics of pollution	11
Michael Allaby	Tibetans in Wales	13
Jay W. Forrester	Alternatives to catastrophe <i>Understanding the counterintuitive behaviour of social systems, Part 2</i>	16

Reports

Peter Bunyard	Eating our way to the grave	25
Roy Bridger	Development v. development	28
Science News	Resources out of place	29

Columns

Gerald Foley	Ecology action <i>Stopping the motorway madness</i>	31
Lawrence D. Hills	Down to earth <i>Hovercraft for gardeners</i>	32
Edward Goldsmith	Towards a unified science <i>The cybernetics of day-to-day behaviour</i>	33

Feedback

34

Books

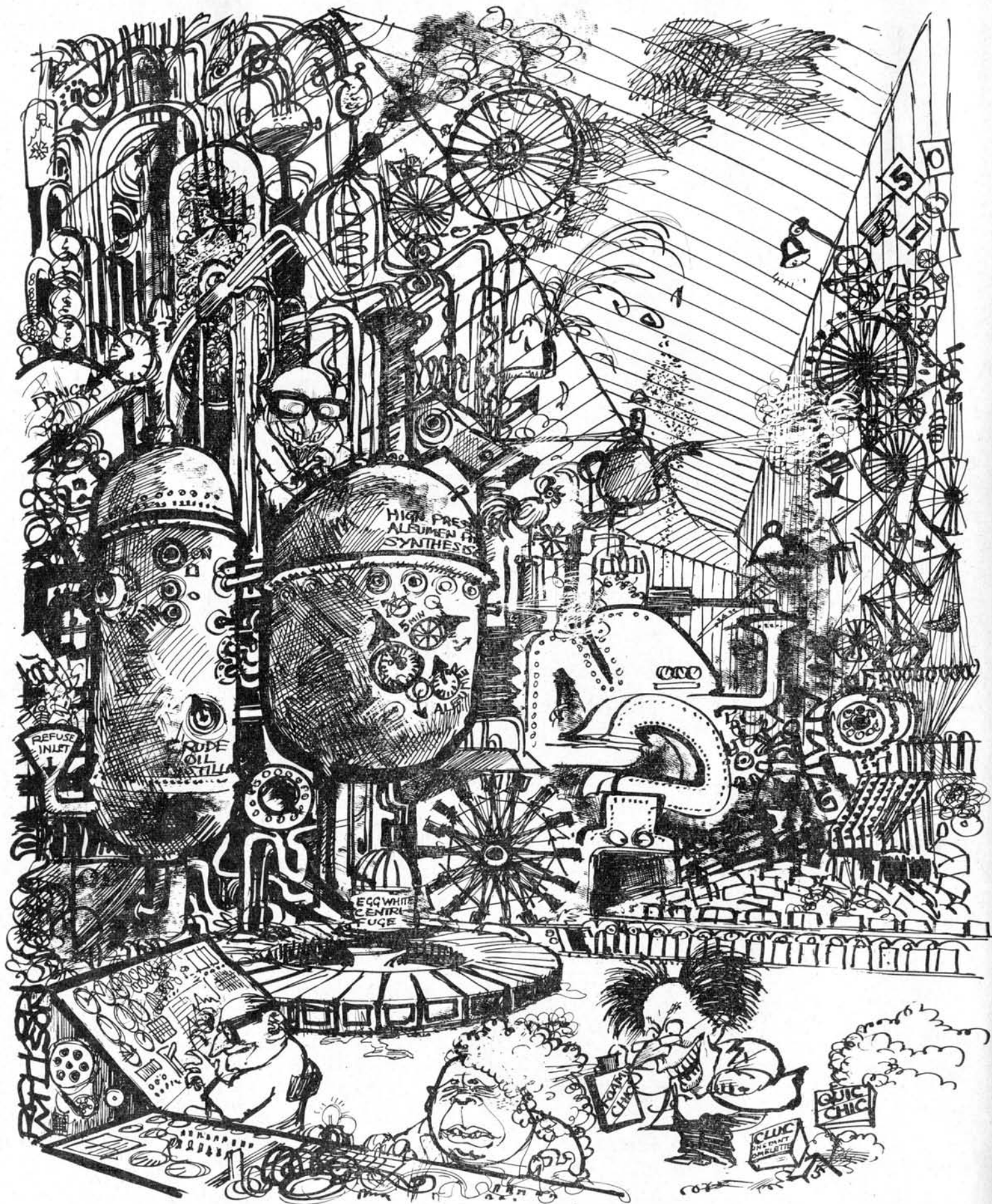
37

Letters

39

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Published by Ecosystems Ltd., registered office 11 Mansfield Street, Portland Place, London W1M 0AH and distributed by the Hachette Group, Continental Publishers and Distributors Ltd., 4 Regent Place, London W1R 6BH; Telephone: 01-734 5259; Telegrams: Aglibairi London W1; Telex: 25114. Subscriptions to: The Ecologist, 73 Kew Green, Richmond, Surrey. Printed by The Garden City Press Ltd., Pixmore Avenue, Letchworth, Hertfordshire, SG6 1JS.



Boys will be boys!

Young farmers testing aerosol white in model barnyard.
Chickanowski's chicken in background (being repaired).

Editorial

Chickanowski's Chicken

An announcement has rocked the business world and provided yet further proof of the infinite capacities of modern technology.

Professor Milton K. Chickanowski of Nuneaton University has developed (thanks to a generous grant from the National Research Council) a solid-state electro-mechanical chicken.

Chickanowski's chicken (as it is familiarly known in the Nuneaton Laboratories) is programmed by means of a £1m RB211 Honeywell Computer (an integral part of the device) to "lay" eggs with the following choice of characteristics:

Shapes: 4 possibilities; flat for sandwiches, square for easy packing, oval for traditionalists, chicken-shaped for fancy-food stores.

Contents: 5 possibilities; yolk and white in equal parts, arranged in layers for convenience; white only: either standard white or aerosol-white for meringues and soufflés; yolk only: either soft-boiled or hard-boiled (regardless of cooking-time).

This remarkable device, once programmed, can be operated by a single unskilled man and requires routine servicing no more than once a month by personnel with easily acquired mechanical and electronic know-how.

Is this Science Fiction?

No, Chickanowski's chickens are being invented every day—that is what Progress is all about. Yet is it really progress? It is held to be so, simply because of its economic advantages. But a little thought will make it apparent that these are quite illusory.

First of all, a real chicken reproduces itself: once you buy a couple, you need never buy any more: Chickanowski's chicken is sterile: it can last a few years—to be generous let us say ten—then you simply have to buy another.

The longer the period over which you calculate your costs, the more uneconomic does it appear: over a hundred years it costs proportionately 10 times more than a real chicken; over a thousand years, 100 times more etc.

Secondly, the real chicken grows by absorbing food available in the fields where it lives, or should live. Chickanowski's chicken is made, with the aid of fossil fuels, from all sorts of mechanical and electronic components, in turn made from metals, all of which have to be extracted from deep down in the earth's crust—leaving scarred and derelict land where once there were virgin forests. These resources have to be shipped across the seas, refined in vast factories, and used for making the appropriate components which must then be assembled. At each step, wastes are produced—some of them very toxic, and these are dumped into our rivers and seas or allowed to contaminate the air in the form of poisoned gases. By contrast, the wastes produced by a real chicken constitute essential organic manure without which plants could not grow and the world would rapidly come to an end.

Apart from this; the food the real chicken feeds on is self-renewing; while the metals required to make Chickanowski's chicken and the fuel it needs to power it are not; and what is more the world's stock is fast running out. As our economy is entirely geared to the short-term, the commercial prices for these resources simply reflect the relationship between the immediate demand and the immediate supply for them. *If it were to reflect that between the long-term demand and the long-term supply prices would be very much higher.*

If it were decided, for instance, to ensure that stocks of oil, copper, zinc, gold and silver were to last another 1,000 years which is not very long (approximately 0.001 per cent of man's tenancy of this planet) prices would have to be increased by at least thirty times, in some cases, possibly much more: with a consequent increase in the prices of Chickanowski's chicken.

Apart from this, by allowing Chickanowski's chicken to replace the real one we are forcing people who once led a pleasant, healthy life in stable rural communities, looking after real chickens, to lead an unpleasant and unhealthy life in the urban wastelands where these monsters tend to be made. The cost to society of the elaborate

machinery required to transport the necessities of life into these ecological deserts and evacuate from them human and industrial wastes is incalculable; as is that of maintaining a semblance of social order in a social and physical environment, than can but breed crime, delinquency, alcoholism and drug-addiction.

In addition, it is presumptuous to suppose that the synthetic eggs laid by Chickanowski's chicken are likely to provide as sound a diet as those that we have been adapted to eat by millions of years of evolution.

If Chickanowski's chicken is regarded as economic, it is only that our economists are working in a vacuum, and that they have failed, in their calculations, to take into account all those costs whose consideration falls (by convention) outside the narrow compass of their pathetically inadequate discipline. If they took into account:

1. the cost of renewing Chickanowski's chickens over a significant period of time;
2. the cost of controlling the pollution generated by their manufacture, transport and exploitation;
3. the amortisation cost over a significant period of the non-renewable resources used in their manufacture, transport and exploitation;
4. the cost in terms of the external controls (both physical and social) rendered necessary by the urbanisation resulting from their introduction;
5. the costs in terms of increased medical bills of the somatic and genetic damage caused by the chemical ingredients of the synthetic eggs,...

then it would become quite apparent that Chickanowski's chicken is totally uneconomic, and that its introduction rather than constitute progress, is a significant step in the march of regress to which our industrial culture is ever further committing us.

Our economists are, in the next few years, going to be totally discredited unless they begin to understand that a nation's wealth cannot be increased by the short-term gimmickry of modern science and technology, but only by observing sound ecological principles.

They must realise that there is no rivalry between ecology and economics as it is often maintained; only between ecology and bad economics.

The Cost of Pollution

by Edward Goldsmith

How much money must be spent on pollution control? Are governments likely to make the necessary funds available? Even if they do, will this provide a complete solution to the pollution problem or will it only enable us to gain time?

In this article (taken from "Can Britain Survive?" published by Tom Stacey, 18 Maiden Lane, London WC2) the author attempts to answer these essential questions.

In what way does pollution affect the country as a whole? What is its total cost to us? This is difficult to answer as no one has really defined the term "cost". It normally refers to "economic" cost, i.e. to cost that can be measured in terms of the units of measurement used by economists. But are these the right units of measurement? One cannot, for instance, measure social and ecological costs in these terms; at least, not until they begin to affect economic life. This of course they must do in the long run, and perhaps one can take them into account by referring to them as "delayed economic costs".

Thus, for over 150 years, industrial waste has been poured into the air, rivers and seas, without any apparent adverse effect on our economy, so much so that it is assumed by many people that the world's capacity for absorbing waste products is infinite. Unfortunately, this is not so. The environment can absorb a finite amount of different wastes; beyond that these tend to accumulate so that even if the annual amount disposed of was constant, which as we know is not the case, the total amount in the environment would be increasing more or less exponentially, depending on their persistence.

Also there must be thresholds beyond which levels for different pollutants become lethal. Before these thresholds are reached, the effects are

not easily observable. This does not mean that biological damage is not being done, but that it will only be translated into economic costs once it has led to a reduction in economic activity.

The reason why there has been this sudden interest in pollution is that many of these thresholds are now being reached and pollution is beginning to affect our economy.

There appear to be few satisfactory studies of the cost of pollution to our society. However, in the US Lester B. Lave and Eugene Seskin of the Carnegie-Mellon University estimate that roughly 25 per cent of all respiratory disease is associated with air pollution. This means that the cost of air pollution to health in the US was about \$2 billion in 1963, the last year for which usable data is available.

Ailing shrubbery

Professor Thomas D. Crocker (1) of the University of Wisconsin and Professor Robert J. Anderson Junior of the University of Purdue have estimated that an increase in air pollution of from 5 to 15 per cent reflected in off-colour paint, ailing shrubbery, sooty surfaces and unpleasant odours, takes \$300 to \$700 off the value of a house. On this basis air pollution in 1965 was costing America \$621 million in reduced property values.

The Beaver Committee Report put

the cost of air pollution in Britain on our health and property at £350 million. This was 16 years ago, and it was probably even then a conservative estimate.

Gerald H. Michael, Assistant Surgeon General, has calculated that the 173 million tons of contaminants ejected annually into the atmosphere in the US cost Americans \$10-20 billion a year in medical bills and cleaning bills.

According to the National Air Pollution Control Administration, the figure is between \$14 and \$19 million. (2)

The harm done by sulphur dioxide alone to crops in the US has been estimated at more than \$500 million a year.

The damage done by the countless poisons we pour into rivers and seas in terms of reduced fish catches must also be colossal, and can only go on increasing. Mercury alone has been considered responsible for an annual billion's worth of damage world-wide.

Representative James Murphy of Staten Island, member of the Merchant Marine and Fisheries Committee, asserts that pollution in general costs the US more than \$30 billion a year and predicts that this figure will rise to 60 billion by 1980.

From these terrifying figures, it must be apparent that pollution control is not the luxury many people think it is. To refuse, for economic or political reasons, to install pollution control

equipment is not to save money, again as many people think, but simply to pay the cost of pollution in a different currency: in reduced plant yields in larger cleaning bills, in higher medical costs etc.

Also the amount of money spent on pollution control has up till now been but a minute fraction of total pollution costs. In Britain the £32 million spent in air pollution control is less than an eleventh of total cost as estimated by the Beaver Committee. In the US the \$10 billion that President Nixon proposes to spend over the next four years (assuming it is in fact spent, which is by no means sure) is also but a fraction of what it would really cost to clean up that country's polluted environment. Let us briefly examine what this is likely to be.

The cost of eliminating water pollution depends primarily on the degree of cleanliness we seek to achieve.

As urbanisation progresses, the amount of sewage requiring secondary treatment must increase. In the US by 1973, according to the Federal Water Pollution Control Agency, 90 per cent of the urban population will need secondary sewage systems. (2)

Water treatment

According to the Federal Water Pollution Control Administration, this would require over \$8 billion in water treatment plants (exclusive of lands costs) and over \$6 billion in sewers. Secondary treatment of industrial wastes will cost another \$5 billion in construction. To separate storm and household sewers could cost anywhere from \$10 billion to \$48 billion and to control thermal pollution will cost yet another \$2 billion. In addition, operating costs for all these facilities would be almost \$2 billion for the municipal plants, \$3.5 billion for the industrial plants and about \$1 billion for the thermal processes. (2)

If America really wants to have clean water and decides to build tertiary treatment plants, then the construction costs would jump from \$31 billion to about \$90 billion. This figure is not far off Professor Barry Commoner's estimate of \$100 billion to clean up US rivers.

The Federal Water Pollution Control Administration estimates that between 26 and 29 billion dollars will have to be spent between 1969 and 1973. (2) A National Survey in July estimated that

between \$33 and \$37 billion will have to be spent within the next six years.

In Britain, there is no estimate of the cost of fighting water pollution. We have 20,000 miles of rivers of which 5,000 are polluted and 2,000 grossly polluted. According to Mr Anthony Crosland, it would cost £30 million to clean up four miles of the River Tyne, but this is a particularly bad stretch. The Jeger Report estimates that the GLC must spend £1 million on cleaning up the Thames Estuary.

Teesside Borough Council has calculated that £22 million are needed just to clean up the River Tees over 10 to 12 years. £500 million has been estimated as the sum required to bring 1,000 miles of grossly polluted British rivers just to tolerable standards. (3)

According to the Jeger Report, 3,000 of our 5,000 sewage works are at the moment overloaded and produce effluent below the quality associated with secondary treatment. Mr Craig Sinclair of Sussex University estimates that £260,000 a year must be spent on sewage works which is twice what is spent at the moment. (3)

Estimates of the cost of controlling air pollution are even more difficult.

According to Professor Goldman, they range in the US from \$300 million to \$3 billion a year simply for construction costs. In the latter case, this would mean capital expenditure of a little less than \$100 billion by the year 2000. This only covers emissions from stationary sources. Air pollution from motor cars is an even more serious problem and in many US cities motor vehicles are responsible for as much as 80 per cent of it. According to Professor Goldman, controlling air pollution from cars might add up to another \$2 to \$3 billion a year. A recent survey suggests a figure of \$400 per car or a total of \$40 billion.

Dr Ernest Starkman, Chairman of the Technical Advisory Committee of the California Air Resources Board, asserts that if air pollution were to be cut down to "levels that would keep the atmosphere clean", one would have to expend an extra \$1,000 per motor car or approximately \$100 billion if every one of the cars at present in use in the USA were appropriately equipped.

The actual cost clearly depends on what percentage of total pollution one wishes to eliminate. It is important to realise that we can never get rid of all

of it. As Professor Goldman writes, "Institution of \$100 billion worth of air quality controls would not mean the elimination of all air pollution nor of the costs that arise from it, but it would considerably reduce the cost of air pollution in terms of medical bills and cleaning bills and help defray the costs of operating expenses."

In Britain, up till now there has been practically no legislation to reduce pollution from motor cars as it has been considered too expensive. The recent reports of the Royal College of Physicians on air pollution and health, has revealed that the savings are largely illusory.

Nevertheless in order to justify the Government's short-sightedness, the Government's official position has been that there is no evidence that air pollution is bad for people at least at existing levels.

Recently, there seems to have been a radical change of policy as Mr Peter Walker announced very firmly on December 1st 1970 that the Government intends to introduce very strict measures to control pollution from the exhausts of motor cars.

Measures to reduce lead

One can also expect in the US and eventually here measures to reduce lead pollution of the air which we know to have a very serious effect on human health. According to the Ethyl Corporation, these additives save the US 215 million barrels of oil each year. The cost of this extra oil consumption would amount to at least \$3 billion for the public to pay each year and \$6 billion to be met by the oil companies. If octane ratings are to be maintained, then further changes are required which will probably give rise to other forms of pollution and hence require further costly controls. (4)

In the UK Lord Rothschild, head of the Government's new Capability Unit recently said that the exhaust from cars could be purified at a cost of an extra £50 to £100 per car, while £5 to £10 would be required to get rid of the lead.

According to Geoffrey Charles, Americans have already spent \$10 billion on anti-pollution devices for their cars and it is estimated that they will have to spend another \$15 billion. (5) Businesses must undoubtedly foot a considerable part of the bill as the principle that businesses must pay for the

disposal of their own waste is rapidly becoming accepted both by Government and industry.

In the US businesses spent an estimated \$1.5 billion to control air and water pollution created by them, which is an increase of 40 per cent over the previous year. The National Industrial Conference Board estimates that investments to control air and water pollution rose from two per cent of manufacturer's capital outlay in 1967 to close to four per cent in 1968. A good number of companies questioned by Fortune report that they are spending 10 per cent of capital outlays, and in extreme cases the figure was 30 per cent. (6)

In Japan where public awareness of pollution is of recent origin, already five per cent of capital expenditure, according to a recent Ministry of International Trade and Industry Report, is devoted to pollution control equipment, while in the chemical industry, the figure is closer to 12 per cent. These figures are increasing every year and must continue to do so at an ever greater rate.

The chemical industry is among the most affected by pollution control problems. It is producing an ever wider range of chemicals which are ending up

in our rivers and hence in our water supply. The Institute of Water Engineers in a recent report warned that, as a result, our water supply is in a precarious position. Many of the chemicals cannot be identified, let alone filtered out. Clearly very tight controls will have to be imposed. Pollution of water supplies with detergents, insecticides and artificial fertilisers is also becoming a matter of national concern and it is but a matter of time before controls are adopted that will seriously reduce the profitability of the industries producing them. In the meantime the major chemical companies are planning large increases in their expenditure on pollution control.

The steel industry is also vulnerable. In the US, it is estimated to use eight billion gallons of water per day for cooling and other purposes and causes extremely serious pollution to waterways.

The cost of controlling pollution from power stations must also increase very radically.

The cost of controlling pollution of the seas may be highest of all. Practically all our waste products end up in the seas, and they cannot absorb it all

indefinitely. Strict measures will undoubtedly soon have to be taken to curb oil pollution by tankers. Nuclear power stations will have to find ways of reducing levels of radioactive waste at present ejected into the seas. Pesticide levels will have to be reduced which simply means that farmers will have to use less of these poisons, though this may in the long run represent a saving both in expenditure and crop yields. There will also have to be a limit to the amount of solid waste indiscriminately tipped into the seas.

According to the Report of the Study of Critical Environment Problems, approximately 73 million metric tons of solid wastes are tipped into the seas annually. The estimated world discharge is probably 150-220 million metric tons per year.

Gaylord Nelson estimates that in the US the total cost of controlling all the different types of pollution will be between \$25 and \$30 billion a year. "No administration has understood the size of the issue. It is much more important than space programmes, weapons systems or the money we are wasting in Vietnam."

Professor Goldman estimates that the cost of controlling air and water and

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solid waste pollution will be between \$130 and \$180 billion in construction costs, and will involve between \$12 and \$18 billion in annual operating costs. These amount to approximately one to two per cent of the annual Gross National Product (GNP) and to four to seven per cent of the value of industrial, agricultural, mining and transportation output. This only includes the cost of secondary sewage plants. If tertiary sewage plants are installed, then construction costs go up to \$200 billion. (2)

This figure does not include construction costs involved in reducing pollution from motor-cars or aeroplanes, nor any undertaken to reduce noise pollution or pollution of the seas, save by improving the quality of effluent to our rivers. Estimates for a more comprehensive programme of pollution control would thus be considerably higher.

How important is it that this money be spent? There are two ways of looking at it. Firstly, pollution control must not tend only to reduce the short-term economic costs but also long-term or delayed economic ones, i.e. long-term social and ecological costs. From this point of view money spent on pollution control will have a far more beneficial effect than might be supposed. On the other hand pollution control can be regarded as maintaining or restoring those conditions that will permit further demographic and economic growth. As such, it is too a means of suppressing some of the more noxious symptoms of these processes which can only serve to render them more tolerable and contribute thereby to their perpetuation. In this way pollution control will favour the continued depletion of our natural resources, the disintegration of society and other calamities brought about by continued growth.

No technological solution

It is also essential to realise that a large amount of pollution can only be controlled by cutting down on economic activity.

How else for instance can heat from the combustion of fossil fuels be reduced? Clearly, only by cutting down on power consumption.

How can the damage done by agricultural chemicals be controlled? Only by closing down the factories that produce them or persuading them to produce something else, and at the same

time returning to sounder methods of husbandry that do not require them.

This must mean reducing economic activity which implies more costs to our economy.

In reality, no pollutants can be controlled save in the very short-term.

This is evident from the following consideration:

Let us suppose that we succeeded in reducing world pollution levels by 80 per cent.

Total "ecological demand" or World GDP is increasing at a rate of six per cent (according to the UN Statistical Yearbook).

This means that it is doubling every 13½ years.

Thus, in 27 years it will have quadrupled, and we would be back to the same pollution levels that we started off with.

Pollution control in other words cannot by itself provide a solution to the environmental crises. It is but a short-term expedient, a useful, indeed a necessary one so long as we realise that it is basically only a means of gaining time and can only be of long-term usefulness if this time is used for what are the only really effective measures, i.e., reducing demographic and economic growth. Meanwhile, let us try to predict how the cost of pollution will be affected by developments in the next few decades. Firstly, one must realise that pollutants over and above that level that can be absorbed by our environment tend to accumulate. This means that even if they are being generated at a constant rate, the total amount in the environment will increase by something approaching compound interest, depending on their persistence. Unfortunately, since the amount generated is roughly a function of economic activity, so a growing economy will mean a still greater rate of pollutant accumulation.

As already mentioned, it is important to realise that the effect of pollutants on biological organisms is unlikely to be linear. There are likely to be thresholds below which concentrations have but sub-lethal long-term effects but above which serious biological damage becomes apparent. When these thresholds are reached, observable and measurable damage to crops, wildlife and humans will start soaring.

It is more likely that within the next 30 years, many such thresholds will be reached; for instance, many marine organisms such as shell fish tend to

concentrate pollutants; radio-isotopes such as iodine-131, heavy metals such as cadmium and mercury etc. It is probable that further pollution of this sort will begin killing them off in appreciable quantities and also seriously to affect the health of those who eat them. We have already had the terrifying example of 70 people dying in excruciating agony at Minimata from eating mercury-polluted fish.

With oil transported across the seas trebling every ten years, interest in the long-term sub-lethal effects of oil pollution has increased. Dr Max Blumer in the US and Dr George in the UK have pointed to its very serious nature. It is possible that in the next decades the accumulated effects of oil pollution will become very costly in terms of fish resources.

The levels of pesticides in marine organisms, birds, and in our rain water is also on the increase—not surprisingly as pesticides in the US are a \$450 million business, (7) and in the UK £20 million worth are sold, an amount that is increasing at six per cent per annum. It must be but a question of time before these levels are no longer tolerated and start taking their toll in human lives.

As little as possible

I think that one can take it as axiomatic that governments and businesses will spend as little on pollution control as they can possibly get away with. Conservationist pressure can force their hand to a certain extent. Political and economic necessity however must be the ultimate determinant of the amount of money spent on pollution control.

Thus DDT was banned for two years in Sweden only when herrings were found to contain higher than permissible levels of this poison, which rendered them unsaleable.

In Britain the Clean Air Act was passed only after 3,000 people had died from the effects of smog in the winter of 1952.

In Northern Italy, at the moment, businesses are spending a lot of money on water pollution control equipment and advertising the fact in the popular press to show just how socially responsible they are. The fact is that they are running out of usable water and their choice is either to spend the money or close down.

Situations of this sort are likely to

occur more and more. For instance, in Japan, pollution is so bad that in certain industrial areas, further expansion is no longer viable. Manufacturers are getting round this by setting up manufacturing facilities in other countries, at the moment, mainly in South East Asia, though some are apparently looking round for suitable sites in Europe.

We have here a totally new phenomenon, "Industrial Nomadism". Manufacturers pollute an area until it is incapable of supporting further industrial growth and then move off to another one.

The trouble is that growing, social and ecological problems will tend to make economic imperialism ever less easy. As problems multiply, foreigners are bound to be singled out as responsible for a country's growing ills and discriminated against as nationalism grows. In the next few decades one can undoubtedly expect more and more foreign firms to be nationalised in developing countries, and more and more protectionist legislation proposed.

Japan and other industrial countries that will soon find themselves in a similar plight will thereby be forced to spend ever greater sums on pollution control to permit economic growth and eventually simply to maintain existing output.

One of the beneficial effects of the growing shortage of raw materials must be the increased profitability of re-cycling waste. Take the example of sulphur dioxide. Monsanto has developed of means of re-cycling it and providing sulphur at £30 a ton which is just about twice the world price. A shortage will clearly make this re-cycling possible.

In the USA approximately 23 million tons of sulphur dioxide are discarded into the air each year, in the UK approximately six million tons. This could provide five million tons of sulphur or 15 million tons of sulphuric acid in the US and about a quarter of this in the UK. It will soon be impossible to waste this precious material, and when that day comes, the huge cost to plants, animals, human health and buildings will be avoided simply because it will be profitable to do so.

The development of ever more efficient re-cycling methods will tend to have a similar effect. Also, as Sanford Rose writes, "Once society, by one means or another, begins charging rent for the use of the environment's capa-

city to absorb wastes, engineers will have to think about pollution control as an integral part of plant design rather than as an afterthought. A lot more research funds will be allocated to pollution control, and costs may go down faster than anyone expects."

On the other hand, the amount spent on pollution control must increase as scientific research reveals the ever greater damage done by different pollutants to biological organisms and in particular to human health.

Things considered harmless are slowly becoming incriminated as research progresses. It is in fact gradually becoming revealed to scientists who should already know it that man has developed phylogenetically as an adaptive response to much more specific environmental conditions than we think, and that any undue modification of these conditions will affect him adversely.

Take sulphur dioxide; there is as yet no legislation calling for its control. Yet we know of its adverse effects on plant growth and we learn from Dr Robert Shapiro that it has a significant mutagenic effect, and can thereby cause infant malformations and probably cancer. It seems probable, Shapiro writes "that sulphur dioxide constitutes a genetic hazard to living organisms." (8)

Research on the effect of radioactivity on biological organisms is constantly leading to further reductions in permissible levels. Recently, Doctors Tamplin and Goffman (9) of the AEC have provided evidence to show that the effects of low radiation levels is much more dangerous than we have so far assumed. They recommend a ten-fold reduction in permissible levels. If these recommendations were adopted the effect on the nuclear power industry would be disastrous.

One reaction was that it would simply put America out of business.

Clearly, as research continues to reveal more and more adverse effects of pollution, so standards of pollution control will have to be increased as will the costs involved.

How are these likely to affect our economy? Clearly, it must tend to reduce economic activity and hence our material standard of living.

To the extent that our society is geared to continued economic growth, it

might also give rise to radical social changes.

Postscript

The second report of the Council on Environmental Quality has just appeared (6 August 1971). Its Chairman, Mr Russell Train, maintains that the US is making "substantial progress" in its fight against pollution.

"Our report shows that in the air over our cities the levels of sulphur oxides is going down. The use of persistent pesticides is declining and ocean dumping has fallen considerably."

Mr Train notes, however, that the total level of emissions in the air over America is going up because of economic and industrial growth. The level of pollutants in the nation's waterways on the other hand appears to be constant.

He warns, however, that noise pollution is worsening and the degradation of the land—primarily the result of "urban sprawl"—is also getting worse. "This is why we have legislation in support of a national urban land policy before Congress."

The latest environmental report estimates that total cumulative expenditures for air, water and solid waste pollution control in the 1970-75 period will be \$105.2 billion—\$38 billion for water clean-up, \$23.7 billion to cleanse the air and \$43.5 billion for solid waste handling and disposal . . . \$525 for each American.

The current damage done by air pollution amounts to some \$16 billion a year, or \$80 per person in terms of damage to health, vegetation, materials and property.

References

1. Rose, Sanford. 1970. The economics of environmental quality. In *The Environment* (ed. Fortune Magazine). New York: Harper & Row.
2. Goldman, Marshall I. 1970. The costs of fighting pollution. In *Current History*, August.
3. *Marine Pollution Bulletin*. 1970. December.
4. *Chemical Week*. 1969. Vol. 105, p. 71.
5. *The Times*. 1970. 10 December.
6. Davenport, John. 1970. Industry starts a big clean-up. In *The Environment* (ed. Fortune Magazine). New York: Harper & Row.
7. Headley and Kneese, A. V. 1970. Economic implications of pesticide use. In *Annals of the New York Academy of Science*.
8. *Journal of the American Chemical Society*. 1970. 28 June.
9. Goffman, John and Arthur Tamplin, 1970. Radiation: The invisible casualties. In *Environment*, 12 (3).

German moves to protect the environment

by
Richard Warner

With Britain moving steadily, and apparently inexorably, towards membership of the European Economic Community it is interesting to speculate what entry into Europe will mean in terms of legislation to combat environmental deterioration.

An instrument to advise on problems of environmental pollution has already been established within the community. It is formed from the Union des Industries de la Communauté Européenne and the "round tables" for questions relating to water and air pollution set up by the Council for European Industrial Federations. Altiero Spinelli, a member of the Brussels Commission of the European Economic Community, announced in Dusseldorf recently that after the entry of the four countries now applying for membership of the community, the question of legislation for environmental protection will be put on the agenda in Brussels.

Individually the six countries of the EEC seem to be actively aware of the environmental problems facing them—

problems which, in many cases, are more severe than those being encountered in Britain today. West Germany provides a fine example of the current state of affairs. A German parliamentary committee on pollution reported recently that the development of children in the industrial Ruhr area was being retarded by the poisoned atmosphere and that the number of cancer deaths was *doubling every ten years*. Other evidence heard by the committee concerned the harm being done to vegetation and to works of art as well as to human health. 150,000 acres of woodland have been destroyed by pollution in the Ruhr and art treasures, frescoes, statues and historical buildings were all subjected to "a rapidly increasing process of destruction." As immediate measures the experts recommended the introduction of an efficient incinerator system to cope with refuse and restrictions on the lead content in petrol.

Problems definitely exist in Germany, and exist in terrifying abundance. But what is being done at a government level

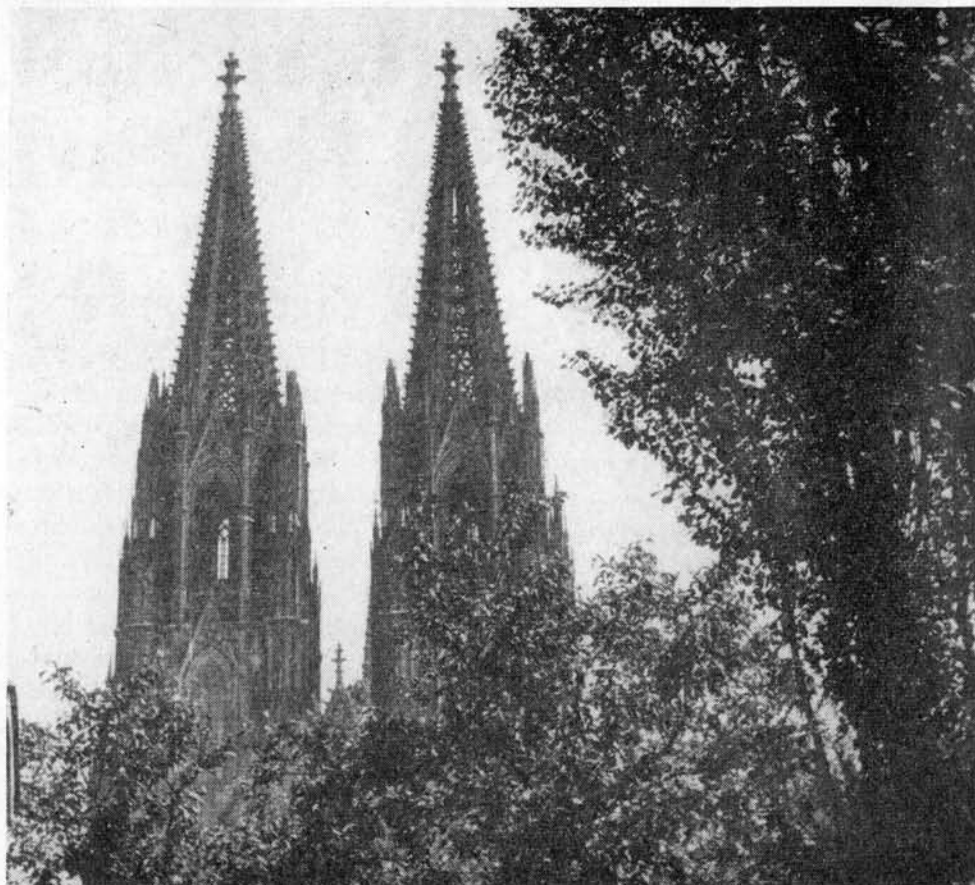
to clear up the mess? Well, there is at present what the German press describes as a "dialogue" going on between the Federal government and industry. Forum for the dialogue has been the meetings of the Federation of German Industry. At the twenty-second ordinary general meeting of the Federation in Dusseldorf recently there was a candid discussion on the subject between State Secretary Hartkopf of the Ministry of the Interior and Fritz Berg, President of the FGI. Another important participant in the discussion was Professor Hansen, Managing Director of the Bayer Chemical Concern—a huge organisation which is Germany's equivalent of ICI. The subject was also discussed at last year's meeting and a certain amount of progress, at least in awareness of the magnitude of the problem, has obviously been made in the last twelve months. All concerned were agreed that there is no sense any more in preaching of the dangers that threaten us all and then trying to find scapegoats. And the period for looking around and taking

Creeping industrialisation and a dense network of autobahns are swallowing up the countryside of northern Germany.



Cologne Cathedral, arguably the most important single piece of Gothic architecture on the continent, is being severely damaged by air pollution and by vibration caused by road traffic and the nearby railway station.

Photographs: Copyright Warner



stock of the situation is also long past—or should be. The most important facts are already known and—perhaps even more important when it comes to convincing a business of something—the first figures are available showing just how much money is needed to keep rivers, lakes and the atmosphere free of pollution and to carry out a successful fight against the increasing flood of waste-products and refuse. German industry, whose representatives in Dusseldorf were quick to point out that they have already spent large sums of money on anti-pollution efforts in the last decade, made no secret of the fact that a clean environment will cost even more in the future. Professor Hansen said quite openly: “We must be prepared to put the brake on prosperity for many years to come. The consumers must be told that they too will have to make sacrifices. Has democracy”, he asked, “the courage to tell the people the truth and risk losing an election?”

The Federal government appears to be reasonably optimistic on this point. A tax levy of ten Marks (a little over a pound) per person per year, over the next fifteen years, would be sufficient, they say, to conquer the waste disposal problem. And just one per cent of the Gross National Product would be enough to initiate a comprehensive programme to keep the environment clean. The State Secretary at the Ministry of

the Interior gave the Federation of German Industry an idea of the basic goals of the government’s overall programme, which is to be published in the late autumn. There are three main points: the putting into effect of the principle of environmental responsibility, the creation of an effective monitoring system with the aid of which the threat to the environment can be countered on a long-term basis and, finally, the foundation of an institution which will immediately be in a position to counter any dangers to the environment that may arise. The specific priorities at present are seen by the Federal government as being the improved processing of sewage, restricting air pollution by a better system of vehicle-exhaust-emission controls and increasing the efficiency of present refuse-disposal systems.

In view of the increased awareness in the country of the advantages of the form of market-economy practised in West Germany, it is not surprising that the Federal government, particularly in its dealings with the Federation of German Industry, should request that the dangers of environmental pollution be overcome within the framework of the market-economy. This means that there are no plans for the granting of governmental subsidies to combat industrial pollution. With the present decline in state revenue the government can not

and does not intend to do more than pass certain anti-pollution laws and to continue to carry out research to keep up-to-date with events in the sector. But, if the Minister of the Interior has his way, there will be limited tax relief for those firms carrying out environmental protective measures. For Bonn it is a question of finding a balance between what is “economically” desirable and what is ecologically necessary. And the most far-reaching results *have to be achieved* with the limited means made available.

Germany in many ways mirrors the future of Britain—this is true economically, ecologically and in the legislative field. Not only is she a long-standing member of the community Britain hopes to join in the near future, she has also reached a stage of economic development, particularly in the industrial sphere, which Britain has yet to emulate. Whether this stage of development is utopian or nightmarish is another question—the fact remains that it is the writing on the wall for Britain. So an intelligent British observer should view the Federal Republic’s efforts to control environmental deterioration with more than academic interest. The Bonn government’s overall plans for conservation will make particularly interesting reading when they are published later in the year.

The Politics of Pollution

by

David N. Leff

When 202 official environmentalists, sent by 28 governments of Europe plus the United States of America, foregathered last May in Prague, they spoke for 25 per cent of the earth's surface, 30 per cent of its inhabitants, 85 per cent of its technology, and 80 per cent of its waste.

The latter percentages were stated to the gathering by Janez Stanovnik of Yugoslavia, who directs the United Nations Economic Commission for Europe (ECE), which sponsored the Prague conclave. The initiative for convening a conference of our planet's principal polluting powers, to undertake ways and means of salvaging its human environment, was taken by the ECE in 1967, when Sweden's Gunnar Myrdal still headed the Geneva-based UN body. The resulting *Conférence sur les Problèmes Relatifs à l'Environnement* was invited by Czechoslovakia to take place in Prague in the Spring of 1971.

Then at the eleventh hour—scarcely three days before the Conference was due to open in Prague, on Monday, 3 May, events in Geneva conspired to downgrade the environment meeting from a "Conference", empowered to take decisions committing the ECE, to the status of a mere "Symposium" of government experts convened by the ECE to talk but not to act.

What happened on Thursday, 29 April in Geneva, at the ECE's 26th session, was the flare-up of a foreseeable issue—East Germany's status in the imminent Environment Conference. Unlike the German Federal Republic, the German Democratic Republic is not a member state of ECE. However its advanced industrialisation, and frontage on two of Europe's most pollution-perilled bodies of water, the Baltic Sea and the Danube River, would make any environmental Concert of Europe an exercise in futility without the participation of the East Germans.

Rather than accepting East Germany's presence on a par with that of

West Germany, the ECE Geneva session "restructured" the Prague Conference into a Symposium, at which the delegates from the German Democratic Republic would be identified as "Guests of the host country", i.e. Czechoslovakia. This did not prevent them from submitting documents and taking the floor, but it did prevent this first world-level attempt to tackle the planet's pollution problems globally from speaking with the voice of UN authority.

International environmental control thus finds itself in the same *impasse* as world arms control, subordinate in priority to east-west rivalry. In practice, in Prague, the delegates—now designated semantically as "participants"—presented and discussed the very same papers they had prepared in advance. (On many of these, the Secretariat had no time to cross out "Conference" and write in "Symposium").

In any event it was all a charade. At best, the conference as originally planned was to have set up a permanent commission within the ECE to co-ordinate environmental watchdog activities. Instead, such a body was hastily created that Thursday evening in Geneva, in advance of the castrated conference. This subsidiary Sanhedrin, styled, "Senior Advisers to ECE Governments on Environmental Problems", will meet at some future date as yet unspecified to consider the Prague Symposium's deliberations, and what to do about them.

Like other UN agencies, the ECE is a paper-excreting organism. The 82 numbered documents compiled from the Conference/Symposium made a pile of 1,400 mimeographed sheets 11 cms thick, weighing 4 kgs, and distributed to participants in plastic bags (non-degradable).

Prise de Conscience—Sur le Papier

The nucleus of this documentation explosion was a series of "Country Monographs" in which each govern-

ment presented an inventory of its own environmental problems, and measures to solve same. These studies had been generated by an ECE questionnaire, and thus displayed a useful degree of comparability, as well as a certain self-critical soul-searching, a national *nostra culpa* as regards pollution.

As ECE officials repeatedly pointed out, the task of drawing up such a monograph, imposed on each member state by the impending conference, compelled many governments to examine for the first time *as a whole* the encroachments on the lives of their peoples being wrought by energy production, metallurgy and chemical processing, building and other industries, agriculture, forestry and fisheries, transportation and waste disposal. These monographs, and the symposium agenda, analysed the foregoing vertical "problem sectors" in relation to horizontal "problem areas"—metropolitan areas and regions, river basins, industrial regions, countrysides, and zones of historic value and interest.

In its discussions—debate would be too strong a term—the Prague parley reconfirmed that effluents are no respecters of ideology, that advanced socialist states are beset by the same foul air and dirty water as advanced capitalist countries—and that counter-measures taken to date are essentially the same, both in kind and in results. The closest thing to an east-west doctrinal controversy took place in an open Panel Discussion among expert consultants (not government representatives) brought together to ventilate the theme of Socio-Economic Action on National and International Levels for Environmental Improvement.

In a keynote parable addressed to this Panel, ECE Director Stanovnik observed: "There are two methods of water treatment. The first is to take pure water, add artificial colouring and sugar, and sell it as 'Coca Cola'. The second way is to take black water from the Rhine River, and remove its colouring by purification. Why is the first



A session of the ECE "symposium" in progress.

method a form of economic consumption: the second not?"

Extending this paradox to the shibboleths which seem to set contemporary economic theory and practice at loggerheads with environmental protection imperatives, the panelists of east and west concurred that "consumption" no longer counts as the decisive indicator of "living standards". Henceforth, the SOL (standard of living) index must be equated not narrowly with GNP (gross national product) but broadly with human well-being and quality of life. The present crisis of environmental conscience, to cite Stanovnik again, is one of welfare versus production, development versus growth, civilisation versus technology.

Agreeing that people and governments must rethink their socio-economic desiderata in this direction, the Panel examined the optimum levers for impelling or inducing offenders against the environment to clean up the messes they make. Professor E. Dahmen, Stockholm School of Economics, ad-

vocated a "policy mix" of three stick-and-carrot instruments by which public authorities can impose anti-pollution practices: (1) regulation, enforced by penalties; (2) levying charges for environmental damages; (3) paying subsidies to industries or interests unduly burdened financially by new environmental improvement standards. Of most utility for the long term, said Prof. Dahmen, would be the second formula—charging a fee, presenting a bill, for harm inflicted on the environment. This, more than regulation or subsidy, would stimulate the pollution-producers to develop new technologies and/or new products to cut their costs. This incentive to innovate means enlisting scientific research.

Czechoslovak, Polish and Soviet speakers each told the Panel that socialist planned economies are *ipso facto* able to cope more effectively with anti-pollution costs and consequences than can capitalist market systems. The former, they asserted, can intervene more decisively in the production pro-

cess, and—in socially justified situations—can absorb the costs of cleaning up rather than passing them on to the consumer in the form of higher prices.

The American Panel expert, Mr Allen V. Kneese of Resources for the Future, Inc., questioned whether a centrally planned economy can respond as sensitively to public environmental demands as a free-market economy in which consumer sovereignty has fuller play.

Mr E Hook, planning director at the Swedish Finance Ministry, asked if environmental imperatives will not operate to effect a certain convergence of the socialist and capitalist economies.

Implicit in the discussion, indeed running through the entire Symposium, was the feeling that to cope with the environment will call not just for new fiscal strategies but a transformed public policy ethic. "Instead of dealing with environmental problems as a sub-system of the economic system", wrote Bertrand de Jouvenal in a study prepared for the Panel, "we must regard the economic system as a sub-system of Man's relationship with Nature". Evoking the impossibility of quantifying human satisfactions, de Jouvenal recalled:

"In Rousseau's *Dialogues* he states that he used to do an hour's walk for the pleasure of hearing the nightingale sing at Bercy (a place where no nightingale would live today). Can we say that he thereby proved the consumer value of the nightingale's song to be worth at least the cost of an hour's walk? But to whom? And what is the monetary equivalent of an hour's walk? Whose walk?"

From Prague to Stockholm?

After comparing a week of notes and experiences in Prague (May 3rd to 11th), after finding a substantial consensus on the causes and cures of environmental disfunction in the ECE area of the globe, after journeying to view the slag-heaps, blast-furnaces, pit-heads and remarkable clean-up efforts of the Ostrava coal and iron region in north-central Czechoslovakia (plus a side excursion to similar scenes of man-made inferno and redemption at nearby Katowice, Poland), the participants dispersed. The UN's first across-the-board attack on pollution passed into history. It will have to find a way of curbing doctrinaire bickerings if the main Stockholm conference is not to pass into history with as little effect.

Tibetans in Wales

by Michael Allaby

The survival of Tibetan culture may be more important than we realise. If ways can be devised whereby small groups of Tibetans are able to live their own lives, preserving their language, religion and customs, surrounded by a larger society, it will mean there can be a future for minority peoples all over the world.

The farm school described in this article cannot guarantee the survival of the Tibetan way of life, but its success will help.

The pigeons had eaten all the young cabbages. It is a minor disaster with which every British farmer is familiar. But the cabbages had been the first vegetable crop and the two boys were disappointed. The potatoes, onions and carrots were planted, but the cabbages had been ahead. They were cheerful, though, and accepted their setback philosophically. There is not much any farmer can do to defend his crops against the pigeons and for these boys the problem was further complicated by the fact that no solution would be acceptable to them if it involved killing the birds. The boys are Tibetan Buddhists and to them all life is sacred.

They live and farm in a beautiful valley in Breconshire, preparing the ground for students from developing countries who will spend two years in the Welsh hills, learning farming as well as a range of rural crafts such as blacksmithing, spinning, milling and carpentry, and then return to their own countries taking with them skills they can pass on to others, skills that will help to raise standards of living. The Tibetans will come from India, but although many of them have lived there a long time, they are not Indians. They are refugees and for the time being India is their home, but they are Tibetans and they believe, every one of them, that one day they will return to their high plateau, deep valleys and mountains.

The two boys are called Sonam Tsering and Lobsang Ngodup. They went to school in India and for them this is further education of a very practical nature. They work with three other Tibetans on a 200 acre hill farm owned by the McLaren Foundation and leased to the "Tibetan Farm School (STRIVE) Ltd." The initials stand for Society for Training in Rural Industries and Village Enterprises.

The farm is on the side of a valley with almost unlimited grazing on the hills above it. The plan is to divide the farm first into four 6 or 7 acre smallholdings. Each of these will be farmed by a "family" of two girls and four boys, all of them straight from school. They will raise their domestic animals on their plots—a cow, poultry and pigs—and they will have a share in the sheep flock that grazes the hills. They will aim to feed and clothe themselves from their plot, and crop rotations have already been devised that will provide wheat grain for bread and barley for the Tibetans' staple dish, "tsampa", as well as grazing and fodder crops for their animals. They will have oxen to work, ponies to ride and dogs if they want them. The four smallholdings and the "home farm" which together comprise the estate will work as a co-operative. The students will meet for training and they will share the work on the "home farm", which will be equipped with better implements than

the smallholdings, implements devised specially for developing countries on principles evolved by the Intermediate Technology Development Group Ltd. The "home farm" will grow cereals to be stockpiled as a reserve as well as most of the vegetables, under the supervision of the farm manager, Donald West.

Already the first crops are growing, there is a commercial herd of 17 cattle that provide milk, butter and cheese, there are two pigs, 18 hens and 400 ewes which, with their followers, make a flock of 900 sheep. When the project is in full swing the size of the sheep flock will be reduced and there will be more cattle, poultry and pigs. Teams of oxen will be trained and there are four horses, two of them with foals.

The aim is to train people in subsistence farming. Although it has the backing of the Indian Government and the enthusiastic support of the Dalai Lama, subsistence farming is not universally popular. The official policy has been that aid schemes should aim higher than mere subsistence, and therefore people should be integrated as quickly as possible into a cash economy, leaving only a margin of land and effort for growing their own food. The STRIVE scheme changes the emphasis. First the farmer feeds himself and his family. Cash crops are grown on the side. The difference is fundamental. It implies an acceptance of the

Tibetans playing traditional instruments at the Tibetan Farm School.



fact that the communities concerned are, and should remain, primarily agrarian.

It is this philosophy that wins the support of the Intermediate Technology Development Group, whose view is that equipment should be obtainable and maintainable by the farmers themselves using materials available locally. Developing peoples should be led forward step by step to better technology at a pace they can master and afford. Anything faster than that invariably turns them into beggars and destroys their self-respect. The project also has the support of the Soil Association, because it is based on a relationship between man and the soil which is sound and because it seeks to develop a system of farming that can be sustained indefinitely and which improves the land, rather than depleting it.

STRIVE was started by Sedley and Diana Sweeny. For 10 years they farmed only a few miles from the present farm. They left to go to India and work among the Tibetan refugees. It was there that they met and came to know the Tibetans.

There are a number of reasons for starting the STRIVE farm in Wales.

Conditions in the Brecon Beacons are somewhat similar to those in Tibet and the Himalayan foothills. The same crops can be grown, the same livestock reared. The people are rather similar, too, and the Tibetans are accepted by the Welsh farmers. They are all highlanders and in this part of Wales farmers have not yet been swept completely into the industrial age. The old crafts still survive. This is important, because it means instructors in rural crafts are easily available. In fact the people round about are more than willing to help. The Forestry Commission has planted trees that stretch away over the hills and that border the farm. The forester has agreed to teach the students forestry and to allow them to manage a small area of woodland themselves. The Nature Conservancy is interested in their plan to make a nature reserve on a part of the farm that is too steep to cultivate. The local planning officer is advising on grants to which they may be entitled. There is a tremendous fund of goodwill.

The Sweenys manage the farm, but Sedley is also the principal fund raiser and this is another reason for starting in Wales; the funds are in Britain and

it would have been impractical to place so much distance between the funds and the project, or, for that matter, between the funds and the fund raiser!

There is one more reason for choosing Wales. The project with the Tibetans is to act as pilot. When it is running successfully the Government of India has asked that a second school be established in India. There is a possibility, too, of one starting in Malawi. Hill farming is hill farming, and techniques that suit one hill farmer should be easily adaptable to the needs of another. Eventually the Welsh farm school will train instructors who will go back to their own countries to start schools there.

The main buildings are being converted by the advance party. Two cottages will be made into hostels, one for boys and the other for the girls. A barn will be made into a recreation room and shrine. The girls' hostel is almost ready. The small, white-painted Welsh farm cottage wears a gay string of red, white, blue, green and yellow prayer flags that flutter between the two chimneys. Outside a tall and very new flagpole carries one large, white flag and a number of smaller coloured



Mr and Mrs Sweeney with three of the Tibetans they are training in subsistence farming. The Forestry Commission plantation is in the background.

ones. There is a notice on the gate warning that this is a sanctuary and no firearms may be carried.

Keeping the tourists at bay is something of a problem. The farm is remote and difficult to find, but still the sightseers turn up to sit and gaze through the gate as though the Tibetans were specimens in a zoo. Casual visitors are not encouraged.

The chief agricultural instructor is Donald West, a Scot from Edinburgh who managed a large family estate for 13 years before leaving to become the National Farmers' Union area secretary in Cornwall, where he lived for two years. He has studied crofting and has a deep understanding of subsistence farming.

The first contingent of students is expected late this summer. Four girls and six boys will arrive, accompanied by a senior monk. He will complete the Tibetan staff and in some ways his job is most important of all. He will teach Tibetan language, history, art, music, drama and religion. The aim of this school is not to turn out Welsh farmers, or even Indian farmers, but Tibetan farmers who are Tibetan. If Tibet is to survive, if these people are

to return one day to homes, a country and a way of life that are truly their own, then viable communities of them must preserve, develop and adjust to a changing world the customs and traditions that make them Tibetan.

There is in this no element of preservation for its own sake. STRIVE is not a zoo or a cultural museum. The old way of life was not perfect and if it is to satisfy future generations it must be allowed to develop in its own way. There is a very real danger that caught between the cultural giants of China to the east and India to the south, the Tibetan way of life may disappear. Communities will break up as young people leave to seek jobs in the cities, customs and patterns of behaviour are abandoned as "old fashioned", the language declines as the children come to speak only the language of the larger society that surrounds them. Step by step the culture itself dies and we have moved a little closer to a monocultural world. Perhaps it is appropriate that the Tibetans should feel at home among the Welsh.

STRIVE is ambitious and its success is important. Starting it has been a long and complicated business and

people with less faith, enthusiasm and determination than the Sweenys might have given up. They did not give up, but the real struggle has only just begun. They need support in the form of money and goods, and they need it now.

The success of STRIVE will not, by itself, ensure the survival of Tibetan culture, but it will help, and the survival of Tibetan culture may be more important than we realise. If ways can be devised by which fairly small groups of Tibetans are able to live their own life surrounded by a larger society, it will mean there can be a future for minority peoples all over the world. This in turn will mean there is a chance of maintaining a cultural diversity which may be seen to have a real survival value as we move closer to the environmental crises that lie ahead.

Readers who would like to help should send donations to STRIVE Tibetan Farm School, Coity Mawr, Talybont-on-Usk, Breconshire.

Alternatives to Catastrophe

by
Jay W. Forrester

Understanding the counterintuitive behaviour of social systems, Part Two

Characteristics of Social Systems

I turn now to some characteristics of social systems that mislead people. These have been identified in our work with corporate and urban systems and in more recent work that I will describe concerning the worldwide pressures that are now enveloping our planet.

First, social systems are inherently insensitive to most policy changes that people select in an effort to alter the behaviour of the system. In fact, a social system tends to draw our attention to the very points at which an attempt to intervene will fail. Our experience, which has been developed from contact with simple systems, leads us to look close to the symptoms of trouble for a cause. When we look, we discover that the social system presents us with an apparent cause that is plausible according to what we have learned from simple systems. But this apparent cause is usually a coincident occurrence that, like the trouble symptom itself, is being produced by the feedback-loop dynamics of a larger system. For example, as already discussed, we see human suffering in the cities; we observe that it is accompanied (some think caused) by inadequate housing. We increase the housing and the population rises to compensate for the effort. More people are drawn into and trapped in the depressed social system. As another example, the symptoms of excess population are beginning to overshadow the country. These symptoms appear as urban crowding and social pressure. Rather than face the population problem squarely we try to relieve the immediate pressure

by planning industry in rural areas and by discussing new towns. If additional urban area is provided it will temporarily reduce the pressures and defer the need to face the underlying population question. The consequence, as it will be seen 25 years hence, will have been to contribute to increasing the population so much that even today's quality of life will be impossible.

A second characteristic of social systems is that all of them seem to have a few sensitive influence points through which the behaviour of the system can be changed. These influence points are not in the locations where most people expect. Furthermore, if one identifies in a model of a social system a sensitive point where influence can be exerted, the chances are still that a person guided by intuition and judgment will alter the system in the wrong direction. For example in the urban system, housing is a sensitive control point but, if one wishes to revive the economy of a city and make it a better place for low-income as well as other people, it appears that the amount of low-income housing must be reduced rather than increased. Another example is the world-wide problem of rising population and the disparity between the standards of living in the developed and the underdeveloped countries, an issue arising in the world system to be discussed in the following paragraphs. But it is beginning to appear that a sensitive control point is the rate of generation of capital investment.

And how should one change the rate of capital accumulation? The common answer has been to increase industrialisation, but recent examination suggests

that hope lies only in reducing the rate of industrialisation. This may actually help raise quality of life and contribute to stabilising population.

As a third characteristic of social systems, there is usually a fundamental conflict between the short-term and long-term consequences of a policy change. A policy which produces improvement in the short run, within five to ten years, is usually one which degrades the system in the long run, beyond 10 years. Likewise, those policies and programmes which produce long-run improvement may initially depress the behaviour of the system. This is especially treacherous. The short run is more visible and more compelling. It speaks loudly for immediate attention. But a series of actions all aimed at short-run improvement can eventually burden a system with long-run depressants so severe that even heroic short-run measures no longer suffice. Many of the problems which we face today are the eventual result of short-run measures taken as long as two or three decades ago.

A Global Perspective

I have mentioned social organisations at the corporate level and then touched on work which has been done on the dynamics of the city. Now we are beginning to examine issues of even broader scope.

In July 1970 we held a two-week international conference on world dynamics. It was a meeting organised for the Club of Rome, a private group of about 50 individuals drawn from many countries who have joined together to attempt a better understand-

ing of social systems at the world level. Their interest lies in the same problems of population, resources, industrialisation, pollution, and world-wide disparities of standard of living on which many groups now focus. But the Club of Rome is devoted to taking actions that will lead to a better understanding of world trends and to influencing world leaders and governments. The July meeting at MIT included the general theory and behaviour of complex systems and talks on the behaviour of specific social systems ranging from corporations through commodity markets to biological systems, drug addiction in the community, and growth and decline of a city. Especially prepared for this conference was a dynamic model of the interactions between world population, industrialisation, depletion of natural resources, agriculture, and pollution. A detailed discussion of this world system will soon appear in my book *World Dynamics*, and its further development is the purpose of the "Project on the Predicament of Mankind" being sponsored by the Club of Rome at MIT for a year under the guidance of Professor Dennis Meadows. The plan is to develop a research group of men from many countries who will eventually base their continuing efforts in a neutral country such as Switzerland. The immediate project will re-examine, verify, alter, and extend the preliminary dynamic study of the world system and will relate it to the present world-wide concern about trends in civilisation.*

The simple model of world interactions as thus far developed shows several different alternative futures depending on whether population growth is eventually suppressed by shortage of natural resources, by pollution, by crowding and consequent social strife, or by insufficient food. Malthus dealt only with the latter, but it is possible for civilisation to encounter other controlling pressures before a food shortage occurs.

It is certain that resource shortage, pollution, crowding, food failure, or some other equally powerful force will limit population and industrialisation if persuasion and psychological factors do not. Exponential growth cannot continue forever. Our greatest immediate challenge is how we guide the transition from growth to equilibrium. There are many possible mechanisms of growth suppression. That some one

or combination will occur is inevitable. Unless we come to understand and to choose, the social system by its internal processes will choose for us. The natural mechanisms for terminating exponential growth appear to be the least desirable. Unless we understand and begin to act soon, we may be overwhelmed by a social and economic system we have created but can't control.

The diagram† shows the structure that has been assumed. It interrelates the mutual effects of population, capital investment, natural resources, pollution, and the fraction of capital devoted to agriculture. These five system "levels" are shown in the rectangles. Each level is caused to change by the rates of flow in and out, such as the birth rate and death rate that increase and decrease population. As shown by the dotted lines, the five system levels, through intermediate concepts shown at the circles, control the rates of flow. As an example, the death rate at Symbol 10 depends on population P and the "normal" lifetime as stated by death rate normal DRN. But death rate depends also on conditions in other parts of the system. From Circle 12 comes the influence of pollution that here assumes death rate to double if pollution becomes 20 times as severe as in 1970; and, progressively, that death rate would increase by a factor of 10 if pollution became 60 times as much as now. Likewise from Circle 13 the effect of food per capita is to increase death rate as food becomes less available. The detailed definition of the model states how each rate of flow is assumed to depend on the levels of population, natural resources, capital investment, capital devoted to food, and pollution.

Individually the assumptions in the model are plausible, create little disagreement, and reflect common discussions and assertions about the individual responses within the world system. But each is explicit and can be subjected to scrutiny. From one viewpoint, the system of Figure 1 is very simplified. It focuses on a few

major factors and omits most of the substructure of world social and economic activity. But from another viewpoint, Figure 1 is comprehensive and complex. The system is far more complete and the theory described by the accompanying computer model is much more explicit than the mental models that are now being used as a basis for world and governmental planning. It incorporates dozens of nonlinear relationships. The world system shown here exhibits provocative and even frightening possibilities.

Transition from Growth to Equilibrium

With the model specified, a computer can be used to show how the system, as described for each of its parts, would behave. Given a set of beginning conditions, the computer can calculate and plot the results that unfold through time.

The world today seems to be entering a condition in which pressures are rising simultaneously from every one of the influences that can suppress growth—depleted resources, pollution, crowding, and insufficient food. It is still unclear which will dominate if mankind continues along the present path. Figure 2 shows the mode of behaviour of this world system given the assumption that population reaches a peak and then declines because industrialisation is suppressed by falling natural resources. The model system starts with estimates of conditions in 1900. Adjustments have been made so that the generated paths pass through the conditions of 1970.

In Figure 2 the quality of life peaks in the 1950's and by 2020 has fallen far enough to halt further rise in population. Declining resources and the consequent fall in capital investment then exert further pressure to gradually reduce world population.

But we may not be fortunate enough to run gradually out of natural resources. Science and technology may very well find ways to use the more plentiful metals and atomic energy so that resource depletion does not intervene. If so, the way then remains open for some other pressure to arise within the system. Figure 3 shows what happens within this system if the resource shortage is foreseen and avoided. Here the only change from Figure 2 is the usage rate of natural resources after the year 1970. In Figure 3, resources are

* The continuing project was made possible by financial support from the Volkswagen Foundation (Stiftung Volkswagenwerk) of West Germany.

† All figures are taken from the manuscript for *World Dynamics* by Jay W. Forrester, Wright-Allen Press, 238 Main Street, Cambridge, Mass. 02142, now published. The diagram (Figure 1) appears with the first part of this article published last month.

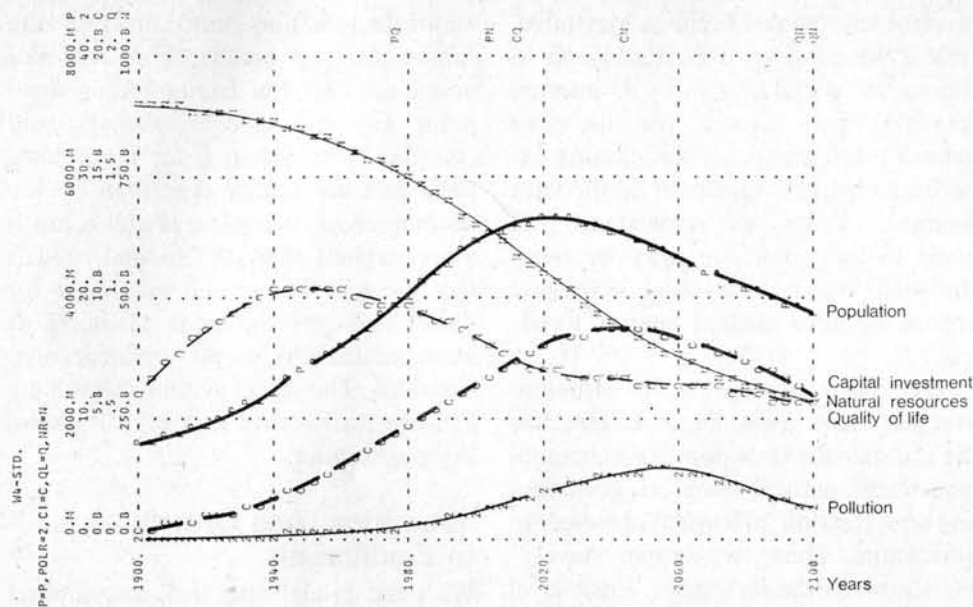


Figure 2

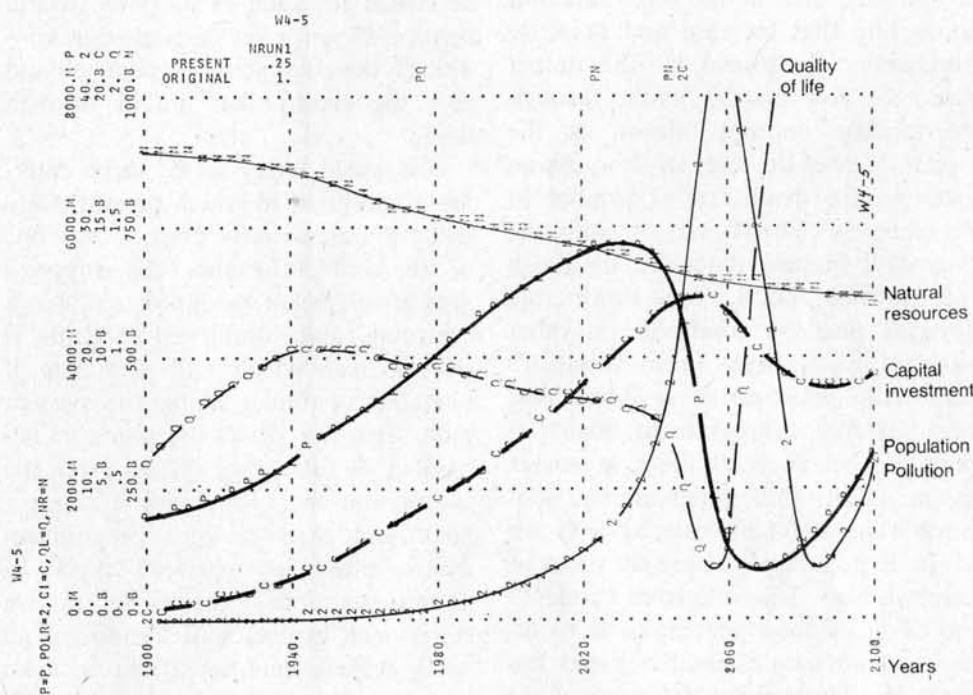


Figure 3

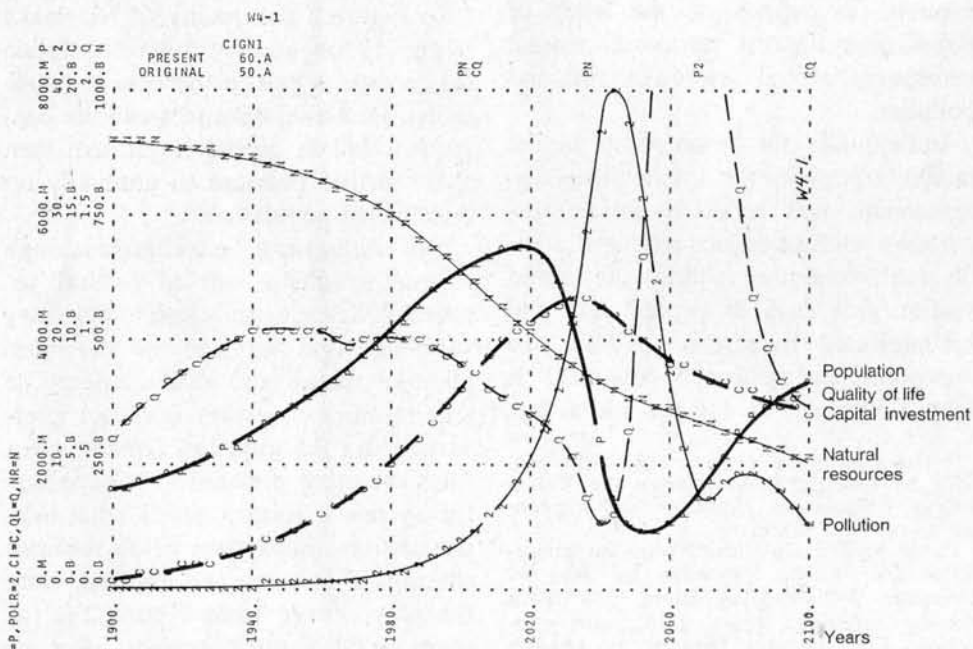


Figure 4

used after 1970 at a rate 75 per cent less than assumed in Figure 2. In other words, the standard of living is sustained with a lower drain on the expendable and irreplaceable resources. But the picture is even less attractive! By not running out of resources, population and capital investment are allowed to rise until a pollution crisis is created. Pollution then acts directly to reduce birth rate, increase death rate, and to depress food production. Population which, according to this simple model, peaks at the year 2030 has fallen to one-sixth of the peak population within an interval of 20 years—a world-wide catastrophe of a magnitude never before experienced. Should it occur, one can speculate on which sectors of the world population will suffer most. It is quite possible that the more industrialised countries (which are the ones which have caused such a disaster) would be the least able to survive such a disruption to environment and food supply. They might be the ones to take the brunt of the collapse.

Figure 3 shows how a technological success (reducing our dependence in natural resources) can merely save us from one fate only to fall victim to something worse (a pollution catastrophe). There is now developing throughout the world a strong undercurrent of doubt about technology as the saviour of mankind. There is a basis for such doubt. Of course, the source of trouble is not technology as such but is instead the management of the entire technological-human-political-economic-natural complex.

Figure 3 is a dramatic example of the general process discussed earlier wherein a programme aimed at one trouble symptom results in creating a new set of troubles in some other part of the system. Here the success in alleviating a natural resource shortage throws the system over into the mode of stopping population caused by industrialisation which has been freed

Fig. 2. Population reaches a peak and then declines because industrialisation is suppressed by falling natural resources.

Fig. 3. Resources are used after 1970 at a rate 75 per cent less than assumed in Fig. 2.

Fig. 4. In 1970, the rate of capital accumulation is increased by 20 per cent in an effort to reverse the beginning decline in quality of life. The pollution crisis occurs before natural resources are depleted.

from natural resource restraint. This process of a solution creating a new problem has defeated many of our past governmental programmes and will continue to do so unless we devote more effort to understanding the dynamic behaviour of our social systems.

Alternatives to Decline or Catastrophe

Suppose in the basic world system of Figures 1 and 2 we ask how to sustain the quality of life which is beginning to decline after 1950. One way to attempt this, and it is the way the world is now choosing, might be to increase the rate of industrialisation by raising the rate of capital investment. Models of the kind we are here using make such hypothetical questions answerable in a few minutes and at negligible cost. Figure 4 shows what happens if the "normal" rate of capital accumulation is increased by 20 per cent in 1970. The pollution crisis reappears. This time the cause is not the more efficient use of natural resources but the upsurge of industrialisation which overtaxes the environment before resource depletion has a chance to depress industrialisation. Again, an "obvious" desirable change in policy has caused troubles worse than the ones that were originally being corrected.

This is important, not only for its own message but because it demonstrates how an apparently desirable change in a social system can have unexpected and even disastrous results.

Figure 4 should make us cautious about rushing into programmes on the basis of short-term humanitarian impulses. The eventual result can be anti-humanitarian. Emotionally inspired efforts often fall into one of three traps set for us by the nature of social systems: The programmes are apt to address symptoms rather than causes and attempt to operate through points in the system that have little leverage for change; the characteristic of systems whereby a policy change has the opposite effect in the short run from the effect in the long run can eventually cause deepening difficulties after a sequence of short-term actions; and the effect of a programme can be along an entirely different direction than was originally expected, so that suppressing one symptom only causes trouble to burst forth at another point.

Figure 5 retains the 20 per cent addi-

tional capital investment rate after 1970 from Figure 4 but in addition explores birth reduction as a way of avoiding crisis. Here the "normal" birth rate has been cut in half in 1970. (Changes in normal rates refer to coefficients which have the specified effect if all other things remain the same. But other things in the system change and also exert their effect on the actual system rates.) The result shows interesting behaviour. Quality of life surges upward for 30 years for the reasons that are customarily asserted. Food-per-capita grows, material standard of living rises, and crowding does not become as great. But the more affluent world population continues to use natural resources and to accumulate capital plant at about the same rate as in Figure 4. Load on the environment is more closely related to industrialisation than to population and the pollution crisis occurs at about the same point in time as in Figure 4.

Figure 5 shows that the 50 per cent reduction in "normal" birth rate in 1970 was sufficient to start a decline in total population. But the rising quality of life and the reduction of pressures act to start the population curve upward again. This is especially evident in other computer runs where the reduction in "normal" birth rate is not so drastic. Serious questions are raised by this investigation about the effectiveness of birth control as a means of controlling population. The secondary consequence of starting a birth control programme will be to increase the influences that raise birth rate and reduce the apparent pressures that require population control. A birth control programme which would be effective, all other things being equal, may largely fail because other things will not remain equal. Its very incipient success can set in motion forces to defeat the programme.

Figure 6 combines the reduced resource usage rate and the increased capital investment rate of Figures 3 and 4. The result is to make the population collapse occur slightly sooner and more severely. Based on the modified system of Figure 6, Figure 7 then examines the result if technology finds ways to reduce the pollution generated by a given degree of industrialisation. Here in Figure 7, the pollution rate, other things being the same, is reduced by 50 per cent from that in Figure 6. The result is to postpone the day of reckoning by 20 years and to allow the world population to grow 25 per cent greater before the

population collapse occurs. The "solution" of reduced pollution has, in effect, caused more people to suffer the eventual consequences. Again we see the dangers of partial solutions. Actions at one point in a system that attempt to relieve one kind of distress produce an unexpected result in some other part of the system. If the interactions are not sufficiently understood, the consequences can be as bad or worse than those that led to the initial action.

There are no utopias in our social systems. There appear to be no sustainable modes of behaviour that are free of pressures and stresses. But there are many possible modes and some are more desirable than others. Usually, the more attractive kinds of behaviour in our social systems seem to be possible only if we have a good understanding of the system dynamics and are willing to endure the self-discipline and pressures that must accompany the desirable mode. The world system of Figure 1 can exhibit modes that are more hopeful than the crises of Figures 2 through 7. But to develop the more promising modes will require restraint and dedication to a long-range future that man may not be capable of sustaining.

Figure 8 shows the world system if several policy changes are adopted together in the year 1970. Population is stabilised. Quality of life rises about 50 per cent. Pollution remains at about the 1970 level. Would such a world be accepted? It implies an end to population and economic growth.

In Figure 8 the normal rate of capital accumulation is *reduced* 40 per cent from its previous value. The "normal" birth rate is reduced 50 per cent from its earlier value. The "normal" pollution generation is reduced 50 per cent from the value before 1970. The "normal" rate of food production is *reduced* 20 per cent from its previous value. (These changes in "normal" values are the changes for a specific set of system conditions. Actual system rates continue to be affected by the varying conditions of the system.) But reduction in investment rate and reduction in agricultural emphasis are counterintuitive and not likely to be discovered or accepted without extensive system studies and years of argument—perhaps more years than are available. The changes in pollution generation and natural resource usage may be easier to understand and to achieve. The severe reduction in world-wide birth rate is the most doubtful.

Even if technical and biological methods existed, the improved condition of the world might remove the incentive for sustaining the birth reduction emphasis and discipline.

Future Policy Issues

The dynamics of world behaviour bear directly on the future of the United States. American urbanisation and industrialisation are a major part of the world scene. The United States is setting a pattern that other parts of the world are trying to follow. That pattern is not sustainable. Our foreign policy and our overseas commercial activity seem to be running contrary to overwhelming forces that are developing in the world system. The following issues are raised by the preliminary investigations to date. They must, of course, be examined more deeply and confirmed by more thorough research into the assumptions about structure and detail of the world system.

Industrialisation may be a more fundamentally disturbing force in world ecology than is population. In fact, the population explosion is perhaps best viewed as a result of technology and industrialisation. I include medicine and public health as a part of industrialisation.

Within the next century, man may be facing choices from a four-pronged dilemma—suppression of modern industrial society by a natural resource shortage, collapse of world population from changes wrought by pollution, population control by war, disease, and social stresses caused by physical and psychological crowding.

We may now be living in a “golden age” where, in spite of the world-wide feeling of malaise, the quality of life is, on the average, higher than ever before in history and higher now than the future offers.

Efforts for direct population control may be inherently self-defeating. If population control begins to result as hoped in higher per capita food supply and material standard of living, these very improvements can generate forces to trigger a resurgence of population growth.

The high standard of living of modern industrial societies seems to result from a production of food and material goods that has been able to outrun the rising population. But, as agriculture reaches a space limit, as industrialisation reaches a natural-resource limit, and as both

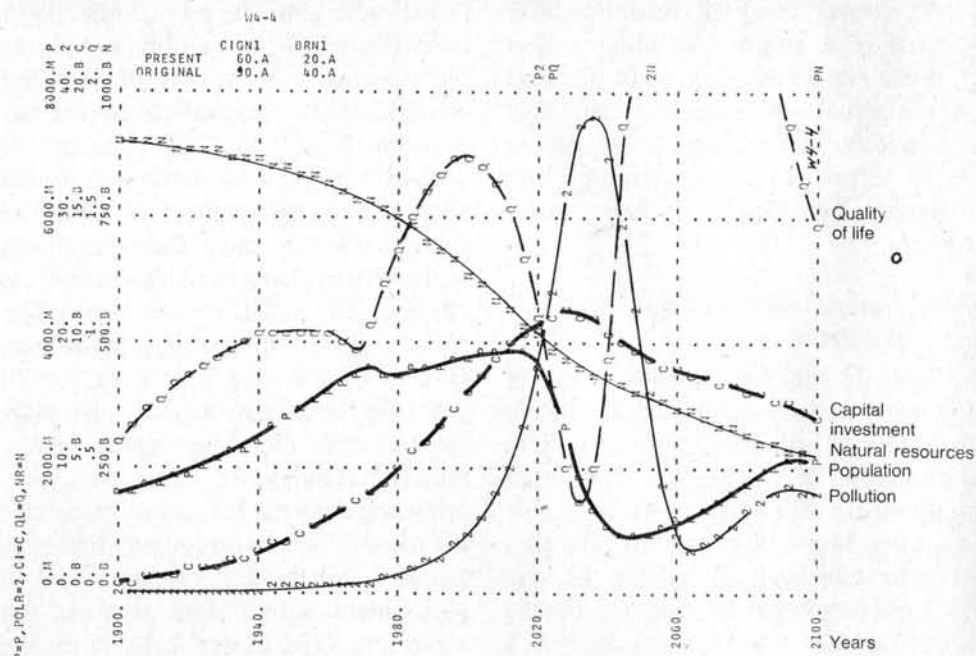


Figure 5

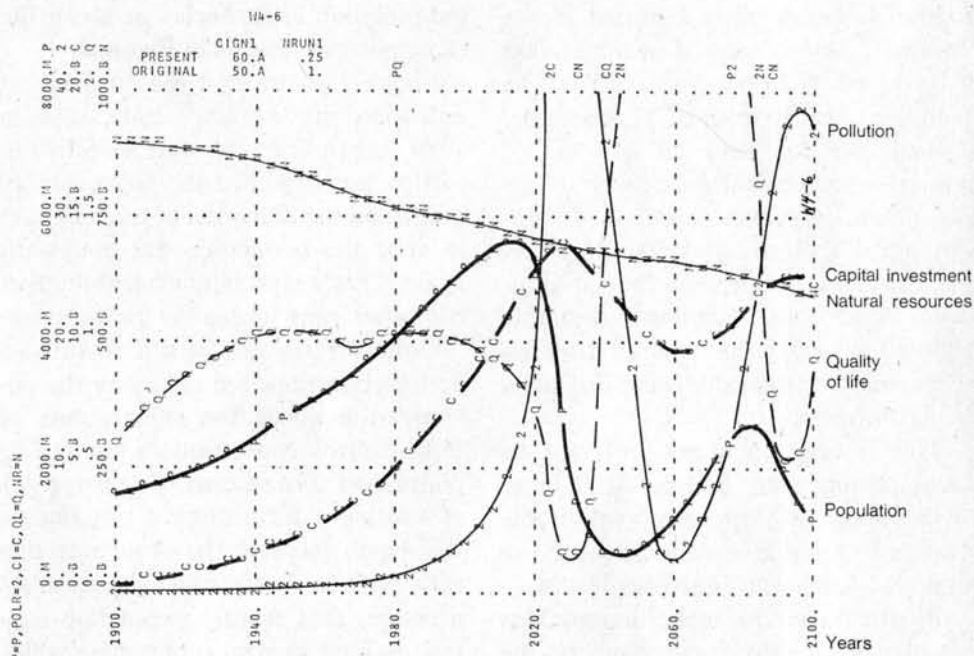


Figure 6

reach a pollution limit, population tends to catch up. Population then grows until the “quality of life” falls far enough to generate sufficiently large pressures to stabilise population.

There may be no realistic hope for the present underdeveloped countries reaching the standard of living demonstrated by the present industrialised nations. The pollution and natural resource load placed on the world environmental system by each person in an advanced country is probably 10 to 20 times greater than the load now generated by a person in an underdeveloped country. With four times as much population in underdeveloped countries as in the present developed countries, their rising to the economic level of the

United States could mean an increase of 10 times in the natural resource and pollution load on the world environment. Noting the destruction that has already occurred on land, in the air, and especially in the oceans, no capability appears to exist for handling such a rise in standard of living for the present total population of the world.

A society with a high level of industrialisation may be unsustainable. It may be self-extinguishing if it exhausts the natural resources on which it depends. Or, if unending substitution for declining natural resources is possible, the international strife over “pollution and environmental rights” may pull the average world-wide standard of living back to the level of a century ago.

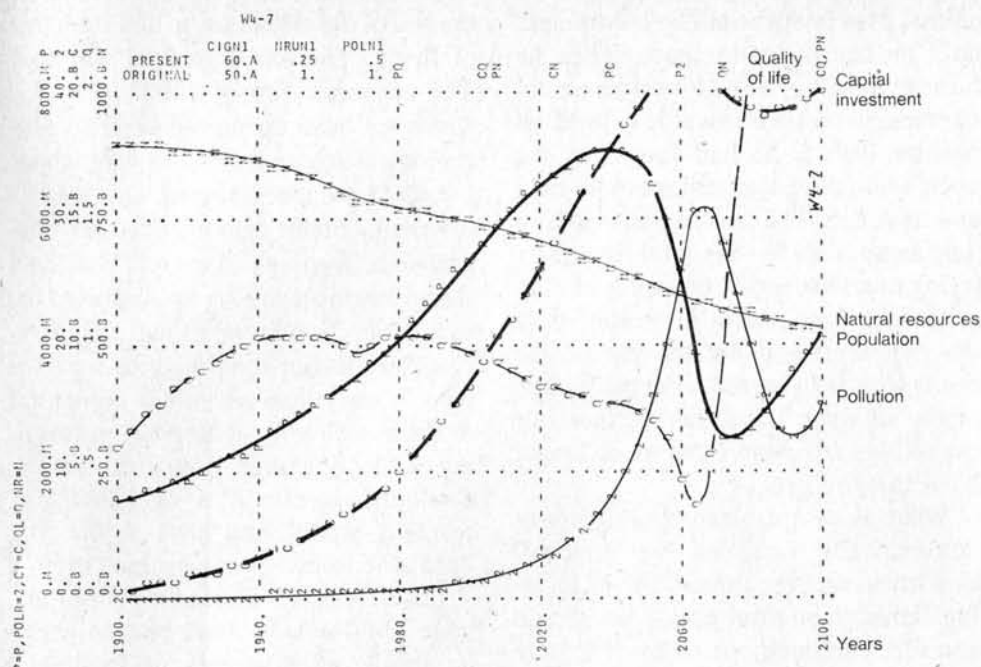


Figure 7

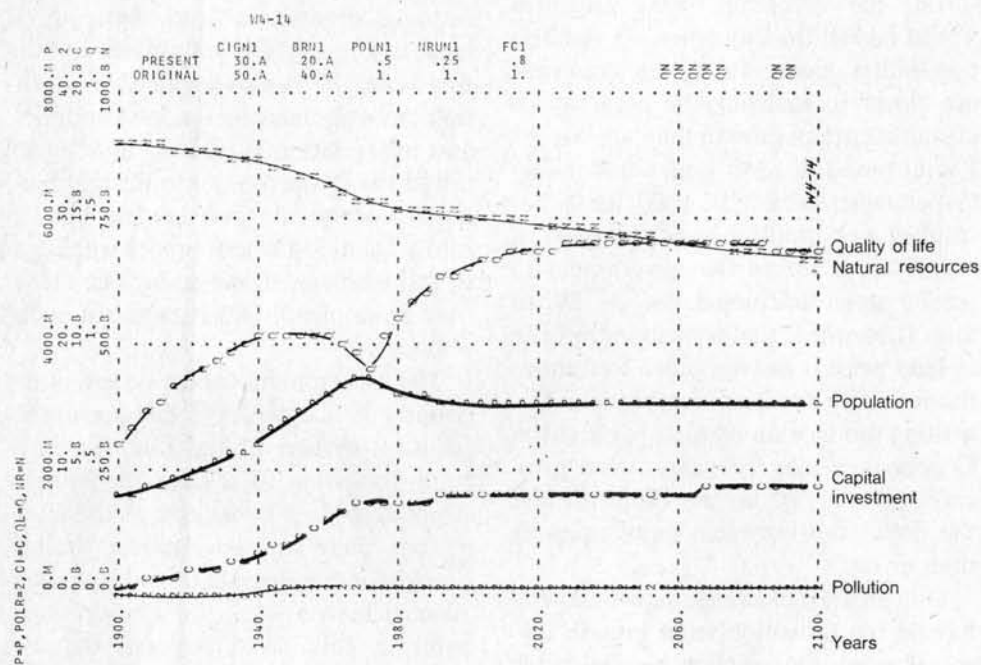


Figure 8

Fig. 5. In 1970 the 20 per cent increase in capital accumulation from fig. 4 is retained, and "normal" birth-rate is reduced 50 per cent. Capital investment continues to grow until the pollution crisis develops. After an initial decline, population is again pushed up by a rapid rise in quality of life that precedes the collapse.

Fig. 6. The 20 per cent increase of capital investment from fig. 4 and the 75 per cent reduction of natural resource usage from fig. 3 are combined.

Fig. 7. Increased capital investment rate and reduced natural resource usage from fig. 6 are retained. In addition in 1970 the "normal" rate of pollution generation is reduced 50 per cent. The effect of pollution control is to allow population to grow 25 per cent further and to delay the pollution crisis by 20 years.

Fig. 8. One set of conditions that establishes a world equilibrium. In 1970 capital investment rate is reduced 40 per cent, birth rate is reduced 50 per cent, pollution generation is reduced 50 per cent, natural resource usage rate is reduced 75 per cent, and food production is reduced 20 per cent.

From the long view of a hundred years hence, the present efforts of underdeveloped countries to industrialise along Western patterns may be unwise. They may now be closer to the ultimate equilibrium with the environment than are the industrialised nations. The present underdeveloped countries may be in a better condition for surviving the forthcoming world-wide environmental and economic pressures than are the advanced countries. When one of the several forces materialises that is strong enough to cause a collapse in world population, the advanced countries may suffer far more than their share of the decline.

A New Frontier

It is now possible to take hypotheses about the separate parts of a social system, to combine them in a computer model, and to learn the consequences. The hypotheses may at first be no more correct than the ones we are using in our intuitive thinking. But the process of computer modelling and model testing requires these hypotheses to be stated more explicitly. The model comes out of the hazy realm of the mental model into an unambiguous model or statement to which all have access. Assumptions can then be checked against all available information and can be rapidly improved. The great uncertainty with mental models is the inability to anticipate the consequences of interactions between the parts of a system. This uncertainty is totally eliminated in computer models. Given a stated set of assumptions, the computer traces the resulting consequences without doubt or error. This is a powerful procedure for clarifying issues. It is not easy. Results will not be immediate.

We are on the threshold of a great new era in human pioneering. In the past there have been periods characterised by geographical exploration. Other periods have dealt with the formation of national governments. At other times the focus was on the creation of great literature. Most recently we have been through the pioneering frontier of science and technology. But science and technology are now a routine part of our life. Science is no longer a frontier. The process of scientific discovery is orderly and organised.

I suggest that the next frontier for human endeavour is to pioneer a better understanding of the nature of our social systems. The means are visible. The task

will be no easier than the development of science and technology. For the next 30 years we can expect rapid advance in understanding the complex dynamics of our social systems. To do so will require research, the development of teaching methods and materials, and the creation of appropriate educational programmes. The research results of today will in one or two decades find their way into the secondary schools just as concepts of basic physics moved from research to general education over the past three decades.

What we do today fundamentally affects our future two or three decades hence. If we follow intuition, the trends of the past will continue into deepening difficulty. If we set up research and educational programmes, which are now possible but which have not yet been developed, we can expect a far sounder basis for action.

The Nation's Real Alternatives

The record to date implies that our people accept the future growth of United States population as preordained, beyond the purview and influence of legislative control, and as a ground rule which determines the nation's task as finding cities in which the future population can live. But I have been describing the circular processes of our social systems in which there is no unidirectional cause and effect but instead a ring of actions and consequences that close back on themselves. One could say, incompletely, that the population will grow and that cities, space, and food must be provided. But one can likewise say, also incompletely, that the provision of cities, space, and food will cause the population to grow. Population generates pressure for urban growth, but urban pressures help to limit population.

Population grows until stresses rise far enough, which is to say that the quality of life falls far enough, to stop further increase. Everything we do to reduce those pressures causes the population to rise farther and faster and hastens the day when expediencies will no longer suffice. The United States is in the position of a wild animal running from its pursuers. We still have some space, natural resources, and agricultural land left. We can avoid the question of rising population as long as we can flee this bountiful reservoir that nature provided. But it is obvious that the reservoirs are limited. The wild

animal usually flees until he is cornered, until he has no more space. Then he turns to fight, but he no longer has room to manoeuvre. He is less able to forestall disaster than if he had fought in the open while there was still room to yield and to dodge. The United States is running away from its long-term threats by trying to relieve social pressures as they arise. But if we persist in treating only the symptoms and not the causes, the result will be to increase the magnitude of the ultimate threat and reduce our capability to respond when we no longer have space to flee.

What does this mean? Instead of automatically accepting the need for new towns and the desirability of locating industry in rural areas, we should consider confining our cities. If it were possible to prohibit the encroachment by housing and industry onto even a single additional acre of farm and forest, the resulting social pressures would hasten the day when we stabilise population. Some European countries are closer to realizing the necessity of curtailing urban growth than are we. As I understand it, farm land surrounding Copenhagen cannot be used for either residence or industry until the severest of pressures forces the government to rezone small additional parcels. When land is rezoned, the corresponding rise in land price is heavily taxed to remove the incentive for land speculation. The waiting time for an empty apartment in Copenhagen may be years. Such pressures certainly cause the Danes to face the population problem more squarely than do we.

Our greatest challenge now is how to handle the transition from growth into equilibrium. Our society has behind it a thousand years of tradition that has encouraged and rewarded growth. The folklore and the success stories praise growth and expansion. But that is not the path of the future. Many of the present stresses in our society are from the pressures that always accompany the conversion from growth into equilibrium.

In our studies of social systems, we have made a number of investigations of life cycles that start with growth and merge into equilibrium. There are always severe stresses in the transition. Pressures must rise far enough to suppress the forces that produced growth. Not only do we face the pressure that will stop the population growth; we also encounter pressures that will stop

the rise of industrialisation and standard of living. The social stresses will rise. The economic forces will be ones for which we have no precedent. The psychological forces will be beyond those for which we are prepared. Our studies of urban systems demonstrated how the pressures from shortage of land and rising unemployment accompany the usual transition from urban growth to equilibrium. But the pressures we have seen in our cities are minor compared to those which the nation is approaching. The population pressures and the economic forces in a city that was reaching equilibrium have in the past been able to escape to new land areas.

But that escape is becoming less possible. Until now we have had, in effect, an inexhaustible supply of farm land and food-growing potential. But now we are reaching the critical point where, all at the same time, population is overrunning productive land, agricultural land is almost fully employed for the first time, the rise in population is putting more demand on the food supplies, and urbanisation is pushing agriculture out of the fertile areas into the marginal lands. For the first time demand is rising into a condition where supply will begin to fall while need increases. The cross-over from plenty to shortage can occur abruptly.

The fiscal and monetary system of the country is a complex social-economic-financial system of the kind we have been discussing. It is clear the country is not agreed on behaviour of the interactions between government policy, growth, unemployment, and inflation. An article by a writer for *Finance* magazine in July, 1970, suggests that the approach I have been discussing be applied in fiscal and monetary policy and their relationships to the economy. I estimate that such a task would be only a few times more difficult than was the investigation of urban growth and stagnation. The need to accomplish it becomes more urgent as the economy begins to move for the first time from a history of growth into the turbulent pressures that will accompany the transition from growth to one of the many possible kinds of equilibrium. We need to choose the kind of equilibrium before we arrive.

In a hierarchy of systems, there is usually a conflict between the goals of a subsystem and the welfare of the broader system. We see this in the urban system. The goal of the city is to expand

and to raise its quality of life. But this increases population, industrialisation, pollution, and demands on food supply. The broader social system of the country and the world requires that the goals of the urban areas be curtailed and that the pressures of such curtailment become high enough to keep the urban areas and population within the bounds that are satisfactory to the larger system of which the city is a part. If this nation chooses to continue to work for some of the traditional urban goals, and if it succeeds, as it may well do, the result will be to deepen the distress of the country as a whole and eventually to deepen the crisis in the cities themselves. We may be at the point where higher pressures in the present are necessary if insurmountable pressures are to be avoided in the future.

I have tried to give you a glimpse of the nature of multiloop feedback systems, a class to which our social systems belong. I have attempted to indicate how these systems mislead us because our intuition and judgment have been formed to expect behaviour different from that actually possessed by such systems. I believe that we are still pursuing national programmes that will be at least as frustrating and futile as many of the past. But there is hope. We can now begin to understand the dynamic behaviour of our social systems. Progress will be slow. There are many cross-currents in the social sciences which will cause confusion and delay. The approach that I have been describing is very different from the emphasis on data gathering and statistical analysis that occupies much of the time of social research. But there have been breakthroughs in several areas. If we proceed expeditiously but thoughtfully, there is a basis for optimism.

Suggested Readings

Jay W. Forrester, *Industrial Dynamics*. Cambridge, Mass. The MIT Press, 1961.

Jay W. Forrester, *Principles of Systems*. Cambridge (238 Main St.), Mass.: Wright-Allen Press, 1968.

Jay W. Forrester, *World Dynamics*. Cambridge: The MIT Press, 1969.

Jay W. Forrester, *World Dynamics*. (238 Main St.), Mass.: Wright-Allen Press, 1971.

Dennis L. Meadows, *Dynamics of Commodity Production Cycles*. Cambridge (238 Main St.), Mass. Wright-Allen Press, 1970.

In the next issue of The Ecologist

Factory farming—a passing aberration by Ruth Harrison. Factory farming is ethically, socially and ecologically unsound.

Can Leviathan long endure so wide a chase? by Scott McVay. The cruel folly of man's exploitation of the whale.

Towards an adversary system of scientific enquiry by John Goffman and Arthur Tamplin. A proposal of the greatest importance to counterbalance the financial superiority of the proponents of unbridled growth and other anti-ecological forces.

Marx, Engels and ecology by G. N. Syer. How close are Marxism and environmentalism?

The Celtic nations by Peter Berresford Ellis. An historical and ecological appraisal.

Natural farming by Michael Allaby. A case study of a dairy farm run on ecological principles.

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Amendments to previous issues

Insects—key conservationists by M. W. Service. Please note that this article is by M. W. Service, not F. W. Service. We apologise to Dr Service for inadvertently altering his initials.

Coming events

5-12 September—17th International Congress on the diseases of civilisation, food supply and the conditions of life and environment, Montreux, Switzerland. Ste. Int. pour la recherche sur les maladies de civilisation et les substances vitales, Weimershof 26, Luxembourg.

14-17 September—Water Pollution Control exhibition and Institute of Water Pollution Control Annual Conference, Brighton. Details from IWPC, 53 London Road, Maidstone, Kent.

20 September, and every Monday thereafter, at 7.30 pm. Adult Education Course on "The Living World" organised by Crusade Against All Cruelty to Animals at its Humane Education Centre, Avenue Lodge, Bounds Green Road, London N22. Scientists, naturalists and other specialists will contribute 24 authoritative lectures ranging from the world of the soil and vegetation to studies of animal and bird life, wildlife and plant conservation, the biological effects of water pollution in rivers and lakes, marine pollution, effects of pesticides on wildlife and the protection and management of wildlife. Details of enrolment (which must be for whole Course) from above address or telephone 01-889 1595.

28 September-3 October—3rd international show on prevention and the protection of man, his environment and his goods at Paris, Le Bourget. Details from Technoexpo, 8 Rue de la Michodière, Paris 2, France.

29 September-6 October—Understanding Your Environment. A one-week course to be held at Kindrogan Field Centre, Scotland, under the joint auspices of the Soil Association and the Scottish Field Studies Association. Cost £17. Full details from the Warden, Kindrogan Field Centre, Enochdu, Blairgowrie, Perthshire.

4-8 October—Annual Conference of the Association of Public Health Inspectors, Eastbourne. Details from 19 Grosvenor Place, London W1. Tel. 01-235 5158. Details of the environmental health exhibition held in conjunction with the conference from Brintex Exhibitions, 3 St Clement's Place, London WC2. Tel. 01-242 1200.

12-13 October—Water Pollution Research Autumn Lectures on "The design of sampling programmes", "Sludge treatment and filtration", "Population dynamics in the activated-sludge process" and "Fisheries and pollution". Cost £18 including course papers and lunches. Apply to the Director, Water Pollution Research Laboratory, Elder Way, Stevenage, Herts. SG1 1TH.

13-18 October—1st international exhibition for the protection of nature and its environment, Parc des Expositions, Rouen. Details from Protecna, 48 Quai de Paris, 76 Rouen, France.

See also page 27



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Reports

Eating our way to the grave

So long as they turn a blind eye to spreading waistlines and a certain puffiness around the jowls, most nutritionists would claim that the British are eating better than ever before. But they would be hard put to it to convince members of the McCarrison Society—a group of doctors, dentists, vets, and nutritionists who believe faulty nutrition is the key to much of the ill-health in Britain today.

Apart from admitting to a deep-rooted nostalgia for the traditional English countryside, and farms where muck is spread on the fields, members of the McCarrison Society are much disturbed at the trend towards synthesised, intensively grown foodstuffs. These foodstuffs, they claim, are missing out on some of the essential ingredients for good nutrition—and they contain others which are positively harmful.

"Sir Robert McCarrison completed his definitive work on nutrition more than 40 years ago, yet most people in Britain are still basically living on the wrong kind of diet," said Mr Elliot-Smith, former senior surgeon at the Radcliffe Infirmary, Oxford, and now running his own male-sterilisation clinic.

Mr Elliot-Smith refers to studies which show that nearly 60 per cent of all schoolchildren in Britain are on unsatisfactory diets and more than 10 per cent on extremely poor diets. Excessive carbohydrates are consumed, he says (particularly the refined ones such as sugar and white flour), too little vitamins, and the wrong kinds of fats.

McCarrison, Mr Elliot-Smith went on, discovered the secrets behind good nutrition when he was in the Indian Medical Service. He was interested in endemic diseases and he discovered the cause of sandfly fever and of goitre in the foothills of the Himalayas. But what struck him forcibly was the outstanding difference in the physique and health of the northwest frontier tribes—the Mahratties, Sikhs, Pathans, and Hunzas—compared with the peoples of the Plains—the Madrassis, Bengalis, and Kanarese. He came to the con-

clusion that the most distinct differences between the two groups were their diets.

Next, McCarrison tested seven different Indian diets on rats and he got extremely convincing results. Rats fed on a Sikh, Mahratti, Hunza, or a Pathan diet did amazingly well. The Sikh diet was, marginally, the best of all and McCarrison remarked that rats maintained on this diet over five years "suffered no case of illness, no deaths from natural causes, no maternal mortality, no infant mortality."

Rats on a Madrassi, Bengali, or Kanarese diet did very badly. They didn't grow well, and although just as well cared for in all other respects as the other group of rats, their health was poor: they suffered particularly from respiratory and gastrointestinal diseases.

In one telling experiment McCarrison fed rats a typical English working-class diet of the late 1930s—white bread, margarine, over-sweetened tea, boiled cabbage, boiled potato, tinned meat, and tinned jam.

"Not only were the rats badly proportioned," said McCarrison, "their coats lacked gloss, they were nervous and apt to bite their attendants, they lived unhappily together and by the sixtieth day of the experiment they began to kill and eat the weaker ones amongst them."

When McCarrison brought the experiment to an end after half a year he found many of the animals suffering from lung and gastrointestinal diseases. In fact they fared little better, Mr Elliot-Smith says, than rats fed on one of the poorer Indian diets. McCarrison believed it more than coincidence that Britons as well as Madrassis suffered more from respiratory and gastrointestinal diseases than from any other disease, rheumatoid arthritis included.

So what was—and still is—the essential difference between two groups of Indian diets? The northern races are wheat- and other cereal-eaters and they stone-grind the grain fresh to make their chapattis. They also use large quantities of milk, pulse (peas, beans, lentils) fresh vegetables, and fruit. Some of the tribes, like the Hunza, eat very little meat. The Pathans eat a lot.

The Madrassis and Bengalis eat rice. This is subjected to processes which drain it of most of its proteins and mineral salts and almost all its vitamins. They consume relatively little

milk, many of them eat no meat, and they have few fresh vegetables.

"Those experiments of McCarrison's are very relevant today," said Mr Elliot-Smith. "During the war we went back to 80 per cent extraction wheat in our bread, compared with the 70 per cent that was permitted before the war. Many doctors and nutritionists are certain that the health of the nation, and particularly of children improved during the war as a result of eating the higher grade bread."

Elliot-Smith claims it was a tragedy when Lord Cohen's committee on The Composition and Nutritive Value of Flour—despite the evidence put before it by such eminent biochemists as Sir Rudolph Peters—concluded in 1956 that the more finely milled flour used in the 70 per cent loaf was as good for health as the 80 per cent.

The irony is that McCarrison himself had already tested the difference between white flour and whole wheat flour. Rats on white flour alone did appallingly and many died, whereas on whole wheat many of them survived quite well. With the flour supplemented with yeast and butter the rats on white flour showed rather shaky growth, whereas on whole-wheat flour they showed excellent growth. "I have little patience," McCarrison was prompted to remark "with those who have us believe that white flour is as good an article of diet as whole wheat flour."

McCarrison couldn't have a better exponent of his ideas than Dr Johann Georg Schnitzer, a dentist from the Black Forest. Dr Schnitzer has somehow managed to achieve the impossible; he has persuaded a village of several thousand people to change its eating habits from typical consumer society products to wholemeal foods. The results are staggering (and they outdo anything that can be achieved with fluoridation), for the incidence of dental caries among the children has come cascading down.

Dr Schnitzer began his experiment in 1963, in Mönchweiler, where he has his practice. He got the co-operation of the mayor, Günther Sick, who suggested he should write a series of articles in the local paper. Instead Dr Schnitzer printed the articles himself on an old duplicating machine and got them dropped into every home with the local paper. He also organised a meeting with the local bakers and showed them (tactfully) how to bake wholemeal

Reports

bread. Another important step was to persuade local shopkeepers not to give away sweets to children doing the shopping for their parents.

The wholemeal bread soon caught on but equally quickly Dr Schnitzer found himself embroiled in a bitter battle with his own colleagues. The German equivalent of the General Dental Council was called in to investigate and shortly afterwards, Dr Schnitzer was summoned to Freiburg, where he was told that if he pursued his campaign outside the four walls of his practice he would be "struck off".

Dr Schnitzer soon had the Press, including radio and television, on his side. Dozens of articles appeared, criticising the Dental Council for trying to muzzle one of its members and stop him informing the public how to prevent dental caries.

Nevertheless Dr Schnitzer had to appear before the Dental Council's

tribunal, and in a hearing which lasted six hours he was accused of practising his profession "in the manner of a pedlar". He was ordered to defray the costs of the tribunal and other expenses incurred by the Council.

Dr Schnitzer managed to get an appeal, and in another hearing which lasted eight hours he deftly reversed the tables on the Council. "The main point at issue," he said at the McCarri-son Society meeting, "was the statement made by the president of the Dental Council. He alleged he had rung me up on one occasion in his capacity as a friend to protect me from damage. In reality he had threatened me with embarrassing litigation if I did not stop an interview with the Press from being transmitted.

"Unfortunately for him," Dr Schnitzer went on, "a television team was in my room at the time and they heard and recorded every word that the President said."

The Dental Council lost the case and had to pay costs.

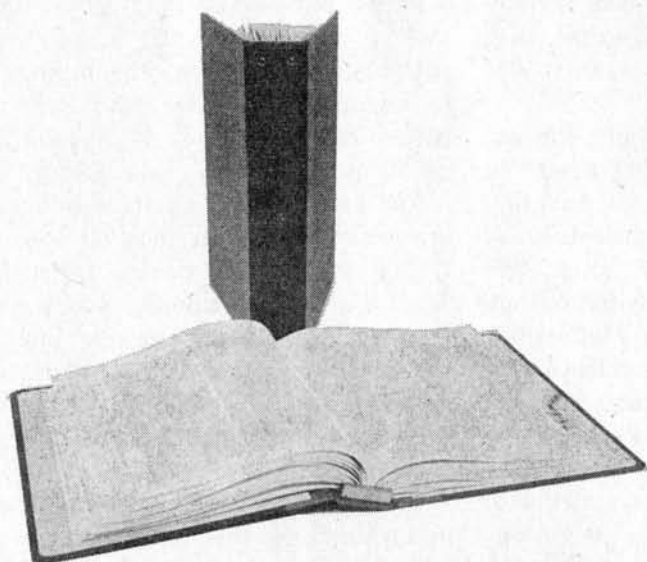
In the meantime Dr Schnitzer's campaign was going from strength to strength. He had compiled a programme consisting of 40 pamphlets and

papers to be spread over a three-year period. "The pamphlets," he remarks, "give the layman a very thorough knowledge as to what constitutes good health as well as to what causes the typical illnesses of modern times."

After three years Dr Schnitzer repeated the course. He also carried out yearly check-ups on schoolchildren and a fair proportion of pre-schoolchildren. In all he looked at about 300 children each year, some 220 of them being at school.

His results included children of every kind of parent; the enlightened ones who scrupulously followed the advice given; those who co-operated in part, but still permitted their children to eat sweets; and those who did not co-operate at all.

When he compared the children of 1963 with those of 1969 he got the best results in the younger groups: for the experiment had been running long enough for the parents to make a good start. In the one to three-year-olds dental caries declined by 100 per cent, in the three- to six-year-olds by 86.5 per cent, in the six- to 10-year-olds by 31 per cent and in the 10- to 14-year-olds by 36.5 per cent.



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Dr Schnitzer points out the results could have been much better, since he found that children who followed his nutritional advice to the letter were completely free of dental caries.

Dr Schnitzer recommends freshly milled whole cereals; root and leaf vegetables which all have to be eaten raw and freshly prepared, nuts, unheated milk, and a certain amount of fruit. Some people, of course, will want to go on eating meat, but refined sugars and white flour must be avoided at all costs.

In Germany there has been growing interest in Dr Schnitzer's scheme and he and his wife have now established a working group on modern hygiene and nutrition with over 1,000 members, as well as a publishing house. But his activities do not stop there. He and his wife own a firm called Galle which originally made only dental instruments. Today the firm also makes stone-grinders for cereals—for private homes and bakeries—and the grinders now make up the largest part of the firm's activities.

At the same meeting Mr Neil Painter, senior surgeon at the Manor House Hospital, London, repeated to the McCarrison Society what he had said at the BMA Clinical Meeting in Aberystwyth on diverticular disease of the colon (*World Medicine*, May 5, 1971, page 43.)

"Diverticular disease is rare before the age of 40, but then it strikes with a vengeance. In some countries up to 30 per cent of the population can be affected," he says.

The countries with the highest incidence are invariably those which are most developed economically. The disease is three times more common in Sweden, for example, than in Finland, but it is virtually absent from Africa and very rare in Asia.

Mr Painter is convinced the disease results from the refining of carbohydrates and he blames not only the refining of sugar but also of flour. Roller-milling was introduced in Britain in the 1880s as an obvious response to the huge imports of wheat brought in from overseas. White bread then became fashionable.

"Since the disease takes some 40 years to develop, it should have first manifested itself in Britain around the 1920s. And that is precisely what happened," says Mr Painter.

Over the past 50 years most doctors have prescribed a low-residue diet for diverticulitis in the belief that roughage in the diet is likely to perforate an already damaged colon.

"There is no evidence that the low-residue diet benefits the patient", says Mr Painter. "Instead patients should eat a high-residue diet consisting of wholemeal bread, fresh vegetables, and fruit."

In one trial he put 70 diverticulitis patients on a high-residue, and he found 80 per cent of them relieved of their abdominal aches and pain.

Health foods may be catching on but the majority of Britons still opt for foods that have been processed or synthesised by the manufacturer, and which contain not only pesticide residues but are artificially flavoured and coloured as well.

At present, particularly because he is helped by Government subsidies, it pays the farmer to produce food through intensifying. This kind of farming is changing the face of the land. Labour is driven off as machinery takes over and the landscape is altered drastically through the ripping up of hedges and trees and the ploughing up of traditional grazing land.

"The industrial approach has been sponsored by the Government, largely in the belief that through it Britain will have a better chance in the future of feeding its population, despite the large yearly loss of land. This kind of thinking is muddle-headed and based on a myth," says Hugh Coates, a council member of the Soil Association, who himself supervises the farming of over 1,000 acres in Buckinghamshire.

"To begin with, intensive farming relies heavily on imports from overseas, particularly from the underdeveloped nations which can ill-afford to lose their proteins, and secondly, intensive farming ruins the soil, sometimes irreparably. We now have the awful spectre of the farmer who goes in for barley year after year using more and more fertilisers and chemicals to maintain productivity and then sells out to the developers. The next thing is, the land has become a caravan site."

Hugh Coates believes a more traditional approach to farming, using

Stapledon's alternative husbandry of grass/grass/grass/arable and then back to grass can succeed financially. The farms he oversees prove the point, and he is about to embark on a venture to sell wholemeal bread in the Oxfordshire area at prices which compete with white processed bread. He will not be able to afford distribution costs, he says, but then "each area should have its own baker."

Hugh Coates is convinced that if Britons accepted a healthy diet and were prepared to pay the price, then Britain's farmers could go a lot further than they do now towards feeding the population. It would mean a reduction in the quantities of meat consumed, but more protein would be taken in from vegetable sources such as whole wheat.

His arguments appear to make sense once we include the real cost of producing food in this country—the imports, the chemicals, the machinery, and the distribution. And to all this we must add the cost to our health.

Peter Bunyard

Coming events

14-21 October—Milieu '71. Exhibition for environmental control techniques, Utrecht, Holland. Details from Exhibition Consultants Ltd., 11 Manchester Square, London W1. Tel. 01-486 1951.

27 October—Pollution: the sources of information. One-day conference at the Library Association Headquarters, 7 Ridgmount Street, London WC1. Details from G. Mort, Somerset County Library, Mount Street, Bridgwater, Somerset. Tel. 0278 51201.

15-19 November—Antiquinamento/Antipollution 71, conference on environmental pollution, Milan Fair, Milan, Italy. Details from the National Society for Clean Air, 134-137 North Street, Brighton BN1 1RG.

2-4 December—International Symposium on Energy, Man and the Environment, Zurich, Switzerland. Details from Gottlieb Duttweiler Institute for Economic and Social Studies, The Green Meadow Foundation, CH-8803 Rüschlikon, Zurich, Switzerland.

See also page 23

Reports

Development versus Development

The Secretary of State for Scotland has now rejected the American-owned Chevron Oil Company's proposal to build a £45 million refinery at Portencross, in the Clyde estuary. (See "Swansong of the Clyde" by Peter Bunyard and Charlie McLean, *The Ecologist*, May 1971). The *Scotsman*, 26 May, reports the decision as having been prompted mainly by environmental considerations, but all the other considerations seem to be as aggressively in the picture as ever. The site has still been left zoned for industrial development, in particular for a "major new green field development by the steel industry". Steel offers 12,000 jobs, oil a mere 375, but the local skylarks and other green field communities might have settled for the unobtrusively-staffed refinery.

Off-stage, too, the pressure remains

on. The central planning argument takes as its starting-point an entity which is neither bird nor beast—the Common Market. Working backwards from there, it proceeds via industrial investment in the south-east, with an admiring look at Foulness, to North Sea oil and gas pulling Scotland's development to the east. That leaves scope for some new factor promoting development in the west, and it turns out to be the need for a reception area for the half million people scheduled to be rehabilitated out of seething Lanarkshire. The reception area needs to be handy, of course, hence all eyes on North Ayrshire. It's as simple as that, and as dangerous as radioactivity.

The howls of protest that went up at the announcement of the decision were as grisly as anything since the cancellation of the South African arms contracts. Scottish Labour MPs tabled a motion demanding Mr Campbell's resignation. They found it "inconceivable" that he should have turned down the proposal. The South Ayrshire MP, Mr James Sillars, said it was "the height of folly". The Central Ayrshire

MP, Mr David Lambie, said it was "a disaster for Scotland". The Lord Provost of Glasgow, Sir Donald Liddle, said that if they had got to sacrifice a fragment of the coastline to create much-needed employment, it was not too dear a price. Their population could not exist on amenity alone. Councillor John Mains, leader of the Labour group in Glasgow Corporation, was quite outraged at the very mention of the word "amenity". The excuse of amenity, coming from the Secretary of State, was farcical and irresponsible, he said. Mr Campbell was very much out of touch.

Conservation Year has come and gone. Perhaps the prize for the star utterance on the part of those who apparently thought it was some sort of eradication campaign, an extended Rat Week effort, should go to Mr William Paterson, convener of Ayr County Council, for the following judgement: "This is one of the worst days in the country's history. The conservationists have won the day for empty land".

Roy Bridger

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Reports

Resources out of place

It is increasingly recognised among ecologists that sewage must be regarded as "resources out of place" rather than wastes. Dr Howard A. Tanner, of Michigan State University, says a policy of requiring industries to pay fees to municipalities for treating their sewage may be exactly the wrong approach in this context. If the ecological goal of recycling wastes is to be met, then dumping industrial effluents into municipal systems simply makes it more difficult to recover valuable materials. "Never dilute 40 per cent ore to 4 per cent" is an old resource recovery principle that should be applied to sewage treatment, Dr Tanner says.

But there are more immediate problems than losing resources, says Mary Fulmer, a sanitary engineer and chairman of the Columbus, Ohio, Sewer and Water Advisory Board. She points out that where industrial wastes are dumped into municipal systems, scheduling is often haphazard and communication nil. Thus a municipal sewage plant can get hit with a dollop of toxic industrial wastes without time for preparation and sometimes even without knowing what the substance is. Bacteria for biological treatment are sometimes killed. Or, Dr Ball points out, some pollutants, such as mercury, go right on through the system and enter waterways.

Mrs Fulmer says one of the problems is that sewage treatment traditionally has been aimed at public health goals, rather than ecological ones. Removal of phosphates, for instance, is primarily an ecological goal of a kind only recently adopted. Cost, she says, can be immense, with a sodium aluminate process for precipitation of phosphates possibly doubling the cost of treatment. And Dr John R. Sheaffer of the University of Chicago says even the public health goals probably are not being met. Coliform bacteria—traditionally gauged by a count of *E. coli*—may be killed in conventional treatment, but there is evidence, says Dr Sheaffer, that pathogenic viruses are getting through.

Dr Sheaffer, now on leave from Chicago to work with the Army Corps

of Engineers, is a major architect of a scheme now getting under way in Muskegon County, Mich., that is being watched with great attention by water scientists everywhere because it promises to solve almost all of these problems and, in addition, provide major by-product benefits.

The Muskegon project, on which construction will begin this year, relies on some surprisingly simple principles. One is that dirty water filtering through soil is quickly cleansed by the soil. Another is that such enrichment of soil makes it far more fertile. Putting these two facts together, scientists at Pennsylvania State University conceived the notion of spraying sewage effluents on marginal soils instead of dumping them into waterways. They tried it, and it worked. Not only was soil fertility greatly increased, but also a decline in the water table was slowed as excess irrigation water filtered through the soil into the water table.

Dr Sheaffer and others decided there was no reason not to try the idea on a far larger scale, and Muskegon County (population 170,000) officials were willing. The sewage outlets of cities and towns in the county will be turned away from the lakes they now pollute, including Lake Michigan, and will go into a large collector system that will take the sewage to marginal land in the eastern part of the county. First, the effluent will go into aeration lagoons for biological treatment by bacteria. Then it will go into storage lagoons capable of holding the effluent during the non-irrigation season. From there it will go to spray-irrigation devices. Corn will be grown on the irrigated fields.

The aeration lagoons will be large enough to accommodate a large dose of industrial wastes toxic to the bacteria in them without killing all the bacteria in any given lagoon. Thus the bacteria killed could be replaced by regrowth.

Another advantage is that the viruses not removed by conventional sewage treatment will be filtered entirely out of the effluent as it goes through the 6,000 acres of soil to be irrigated. One estimate of the annual return from the corn growing on the now marginal soil is \$740,000. There are many other side benefits, the major one perhaps being that recreational development of Lake Muskegon and two other small lakes in the county will be possible because they will no longer be polluted.

The plan is an expensive one, but most scientists are optimistic about its eventual success. Mrs Fulmer and others, however, believe there simply have not been extensive enough pilot projects for many of the innovative new approaches. Sometimes, she says, a so-called pilot project for a new sewage treatment technique is conducted with glassware and quarter-inch tubing. And she is still leary of industrial wastes in connection with techniques that use sewage—either effluent or sludge—as fertiliser.

There is little doubt that far more extensive R & D is needed. In its fiscal 1972 budget, the Nixon Administration is emphasising increased sewer construction grants and assistance to local and state enforcement agencies. The fiscal 1972 R & D budget of WQO is actually down from 1971—from about \$60.5 million to \$56.5 million. Thus projects such as the Muskegon one will get shorter shrift, while enforcement, which may compel construction of more of the conventional treatment plants, will be stressed.

But the Muskegon project will be completed in 1973. Dr Sheaffer points out that most major cities have the right combination of nearby marginal soils and inadequate sewage treatment plants to make similar projects feasible. If the Muskegon project works as planned, it may serve as the major model for sewage treatment.

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Stopping the Motorway Madness

The Greater London Development Plan Inquiry still grinds its weary way at County Hall barricaded by its walls of procedure and legalistic irrelevancies. Yet this Inquiry was the great hope of the opposition to the Plan with its key feature of £2,000m worth of motorways and "improved" secondary roads, around which the remainder of London was to be made to fit.

The form of the Inquiry, the viperish intimidation of objectors by Mr Boydell, QC for the GLC, the resolute avoidance of debate on the real issues are building up a sense of pessimism among London's amenity groups. There is a widespread belief that the Panel will merely tinker with the GLC's proposals: the radical reassessment and consideration of alternatives promised in the balmy days when Anthony Crosland set up the Inquiry are now quietly ignored.

It is as well to be clear about what is involved in this. The opposition to the motorway plans is not freakish or woolly-headed. An astute politician like Douglas Jay does not spend his time chasing chimeras on the outer fringes of politics. His London Motorway Action Group lists thirteen MP's of all parties among its supporters. The London Amenity and Transport Association (LATA) works in close collaboration with Jay's group. It is headed by Michael Thomson, an LSE transportation economist with an international reputation. This group links some sixty amenity societies in opposition to the Plan. Its three hundred pages of evidence at the Inquiry met the GLC transportation planners on their own ground and showed that even using its own figures and hypotheses the GLC's plan does not work.

This is where the motorway argument is unique. There is clear evidence from all over the world that urban motorway systems do not work. They do not relieve secondary roads of heavy traffic,

they do not enhance the environment, they do not enable essential business to be carried out more efficiently, they do not enable public transport services to be provided more effectively: all of which are reasons adduced by the GLC in favour of its plans for London.

Urban motorways are one of technology's greatest confidence tricks. They may in the short term provide some of the advantages claimed for them. But inexorably they fill to capacity with new traffic, the jams become worse, the environment deteriorates, public transport declines. And then the cry goes up: we need more roads.

The approach to planning London has got to begin with the capabilities of a humane environment to absorb the despoliation associated with the provision of facilities for car mobility. Planning must be around the human being existing as an individual in this situation: Westway concedes nothing to anything short of collective man in his role as a queue of cars subject only to the laws of statistics.

We are pedestrians, all of us, every day. If our cities are not right for pedestrians they are not right for anyone.

Public transport is as vital for the functioning of a city as is its water supply or sewage system and it must be maintained even if it requires financial help from other sources. Yet in London the GLC primarily requires of London Transport that it make a profit.

Goods distribution is an essential part of the life of a city. Provision must obviously be made for it in the sane planning of urban transport systems.

Only then and lastly do we come to the provision of facilities for the expensive luxury of private transport.

This is not, of course, in order of action. It is our order of priority of consideration. It is the precise reverse of that adopted by the GLC's planners in the GLDP.

Mr Layfield's Inquiry has allowed itself to be trapped into fiddling with the

details of a fundamentally misconceived plan. The individual faced with things as they are realises that the battle for sanity in planning is now squarely in the political field. If the GLDP Inquiry's findings are the logical outcome of its procedures then Layfield's Inquiry must be made to join Roskill's in the Pantheon of the irrelevant.

The London Labour Party's Chairman Bob Mellish has pledged his party's "clear and unequivocal opposition to Ringway's 1 and 2." The party must be held rigidly to that pledge. In the General Election, Labour MP Michael Barnes held the marginal seat of Brentford and Chiswick with the lowest swing against him of any Labour MP in the country. It was in Conservative Grove Park, scheduled for obliteration by Ringway 2 that the election battle turned. The Tory candidate had publicly stated he "believed in motorways". He is not in parliament: the eminently sane Mr Barnes is.

From Canada comes perhaps the best news yet. The gigantic Spadina Expressway which was to have ripped through some of Toronto's most attractive areas has been stopped dead despite the \$60m already spent on it. Three other expressways are likely to go with it.

Ontario Premier William Davies has said Toronto has had enough and the cabinet decision is final. Work will be turned to the provision of adequate public transport facilities.

He referred to "the growing evidence and accumulated experience gathered elsewhere which demonstrates the ultimate futility of giving priority to the passenger car as a means of transportation into and out of cities".

He finished by saying: "If we are building a transportation system to serve the automobile the Spadina Expressway would be a good place to start. But if we are building a transportation system to serve people the Spadina Expressway is a good place to stop".

Gerald Foley

Down to Earth



by Lawrence D. Hills

Hovercraft for gardeners

The development of "hovercraft" among gardeners is at an early stage for it is only within the last six years that the amateur experimenters of the Henry Doubleday Research Association have begun learning the craft of helping hoverflies to control the aphides in their gardens.

The basis of the craft is the fact that, unlike ladybirds which search at random, the adult hoverfly can spend up to four weeks searching far and hard for colonies of aphides to lay its eggs among. Both ladybirds and their larvae are aphide eaters, but the hoverfly must fuel itself on nectar for as long as ten weeks of carting and poisoning like a humming bird on wings too swift to see, and during the six week pre-egg laying period, the "hens" must also feed on pollen to develop 100-300 eggs inside their wasp-like bodies.

Bees and butterflies have long tongues for feeding from awkward flowers, but the hoverfly is limited to those with short and easy access to their nectar and pollen.

The first attractant flower was found by chance and it is still the best. This is buckwheat (*Fagopyrum esculentum*) grown for buckwheat cakes in the USA, making noodles in Japan, and for pheasant food and green manure in Britain. It grows from two to three feet high with red stems and short plumes of white flowers from late May until October. These last well in water as cut flowers and make it an attractive hardy annual apart from its value as bee and hoverfly fodder.

There are roughly 250 hoverflies native to Britain and of these only about 29 have aphide eating larvae. One large group of the others have larvae like white maggots which live in pond mud and breath through slender, squirming tubes that dart back into the mud on the approach of a fish or newt. Another is the Volucellas who resemble wasps and bees so closely

that *V. Bombylans* can follow a bee back to the hive, bluff her way past the sentries and lay her eggs in quiet corners. These hatch to excreta-eating larvae which spend about a year scavenging before changing to adult flies, joining the rush hour traffic over the alighting board in the morning, and repeating the fraud after a short honeymoon among dog rose and blackberry blossom for choice.

The value of buckwheat lies in the excellent aphide eaters it attracts as well as assorted oddities that do useful but unusual jobs like improving the breakdown of pond mud and cleaning up inside wasp and even ants nests. A single row of buckwheat behind a rose bed or beside six rows of broad beans sown in March or April will draw enough *Syrphus balteatus*, *S. luniger* and *S. ribesii* which look like small, slender wasps, and the larger *Scaeva pyrastris*, which is dark grey and cream, to keep both crops free from greenfly and blackfly without the trouble and cost of spraying, for seed is cheaper than even the safest pesticides.

Though the egg laying season does not start until mid July, it pays to have buckwheat in flower early for the pollen seeking period so that the aphide hunting starts in your garden. In cold springs mustard gets away faster, and sowing a row in March will make sure of yellow flowers early when hoverflies are drawn to this colour and are often seen crawling in dandelion and buttercup centres for the pollen they must have if they are to lay fertile eggs. Mustard is far more trouble than buckwheat for later on because it needs constant resowing for succession.

The hunt has begun when you see hoverflies poised and staring at green shoots with their compound eyes, and rising and falling like helicopters searching a jungle. Unlike ladybirds again instead of laying a whole clutch together to compete with each other, hoverflies space out their maximum of 26 eggs a day at one per colony, so from the view point of the gardener who wants his aphides cleared, the more individuals laying their single eggs there are, the quicker the pests are cleared.

One hoverfly larva, (looking like a small slug, or a kipper with its tail in the air) per infested broad bean tip has cleared the blackfly in six days, while one two-spot ladybird larva left from 60 per cent to 80 per cent still

alive and multiplying. Though the larvae appear to be blind and are legless, looping along like land leaches in the Burmese jungle, they have a keen sense of smell and will track down small aphides hidden in leaf folds which the ladybird larvae usually miss. In the three weeks from egg to adult one hoverfly larva can eat from 200-600 aphides, and the record is 21 consumed in 20 minutes. The most efficient appears to be *Syrphus balteatus*, but *S. luniger* will attack small caterpillars, including newly hatched cabbage whites and those of the lackey moth on apples. All the *Syrphus* species will dive in under the wool and destroy American blight or woolly aphids, and they can produce a slime that defends them against ants, at least avoiding being thrown right off the plant like ladybird larvae, even though they may be driven away in the silent battles of science fiction monsters that we should see in every garden that had not been sprayed into emptiness, had we but microscope eyes.

The long flowering buckwheat is of special value when the second generation of hoverflies is going through its pollen feeding period, for it draws the late comers, unlucky in their aphide search, to lay among the surviving aphides and continue the attack until the last larvae take over and feed furiously to become pupae to live through the winter and become next year's early pollen hunters.

In some years countless billions of hoverflies are blown across from Europe and these, with the local second generation, feed frantically on pollen and nectar from dahlias, marrows, dandelions and anything they can find, with buckwheat still earning its keep by putting up the local survival rate and the odds on a clearance of the last aphide swarms.

Biological pest control in Britain is mainly effective in the controlled environment of the greenhouse, the whitefly parasite *Encarsia formosa*, the new red spider control and others, under investigation at the Ministry Glasshouse Research Station at Worthing. The problem of introducing a predator from one country to eat a pest in another is that the predator "eats itself out of a job" and dies out. This new field of finding how to make life just slightly easier for our native predators to give them a chance of overtaking our pests, could be one with a future.

Towards a unified science



The cybernetics of day-to-day behaviour

One cannot study a man eating a sandwich, without taking into account both the properties of the man and those of the sandwich. Similarly, one cannot regard a man apart from the environmental conditions to which his evolutionary development was but a long-term adaptive response.

The minimum unit of behavioural analysis must clearly be the biological system plus its environment which together must be regarded as constituting a larger system. The former must possess a control mechanism which must fulfil what are teleonomically two different functions: that of providing a hierarchical organisation of instructions transmitted from generation to generation and a mechanism for ensuring its adaptation to environmental changes. *This can only be accomplished if associated with a model paralleling or representing the system to which adaptive responses must be mediated.* In the field of genetics, protein synthesis, i.e., the process of ontogenetic growth, is today explained in terms of a control system of this sort. Thus Horowitz writes (1):

"It seems evident that the synthesis of an enzyme—a giant protein molecule consisting of hundreds of amino acid units arranged end to end in a specific and unique order—requires a model or set of instructions of some kind. These instructions must be automatically transmitted from generation to generation, and they must be constant yet capable of evolutionary change. The only known entity that could perform such a function is the gene. There are many reasons for believing that it transmits information by acting as a model or template."

Kenneth Craik (2) was undoubtedly the first to provide a similar explanation for ordinary behaviour, i.e., that which is mediated by the nervous system. He

viewed the nervous system "...as a calculating machine, capable of modelling or parallelling external events", and he considered this to be "...the basic feature of thought and of explanation".

The most important quality of the model is that it does not represent the environment but the system, i.e. the sub-system and its environment. Why this is so is clear from the consideration that if the model is to provide that information required to ensure the increased stability of the system in a given environment, it must represent both the former and the latter, since changes in either one or the other will result in different behavioural requirements. The model will therefore be of the system as a whole.

One of the consequences of adopting this model of behaviour, is that the notion of learning by trial and error becomes untenable.

If we put a rat in a maze, we know that it can be taught to find its way out. However, before hitting upon the correct route, it will have to make a series of unsuccessful trials. Now, if these trials were arranged to form a series, would it be possible to put order into this series, or must each trial be considered merely a random one? The trial-and-error theory appears to assume the latter hypothesis. However, strictly random behaviour does not occur in an ordered system made up of a system whether it be an organism, a society, or an ecosystem. These all display varying degrees of order, and hence of non-randomness. It has been shown that people are incapable of choosing a random series of numbers, even when they set out to do so purposefully. If this is true, it is even more unlikely that they will be capable of making a random series of moves. (3).

Where there is order, there must be instructions, and an organisation of information, i.e., a cybernism.

Looked at slightly differently, if a rat finds its way through a maze as a result of a series of trials, what will determine its first trial? If a hundred possible moves are open to it, why should it start off by making one rather than any other?

If the move in fact it makes is haphazard, why should not all the others be haphazard too? Is a rat behaving in a haphazard way when it chooses to eat a piece of cheese rather than an iron nail, or when it feeds its own family rather than that of some other rat? If not, which actions are to be considered haphazard and which are not? *The answer is that the notion of non-directive, haphazard or trial-and-error learning is totally irreconcilable with our knowledge of behaviour. Instead, one must regard each action as based on what, in the light of a system's model of the environment, constitutes the most probable hypothesis.*

Let us look a little more closely into the mechanism involved. Supposing that the first move made by the rat, rather than lead it towards the opening, led it instead to a further cul-de-sac, the model responsible for this error would have to be modified. Thus, when the rat made its move, the situation would be interpreted in the light of a new model—one that had taken into account the failure of its predecessor to interpret correctly the short-term environmental situation in which the rat had found itself, and one furnishing it with an ever-more precise representation of the system for the purpose of finding its way out of the maze. In other words, each action could be regarded as a correction of an error; and if we regard these actions as forming a series, then the latter would be 'damped', in the sense that the errors would be progressively reduced, until the correct route was found. Its ability to do this must be the function of the development of the rat's nervous system and in particular of the precision with which the model represents the system of which the animal is part.

Edward Goldsmith

References

1. Horowitz, Norman H., "The Gene", in *Scientific American*, October 1956.
2. Craik, Kenneth, *The Nature of Explanation*, Cambridge University Press, 1952.
3. Ramsey, W. R., Broadhurst, Anne, *The Non-Randomness of Attempts at Random Responses*, The British Journal of Sociology, Autumn 1968.

Feedback

Unlimited hope from vodka

Most of the 1,900 delegates to the eighth World Energy Conference in Bucharest seemed to be concerned at the inevitable exhaustion of the world's fossil fuels. Sir Harold Hartley from the UK urged them all to concentrate on the development of fast breeder reactors so that energy demand can continue to be met.

Refreshingly, a number of African delegates suggested that the developed countries should stop lecturing them on energy alternatives. As one of them remarked to Gerald Segal: "Why don't they just pay us reasonable prices for our primary products and leave us to decide on how to make the best use of our resources."

One delegate remained untroubled by the future. Pyotr Neporozhny, Soviet Minister for Electrical Power and president of the conference, announced that he was an optimist and felt sure that somehow, somewhere, we would still be finding more oil and natural gas in the year 2000. "Even when you have drunk all the bottles of vodka to the dregs," he said, "you can always find another half-bottle somewhere."

Guardian, 30.6.71

SO₂ exports to be tested

The RAF and Warren Spring Laboratory are to take air samples over the North Sea to test the claim by Sweden that British industry and the CEBG are responsible for some of the increasing sulphur dioxide pollution in Sweden. The acidity of Swedish rainfall has more than doubled in a decade, and this in part has been attributed to Britain's tall chimneys.

Observer, 13.6.71

Don't go back to Knapsack

The people of Knapsack share the unusual distinction of being the first

community in Europe to be forced to move by industrial pollution. Knapsack, a suburb of Hürth, seven miles south of Cologne, was once a thriving township of over 4,000 people. Now the 2,500 that are left are being evacuated, because pollution from the chemical and soft coal industries there is unbearable and potentially dangerous. The operation is likely to take five years at a total cost of £3,400,000. The risk to health was an important factor, but the main spur was the feeling that every citizen has the right to a certain amount of physical comfort and reasonably fresh air, and that these were no longer possible at Knapsack due to the dust, noise and smells.

Daily Telegraph, 12.6.71

Lead levels already impairing mental health of minister?

Peter Walker, Secretary of State for the Environment, has said in Parliament that he is "arranging for up-to-date measurements of lead concentrations to be obtained and will publish the results". He was replying to questions about the possible hazards to health of emissions from motor vehicles. Previously his department has tended to discount fears of vehicle pollution, in particular the effects of lead additives to petrol. In the same debate, Mr Michael Alison, Under Secretary for Health, took the view that there are no dangers to health attributable to high concentrations of motor vehicle fumes under the conditions prevailing in this country.

Financial Times, 1.4.71

Borates a bore, too

Since the introduction of perborates in detergents, the amounts entering waters have naturally increased. Borates, which are used in detergents for their bleaching properties, are not removed by any of the existing methods of waste

water treatment. There has been some concern that the borates may cause disturbances in ecological systems, since boron is known to inhibit plant growth if given in large doses.

According to a working group of the Royal Swedish Academy of Engineering Sciences, although very little is known of the amounts of borates in Swedish waters, there is no immediate danger of toxic effects. However, if discharges continue the situation may become serious.

The group points out that knowledge of the effects of boron on higher plants is very scanty. The fact that ecological effects of many substances tend to appear suddenly when a certain threshold is exceeded makes it important that discharges of borates be reduced. This should be done, the group says, without waiting for the results of further studies on the toxicity of borates to plants and animals.

Environmental Planning in Sweden, 20

Continental giants may be killed

Many of the lorries and trailers which cross the Channel from the continent exceed the 32-ton limit imposed on British lorries by as much as 23 tons. Life in the villages of Kent and Essex is made a misery by them, yet police have no power to stop them. Now the Minister of Transport, Mr John Peyton, has promised to introduce a Bill "as soon as possible" to ensure that foreign lorries comply with current regulations.

The Times, 19.5.71

On the nod

It took only four minutes for Greenwich Council to approve, without a division, a Greater London Council scheme to drive a six-lane motorway through the middle of Greenwich. Just to be on the safe side, however, the GLC commissioned an independent report from Sir Colin Buchanan, who

recommended that the idea be abandoned in favour of replanning Greenwich as an almost traffic-free tourist centre. The rival proposals are to be considered by the Greater London development plan.

Guardian, 1.5.71



Peabody and the Pope

The Peabody Coal Company has taken over the Vatican and is strip-mining St Peters. They are ignoring the protests of the Pope since there is an urgent demand for marble and to stop mining would increase unemployment.

Preposterous? Not really—for this is exactly how the Hopi Indians view Peabody's strip mining of the Black Mesa, Arizona. This area is the sacred ancestral ground of the Hopi and to rip it up and remove material from it is an insult to their culture and religion. Yet the strip mining goes on regardless.

They'd better double the guard at the Vatican!

Rodale's environment action bulletin, 9 (24)



Water treadmill

Each one of us in Britain uses an average of 38 gallons of water a day, and demand is likely to double by the end of the century. The volume of effluent to be diluted will also double. Thus Mr Eric Gilliland, treasurer and accountant of the Thames Conservancy, concludes that by the year 2000 water will cost twice as much "in real terms" as today.

Capital investment needed over the next 30 years for reservoirs, barrages, ground storage schemes, sewage works, and so on, will be high: it is estimated that schemes proposed for the north will cost up to £465 million, and for the south-east up to £500 million. The government has stated that the amount spent on cleaning up effluent will be increased by £700 million over the next five years, but Mr Gilliland calculates that this is only enough for present needs. (1)

Meanwhile, the Metropolitan Water Board has warned that unless a large new reservoir is built in the south-east there will be "serious and widespread shortages of water" in the next 10 years. (2) There appears to be a more immediate shortage of water in the south-west, where the South West Devon Water Board is anxiously

casting around for a site for a new reservoir. The Swincombe site was turned down by Parliament as it would have obliterated 787 acres of Dartmoor National Park. Now they are looking at three other sites, Woodcourt, Torcorn Hill and Bow Cross, in the Totnes area. This has provoked a storm of fury from local farmers for if any of the sites were chosen valuable farming land, which in its way is as lovely as Dartmoor, would be drowned. (3)

The River Authorities and Water Boards might possibly agree that demand cannot be met indefinitely. There must be a point where too much can be sacrificed for the sake of the washing-up. We seem to be there already. Why don't we pay a bit more for our water and use a lot less? And why don't the conservationists and farmers of Devon decide that the arguments against a reservoir on Dartmoor are as good as the ones against a reservoir in the Totnes area, and it's time they forgot their differences and joined together to declare, enough is enough. (4)

(1) *Times*, 9.6.71; (2) *Daily Telegraph*, 5.6.71; (3) *Daily Telegraph*, 18.6.71; (4) editorial comment.



Teesdale teaser

The Cow Green Reservoir of the Tees Valley and Cleveland Water Board, which was opened on 22 July 1971, is a good example of the folly of short-term thinking over water supplies, however well-intentioned.

Costing about £2.4 million, the reservoir covers 770 acres and holds 9,000 million gallons of water. It will store the winter spates at the head of the valley, and provide Teesside with an extra 35 million gallons a day (mgd), as well as a continuous discharge of 8.5 mgd of compensation water.

Upper Teesdale is well known to botanists because of its unique sugar-limestone geology. The crumbly lime-rich soils derived from the sugar-limestone support "open" plant communities in which less vigorous plants, including many rare varieties, flourish. Some 10 per cent of this area has now been drowned by the reservoir.

ICI have agreed to give up to £100,000 over a 10 year period (beginning in 1967) so that the ecology of the area can be studied. That of the

flooded section has already been completed, and the plants and animals there have all been documented. At its own expense, the Tees Valley and Cleveland Water Board appointed a site research officer to liaise between scientists and engineers, and ensure that construction work would not disturb areas of scientific interest. In addition, the Board has been at some pains to see that access roads, etc., avoided fragile habitats.

However, a significant proportion of a unique area has now been destroyed, and a bundle of documents and photographs is no compensation for their loss. Yet Cow Green Reservoir will meet Teesside's increasing demands for water only up to 1977, a mere six years, after which the Water Board hopes to draw from the immense Kielder Water reservoir by which the Northumbrian River Authority proposes to drown the North Tyne Valley. Without Kielder they expect a major water crisis in the late 1970's or early 1980's.

How long will Kielder last? Will the drownings continue, or will we begin ringing the coastline with desalination plants? It is high time water boards were told that their job is to satisfy only reasonable demands for water—and we as communities must decide what is reasonable.

Press releases from the Tees Valley and Cleveland Water Board, and the British Waterworks Association, 21.7.71 & 22.7.71, with editorial comment.



Victory for housewives

United Carbon Black Ltd., whose Swansea factory was blockaded day and night for three weeks by housewives disgusted by the pollution it causes, is to spend £35,000 on anti-pollution measures.

Observer, 18.7.71



Development grant crucial

Sir Val Duncan, chairman and chief executive of RTZ, in evidence to the Parliamentary Sub-Committee on Trade and Industry, stated that without a development grant his company would not have built the Anglesey aluminium smelter, even if they had found a site outside a development area, which was just as attractive in every other respect.

Times, 8.7.71

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January '70	Robin Williams	Birds of prey <i>their aesthetic, scientific and ecological value</i>
	John Noble and Harry Rothman	PCB <i>The by-product of industry and possibly a serious threat to our wildlife</i>

THE ECOLOGIST, 73 Kew Green, Richmond, Surrey



Environmental Non-Revolution

NO DEPOSIT—NO RETURN by Huey D. Johnson. Addison-Wesley Publishing Company.

THE USER'S GUIDE TO THE PROTECTION OF THE ENVIRONMENT by Paul Swatek. F.O.E./Ballantine.

TEACHING FOR SURVIVAL by Mark Terry. F.O.E./Ballantine.

Any good revolutionary knows that analysing what is wrong with the system is only the first step. Or as Marx put it: "The philosophers have interpreted history; the point, however, is to change it." The environmental movement, in so far as it is real, is revolutionary. It seeks the total overthrow of those of our institutions which are slowly, but surely, poisoning this planet. We would rather be peaceful than otherwise, but with the life of our children at stake, that may not be possible.

Having reviewed at least twenty books on the environment over the last year, I have become increasingly depressed and cynical about the methods which have been devised for us by our experts. Last week, I spent an afternoon browsing in the Ecology Bookshop near Victoria. The spines of hundreds of shiny new paperbacks sold their contents as "action-oriented", "a radical new approach", etc. Inside were the same tired thoughts and essays. Most depressing of all, the best writers—Ehrlich, Borgstrom, Hardin—have allowed their essays to be reprinted over and over again, adding nothing new.

No Deposit—No Return is in the worst of the "something must be done" tradition. It is the result of the 1969 US conference for Unesco, in preparation for the bureaucratic beano that will take place in Stockholm in 1972. Yet again we have the depressing spectacle of dozens of bright and not so bright ego

freaks uncertain of what they have been brought together for, trotting out the old platitudes. Arthur Godfrey called for the setting up of a pollution pentagon, as though the military one were not bad enough. Lee DuBridge, Nixon's top science advisor, opted for that ultimate delaying tactic—"We need more research." A business man called for industrial statesmanship. Even the impassioned cries of the token youth representative sounded a little false. Altogether, a waste of time and money. Despite the passion, the book is only analysis. As such, it could have been summarised far more simply:

We are too many, consuming (in the West, at least) more than the planet can support, and destroying the ecosphere on which we are totally dependant, in the process. That, it seems to me, is all the analysis we need. The next question is one of priorities, of tactics. So far, only a limited number are available:

- (1) Elect the politicians who will do what needs to be done, or pressure those already in office to do it. This is the standard political line, which, it seems to me, is damned by the impossibility of influencing politics on any substantial scale for any purpose whatever. The technocracy runs by its own rules, for its own purposes, independent of those whom it is supposed to serve.
- (2) Boycott unsound products.
- (3) Educate children to an ecologically sound view of life.
- (4) Prosecute polluters under the law. But in many cases, it is impossible to identify the source of the pollutant. In any event, most of the worst processes are not liable under the law.
- (5) Use technology to save us from the fruits of technology. At first attractive, this tactic comes to seem less so, when one realises that the treatment will probably be worse than

the cure. (For example, the detergent used to clean up the Torrey Canyon oil slick did more damage than the oil.)

- (6) Burn it all down. It has been argued that the "trashing" of the Bank of America branch at Isla Vista by university of California students was the best thing that has happened to the environment in the last decade. I doubt whether many readers agree, and in any event, the consequences could be disastrous. Should we blow up nuclear power stations and PCB stores, so scattering their intensely poisonous products all over the map?
- (7) A quasi-religious movement.

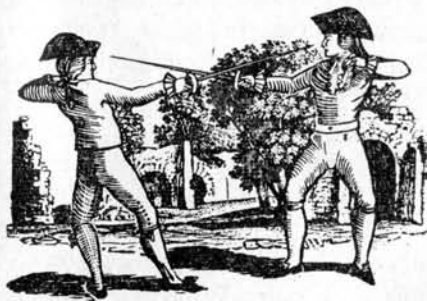
Paul Swatek takes line number two. He hopes that if enough people refuse to use or buy enough of the wrong things, they will generate pressure to start industry manufacturing sound products. Within the American context this may make sense, as the successes of Ralph Nader testify. But these have been the result of the well-publicised actions of a single man. Does Mr Swatek have such trust in human nature that he expects that hundreds of thousands, or millions of people will really stop before every action or purchase to consider the environmental consequences?

The book is essentially a list, of the dangers of products from packaged foods and pesticides, to cars, deodorants, and water use. Of course, being American, it refers to US products and trade names. In the US, by law it is necessary to list what most of these are made of. That makes it easier. But I doubt whether anyone will seriously read the list every time (added monosodium glutamate, artificial colouring, sodium citrate, riboflavin, MDA, DMT, THC, etc.). If they do, they may not be much the wiser.

The author talks of the "dollar vote", consumer action, and returning excess packaging to stores. He is very good with aphorisms: "The Chinese fortune

Francis Arnold

Letters



Has Bath a future?

Sir,

Recently while in England, I read the article in your July issue, "Has Oxford a future?" I had been in Bath for several weeks completing the purchase of my new home, as I plan to move there.

During my stay, I learned from the local papers that Bath too is threatened by the motor car. Some people had started putting up anti-tunnel posters.

Subsequent investigations revealed that under the "Buchanan Plan" Bath was to "save" its Georgian heritage by building a totally new dual carriageway motorway right through Bath, with a tunnel three-tenths of a mile long under the Circus and the Paragon. This would allow a projected 87,000 cars and lorries moving at an estimated 50 mph through Bath, and through the narrow valley in which the city nestles.

I was in the visitors' gallery when the town councillors voted 27 to 25 to proceed with the motorway. Many councillors spoke pro and con, but the arguments seemed largely confined to "How many pounds will it cost the rate-payers?" and "It's our best (and only) solution".

Not one councillor questioned the accumulation of air pollution from the vehicles caught in the valley (a mini-Los Angeles?). Nor did anyone mention the effect of the polluted air on Bath's stone façades, now being cleaned at great expense. Indeed, the Bath Abbey façade which was cleaned 10 years ago, is already once again black on the lower part—the level of most of the lungs of Bath. Nor was any consideration given to the noise and vibration caused by the traffic moving two-and-a-half times faster than now experienced by Bath on the A4.

To be sure the noise and vibration said to be shaking down the Paragon

building, caused by the A4 traffic, is a matter of great concern. But here is where semantics comes in. The scheme is referred to as the "Buchanan Tunnel Plan". The average person visualises a tunnel all the way under Bath, whereas the tunnel is to be only 500 yards, and the motorway over three miles.

After five trips around the world teaching sociology to American University students, I am convinced that Bath is the most beautiful city of its size in the world. But it is now threatened by ignorance. Help! Please put Bath on your front cover, and give the people of Bath some hard statistics; distances, noises carry when lorries and cars move at 50 mph, about the amount of dust created, the number of trees lost, acres lost, and the alternatives.

If the councillors are truly concerned about 20 mph lorries shaking down Bath's Georgian buildings, why not reduce the speed to 10 mph tomorrow, instead of waiting five years until a tunnel and motorway are built?

Sincerely yours,

Karl G. Jaeger,
Executive Director, International
School of America, New England
Office, 14 Concord Avenue, Cambridge,
Massachusetts 02138, USA.

Mercury in potatoes

Sir,

The problem with many of the warnings on pollution in the Press or in "Feedback" is that unless a disaster occurs of sufficient size to secure Press and TV coverage, there is no way of financing further research to find if the warning is justified and to secure action before it is too late. The risk for the ordinary man is that *his* will be the family that makes the news that brings the ban.

We have some evidence that potatoes can concentrate mercury until they hold as much as the tinned tuna fish that was banned in the US, but so far it is not good enough to justify action or alarm without further research, though it is highly important in a country that eats "chips with everything". Our first attack on the problem cost us £50, for mercury analysis in quantities round 3 ppm is expensive. We would now like to test at least 50

samples of potatoes from amateur gardeners, and if we can set up the experiment and do them all together this will cost about £500.

Though at least eight new bodies connected with pollution are being formed so far this year, and several thousand school children are doing "projects" on this topical subject, there is no Trust or Foundation able to make grants to forestall the consequences of warnings, or establish if they are false alarms. May I, as Director of Registered Charity No. X97009A, appeal to readers for funds to track down this mercury pollution problem which could be responsible for much undiagnosed illness because such tiny traces of it can act on the central nervous system?

Yours sincerely,

Lawrence D. Hills,
Director-Secretary,
Henry Doubleday Research
Association,
20 Convent Lane, Bocking,
Braintree, Essex.

Venetian museum

Sir,

Your March 1971 number has just arrived in this part of the world. It was good to read Sir Ashley Clarke's article, "Need Venice Disappear?"

Habits of diplomatic finesse and his present position as Vice-Chairman of the "Venice in Peril Fund" have perhaps inhibited the ex-ambassador to the Quirinale from giving your readers the picture in depth. While it is interesting to learn the history of the *Magistratura alle acque*, it is more important to understand the present interplay and proliferation of committees, advisory groups, research institutes, the Mayor and Corporation of Venice and vested interests generally.

If the answer to the question "Need Venice disappear?" is to be realistically phrased it will have to be neither in terms of land and water-mass dynamics, nor in lists of newly formed institutes, central government grants and UNESCO support. The answer must be expressed in terms of the local wish to survive and of how Venetians themselves view their city. Far too much was veiled in Sir Ashley's phrase about a nation and a Venice of individualists.

May I suggest that *The Ecologist*

now commission a second article by an informed but independent individual who holds no position of responsibility on any body dedicated to "saving Venice"?

Such an article should at the very least consider the following points:

(1) The open war between the forces for conservation of Italy's natural and artistic heritage and the forces for her industrial and urban development. This war is not the genteel minuet now being trod by their British counterparts. Note the story of *Italia Nostra*, for example. (*Italia Nostra* v. *Cosa Nostra*?)

(2) The recent (i.e. post 1966) proliferation of committees, investigatory bodies, etc. Note especially the real attitude of the *Comitatone* as contrasted with its proclaimed function. Note the treatment of the Dutch advisors and their findings.

(3) The attitude of the Mayor and Corporation of Venice towards the human resources of their own city; the decline of Venice into a single-industry (tourism) city; population drift, not because Venice is sinking and crumbling, but because no one wants to live in a museum.

(4) The interpenetration, and often the identity, of interests: landowners in old Venice, and industrialists and majority shareholders in the Mestre and Marghera developments.

I am not asking for a sensationalist piece of "full and frank" reporting, but your treatment will remain superficial, unless *The Ecologist* goes to Venice and speaks to the Venetians. If Venice disappears beneath the Adriatic, this will be because—under the weight of tourism and committees for its own preservation—it will already have disappeared as a viable human community. Only Venetians can save Venice. Cities depend for their survival as cities on the will of their own people. UNESCO and international bodies alone, if they have any success, will find that they have salvaged an international toy.

I have no personal animus against Sir Ashley (or his Fund). It is his position which places him awkwardly. *The Ecologist* owes itself a second article.

Yours faithfully,

Tony Clark,
Rishi Valley P.O., Chittoor District,
Andhra Pradesh, India.

The Valley Trust

Sir,

I was most interested to read Lawrence Hill's article on the Valley Trust in South Africa ("Valley of a thousand hopes", July 1971, p. 29). Your readers, in turn, may be interested to learn that a nutrition education unit is being set up to provide simple accommodation for visiting "trainees" to come and learn about the work of the Trust, in particular the development of the deep-trench cultivation. At the end of 1970 there was a waiting list of 23 organisations wanting to send men and women for training. Lack of funds has delayed the start of the programme, but it was hoped that the building would be ready to take the first trainees in June. A film has also been made of the work of the Trust which will be ready later this year.

Oxfam has helped the Valley Trust for the last 10 years, to a total of more than £20,000, with funds for buildings, a vehicle, salaries, and for the establishment and later enlargement of a rotating loan fund for tools, seeds, fencing and other items for people wishing to start vegetable gardens. The fund has helped just over 200 "gardeners" in the Valley; but another 400 have started gardens on their own initiative and at their own expense—a tribute to the demonstration work of the Valley Trust. The new education unit and the film should spread the message further afield to other dry and malnourished areas.

Yours faithfully,

Elizabeth Stamp,
Information Officer, Oxfam, 274 Banbury Road, Oxford OX2 7DZ.

Tourism's effects

Sir,

I am writing a book which concerns the effects of tourism on places and their inhabitants. How real is their newfound affluence; what happens in the off-season; do they really prefer being waiters; what do they think of tourists; does a community become divided; what happens to customs and traditions; does cynicism offset other benefits; how are architecture, flora and fauna affected, and what pollution results? Questions like these. I am

concerned not only with the Mediterranean, but the world, as the frontiers roll back. If any reader can provide documented experience of specific places, or quote research or other sources of information, I should be most grateful.

Yours faithfully,

Patrick Rivers,
Garden Flat, 27 Upper Addison
Gardens, London W14 8AJ.

Pollution and the profit motive

Sir,

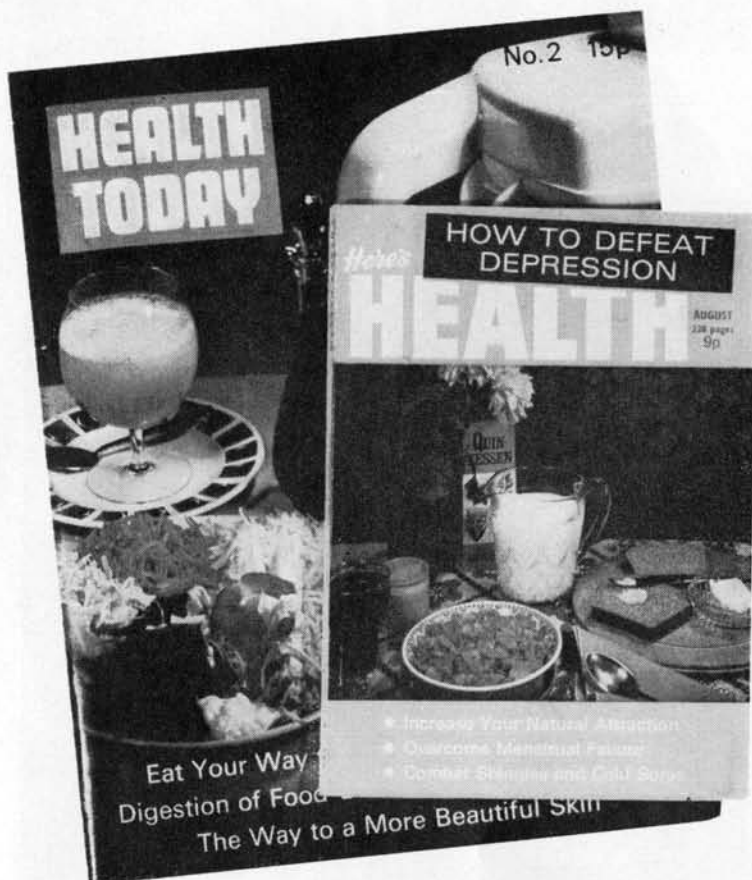
I have read *The Ecologist* from the first issue, and I fail to see how it can have any real influence on the problems of pollution, because it appears oblivious of the fact that the social system creates pollution in its search for profits. Consequently, if no attempt is made to remove the profit motive from society, pollution will continue and the world's resources be squandered. Legislation is of no avail, because in the end one would have to legislate to the extent of abolishing profits and so bankrupting the system.

The position is similar to that for war. The formation of the League of Nations (and later the United Nations) with all their negotiations have achieved nothing in the direction of real or permanent disarmament. All the talk and articles written are destined to be no more effective. We console ourselves that the smoke abatement act has diminished pollution, but the real dangers from poisonous nerve gases and nuclear contamination continue apace; and all because of the profit motive in society. So long as society is run on its present basis war and pollution will continue. To abolish them we must eradicate the cause and not treat the symptoms. This entails an essential change in society, from one that produces commodities and services for the profit of a few, to one that is run for the health and future benefit of the community.

I would like to see a few articles on this aspect in your magazine.

Yours sincerely,

Horace Jarvis,
72 Beechwood Road, Sanderstead,
Croydon, Surrey.



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