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# Economics & Entropy

by Nicholas Georgescu-Roegen

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**THE ECOLOGIST, 73 Kew Green, Richmond, Surrey**

# The Ecologist

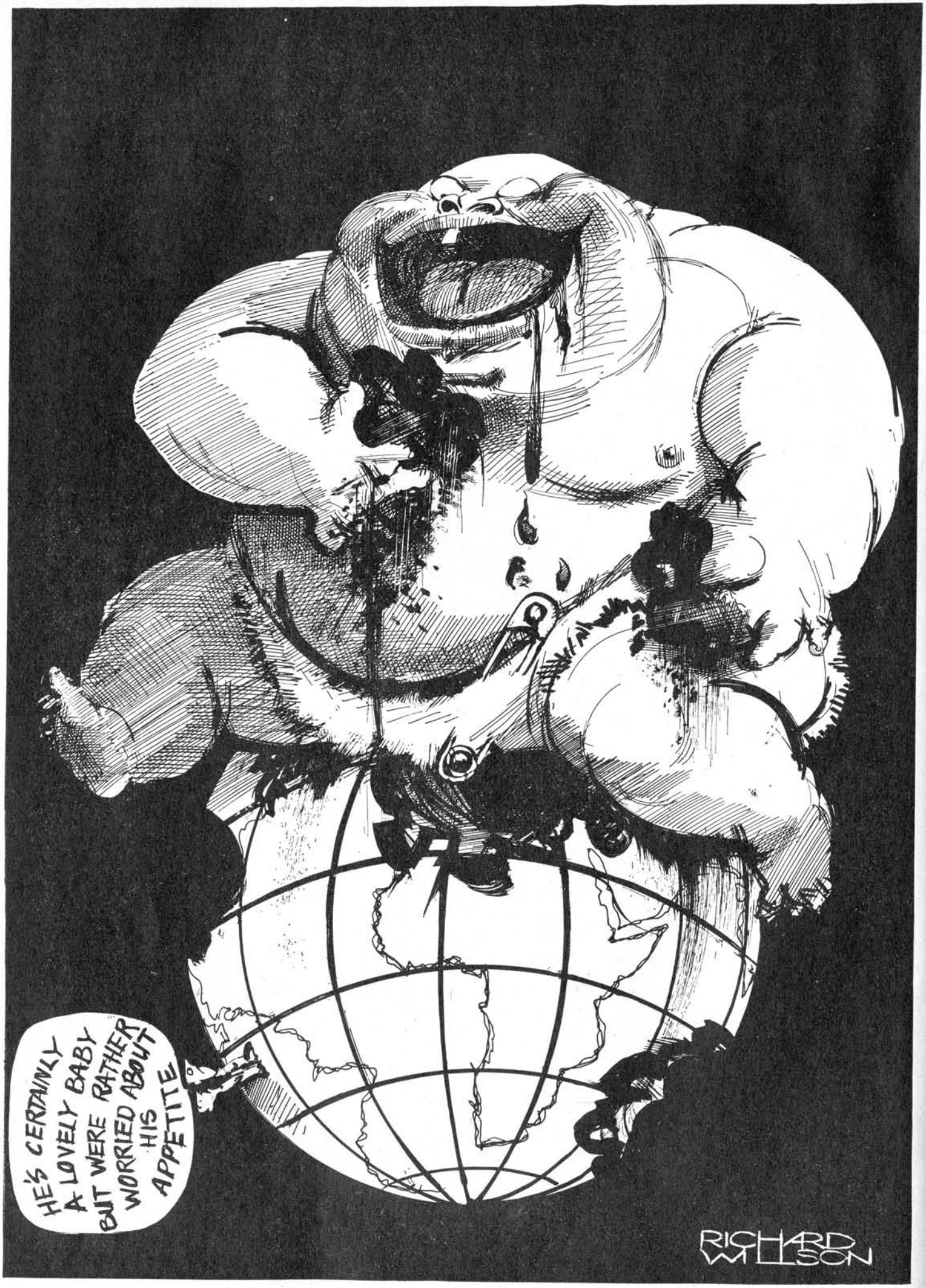
Vol. 2 No. 7 July 1972

The Ecologist is printed on recycled paper





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: Alibrairi 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.




**Homo economicus (growing)**

# Editorial

*Edward Goldsmith*

## Economics

Economics is the study of the distribution of resources within and among societies. Resources do not distribute themselves, they are distributed by people. Economics is thus concerned with behaviour and is or should be a branch of behavioural science.

Behaviour, of whatever type it may be, is subject to constraints which accumulate as it evolves; as the primeval dust gives way to organisation or negative-entropy.

Perhaps the most sophisticated type of organisation is the human society, and not only are its parts subjected to the constraints imposed on its sub-parts and sub-sub-parts, but also to those constraints that will enable them to fulfil their differentiated tasks within the social system.

Thus to understand any aspect of human behaviour one must ask oneself how it contributes to the functioning of the specific society in which it occurs.

This is true of economic behaviour —that which ensures the distribution of resources within the system, for if the latter is to function properly, the resources must be made available where they are required. Only in this way can the delicate structure of the social system be maintained.

Thus, as one would expect, economic behaviour in a stable society is entirely geared to social ends. As Polanyi writes "... a man is not an economic, but a social being. He does not aim at safeguarding his individual interest in the acquisition of material possessions, but rather at ensuring social goodwill, social status, social assets. He values possessions primarily as a means to that end".

As, with the development of the industrial state, social structures began to disintegrate, so did economic behaviour tend to disassociate itself from its normal ends. As Polanyi remarks "Man's economy is, as a rule, submerged in his social relations. The change from this to a society which was, on the contrary, submerged in the economic system was an entirely novel development". Such a development meant a radical change in our attitude to what were previously regarded as inextricable parts of the social system and which now came to be regarded more and more as commodities, ie as mere components of a separate economic process. I refer in particular to labour and land.

As Polanyi points out, these are not commodities. "Labour is only another name for a human activity that goes with life itself, which is not produced for sale but for entirely different reasons, nor can that activity be detached from the rest of life, be stored or mobilised; land is only another name for nature". Neither are produced for sale and neither can be regarded, with impunity, as commodities.

Once they are, then that complex set of cultural constraints that normally governs man's behaviour towards nature and towards other men must disintegrate. These now come to be treated in the way that will most accelerate the distributive process, regardless of the effect of such treatment on other processes, in particular on long-term social and ecological ones.

In such conditions, people are transferred from one society to another for purely economic reasons and nature is transformed into a factory catering for man's short-term material requirements.

In such conditions, the only constraints on economic behaviour are economic ones. Things get done because they are economic, which means that there is a demand for them which can be satisfied in conditions that yield the financial surplus necessary for ensuring their further supply.

The demand for things, unfortunately, no longer corresponds to the individual's let alone the society's need for them, as would be the case if the former were living in the social and physical environment to which he had been adapted phylogenetically and ontogenetically. In such conditions, normal intuitive behaviour would, in all likelihood, be adaptive.

When, however, the environment undergoes too radical a transformation, it becomes counterintuitive, in the sense that intuition no longer provides a means of interpreting it, no more than it would enable a wart-hog to comprehend the functioning of an electric toothbrush factory in which it had been projected by some practical joker.

In this way responses based on intuitive interpretations are likely to be counterproductive. What is more, they will tend to give rise to an increasingly counterintuitive environment to which responses are likely to be correspondingly more counterproductive.

Needs, in such conditions would tend to accumulate by positive-feedback, the satisfaction of one serving but to create the need for another—each more outlandish and ever less designed to satisfy social and ecological requirements.

Thus only those already provided with drive-in shops and drive-in cinemas will genuinely feel that they require that ultimate blasphemy, the drive-in church, while only those accustomed to travel by jet plane are likely to crave for what must provide the final indictment of the consumer society: supersonic transport.

Each step in this process further reduces the systemic constraints to which economic behaviour is normally subjected. The latter is ever more out of control and society is increasingly unstable. Also the supply of things no longer coincides with the ecosystem's productive capacity. Things are supplied economically only because their price does not reflect their true cost to society or to the ecosystem.

Environmental deterioration caused by pollution, the simplification of ecosystems, the replacement of self-regulating controls by externally regulated ones, resource depletion and social disruption are simply not taken into consideration in the accounting system we happen to have adopted. As a result, the productive process knows no long-term social and ecological constraints, and becomes but a means of transforming the delicate fabric of the ecosphere into random parts or waste products, as must be regarded the manufactured goods in terms of which we misguidedly measure the wealth of nations and the welfare of mankind.

If we are to develop a less destructive economy, we must cease trying to understand it *in vacuo*, but rather as a disassociable aspect of social and ecological behaviour. In this way we can console ourselves that *homo economicus*, monster that he appears to be, is but a fiction. It is *homo domesticus industrialis* that is causing all the problems.

# The Stationary-State Economy

## by Herman E. Daly

"Growthmania" is the paradigm that puts growth in the first place, arguing that if output is a good thing, it follows that there cannot be enough of it. It is admitted that economic growth is accompanied by environmental costs, which at some point may become unacceptable, but when, as in the GNP concept, these costs are included as benefits, we have "hyper-growthmania". Prof. Daly argues that the growth paradigm has outlived its usefulness and that it should be replaced by a "stationary state" economic system, with all that that implies.

### I. Growthmania

The fragmentation of knowledge and people by excessive specialisation, the disequilibrium between the human economy and the natural ecosystem, the congestion and pollution of our spatial dimension of existence, the congestion and pollution of our temporal dimension of existence with the resulting state of harried drivenness and stress—all these evils and more are symptomatic of the basic malady of growthmania.

"Growthmania" is an insufficiently pejorative term for the paradigm or mind-set that always puts growth in first place—the attitude that there is no such thing as enough, that cannot conceive of too much of a good thing. It is the set of unarticulated preconceptions which allows the President's Council of Economic Advisors to say, "If it is agreed that economic output is a good thing it follows by definition that there is not enough of it."[1] As a sop to environmentalists the Council does admit that "growth of GNP has its costs, and beyond some point they are not worth paying".[2] But instead of raising the obvious question—"What determines this point of optimal GNP, and how do we know when we have reached it?"—the Council merely pontificates that "the existing propensities of the population and the policies of the government constitute claims upon GNP itself that can only be satisfied by rapid economic growth". That of course is merely to restate the problem, not to give a solution. Apparently these "existing propensities and policies" are beyond discussion. That is growthmania. Brezhnev, Castro, and Franco receive much the same advice from their respective Councils of Economic Advisors. Growthmania is ecumenical.

The answer to the avoided question "When do the costs of growth in GNP outweigh the benefits?" is contained in the question itself. This occurs when the decreasing marginal benefit of extra GNP becomes less than the increasing marginal cost. The marginal benefit is measured by the market value of extra goods and services—i.e. the increment in GNP itself in value units. But what statistical series measures the cost? Answer: *none*! That is growthmania; literally not counting the costs of growth.

But the worst is yet to come. We take the real costs of increasing GNP as measured by the defensive expenditures incurred to protect ourselves from the *unwanted* side effects of production, and *add* these expenditures to GNP rather than subtract them. We count the real costs as benefits—this is hyper-growthmania. Since the net benefit of growth can never be negative with this Alice-in-Wonderland accounting system, the rule becomes "grow forever" or at least until it kills you—and then count your funeral expenses as further growth. This is terminal hyper-growthmania. Is the water-table falling? Dig deeper wells, build bigger pumps and up goes GNP! Mines depleted? Build more expensive refineries to process lower grade ores, and up goes GNP! Soil depleted? Produce more fertiliser, etc. As we press against the carrying capacity of our physical environment these "extra-effort" and "defensive" expenditures (which are really costs masquerading as benefits) will loom large and larger. As more and more of the finite physical world is converted into wealth, less and less is left over as non-wealth—i.e. the non-wealth physical world becomes scarce, and in becoming scarce it gets a price and thereby becomes wealth. This creates the illusion of getting better off, when in actuality we are getting worse off. We may already have passed the point where the marginal cost of growth exceeds the marginal benefit. This suspicion is increased by looking at who gets the costs and who gets the benefits. We all get some of each, but not equal shares. Who buys a second car or a third TV? Who lives in the most congested, polluted areas? The benefits of growth go mainly to the rich, the costs mainly to the poor. That statement is based on casual empiricism—we do not have social accounts which allow us to say precisely who gets the benefits and who gets the costs of growth, a fact which is itself very revealing. Ignorance, if not blissful, is often politically expedient.

Growthmania is the paradigm upon which rests the models and policies of our current political economy. The answer to every problem is growth. For example:

(1) Poverty? Grow more to provide more employment for the poor and more tax revenues for welfare programmes.

(2) Unemployment? Invest and grow to bolster aggregate demand and employment.

(3) Inflation? Grow by raising productivity so that more goods will

be chased by the same number of dollars and prices will fall.

(4) Balance of Payments? Grow more and increase productivity in order to increase exports. Cutting imports is seen only as a short-run stop-gap, not a solution.

(5) Pollution and Depletion? Grow so we will be rich enough to afford the cost of cleaning up and of discovering new resources and technologies.

(6) War? We must grow to be strong and have *both* guns and butter.

The list could be extended, but it can also be summarised in one sentence: The way to have your cake and eat it too is make it grow.

Growthmania is the attitude which in economic theory begins with the theological assumption of infinite wants, and then with infinite hubris goes on to presume that the original sin of infinite wants has its redemption vouchsafed by the omnipotent saviour of technology, and that the first commandment is to produce more and more goods for more and more people, world without end. And that this is not only possible, but desirable.

Environmental degredation is an iatrogenic disease induced by economic physicians who treat the basic malady of unlimited wants by prescribing unlimited economic growth. We experience environmental degredation in the form of increased scarcity of clean air, pure water, relaxed moments, etc. But the only way the growthmania paradigm knows to deal with scarcity is to recommend growth. Yet one certainly does not cure a treatment-induced disease by increasing the treatment dosage! Nevertheless the usual recommendation for combatting pollution is to grow more because "a rising GNP will enable the nation more easily to bear the costs of eliminating pollution".[3] Such a view is patently inept.

The growth paradigm has outlived its usefulness. It is a senile ideology that should be unceremoniously retired into the history of economic doctrines. In the terminology of Thomas Kuhn's book, *Structure of Scientific Revolutions*, the growth paradigm has been more than exhausted by the normal science puzzle-solving research within its confines. Political economy must enter a period of revolutionary science to establish a new paradigm to guide a new period of normal science. Just as physiocracy gave way to mercantilism, mercantilism to classical laissez-faire, laissez-faire to Keynesianism, Keynesianism to the neo-classical growth synthesis, so the current neo-classical growthmania must give way to a new paradigm. What will the new paradigm be? I submit that it must be very similar to an idea from classical economics that never attained the status of a paradigm, except for a brief chapter in John Stuart Mill's *Principles of Political Economy*. This idea is that of the stationary-state economy.

## II. The Stationary State

What is meant by a "stationary-state economy"?

Why is it necessary?

How can it be attained?

The first two questions are relatively easy and have been dealt with elsewhere.[4] Hence they will be treated rapidly. The third question is extremely difficult, and will be the main focus of attention.

The stationary state is defined as an economy in which the total population and the total stock of physical wealth are maintained constant at some desired levels by a "minimal" rate of maintenance throughput (i.e. by birth and death rates which are equal at the lowest feasible level, and by physical production and consumption rates which are equal at the lowest feasible level). The first part of the definition (constant stocks) goes back to John Stuart Mill, and the second part ("minimal" flow of throughput) goes back to 1949 vintage Kenneth Boulding. Minimising throughput implies maximising the average life expectancy of a member of the stock.[5]

Why is the stationary state necessary? Not for the reasons given by the classical economists who saw increasing rent and interest eliminating profit and thus the incentive for "progress". Rather, the necessity follows immediately from physical first principles. The world is finite, the ecosystem is a steady state. The human economy is a subsystem of the steady-state ecosystem. Therefore at some level and over some time period the subsystem must also become a steady state, at least in its physical dimensions of people and physical wealth. The stationary-state economy is therefore a physical necessity. One may counter this by arguing that we always have the alternative of extinction, and that therefore the stationary state is a moral choice, not a physical necessity. But even this is mistaken. Extinction itself is a stationary state, the special case of zero stocks maintained by a zero throughput. The choice of stock levels and rates of maintenance thoughput requires value judgments, but the eventual attainment of a stationary state at some level is a physical necessity.

Our definition of "stationary state" is much closer to the Classical than to the Neo-Classical definition of the term. The Neo-Classical definition of stationary state assumes constant wants and technology (non-physical parameters) and investigates the adjustment of physical variables to the non-physical parameters. Our definition assumes constant physical wealth and population (physical parameters) and inquires how the non-physical variables of wants (including the ethical want for "better wants") and technology can be sensibly adjusted to the physical parameters. Furthermore the Neo-Classical concept is an epistemological fiction useful mainly as a first step in the analysis of a growing economy. It is in no sense a target for policy or a real state towards which the economy actually tends. Our concept is not epistemological fiction, but an attempt to describe in broad outlines a real and necessary future state of society.

The above differences represent a paradigm shift in the sense of Thomas Kuhn. The stationary-state paradigm will not be easily accepted by those who have been trained in and worked within the growth paradigm. But the arguments are too logical and too simple to be resisted for long, and the weight of anomaly under which the old paradigm is groaning will eventually crush it. An example of a simple argument which cannot be long resisted is the following. All reasonable men by now accept the ultimate necessity of zero population growth. But in addition to the population of human bodies (the stock of endosomatic capital) we must consider the population of extensions of the human body (exosomatic capital). Bicycles and automobiles are extensions of man's legs; hammers and pliers are


**"I assure you that our preliminary prospecting will not disrupt any of your services"**

extensions of his arms and hands; pots and pans and ovens are extensions of his digestive system; the telephone and phonograph extend man's ears; the TV extends his eyes; clothing and buildings extend his skin, etc. Both endosomatic and exosomatic capital are necessary to maintain life. More importantly both endosomatic and exosomatic capital stocks are physical open systems which maintain themselves by continually importing low entropy matter-energy from the environment and exporting high entropy matter-energy back to the environment.[6] The same physical laws which limit the population of organism apply with equal force to the population of extensions of organisms. If the first limitation is admitted, how can the second be denied?

In sum the stationary state is necessary. It must be the norm. The growing or declining economy must be the *temporary* aberration from the norm, corresponding to the movement from one stationary state to another, whenever such a change is made desirable by changes in technologies or values. But the burden of proof should rest on those advocating growth or decline.

When we raise the third question of how to attain the stationary state, things become more difficult. First we must give operational definitions to the specific goals contained in the definition of stationary state. Second, we must specify the technologies, social institutions, and moral values which are in harmony with and supportive of the stationary state.

To define more clearly the goal of the stationary state we must face four questions.

(1) *At what levels should the stocks of wealth and people be maintained constant?* Specifying the stock of wealth and of people also specifies the wealth per person or standard of living. In other words the question becomes the old one of what is the optimum population? So far no one has given a definitive answer, and I certainly cannot. However, it is sometimes argued that it is vain to advocate a stationary population unless one can specify the optimum level at which the population should become stationary. But I think that puts it backwards. Rather it is vain to speak of an optimum population unless you are first prepared to accept a stationary population—unless you are able and willing to stay at the optimum once you find it. Otherwise knowing the optimum merely enables us to wave goodbye as we pass through it. Furthermore the optimum population is more likely to be discovered by experience than by *a priori* thought. We should attain a stationary population at some feasible nearby level. After experiencing it we could then decide whether the optimum level is above or below the current level. Also the optimum may be a welfare plateau spanning a whole range of populations and not just one. It is more important to be able to attain a stationary state (at any level) than to know in advance which level is optimal.

(2) *What is the optimal level of maintenance throughput for a given level of stocks?* For the time being the answer is probably "as low as possible" or at least "less than presently". If it is good for people to live longer and for goods to last longer, then it is good to reduce the rate of throughput. Under the constraint of present technology perhaps we could advocate minimising throughput, but as technology increases the potential life expectancy of people and goods we will surely reach a point where optimum life expectancy is less than maximum—or, what is the same thing, optimum throughput is greater than the minimum. But for the present, minimising throughput makes vastly more sense than the current practice of maximising it.

(3) *What is the optimal time horizon or accounting period over which population and wealth are required to be constant?* Obviously we cannot mean day-to-day constancy and probably not even year-to-year constancy. Related to this is the question of the optimum amplitude of fluctuation around the steady-state mean during the accounting period.

Again, I cannot pretend to be able to answer this question. But it must be pointed out that the question of the proper accounting period is a very general one which applies in equal force to standard economic theory. The fundamental assumption of profit maximisation is meaningless unless one specifies the length of the accounting period. Surely we do not maximise daily profits, and often not even yearly profits. Behaviour which is "rational" (consistent with profit maximization) over one time period is irrational over another. My favourite example is that of the village idiot who when offered the choice between a nickel and a dime always chose the nickel, much to the villagers' continuing amusement. Finally one day a villager said to him, "look I know you are not that stupid; you know a dime is worth more than a nickel—why do you always take the nickel?" To which the "idiot" replied "It's obvious—if I took the dime they would stop making the offer!" Idiocy on one time horizon is cleverness on another. But somehow we manage to choose an accounting period and muddle through, and so we could also in a stationary state.

(4) *What is the optimal rate of transition from the growing economy to the stationary state?* We can never attain a stationary state in the long run if our efforts to do so kill us in the short run. In the case of population there are interesting trade-offs between speed of attainment of a stationary population versus size of the stationary population and the amplitude of fluctuations in the birth-rate induced by the current non-equilibrium age structure.[7]

Once again I do not know the optimum rate of transition. But I think we are very unlikely to exceed it. In any case the sooner we begin deceleration to zero growth the longer we can afford to take and the less disruptive that adjustment will be. The important thing from all points of view is to begin deceleration now. Later we can argue about the optimum rate.

**Growth of GNP has its costs**

The fact that these four optima cannot be well-defined should come as no surprise. In social science all our concepts are dialectical and necessarily imprecise. We may make use of analytical models in which all concepts are given analytically precise definitions which allow logical and mathematical manipulation. But these models are analytic similes sometimes useful, sometimes not. They do not remove the dialectical imprecision of our concepts, they merely abstract from it.

As for the above four questions the immediate directions are clear enough though the optimum magnitudes be vague. We are sometimes too clever in exploiting the imprecision of our knowledge in order to evade moral responsibility for our inaction.

The questions raised so far involve clearer definitions of the goals of the stationary state. A more important set of questions follows concerning the means for attaining the stationary-state goals: the appropriate technology, the appropriate social institutions of control for maintaining constant stocks of physical wealth and people, and for distributing constant wealth among a constant population.

**Stationary-State technology**

The main aim of production technology must, in the stationary state, become more analogous to the legitimate aim of medical technology. Just as medical technology seeks (or should seek) to increase average life expectancy, so must production technology seek to increase the "life expectancy" or durability of physical commodities. How? By making individual commodities more durable and designing them for easy repairability, and also by designing for easier recyclability either through man-made closed loops or natural material cycles (biodegradability). High biodegradability may seem to contradict "durability" and in a physical sense it does. But what we are interested in is durability as a part of the stock of wealth, not the durability of garbage. Maximising durability means maximising the time matter spends as wealth and minimising the time it spends as garbage. Our current technology aims instead at minimising durability in order not to spoil the market for replacement demand.

One extremely interesting technological possibility from the stationary state perspective is the "fusion torch" idea being pursued by William Gough and Bernard Eastlund of the AEC.[8] An ultra-high temperature plasma held in a magnetic field is used to provide energy for electric power generation. Garbage is thrown into the plasma which reduces any material to its basic elements. The elements are then separated and collected electromagnetically and made available for re-use. Although this closes the material cycle there is still the unavoidable problem of thermal pollution. But the idea is to minimise it by cascading heat downwards to lower and lower grade uses. For example the waste heat of power generation would be used for space heating, replacing fossil fuels. There are many technical problems which remain and I am not competent to assess them. But the idea of a fusion torch fits the stationary-state paradigm, a fact which its proponents consider of great importance.

The above example of "cascading

heat downward" illustrates the principle that technology should be designed so as to minimise negative externalities. One way of accomplishing this may be to shift to a smaller scale of plant. Smaller scale and reduced power also aid accessibility and facilitate the distribution of both the benefits of and the controls over technology. As an example Dr Ivan Illich convincingly argues that the mobility of the entire population of a country would be increased by substituting cheap, repairable "mechanical donkeys" for expensive automobiles, and by reducing the speed limit from 70 to 10 miles per hour!

Also the focus of technological efficiency must shift from increasing output per constant period of labour time to decreasing labour time per constant quantity of output. The fruits of technical progress must be taken in the non-physical form of increased leisure time.

The social institutions of control are of three kinds: those for maintaining a constant population, those for maintaining a constant stock of physical wealth, and those governing distribution. In all cases the guiding design principle for social institutions is to provide the necessary control with a minimum sacrifice of personal freedom, to provide macro-stability while allowing for micro-variability, to combine the macrostatic with the micro-dynamic.[9]

### A. Constant Population

For maintaining a constant population an ingenious institution has been proposed by Kenneth Boulding.[10] Unfortunately it has been treated more as a joke than as a serious proposal. The idea is to issue directly to individuals licences to have children. Each person receives certificates in an amount permitting 1.1 children or each couple at marriage receives certificates permitting 2.2 children, or whatever number corresponds to replacement fertility. The licences can be bought and sold on a free market. Thus macro-stability is attained, micro-variability is permitted. Furthermore those having more than two children must pay for extra licences, those who have fewer than two children receive payment for their unused licence certificates. The right to have children is distributed equally. Market supply and demand then redistributes these rights. People who do not or cannot have children are rewarded financially. People who wish to have more than two are penalised financially. And the subsidies and penalties are handled by the market with no government bureaucracy.

A slight amendment to the plan might be to grant 1.0 certificates to each individual and have these refer not to births but to "survivals". If someone dies before he has a child then his certificate becomes a part of his estate and is willed to someone else, e.g. his parents, who either use it to have another child, or sell it to someone else. The advantage of this modification is that it offsets existing class differentials in infant and child mortality. Without the modification a poor family desiring two children could end up with two infant deaths and no certificates. The best plan of course is to eliminate class differences in mortality, but in the meantime this modification may make the plan initially easier to accept.

Let us dispose of two common objections to the plan. First it is argued that it is unjust because the rich have an advantage. Of course the rich always have an advantage, but is their advantage increased or decreased in Boulding's plan? Clearly it is decreased. The effect of the plan on income distribution is equalising because (1) the new marketable asset is distributed equally, (2) as the rich have more children their family per capita incomes are lowered, as the poor have fewer their family per capita incomes increase. Also from the point of view of the children there is something to be said for increasing the probability that they will be born rich rather than poor. Whatever injustice there is in the plan stems from the existence of rich and poor, not from Boulding's plan which actually reduces the degree of injustice. Furthermore income and wealth distribution are to be controlled by a separate institution, discussed below, so that in the overall system this objection is more fully met.

A more reasonable objection raises the problem of enforcement. What to do with law-breaking parents and their illegal children? What do we do with illegal children today? One possibility is to put the children up for adoption and encourage adoption by paying the adopting parents the market value, plus subsidy if need be, for their licence thus retiring a licence from circulation to compensate for the child born without a licence. Like any other law breakers the offending parents are subject to punishment. They may have the choice of a fine, a jail sentence or sterilisation. Of course if everyone breaks a law no law can be enforced. The plan presupposes the acceptance by a large segment of the public of the morality and necessity of the law. It also presupposes widespread knowledge of contraceptive practices. But these presuppositions would apply to *any* institution of population control. The moral issue is of such critical importance that it will be considered separately later.

Choice may be influenced in two ways: by acting on or "rigging" the objective conditions of choice (prices and incomes in a broad sense), or by manipulating the subjective conditions of choice (preferences). Boulding's plan imposes straightforward objective constraints and does not presumptiously attempt to manipulate people's preferences. Preference changes due to individual example and moral conversion are in no way ruled out. If preferences should change so that, on the average, the population desired replacement fertility, the price of a certificate would approach zero and the objective constraint would automatically vanish. The moral basis of the plan is that everyone is treated equally, yet there is no insistence upon conformity of preferences, the latter being the great drawback of "voluntary" plans which rely on official moral persuasion. Some people, God bless them, will never be persuaded, and their individual non-conformity wrecks the moral basis (equal treatment) of "voluntary" programmes.

### B. Constant Physical Wealth

The guiding principle is the same as in the case of population: to combine macro-stability with micro-variability, or macro-statics with micro-dynamics. However, I am unable to imagine in this case a control mechanism as simple and elegant as Boulding's plan for population control.

The strategic point at which to impose macro control seems to me to be the rate of depletion of material resources. If we control aggregate depletion, then by the law of conservation of matter and energy, we will

**The illusion of getting better off, when in actuality we are getting worse off.**

also control aggregate pollution. Intervention at the depletion end of the pipeline seems preferable to intervening at the pollution end for several reasons. First depletion is more spatially concentrated than pollution. Pollution results directly from production and consumption, which are very widely diffused activities. Pollution results indirectly from depletion which is concentrated spatially and is specific to the extractive industries. Thus it is easier to directly control the rate of depletion than the rate of pollution. Effluent or pollution taxes could be supplements.

But what kind of institutions of control are appropriate? We are familiar with the fact that a national economy has a balance of international payments with the rest of the world, which must be kept within some limits. The stock of foreign exchange reserves is not allowed to fall too low because illiquidity is inconvenient and costly, but idle funds are also costly so reserves are not allowed to pile up endlessly. Over some period the aim is to maintain an optimal stock of reserves, with the flow of payments equal to the flow of receipts. We should also think in terms of an ecological balance of payments of the human economy with the rest of the ecosystem. We import low entropy raw material inputs and export high entropy waste outputs. The stationary-state paradigm requires that we maintain a desired or equilibrium stock of physical wealth. Thus we must balance physical exports and imports—and at the lowest feasible level given the size of the stock to be maintained. To bring about this balance we cannot appeal to anything so automatic as the price-specie flow mechanism or fluctuating exchange rates. It would be nice if we could. Instead we must appeal to something analogous to the instruments of trade control, i.e. tariffs, quotas, etc.

Many such institutions could be imagined, some directly controlling price in order to influence quantity, some directly controlling quantity and allowing price to be indirectly determined by the market. Let us sketch only one variant among many possible. Suppose we measure, in so far as possible, the amount of physical depreciation, in the sense of unrecoverable physical using up of the stock of wealth, say, over one year.[11] Annual new extraction of this resource is then set equal to annual unrecoverable waste. The right to produce and sell this limited amount is then auctioned off (in some conveniently divisible units) to firms in the industry that produces the resource in question—just as some governments have auctioned foreign exchange to importers. The rest is left up to the price system. Some consequences would be the following. The prices of the limited quantities of resources would rise, and the prices of goods made with them would rise. Aggregate consumption would be reduced. The increase in price due to limitation of supply by government would accrue to the government through the auctioning of the legal rights to produce. The higher prices of raw materials and of goods give a double incentive to recycling, thus reducing material pollution. Reliance on the price system presupposes effective anti-trust on the producer side, and reasonable equality of wealth and income on the consumer side. The latter will be discussed below.

The rise in prices of all goods resulting from the restriction on supply of resources, has the same incidence as a general sales tax on resources. We might therefore expect it to be regressive. However there is some doubt that a general sales tax really is regressive.

The only income not taxed is that which is not spent, i.e. saved. What an individual saves this year he will either spend in the future, or save forever. If he spends in the future it is subject to the general sales tax at that time. If he never spends it, that is, from the stationary-state viewpoint, even better.

In any case income and wealth distribution are too important to be determined merely as a by-product of policies to stabilise wealth and people.

One seemingly major difficulty is to measure accurately physical depreciation and equate it to new depletion. But accurate measures are not really necessary. Operationally the first step may simply be to limit new depletion to last year's level. In subsequent years the level could be reduced by say 3 per cent annually until we reach a "long-run desirable rate" of depletion and pollution which is well below the thresholds of all known ecological limits. The stock could then grow or decline until it reached an equilibrium level at which depreciation equalled new depletion. The basic parameter to be fixed would be the rate of depletion of low entropy.

### C. Control of Distribution

Distribution is the rock upon which most ships of state, including the stationary state, are very likely to run aground. Currently we seek to improve distribution by establishing a minimum standard of living guaranteed by a negative income tax. In the growthmania paradigm there is no upper limit to the standard of living. In the stationary-state paradigm there is an upper limit. Furthermore the higher the lower limit below which no one is allowed to fall, the lower must be the upper limit above which no one is allowed to rise. The lower limit has considerable political acceptance, the upper limit does not. But in the stationary state the upper limit is a logical necessity. It implies confiscation and redistribution of wealth above a certain limit per person or per family. What does one say to the cries of "destruction of incentive"? Remember—we are no longer anxious to grow in the first place! Also one recalls Jonathan Swift's observation,

> "In all well-instituted commonwealths, care has been taken to limit men's possessions; which is done for many reasons, and, among the rest, for one which, perhaps, is not often considered; that when bounds are set to men's desires, after they have acquired as much as the laws will permit them, their private interest is at an end, and they have nothing to do but to take care of the public."[12]

### D. On Moral Growth

Is the above sketch of a stationary state unrealistic and idealistic? On the contrary, it is in broad characteristics the only realistic possibility. The present economy is literally unrealistic because in its disregard for natural laws it is attempting the impossible. The stationary-state paradigm, unlike growthmania, is realistic because it takes the physical laws of nature as its first premise.

Let us assume for a moment that the necessity of the stationary state and the above outline of its appropriate technologies and social institutions are accepted. Logic and necessity are not sufficient to bring about social reform. The philosopher Leibnitz observed that,

> "If geometry conflicted with our passions and interests as much as do ethics, we would contest it and violate it as much as we do ethics now, in spite of all the demonstrations of Euclid and Archimedes, which would be labelled paralogisms and dreams."[13]

Leibnitz is surely correct. However logical and necessary the above outline of the stationary state, it is, on the assumption of static morality, nothing but a dream. The physically stationary economy absolutely requires moral growth beyond the present level.

Economists and other social scientists of positivistic bias seem to consider appeals to morality as cheating, as an admission of intellectual defeat, like bending the pieces of a jig-saw puzzle. In economics there is a long and solid tradition of regarding moral resources as static and too scarce to be relied upon. In the words of the great British economist Alfred Marshall,

> "progress chiefly depends on the extent to which the *strongest* and not merely the *highest* forces of human nature can be utilised for the increase of social good."[14]

Presumably self-interest is stronger and more abundant than brotherhood. Presumably "progress" and "social good" can be defined independently of the driving motive of society.

Another British economist, D. H. Robertson, once asked the illuminating question: What is it that economists economise? His answer was "love, the scarcest and most precious of all resources."[15] Paul Samuelson quotes Robertson approvingly in the latest edition of his influential textbook. Nor are economists alone in ruling out reliance on moral resources. Biologist Garrett Hardin in his "tragedy of the commons" identifies a class of problems with no technical solution.[16] He rules out moral solutions as self-eliminating on a somewhat far-fetched evolutionary analogy, and advocates a political solution: mutual coercion mutually agreed upon. This is fine, but where is the mutual agreement to come from if not from shared values, from a convincing morality? Political scientist Beryl Crowe in revisiting the tragedy of the commons argues that the set of no-technical-solution problems coincides with the set of no-political-solution problems and that Hardin's "mutual coercion mutually agreed upon" is politically impossible.[17] Between them they present a convincing case that "commons problems" will not be solved technically nor politically, assuming static morality. And yet both refuse to consider moral solutions—that would be "unscientific".

Going back to Robertson's repulsive but correct idea that economists economise love, one may ask, "How"? Mainly by maximising growth. Let there be more for everyone year after year so that we need never face up to sharing a fixed total. Unequal distribution can be justified as necessary for saving, incentive and hence growth. This must continue, otherwise the problem of sharing a fixed total will place too heavy a strain on our precious resource of love, which is so scarce that it must never be used. I am reminded of Lord Thomas Balough's statement that one purpose of economic theory is to make those who *are* comfortable *feel* comfortable.

To paraphrase the above, we are told "Don't worry about today's inequities, but anxiously fix your attention on tomorrow's larger total income". Compare that with the Sermon on the Mount, "do not be anxious

about tomorrow, for tomorrow will be anxious for itself. Let the day's own evil be sufficient for the day". The morality of the stationary state is that of the Sermon on the Mount. Growthmania requires the negation of that morality. If we give our first attention to the evils of the day we will have moral growth, though not so much economic growth. If we anxiously give our first attention to tomorrow's larger income we will have economic growth but little or no moral growth. Since economic growth is reaching physical limits anyway we may now find the Sermon on the Mount more appealing and easier to accept.

The same idea is stated in Alexander Solzhenitsyn's *Cancer Ward* in the chapter entitled "Idols of the Market Place" in which the position of "ethical socialism" is advocated. The main theme is "ethics first and economics afterwards"—a theme which finds as little or less acceptance in the USSR as it does in the USA. The following words are from the character Shulubin. (p. 443)

> "Happiness is a mirage—as for the so-called 'happiness of future generations' it is even more of a mirage. Who knows anything about it? Who has spoken with these future generations? Who knows what idols they will worship? Ideas of what happiness is have changed too much through the ages. No one should have the effrontery to try to plan it in advance. When we have enough loaves of white bread to crush them under our heels, when we have enough milk to choke us, we still won't be in the least happy. But if we share the things we don't have enough of, we can be happy today! If we care only about 'happiness' and about reproducing our species, we shall merely crowd the earth senselessly and create a terrifying society. . . ."

There are other sources of moral support for the stationary state beside the Sermon on the Mount. From the Old Testament we have two creation myths, the Priestly and the Yawistic, one which gives value to creation only with reference to man, and one which gives value to creation independently of man. In Western thought the first tradition has dominated, but the other is there waiting to receive its proper emphasis. Also Aldo Leopold's "land ethic" is extremely appealing and would serve admirably as the moral foundation of the stationary state. Finally Karl Marx's materialism and objection to the alienation of man from nature can be enlisted as a moral foundation of the stationary state. Marx recognised that nature is the "inorganic body of man" and not just a pile of neutral stuff to be dominated.[18]

In this paper the stationary state has been considered only at a national level. Clearly the world as a whole must eventually adjust to a stationary state. Perhaps ultimately this recognition will promote unity among nations —or conversely the desire for unity may promote the recognition. However when nations cannot even agree to limit the stock of "bads" through disarmament it is hard to be optimistic about their limiting the stocks of "goods." There is no alternative except to try, but national efforts need not wait for international agreement.

Finally one rather subtle, yet very powerful moral force can be enlisted in support of the stationary-state paradigm. That is wholeness. If the truth is the whole, as Hegel claimed, then our current splintered knowledge is so far from truth that it is hardly worth learning. I believe this is why many of our best university students do not work very hard at their studies. Why continue mining the deep narrow disciplinary shafts sunk into man's totallity by the intellectual fragment-makers? Why deepen the tombs in which we have buried the wholeness of knowledge? Why increase the separation of people by filling separate heads with separate fragments of knowledge? The malaise reflected in these questions is very grave, and is, in my view, a major reason for the new surge of interest in ecology. Ecology is whole. It brings together the broken, analysed, alienated, fragmented pieces of man's image of the world. Ecology is also a fad, but when the fad passes the movement towards wholeness must continue. Unless the physical, the social, and the moral dimensions of our knowledge are integrated in a unified paradigm offering a vision of wholeness, no solutions to our problems are likely. It seems to me that John Stuart Mill's concept of the stationary state may offer just such a paradigm.

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# Economics and Entropy

## by Nicholas Georgescu-Roegen

The entire economic history of mankind proves beyond question that nature plays an important role in the economic process as well as in the formation of economic value. It is high time that we accept this fact and consider its consequences, for some of them have an exceptional importance for the understanding of the nature and evolution of man's economy.

A curious event in the history of economic thought is that, years after the mechanistic dogma had lost its supremacy in physics and its grip on the philosophical world, the founders of the Neoclassical school set out to erect an economic science after the pattern of mechanics—in the words of Jevons, as *"the mechanics of utility and self-interest."*[1] And while economics has made great strides since, nothing has happened to deviate economic thought from the mechanistic epistemology of the forefathers of standard economics. A glaring proof is the standard textbook representation of the economic process by a circular diagram, a pendulum movement between production and consumption within a completely closed system.[2] The situation is not different with the analytical pieces that adorn the standard economic literature; they, too, reduce the economic process to a self-sustained mechanical analogue. The patent fact that between the economic process and the material environment there exists a continuous mutual influence which is history-making carries no weight with the standard economist. And the same is true of Marxist economists, who swear by Marx's dogma that everything nature offers man is a spontaneous gift.[3] In Marx's famous diagram of reproduction, too, the economic process is represented as a completely circular and self-sustaining affair.[4]

Earlier writers, however, pointed in another direction, as did Sir William Petty in arguing that labour is the father and nature is the mother of wealth.[5] The entire economic history of mankind proves beyond question that nature, too, plays an important role in the economic process as well as in the formation of economic value. It is high time, I believe, that we should accept this fact and consider its consequences for the economic problem of mankind. For, as I shall endeavour to show in this paper, some of these consequences have an exceptional importance for the understanding of the nature and the evolution of man's economy.

Some economists have alluded to the fact that man can neither create nor destroy matter or energy[6]—a truth which follows from the Principle of Conservation of Matter-Energy, alias the First Law of Thermodynamics. Yet no one seems to have been struck by the question—so puzzling in the light of this law—"what then does the economic process do?" All we find in the cardinal literature is an occasional remark that man can produce only utilities, a remark which actually accentuates the puzzle. How is it possible for man to produce something material, given the fact that he cannot produce either matter or energy?

To answer this question, let us consider the economic process as a whole and view it only from the purely physical viewpoint. What we must note first of all is that this process is a partial process which, like all partial processes, is circumscribed by a boundary across which matter and energy are exchanged with the rest of the material universe.[7] The answer to the question of what this *material* process does is simple: it neither produces nor consumes matter-energy; it only absorbs matter-energy and throws it out continuously. This is what pure physics teaches us. However, economics—let us say it high and loud—is not pure physics, not even physics in some other form. We may trust that even the fiercest partisan of the position that natural resources have nothing to do with value will admit in the end that there is a difference between what goes into the economic process and what comes out of it. To be sure, this difference can be only qualitative.

An unorthodox economist—such as myself—would say that what goes into the economic process represents *valuable natural resources* and what is thrown out of it is *valueless waste.* But this qualitative difference is confirmed, albeit in different terms, by a particular (and peculiar) branch of physics known as thermodynamics. From the viewpoint of thermodynamics, matter-energy enters the economic process in a state of *low entropy* and comes out of it in a state of *high entropy.*[8]

To explain in detail what entropy means is not a simple task. The notion is so involved that, to trust an authority on thermodynamics, it is "not easily understood even by physicists."[9] To make matters worse not only for the layman, but for everyone else as well, the term now circulates with several meanings, not all associated with a physical coordinate.[10] A recent edition of *Webster's*


**Going West — Groucho Marxist Economics.**

*Collegiate Dictionary* (1965) has three entries under "entropy." Moreover, the definition pertaining to the meaning relevant for the economic process is likely to confuse rather than enlighten the reader: "a measure of unavailable energy in a closed thermodynamic system so related to the state of the system that a change in the measure varies with change in the ratio of the increment of heat taken in the absolute temperature at which it is absorbed." But (as if intended to prove that not all progress is for the better) some older editions supply a more intelligible definition. "A measure of the unavailable energy in a thermodynamic system"—as we read in the 1948 edition—cannot satisfy the specialist but would do for general purposes. To explain (again in broad lines) what unavailable energy means is now a relatively simple task.

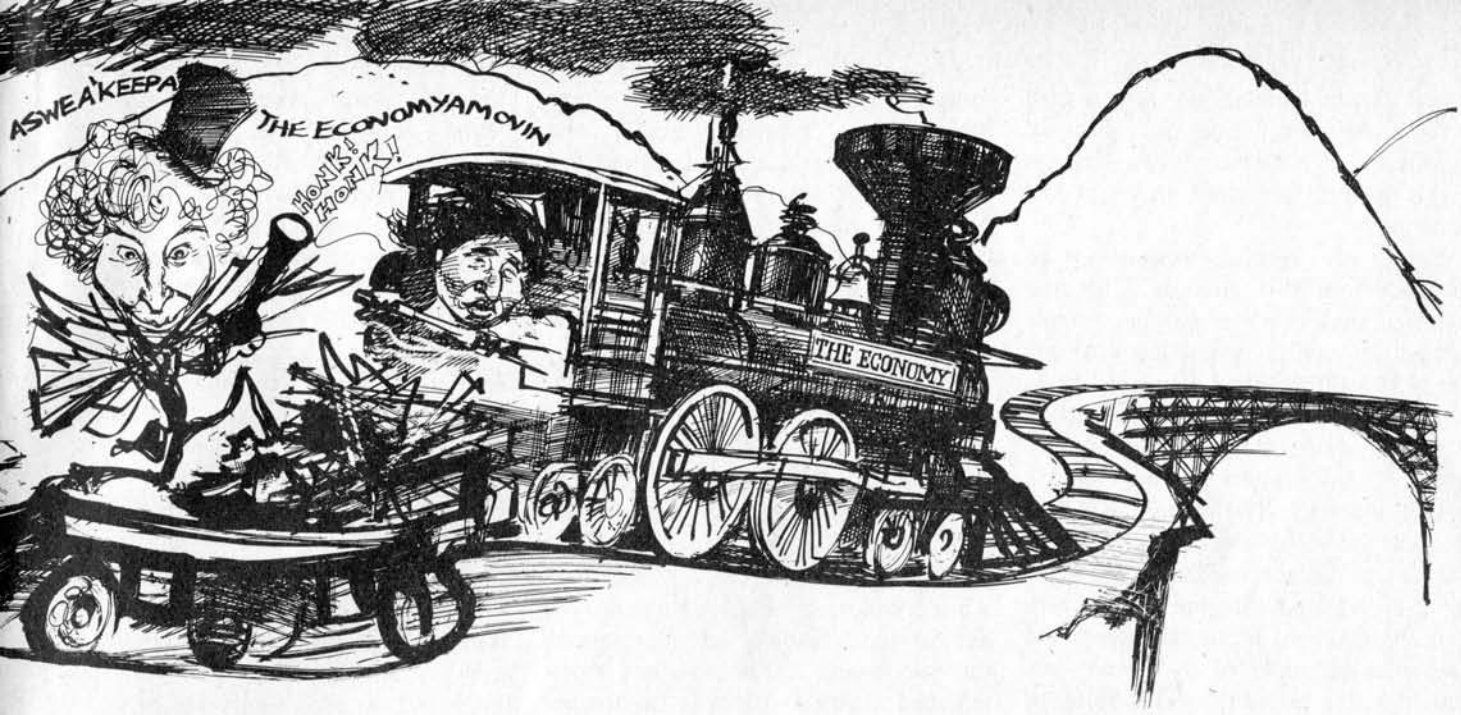
Energy exists in two qualitative states—*available* or *free* energy, over which man has almost complete command, and *unavailable* or *bound* energy, which man cannot possible use. The chemical energy contained in a piece of coal is free energy because man can transform it into heat or, if he wants, into mechanical work. But the fantastic amount of heat-energy contained in the waters of the seas, for example, is bound energy. Ships sail on top of this energy, but to do so they need the free energy of some fuel or of the wind.

When a piece of coal is burned, its chemical energy is neither decreased nor increased. But the initial free energy has become so dissipated in the form of heat, smoke and ashes that man can no longer use it. It has been degraded into bound energy. Free energy means energy that displays a differential level, as exemplified most simply by the difference of temperatures between the inside and the outside of a boiler. Bound energy is, on the contrary, chaotically dissipated energy. This difference may be expressed in yet another way. Free energy implies some ordered structure, comparable with that of a store in which all meat is on one counter, vegetables on another, and so on. Bound energy is energy dissipated in disorder, like the same store after being struck by a tornado. This is why entropy is also defined as a measure of disorder. It fits the fact that a copper sheet represents a lower entropy than the copper ore from which it was produced.

The distinction between free and bound energy is certainly an anthropomorphic one. But this fact need not trouble a student of man, nay, even a student of matter in its simple form. Every element by which man seeks to get in mental contact with actuality can be but anthropomorphic. Only, the case of thermodynamics happens to be more striking. The point is that it was the economic distinction between things having an economic value and waste which prompted the thermodynamic distinction, not conversely. Indeed, the discipline of thermodynamics grew out of a memoir in which the French engineer Sadi Carnot (1824) studied for the first time the *economy* of heat engines. Thermodynamics thus began as a physics of economic value and has remained so in spite of the numerous subsequent contributions of a more abstract nature.

Thanks to Carnot's memoir, the elementary fact that heat moves by itself only from the hotter to the colder body acquired a place among the truths recognised by physics. Still more important was the consequent recognition of the additional truth that once the heat of a closed system has diffused itself so that the temperature has become uniform throughout the system, the movement of the heat cannot be reversed without external intervention. The ice cubes in a glass of water, once melted, will not form again by themselves. In general, the free heat-energy of a closed system continuously and irrevocably degrades itself into bound energy. The extension of this property from heat-energy to all other kinds of energy led to the Second Law of Thermodynamics, alias the Entropy Law. This law states that the entropy (i.e., the amount of bound energy) of a closed system continuously increases or that the order of such a system steadily turns into disorder.

The reference to a closed system is




crucial. Let us visualise a closed system, a room with an electric stove and a pail of water that has just been boiled. What the Entropy Law tells us is, first, that the heat of the boiled water will continuously dissipate into the system. Ultimately, the system will attain thermodynamic equilibrium—a state in which the temperature is uniform throughout (and all energy is bound). This applies to every kind of energy in a closed system. The free chemical energy of a piece of coal, for instance, will ultimately become degraded into bound energy even if the coal is left in the ground. Free energy will do so in any case.

The law also tells us that once thermodynamic equilibrium is reached, the water will not start boiling by itself.[11] But, as everyone knows, we can make it boil again by turning on the stove. This does not mean, however, that we have defeated the Entropy Law. If the entropy of the room has been decreased as the result of the temperature differential created by boiling the water, it is only because some low entropy (free energy) was brought into the system from the outside. And if we include the electric plant in the system, the entropy of this new system must have decreased, as the Entropy Law states. This means that the decrease in the entropy of the room has been obtained only at the cost of a greater increase in entropy elsewhere.

Some writers, impressed by the fact that living organisms remain almost unchanged over short periods of time, have set forth the idea that life eludes the Entropy Law. Now, life may have properties that cannot be accounted for by the natural laws, but the mere thought that it may violate some law of matter (which is an entirely different thing) is sheer nonsense. The truth is that every living organism strives only to maintain its own entropy constant. To the extent to which it achieves this, it does so by sucking low entropy from the environment to compensate for the increase in entropy to which, like every material structure, the organism is continuously subject. But the entropy of the entire system—consisting of the organism and its environment—must increase. Actually, the entropy of a system must increase faster if life is present than if it is absent. The fact that any living organism fights the entropic degradation of its own material structure may be a characteristic property of life, not accountable by material laws, but it does not constitute a violation of these laws.

Practically all organisms live on low entropy in the form found immediately in the environment. Man is the most striking exception: he cooks most of his food and also transforms natural resources into mechanical work or into various objects of utility. Here again, we should not let ourselves be misled. The entropy of copper metal is lower than the entropy of the ore from which it was refined, but this does not mean that man's *economic* activity eludes the Entropy Law. The refining of the ore causes a more than compensating increase in the entropy of the surroundings. Economists are fond of saying that we cannot get something for nothing. The Entropy Law teaches us that the rule of biological life and, in man's case, of its economic continuation is far harsher. In entropy terms, the cost of any biological or economic enterprise is always greater than the product. In entropy terms, any such activity necessarily results in a deficit.

The statement made earlier—that, from a purely physical viewpoint, the economic process only transforms valuable natural resources (low entropy) into waste (high entropy)—is thus completely vindicated. But the puzzle of why such a process should go on is still with us. And it will remain a puzzle as long as we do not see that the true economic output of the economic process is not a material flow of waste, but an immaterial flux: the enjoyment of life. If we do not recognise the existence of this flux, we are not in the economic world. Nor do we have a complete picture of the economic process if we ignore the fact that this flux—which, as an entropic feeling, must characterise life at all levels—exists only as long as it can continuously feed itself on environmental low entropy. And if we go one step further, we discover that every

object of economic value—be it a fruit just picked from a tree, or a piece of clothing, or furniture, etc.—has a highly ordered structure, hence, a low entropy.[12]

There are several lessons to be derived from this analysis. The first lesson is that man's economic struggle centres on environmental low entropy. Second, environmental low entropy is scarce in a different sense than Ricardian land. Both Ricardian land and the coal deposits are available in limited amounts. The difference is that a piece of coal can be used only once. And, in fact, the Entropy Law is the reason why an engine (even a biological organism) ultimately wears out and must be replaced by a *new* one, which means an additional tapping of environmental low entropy.

Man's continuous tapping of natural resources is not an activity that makes no history. On the contrary, it is the most important long-run element of mankind's fate. It is because of the irrevocability of the entropic degradation of matter-energy that, for instance, the peoples from the Asian steppes, whose economy was based on sheep-raising, began their Great Migration over the entire European continent at the beginning of the first millenium. The same element—the pressure on natural resources—had, no doubt, a role in other migrations, including that from Europe to the New World. The fantastic efforts made for reaching the moon may also reflect some vaguely felt hope of obtaining access to additional sources of low entropy. It is also because of the particular scarcity of environmental low entropy that ever since the dawn of history man has continuously sought to invent means for sifting low entropy better. In most (though not in all) of man's inventions one can definitely see a progressively better economy of low entropy.

## Definite constraints

Nothing could, therefore, be further from the truth than the notion that the economic process is an isolated, circular affair—as Marxist and standard analysis represent it. The economic process is solidly anchored to a material base which is subject to definite constraints. It is because of these constraints that the economic process has unidirectional irrevocable evolution. In the economic world only money circulates back and forth between one economic sector and another (although, in truth, even the bullion slowly wears out and its stock must be continuously replenished from the mineral deposits). In retrospect it appears that the economists of both persuasions have succumbed to the worst economic fetishism—money fetishism.

Economic thought has always been influenced by the economic issues of the day. It also has reflected—with some lag—the trend of ideas in the natural sciences. A salient illustration of this correlation is the very fact that, when economists began ignoring the natural environment in representing the economic process, the event reflected a turning point in the temper of the entire scholarly world. The unprecedented achievements of the Industrial Revolution so amazed everyone with what man might do with the aid of machines that the general attention became confined to the factory. The landslide of spectacular scientific discoveries triggered by the new technical facilities strengthened this general awe for the power of technology. It also induced the literati to overestimate and, ultimately, to oversell to their audiences the powers of science. Naturally, from such a pedestal one could not even conceive that there is any real obstacle inherent in the human condition.

The sober truth is different. Even the lifespan of the human species represents just a blink when compared with that of a galaxy. So, even with progress in space travel, mankind will remain confined to a speck of space. Man's biological nature sets other limitations as to what he can do. Too high or too low a temperature is incompatible with his existence. And so are many radiations. It is not only that he cannot reach up to the stars, but he cannot even reach down to an individual elementary particle, nay, to an individual atom.

Precisely because man has felt, however unsophisticatedly, that his life depends on scarce, irretrievable low entropy, man has all along nourished the hope that he may eventually discover a self-perpetuating force. The discovery of electricity enticed many to believe that the hope was actually fulfilled. Following the strange marriage of thermodynamics with mechanics, some began seriously thinking about schemes to unbind bound energy.[13] The discovery of atomic energy spread another wave of sanguine hopes that, this time, we have truly gotten hold of a self-perpetuating power. The shortage of electricity which plagues New York and is gradually extending to other cities should suffice to sober us up. Both the nuclear theorists and the operators of atomic plants vouch that it all boils down to a problem of cost, which in the perspective of this paper means a problem of a balance sheet in entropy terms.

## Technological illusion

With natural scientists preaching that science can do away with all limitations felt by man and with the economists following suit in not relating the analysis of the economic process to the limitations of man's material environment, no wonder that no one realised that we cannot produce "better and bigger" refrigerators, automobiles, or jet planes, without producing also "better and bigger" waste. So, when everyone (in the countries with "better and bigger" industrial production) was, literally, hit in the face by pollution, scientists as well as economists were taken by surprise. But even now no one seems to see that the cause of all this is that we have failed to acknowledge the entropic nature of the economic process. A convincing proof is that the various authorities on pollution now try to sell us, on the one hand, the idea of machines and chemical reactions that produce no waste, and, on the other, salvation through a perpetual recycling of waste. There is no denial that, in principle at least, we can recycle even the gold dispersed in the sand of the seas just as we can recycle the boiling water in my earlier example. But in both cases we must use an additional amount of low entropy much greater than the decrease in the entropy of what is recycled. There is no free recycling just as there is no wasteless industry.

The globe to which the human species is bound floats, as it were, within the cosmic store of free energy, which may be even infinite. But for the reasons mentioned in the preceding section, man cannot have access to all this fantastic amount, nor to all possible forms of free energy. Man

cannot, for example, tap directly the immense thermonuclear energy of the sun. The most important impediment (valid also for the industrial use of the "hydrogen bomb") is that no material container can resist the temperature of massive thermonuclear reactions. Such reactions can occur only in free space.

The free energy to which man can have access comes from two distinct sources. The first source is a *stock*, the stock of free energy of the mineral deposits in the bowels of the earth. The second source is a *flow*, the flow of solar radiation intercepted by earth. Several differences between these two sources should be well marked. Man has almost complete command over the terrestrial dowry; conceivably, we may use it all within a single year. But, for all practical purposes, man has no control over the flow of solar radiation. Neither can he use the flow of the future *now*. Another asymmetry between the two sources pertains to their specific roles. Only the terrestrial source provides us with the low entropy materials from which we manufacture our most important implements. On the other hand, solar radiation is the primary source of all life on earth, which begins with chlorophyll photosynthesis. Finally, the terrestrial stock is a paltry source in comparison with that of the sun. In all probability the active life of the sun—during which the earth will receive a flow of solar energy of significant intensity—will last another five billion years.[14] But hard to believe though it may be, the entire terrestrial stock could yield only a few days of sunlight.[15]

All this casts a new light on the population problem, which is so topical today. Some students are alarmed at the possibility that the world population will reach seven billion by A.D. 2000—the level predicted by United Nations demographers. On the other side of the fence, there are those who, like Colin Clark, claim that with a proper administration of resources the earth may feed as many as forty-five billion people.[16] Yet no population expert seems to have raised the far more vital question for mankind's future: How long can a given world population—be it of one billion or of forty-five billion—be maintained? Only if we raise this question can we see how complicated the population problem is. Even the analytical concept of optimum population, on which many population studies have been erected, emerges as an inept fiction.

What has happened to man's entropic struggle over the last two hundred years is a telling story in this respect. On the one hand, thanks to the spectacular progress of science man has achieved an almost miraculous level of economic development. On the other hand, this development has forced man to push his tapping of terrestrial resources to a staggering degree (witness off-shore oil-drilling). It has also sustained a population growth which has accentuated the struggle for food and, in some areas, brought this pressure to critical levels. The solution, advocated unanimously, is an increased mechanisation of agriculture. But let us see what this solution means in terms of entropy.

In the first place, by eliminating the traditional partner of the farmer—the draft animal—the mechanisation of agriculture allows the entire land area to be allocated to the production of food (and to fodder only to the extent of the need for meat). But the ultimate and the most important result is a shift of the low entropy input from the solar to the terrestrial source. The ox or the water buffalo—which derive their mechanical power from the solar radiation caught by chlorophyll photosynthesis—is replaced by the tractor—which is produced and operated with the aid of terrestrial low entropy. And the same goes for the shift from manure to artificial fertilizers. The upshot is that the mechanisation of agriculture is a solution which, though inevitable in the present impasse, is anti-economical in the long run. Man's biological existence is made to depend in the future more and more upon the scarcer of the two sources of low entropy. There is also the risk that mechanised agriculture may trap the human species in a cul-de-sac because of the possibility that some of the biological species involved in the other method of farming will be forced into extinction.

## Low entropy stock

Actually, the problem of the economic use of the terrestrial stock of low entropy is not limited to the mechanisation of agriculture only: it is the main problem for the fate of the human species. To see this, let $S$ denote the present stock of terrestrial low entropy and let $r$ be some average annual amount of depletion. If we abstract (as we can safely do here) from the slow degradation of $S$, the *theoretical* maximum number of years until the complete exhaustion of that stock is $S/r$. This is also the number of years until the *industrial* phase in the evolution of mankind will forcibly come to its end. Given the fantastic disproportion between $S$ and the flow of solar energy that reaches the globe annually, it is beyond question that, even with a very parsimonious use of $S$, the industrial phase of man's evolution will end long before the sun will cease to shine. What will happen then (if the extinction of the human species is not brought about earlier by some totally resistant bug or some insidious chemical) is hard to say. Man could continue to live by reverting to the stage of a berry-picking species—as he once was. But, in the light of what we know about evolution, such an evolutionary reversal does not seem probable. Be that as it may, the fact remains that the higher the degree of economic development, the greater must be the annual depletion $r$ and, hence, the shorter becomes the expected life of the human species.

The upshot is clear. Every time we produce a Cadillac, we irrevocably destroy an amount of low entropy that could otherwise be used for producing a plough or a spade. In other words, every time we produce a Cadillac, we do it at the cost of decreasing the number of human lives in the future. Economic development through industrial abundance may be a blessing for us now and for those who will be able to enjoy it in the near future, but it is definitely against the interest of the human species as a whole, if its interest is to have a lifespan as long as is compatible with its dowry of low entropy. In this paradox of economic development we can see the price man has to pay for the unique privilege of being able to go beyond the biological limits in his struggle for life.

Biologists are fond of repeating that natural selection is a series of fantastic blunders since future conditions are not taken into account. The remark, which implies that man is wiser than nature and should take over her job, proves that man's vanity

and the scholar's self-confidence will never know their limits. For the race of economic development that is the hallmark of modern civilisation leaves no doubt about man's lack of foresight. It is only because of his biological nature (his inherited instincts) that man cares for the fate of only some of his immediate descendants, generally not beyond his great-grandchildren. And there is neither cynicism nor pessimism in believing that, even if made aware of the entropic problem of the human species, mankind would not be willing to give up its present luxuries in order to ease the life of those humans who will live ten thousand or even one thousand years from now. Once man expanded his biological powers by means of industrial artifacts, he became *ipso facto* not only dependent on a very scarce source of life support but also addicted to industrial luxuries. It is as if the human species were determined to have a short but exciting life. Let the less ambitious species have a long but uneventful existence.

Issues such as those discussed in this lecture pertain to long-run forces. Because these forces act extremely slowly we are apt to ignore their existence or, if we recognise them, to belittle their importance. Man's nature is such that he is always interested in what will happen until tomorrow, not in thousands of years from now. Yet it is the slow-acting forces that are the more fateful in general. Most people die not because of some quickly acting force—such as pneumonia or an automobile accident—but because of the slow-acting forces that cause aging. As a Jain philosopher remarked, man begins to die at birth. The point is that it would not be hazardous to venture some thoughts about the distant future of man's economy any more than it would be to predict in broad lines the life of a newly born child. One such thought is that the increased pressure on the stock of mineral resources created by the modern fever of industrial development, together with the mounting problem of making pollution less noxious (which places additional demands on the same stock), will necessarily concentrate man's attention on ways to make greater use of solar radiation, the more abundant source of free energy.

Some scientists now proudly claim that the food problem is on the verge of being completely solved by the imminent conversion on an industrial scale of mineral oil into food protein—an inept thought in view of what we know about the entropic problem. The logic of this problem justifies instead the prediction that, under the pressure of necessity, man will ultimately turn to the contrary conversion, of vegetable products into gasoline (if he will still have any use for it).[17] We may also be quasi-certain that, under the same pressure, man will discover means by which to transform solar radiation into motor power directly. Certainly, such a discovery will represent the greatest possible breakthrough for man's entropic problem, for it will bring under his command also the more abundant source of life support. Recycling and pollution purification would still consume low entropy, but not from the rapidly exhaustible stock of our globe.

**About the author . . . Nicholas Georgescu-Roegen was born in Rumania and educated at the University of Bucharest, Sorbonne (Paris), and University College (London), Professor Georgescu-Roegen is currently Distinguished Professor of Economics at Vanderbilt University. He has been on the faculties of the University of Bucharest and Harvard University, and Secretary General of the Rumanian Armistice Commission. His many publications include credits in the *Quarterly Journal of Economics*, *Southern Economic Journal*, *Econometrica*, *Review of Economic Studies*, Oxford Economic Papers and the *American Economics* (Harvard University Press, 1967) contains a preface by Paul Samuelson in which he characterises Professor Georgescu-Roegen as ". . . a scholar's scholar, an economist's economist."**

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2. E.g., R. T. Bye, *Principles of Economics* (5th edn., New York, 1956), p. 253; G. L. Bach, *Economics* (2nd edn., Englewood Cliffs, N. J., 1957), p. 60; J. H. Dodd, C. W. Hasek, T. J. Hailstones, *Economics* (Cincinnati, 1957), p. 125; R. M. Havens, J. S. Henderson, D. L. Cramer, *Economics* (New York, 1966), p. 49; Paul A. Samuelson, *Economics* (8th edn., New York, 1970), p. 42.

3. Karl Marx, *Capital* (3 vols., Chicago, 1906-1933), I, 94, 199, 230, and *passim*.

4. *Ibid.*, II, ch. XX.

5. *The Economic Writings of Sir William Petty*, ed. C. H. Hull (2 vols., Cambridge, Eng., 1899), II, 377. Curiously, Marx went along with Petty's idea; but he claimed that nature only "helps to create use-value without contributing to the formation of exchange value." Marx, *Capital*, I, 227. See also *ibid.*, p. 94.

6. E.g., Alfred Marshall, *Principles of Economics* (8th edn., New York, 1924), p. 63.

7. On the problem of the analytical representation of a process, see my *The Entropy Law and the Economic Process* Cambridge, Mass., 1971), pp. 211-231.

8. This distinction together with the fact that no one would exchange some natural resources for waste disposes of Marx's assertion that "no chemist has ever discovered exchange value in a pearl or a diamond." *Capital*, I, 95.

9. D. ter Haar, "The Quantum Nature of Matter and Radiation," in *Turning Points in Physics*, ed. R. J. Blin-Stoyle *et al.* (Amsterdam, 1959), p. 37.

10. One meaning that has recently made the term extremely popular is "the amount of information." For an argument that this term is misleading and for a critique of the alleged connection between information and physical entropy, see *The Entropy Law of Economic Process*, Appendix B.

11. This position calls for some technical elaboration. The opposition between the Entropy Law—with its unidirectional qualitative change—and mechanics—where everything can move either forward or backward while remaining self-identical—is accepted without reservation by every physicist and philosopher of science. However, the mechanistic dogma retained (as it still does) its grip on scientific activity even after physics recanted it. The result was that mechanics was soon brought into thermodynamics in the company of randomness. This is the strangest possible company, for randomness is the very antithesis of the deterministic nature of the laws of mechanics. To be sure, the new edifice (known as statistical mechanics) could not include mechanics under its roof and, at the same time, exclude reversibility. So, statistical mechanics must teach that a pail of water may start boiling by itself, a thought which is slipped under the rug by the argument that the miracle has not been observed because of its extremely small probability. This position has fostered the belief in the possibility of converting bound into free energy or, as P. W. Bridgman wittily put it, of bootlegging entropy. For a critique of the logical fallacies of statistical mechanics and of the various attempts to patch them, see *The Entropy Law and the Economic Process*, ch. VI.

12. This does not mean that everything of low entropy necessarily has economic value. Poisonous mushrooms, too, have a low entropy. The relation between low entropy and economic value is similar to that between economic value and price. An object can have a price only if it has economic value, and it can have economic value only if its entropy is low. But the converse is not true.

13. See not 11, above.

14. George Gamow, *Matter, Earth, and Sky* (Englewood Cliffs, N.J., 1958), pp. 493 f.

15. Four days, according to Eugene Ayres, "Power from the Sun," *Scientific American*, August 1950, p. 16. The situation is not changed even if we admit that the calculations might be in error by as much as one thousand times.

16. Colin Clark, "Agricultural Productivity in Relation to Population," in *Man and His Future*, ed. G. Wolstenholme (Boston, 1963), p. 35.

17. That the idea is not far-fetched is proved by the fact that in Sweden, during World War II, automobiles were driven by the poor gas obtained by heating wood with wood.

# The Proposed Use of Beech Forests on the South Island of New Zealand

## A criticism by C. L. Boyle

Before the arrival of the European, the South Island of New Zealand was largely forested. In 1971 almost a quarter still remained, covering thirteen thousand square miles and extending from sea level to altitudes of from 3,500 to 4,500 feet. Of this about three thousand two hundred square miles (2,100,000 acres) are preserved as national parks and other reserves. Seven thousand three hundred square miles (4,700,000 acres) are administered by the Forest Service as State Forests.

Much of the N.Z. forest clothes the Southern Alps, which form the "spine" of South Island. Here is some of the most beautiful scenery in the world. Protection forests, essential for soil and water conservation, cover much of the high mountain country. It is against the thirteen hundred square miles (839,000 acres) of lowland forests in the provinces of Nelson, West Coast and Southland, that the present Management Project is directed.

Eighty per cent of the forest area of South Island is covered by five varieties of the Southern Beech, *Notofagus*, a beautiful evergreen, related to the beech of Europe. Generally beech forests do not occupy good agricultural soils. Land which used to be beech covered, but is so no longer, now consists of rough pasture, gorse and fern, or introduced conifers, mostly the Monterey pine, *Pinus radiata*. The rest of the native forest still existing consists chiefly of softwoods, Podocarps, of which the Rimu, *Dacrydium cupressinum*, is the most important.

Any visitor from abroad roaming the South Island of New Zealand must be amazed by the extent of unspoilt country, the wonderful mountains, the beautiful rivers and lakes but above all, by the glorious symphony of the whole natural assembly. Other mountains, other rivers, other lakes may, individually, equal the mountains, rivers and lakes of New Zealand; but no other landscape can combine with these the wonder of New Zealand's native forests. Is it possible that the New Zealander himself can be so bemused by all this beauty, that he does not appreciate the threat with which he is now confronted? Can he be so brain-washed by cries of "development", "export targets" and "need for foreign exchange" that he will tolerate the devastation to which his country is now exposed? For devastation it would be, although the Report employs all the jargon of modern conservation to conceal it. Thus "The beech forests of New Zealand constitute a valuable wood resource. Beech species are amenable to regeneration and sustained yield management. The growing world-wide demand for hardwood pulp may provide a better opportunity than has previously been available to achieve a planned, rational and full utilisation of this resource."

"Management" and "Sustained yield" have a comfortable soothing sound, and one might think that "Enrichment" would positively improve the 320 square miles of Westland's indigenous forest for which it is intended. But all these are but euphemistic disguises. What is the reality?

### The Forest Utilisation Project

The Project envisages that thirteen hundred square miles of South Island indigenous forest shall be managed for industrial development. Let there be no deception. Management means felling the trees. Half the logged forest, 660 square miles, would be devoted to growing exotics; 220 square miles to Beech management, 320 square miles to Enrichment, 80 square miles to Podocarp management, and the remaining 20 square miles to farming. And this would not be the end of it. "Areas of forest, in the main relatively small in extent, in tenures other than State forests, are excluded from the statements that follow, but unless precluded from felling by soil and water considerations, would be available for utilisation at the discretion of the occupant." In other words any nearby landowner may cash in.

Exotic forests already cover 2,200 square miles of New Zealand. The justification offered for the extension suggested is "The fast growth rate of the forestry sector has only been made possible by the mass radiata plantings of the 1920s and 1930s. The raw material thus created is now almost fully committed and there will be no prospects for further large scale industrial expansion until forests planted since World War II come into production. Thus from the late 1970's onwards there is likely to be a decline *in the rate at which forest industries and forest products exports could increase*" (my italics). "Should one or more pulp or paper industries prove to be economic, production should come on stream when it is most needed."

So the sacrifice of the beech forest is to maintain the rate of increase of forestry industries and products.

Certainly conversion to exotics of 660 square miles of indigenous forest, a creeping barrage of conifers, is the most immediately terrifying aspect of the Project, but Beech Management and Enrichment need examination too.

### Beech Management

In the Report and in my Tables the heading Beech Management covers all areas of Management not recom-

mended for other uses. It comprises 16,000 acres of Nelson, 84,000 acres of West Coast and 40,000 acres of Southland—a total of 220 square miles. Tables 2 and 3. But "The final area could be considerably larger."

To see what Beech Management means look at the photographs in the Report and consider first the beauty of the mature forest in the background. Then notice the squalor of the foreground after logging, and then look at the dull regenerated forest of eighteen years later. Who can say how long it would take for the regenerated forest to regain its mature splendour? It matters little, for such forest will never be allowed to grow old. It is destined for the chip and pulp trade.

## Enrichment

Because the regeneration, after logging, of some of the beech forests of the West Coast is uncertain, 320 square miles (206,000 acres) of them would be "enriched" after logging by planting eucalypts of proved commercial worth, resistant to browsing by deer and opossums. During the logging, some beech trees would have been left standing to provide seed for beech regeneration, so that Beech and eucalypts would grow up together.

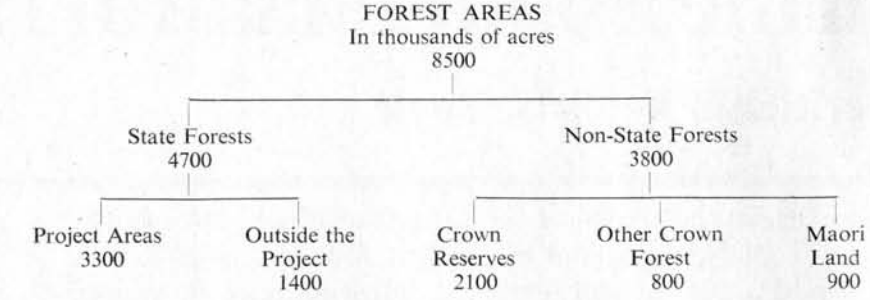
## The use of the wood

The total amount of wood resulting from felling the Project forests is estimated at between sixteen hundred million and two thousand million cubic feet. Table 4.

During the past ten years there has been a revolution in the world pulp and paper industries. Formerly it relied on softwoods; but now the use of the kraft, NSSC and cold soda processes has enabled beech wood also to be used in the manufacture of cheap wrapping paper and of fine printing and writing papers. The economics of establishing industries in New Zealand, based on the commercial use of beech forests, has yet to be proved but, in the knowledge that New Zealand beeches can be pulped, the Nelson company manufacturing and exporting softwood chips to Japan, has started exporting beech chips also. The hundred million cubic feet of beech from Nelson would not be enough to establish a pulp industry, but after a few years a mixed hard-

To illustrate a criticism of the 1971 forest utilisation project. Ref: Report by the Director General of Forests on Utilisation of South Island Beech Forests, New Zealand, October 1971.

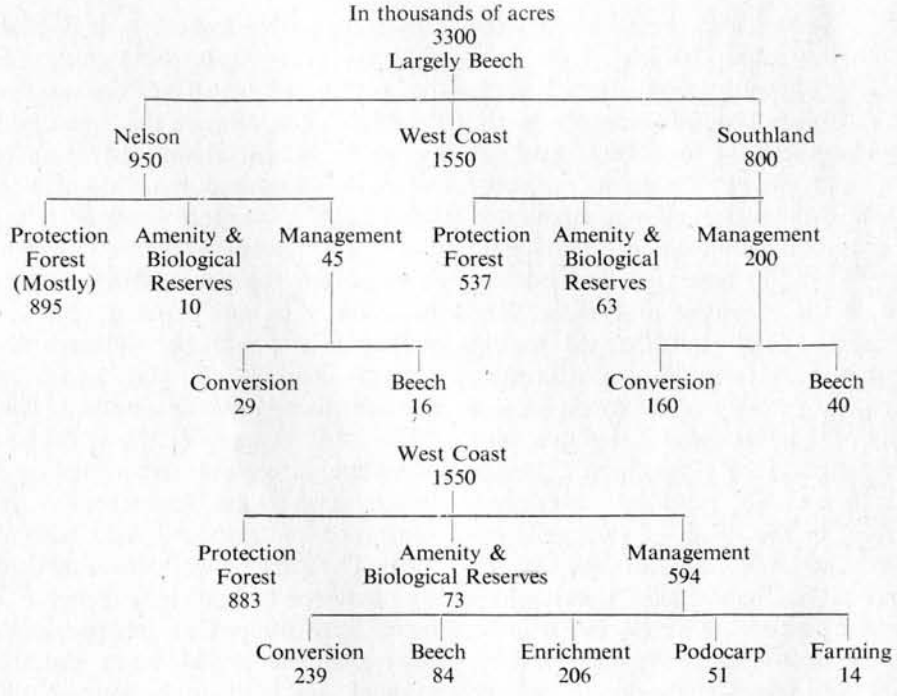
1. THE INDIGENOUS SOUTH ISLAND FORESTS
Total area 13,000 sq. miles consisting chiefly of Southern Beech.




PERCENTAGE DIVISION

| | | |
|---|---|---|
| State forests | Project Areas | 39% |
| | Outside the project | 16% |
| Crown Reserves | | 25% |
| Other Crown Forests | | 9% |
| Maori Land | | 11% |

2. STATE FOREST PROJECT
Total area 5,000 sq. miles




3. SUMMARY OF PROJECT UTILISATION in thousands of acres

| | *Nelson* | *West Coast* | *Southland* | *Total* |
|---|---|---|---|---|
| Protection Forest | 895 | 883 | 537 | 2315 |
| Reserves | 10 | 73 | 63 | 146 |
| Management | 45 | 594 | 200 | 839 |
| | | | | 3300 |

SUMMARY OF METHODS OF MANAGEMENT in thousands of acres.

| | |
|---|---|
| Conversion to exotics | 428 |
| Beech management | 140 |
| Enrichment (W. Coast only) | 206 |
| Podocarp management | 51 |
| Farming | 14 |
| Total | 839 |

4. USABLE WOOD AVAILABLE estimated in million cubic feet.

| | |
|---|---|
| Nelson | 100-125 largely Beech. |
| West Coast | 1000-1200 Beech 67% Podocarp 15% Various hardwoods 18%. |
| Southland | 500-600 80%-95% Beech. |

wood and exotic soft wood pulp industry might be started.

The thousand million or so cubic feet of wood available in West Coast from the Project, on a 30 year cutting cycle, would be enough to maintain a hardwood kraft mill making no less than 500 tons a day and a large saw-milling and veneer or plywood plant. A paper mill is also a possibility. "The permanence of such an industry would depend on the replanting of part of the beech with exotic species. The economics of such an industry have yet to be proved."

The five hundred or so million cubic feet of beech wood available in Southland would probably form a chip export industry "a development which some interests prefer to the alternative of local pulp manufacture."

Mr Tom Hay, chairman of the Canterbury branch of the Royal Forest and Bird Protection Society, condemned the destruction of the beech forest. He stressed the warning against monosilviculture by Dr De Gryce and Mr N. Muhlenberg and by the 1957 British Commonwealth Forestry Conference. He said that the practice of replacing a country's native forest with faster growing American exotics had already been proved wrong in Germany, where yields from spruce and pine began to drop as growth rates and timber quality fell off. "The success of *Pinus radiata* is spectacular; it may also be short-lived. Kauri can be utilised from 200 years, Rimu 300 years and Beech 160 years. This is what silviculture is about; not the super-imposing of an exotic forest over a native one, with Japanese yen in mind." He describes the Amenity areas of the Report as "strips of untouched native forest, to afford broad roadside avenues, to provide a 'mock up' of a solid block of native bush, from road viewing points."

Supporting the Forest and Bird Protection Society's plea that no beech forest should be cut until all marginal land has been used, he says "Gorse and fernland is not planted (with conifers) because it is easier to erase native bush and substitute pine." Mr Hay deplored the loss of the national character in the landscape and the loss of bird life inherent in the proposals, and pointed out that the ever-growing industry of tourism in New Zealand depended upon her "sparse population and large areas of near-virgin wilderness." Yes, of course, tourists do not seek areas of industrial development. They come from them.

A Japanese, questioned as to why they did not fell their own trees, very politely asked why they should destroy their own assets, as long as they could get logs from New Zealand.

## Conclusion

In the Report there are references to other than materialistic values, to conservation, "amenity" and to "the environment", to the "quality of life", to the difficulty of arriving at "the optimum balance between development and growth on the one hand and preservation of natural resources on the other" but the reality of such a conflict in use of the beech forests is denied because "the areas involved are large enough to accommodate both interests."

But even conservation and amenity can be materialistic. Throughout the Report there is no realization that the whole concept of development and growth can possibly be called in question and, less understandably, no appreciation that beech forests of New Zealand may have an eternal value, apart from any use to which man may misguidedly wish to put them.

The claim by the Royal Forest and Bird Protection Society that there is enough land in scrub or fern, or in marginal or sub-marginal pasture, for all needed exotic plantings "without clearing and burning the beech forests" is answered on grounds of immediate temporary expediency only. "Most new Forest Service planting currently does take place on open country, but in this situation a long time lag is necessary before new industries can be developed. The beech proposals differ in that they envisage the use of resources already on the ground, thus enabling new industry to start much earlier."

Conditions everywhere are changing rapidly. Chips and hardwood pulp, now considered valuable, may become a drug in the market. Then the loss of New Zealand's irreplaceable natural forests would be merely a bitter regret.

New Zealand should think again.

This article refers to "Utilisation of South Island Beech Forests" a report by the Director General of Forests, October 1971.

# A BLUEPRINT FOR SURVIVAL

## Comments

### From Professor J. H. Fremlin

Sir,

As a result of the large and justified demand for your January issue giving the Blueprint for Survival, I have only very recently been able to locate a copy. While approving very strongly of the effort you are making to get an exceedingly serious situation properly considered, I would like to make a few comments criticising some of the details, which may seriously weaken its impact on technical audiences. These are mainly concerned with the appendices, which seem to me to be less accurately considered than they should have been.

In Appendix A, for example, on page 26 in second paragraph, there is a comment that strontium 90 gets into the bones of growing children and iodine 131 accumulates in the thyroid gland and that these can give rise to cancer. This is undoubtedly true, and there is no question that the amount of material liberated in test explosions will have had the effect of producing considerable numbers of deaths from such causes. It is, however, quite inappropriate to introduce this in a discussion of the pollution arising from power production. Given that we are going to use any energy at all, other than muscular, the pollution resulting from nuclear power stations is very much less in its effects than the pollution from any other source. In particular, the number of cancers produced would be far less than the number of deaths produced by smoke from coal or oil fired stations, or even the number produced in non-smokers as a result of their normal contacts with other people's cigarette smoke! Its ecological importance is utterly negligible.

In the following paragraph, it is stated that carcinogenic agents also tend to be mutagens, which is true, and goes on to say that their proliferation must mean a gradual reduction in the adaptability of our species. This is the exact opposite of the truth. Our physical adaptability depends entirely on the presence of a good number of non-lethal mutations, which are available for selection when the environment changes. Mutagens may be, and are, responsible for "genetic deaths" but do not reduce adaptability.

Later in the same paragraph you say "It is extremely difficult for ecological invasions to occur . . .". Have you not heard of the prickly pear in Australia, or the rabbit in the same country or the grey squirrel in Great Britain? A very large number of cases have occurred where a species foreign to the system has entered an alien system and cut out a niche for itself to the disadvantage of indigenous plants or animals.

On page 28 line six the projection would surely give 8.4 not 18 per cent. On page 32 below line 12, a virus was not found to manifest anything when confronted with a source of protein, but shows its multiplying ability when it has entered a living cell in which it can interfere with the system for production of protein and of DNA.

On page 34, at the end of the second paragraph, it is absolute nonsense to say that our particular scientifically based culture is in *no way* superior to those developed by the most primitive societies. It is superior in competitive strength, and in a number of ways that people enjoy. I suppose what is meant is that the other ways in which it is inferior are more important than the ways in which it is superior. If so this should have been stated. Nonsense statements of the present form do not encourage confidence in judgment elsewhere. Nor do the statements about the "primitive wisdom", whatever that may be, of the 700 cultures of New Guinea. Doubtless we can learn something, and perhaps something important, from them, but the maintenance of 700 different languages does not suggest that we can learn much about the worldwide friendliness and co-operation which is obviously our most vital need if any part of the Blueprint is to be successfully implemented on the international scale required.

You may feel that all this is a matter of niggling detail and that I am diverting attention from the main important issues. In a sense this is true, but the practicability of the important proposals, and especially of long-term ones, is *necessarily* a matter of judgment based on very inadequate knowledge. If judgment on minor matters which we can understand is unreliable, it reflects doubt upon judgments of major matters. I am surprised that your eminent supporters did not take this into account more seriously than by merely stating that they were not endorsing every detail.

Yours sincerely,

*J. H. Fremlin,*

Professor of Applied Radioactivity,
Department of Physics,
University of Birmingham.

### From John E. Sussams

### Transportation is Waste

(*Implications of "A Blueprint for Survival" for Transportation and Land Use Planning*)

The urgent message of the *Blueprint* is, briefly, that our industrial way of life with its emphasis on conspicuous consumption and concommitant pollution of the environment and our failure to check the population explosion will lead to disaster unless steps are taken to counteract these trends and, eventually, stabilise the situation.

Many thinking people will agree in principle with this thesis. But on matters of detail—means rather than ends—experts will disagree. What will the "stable society" look like? How will the transition from the present system be achieved? The purpose of the present essay is to show that the essential ideas of the *Blueprint*—conservation of our resources, avoidance of pollution, population control—are not incompatible with a civilised, urban way of life and that understanding of and manipulation of the transportation system will be key factors in making a satisfactory transition from the present muddle to a cleaner and more relaxed way of living in the future.

### Transportation

A transportation system can be described as a network, its size and complexity measured in terms of the length and number of its links. The size and complexity of the road and rail network of Britain are largely determined by the number of places which

the networks are designed to serve. If this number could be drastically reduced, by concentrating the population into relatively few, compact urban areas, then the size of the network, the area of land covered by roads, the amount of traffic and the pollution it causes would all be correspondingly reduced.

## Distribution of goods by road

There are over 200,000 miles of road in Britain. However, a network of under 10,000 miles of trunk roads and motorways connects all the main population centres. If it were possible to vacate all the minor population centres which are not on (or very close to) this trunk road network it would be possible to dispense with more than 100,000 miles of secondary and unclassified roads. At the same time, avoiding the need for small deliveries, it would be possible to cut out a great deal of inefficient transport. (One large truck travelling fast and fully laden on a motorway could replace up to fifty average delivery vans travelling slowly and more than half empty on minor roads.)

It is perhaps not always realised that the redelivery of goods from warehouses, depots and wholesale markets to small retail establishments occupies up to ten times as many vehicles as the initial distribution from the factories, farms and ports to the bulk breaking and trans-shipment points. The amount of goods traffic at present carried by the road system could be reduced, possibly by as much as 90 per cent in terms of vehicle miles, if the existing methods of retail distribution (involving nearly 500,000 separate outlets at the last census) were replaced by a configuration of about 5,000 strategically placed shopping centres.

It would be perfectly feasible for a single shopping complex to serve a population of 5,000 or more, all living within walking distance of it. Goods could be delivered in bulk to such a complex, assuming it to be under unified control, and there would be no need for redelivery. It would be necessary, of course, for a small proportion of the population, say 5 per cent, particularly those connected with agriculture and forestry, to live in small, isolated communities, away from the trunk road network. Essential supplies for these communities could be fetched at moderate cost from the nearest shopping centre using local transport.

## The role of the railways

It is a popular misconception, reflected in the *Blueprint* (para. 270), that railways are generally more efficient than roads. It is true that, for certain traffics, particularly the bulk movement of commodities such as coal, iron ore, steel, oil or cement, the railways are indeed extremely efficient. However, for most freight the railways are irrelevant or, at most, form only a part of a total system. This is because of transshipment and limitations imposed by the handling capacity of terminals.

A commuter train can empty itself of a thousand passengers in a few minutes. But in order to run a trainload of containers once a day in each direction between London and Glasgow it is necessary to operate a large fleet of road vehicles (to feed the terminals and to deliver consignments to their final destinations) and, in addition to the railway staff required to move the trains, hundreds of staff have to be employed to load and unload and to administer the system. Even a trainload of goods carried in bulk takes about two hours to discharge. Waterloo Station can handle passenger trains arriving at the rate of about one a minute. If a comparable number of freight trains were to arrive carrying general merchandise, 60 miles of sidings and 60 miles of roadway between the sidings would be required and lorries would be leaving this complex at the rate of about one a second. It is evident that the railways could not begin to cope with this kind of traffic. The motorways however can and do.

Over relatively short distances, with the exception of commodities which can be discharged by gravity, it is cheaper and quicker to send goods by road. If there appears to be too much traffic on the roads the solution is not to transfer it to rail, particularly where rail is a less efficient mode. The solution is to find ways in which the need for this transport can be avoided altogether.

## The location of industry

We have seen how the amount of transport can be greatly reduced by concentrating the population on to a simple but efficient network of trunk roads. Further reductions can be achieved by ensuring that, as far as possible, factories are located within the areas where their products are sold. This is particularly significant in the case of those consumer products which are required in large volume.

If the regional demand for a product is sufficient for an economic production unit to be established within the region there should be no need for any interregional transport of that product. Conversely, no region should be so small that it cannot generate enough demand for viable units to be established to produce a substantial proportion of all the goods and services required to maintain life at a civilised level. There will naturally be some specialised products which cannot be provided universally. Each region will produce those specialised goods for which, because of its geography or climate, it is peculiarly suited. These will be exported in return for other goods which are best made elsewhere.

## Regional self-sufficiency

In order to discourage the import of goods from remote locations when similar goods of local manufacture are also available a pricing system which differentiated between production and distribution costs could be introduced. This would also encourage each region to provide a variety of employment for the local population and thus lessen the dependence of some towns and districts on single industries. This dependence at present makes such places dull at any time and vulnerable when the particular industry which sustains them goes into a period of decline. For example ships as a means of passenger transport have been largely replaced by aircraft, but aircraft are not built in the same places as ships—to the detriment of both industries. When a whole town depends on the success or failure of a single project the outlook can be very bleak indeed.

It is, of course, the variety of employment, of entertainment and of cultural activity which makes the metropolis so attractive and prosperous by comparison with smaller, provincial centres. The need for diversity is a further argument for the concentration of the population into major centres and for the devolution of certain administrative responsibilities, at present regarded as the prerogative of central government, to regional capitals.

If the population is dispersed into relatively small communities, then, either these communities will be self-supporting—and primitive, or they will not be self-supporting—and will have

to rely on an expensive and wasteful transport system for the import of a variety of goods. They will also have to rely on other, larger communities to train and supply doctors, dentists, teachers, engineers and a variety of other specialists. It is generally true that in primitive communities life is nasty, brutish and short. If the population is not controlled by disease and famine then there is always warfare, ritual murder and infanticide. The bringing of medicine, a balanced diet all the year round, education, modern contraception and a host of other benefits to a small settlement implies the absorption of that community into a wider system with the city as the focal point. The process of urbanisation begins.

## The problem of size

The stable society which the *Blueprint* discusses must be seen as an advance of civilisation and not as a retreat back to some kind of peasant society, otherwise it will be rejected. The simple life is a minority taste. The mark of civilisation from the most ancient of times has always been urban life and the culture which urban life alone makes possible. The major centres of civilisation, since long before the industrial revolution, have almost invariably been cities.

The statement in the *Blueprint* (page 33) that "The Greek City States . . . were, in fact, very small. Only three had more than 20,000 citizens (Athens, Corinth and Syracuse)" is incorrect and misleading. Professor Michael Grant indicates (*Ancient History Atlas*, Weidenfeld and Nicolson, 1971, page 36) that in classical Greece there were two cities over 100,000 (Athens and Syracuse), seven in the range 65,000–1,000,000 (Corinth, Argos, Samos, Acragas, Coryra, Tyre and Memphis) and no less than 26 in the range 30,000–65,000. In Roman times and later much larger cities flourished, Rome itself having over a million population.

Of course sheer size is a problem but this does not mean that small is good. There are ways of tackling the problem without going to the extreme of breaking up communities into settlements which are so small that they would be unable to provide more than the most rudimentary services for the local population without outside assistance. What would life be like in the Falkland Islands or in Tristan da Cunha without the doctors, teachers, books and tools supplied from Britain? The solution to the problem of city living outlined in the *Blueprint* is not to be found in the abandonment of cities but rather in their reorganisation.

The problem of the optimum size for a city requires detailed consideration. Numerous factors are involved and not all of these are easy to evaluate in a cost benefit analysis. Transport is only one of the factors. It seems likely that cities of half a million population may be required to ensure that transport is kept at a near minimum level while, at the same time, the services which people want are provided. However, from some other points of view a much smaller unit would seem desirable. When all factors are taken into account it may well be found that the ideal solution is a compromise—a city which is a cluster of closely connected towns sharing certain common services.

## The hierarchical structure of community life

There is a well defined hierarchial structure in the organisation for the provision of goods and services. For example, in education, primary schools can be small, numerous and dispersed; secondary schools must be larger, or organised into groups, otherwise it will not be possible to provide the variety of courses which are desirable: a college or a department of education, turning out, say, a hundred teachers annually, would serve a regional population of half a million or more. Similarly, in medicine there is the hierarchy of the general practitioner, the health centre or local hospital, and the large teaching hospital. Again, in engineering, there is the local organisation which distributes, maintains and repairs the products of some major manufacturer and then there is the machine tool industry without which the numerous manufacturers of consumer products would themselves be unable to operate. This structure is to some extent reflected in the way the country as a whole is organised. But there are many anomalies.

## Delegation of responsibility

There are some responsibilities such as the care of the elderly, the provision of nurseries, the ownership and upkeep of dwellings, the final distribution of food and household goods, which can be largely delegated to small communities or "urban villages". There are other services such as education and health which cannot be organised efficiently except at a a higher, say, regional level. Even so there is every reason why the local employer of the teacher, or the doctor, that is, the citizens through their locally elected representatives, should have the final say in his appointment. When every activity which can be delegated has been delegated as far down the line as possible, so as to secure the maximum participation of all members of the community in the regulation of their daily life, there is little left for central government to do other than lay down broad principles, coordinate certain functions at national level and look after defence and foreign policy. By the same logic taxes should be collected and, to a large extent, spent by the lower level authorities.

The grip of central government is currently very tight. However, the reorganisation of local government in such a way as to ensure that each unit has the capability of providing the majority of the services required is a step in the right direction. The next step must presumably be to make these units financially independent. In recent years the Outer London Boroughs have been established as major units with central areas increasingly well defined and providing facilities on a scale and of a quality to compare with important provincial centres such as Leicester or Coventry. This goes some way towards counteracting the magnetic effect of Central London and also helps to ease the congeston caused by commuter traffic.

## Commuting

When people say that a city is too large this may often be interpreted as meaning that it takes too long and costs too much to travel to work, to school or to the shops. Moreover the journey is uncomfortable and fatiguing. There is something wrong with the transport system or with the architecture of the city. When people say that a town is too small this may be interpreted as meaning that the facilities are inadequate. Somewhere between too large and too small is the notional optimum—just right. Since the variety and quality of the facilities which can be provided increase with size and since the cost of transport also increases with the size of the system, it follows that the efficiency of the transport system must be a key factor in the determination of the optimum size for a city.

In a great conurbation such as London the commuting problem can be tackled in a number of ways, particularly: (a) by making the transport system more efficient, (b) by making it easier for people to move house so as to reside closer to their place of work, (c) by making it easier for people to change their jobs so that they can work closer to their homes, (d) by improving the efficiency of work in the central area so as to reduce the number of those who are required to work there and by redeploying the surplus labour in new jobs in peripheral locations.

Improving the transport system is a costly business but possibly worth while if as a result the use of the private car for commuting can be eliminated. Solutions (b) and (c) raise a number of administrative problems which, in the long run, it will be necessary to face. As a short term measure solution, (d) has a great deal to recommend it since all that would be required in the first instance would be the systematic application of well known techniques for the improvement of efficiency in offices and other establishments.

The various problems which have been mentioned—transport, housing, employment, taxation, the location of industry, planning, administration, education, health and welfare—are so interlocked that they cannot be dealt with separately. Jay W. Forrester has pointed out that intuitive plans to solve complex urban problems often produce results opposite from those intended. Subsidised housing is the classic example of this. Nevertheless it may be possible to solve some social problems and at the same time give the whole system a push in the direction indicated as desirable in the *Blueprint* by paying greater attention, at both national and local levels, to the connection between transportation and land use.

Transportation is waste. Therefore it should be avoided. This objective can be achieved by concentrating the population into urban communities which are as near self supporting as possible. The degree of independence of each city (or borough within a major conurbation) will largely determine the amount of inter-urban transport and the amount of commuting within the conurbations. To the extent that transr port is necessary, whether between o-within cities, the system should be as efficient as possible.

This does not mean scrapping the motorways. On the contrary, it means looking very carefully at all roads, particularly country roads which carry very little traffic and suburban roads the length of which could be greatly reduced if houses occupied only the minimum frontage. It means paying particular attention to the interchange points between routes and between modes of transport. above all it means making the best possible use of urban land. It is said that there are up to 5,000 acres of bombed sites in London. That is enough room to house a population of 250,000 or more. Certainly it costs more, initially, to clear up the ugliness of today's cities than it does to build a Milton Keynes on a green field site. Should we not set a higher value on our green fields than on our bombed sites? The stable society of the *Blueprint* must surely be one which uses and re-uses existing sites, hopefully embellishing them in the process.

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# Classified Adverts



# Coming events

**13–15 July**—'Liverpool Show '72: Europe and the Environment', an industrial exhibition and civic exhibition as well as special environmental exhibition—to be held at the Wavertree Showground. Further details: Public Relations Officer, Town Clerk's Department, Dale Street, Liverpool.

**19–22 July**—"Designing for Survival: Architects and the Environmental Crisis." (RIBA Conference 1972) to be held at the University of Lancaster. Further information: Information Officer, Royal Institute of British Architects, 66 Portland Place, London, W.1. Tel: 01-580 5533.

**20 July**—"The Social Environment" the sixth of a series of public lectures on population, resources and environment held by the Conservation Society at Overseas House, Park Place, St. James Street, S.W.1, at 7 p.m.

**2–12 August**—Teacher Training in Environmental Conservation and Education-International Course for teaching staff of teacher training colleges will be held at The Drapers' Field Centre, Ryd-Y-Creuau, Betws-y-Coed, Caernarvonshire, North Wales.

**28 August–3 September**—The International Water Conservancy Exhibition—Jönköping, organised in collaboration with the National Swedish Environment Protection Board, the Swedish Association for Water Hygiene, the Swedish Water and Air Pollution Research Laboratory and the Water Purification Group within the Swedish Association of Metalworking Industries. Further details: R. D. Sherman, Exhibition Consultants Ltd., 11 Manchester Square, London, W.1. Tel: 01-486 1951.

# Reports

## Future Imperfect

"I rubbed depilatory soap over my face and rinsed it with the trickle from the fresh-water tap. Wasteful, of course, but I pay taxes and salt water always leaves my face itchy. Before the last of the greasy stubble was quite washed away the trickle stopped and didn't start again. I swore a little and finished rinsing with salt. It had been happening lately; some people blamed Consie saboteurs. . .". Thus begins the second paragraph of *The Space Merchants* by Frederik Pohl and C. M. Kornbluth. A hundred years from now and fresh water is precious and taxed; an underground army of Conservationists struggles against the conventional wisdom of infinite exploitation and economic growth. Written twenty years ago, the book describes a society horribly like the one we seem to be heading for, a society based on consumerism and economic growth run mad. Ordinary national and international political systems remain only vestigially. Instead, the world is run by advertising agencies which have all the powers nation-states have today. Moral values are determined by the constant need to find new markets and sources of raw materials, the need itself the product of the continuous population growth necessary for the perpetuation of the ruling commercial oligarchies.

Thus, while murder of rival admen is permitted by a new kind of Geneva Convention, ordinary people, living except for the occasional expensive potato on synthetic food, such as the algae Chlorella and the curious Chicken Little, are valued only as consumers, the name by which they are contemptuously known. Wood is now so scarce and valuable that rings of oak and mahogany are status symbols and, like real flowers, are sold only by expensive jewellers. They can be bought only by the top members of the hierarchy (the system is of course rigidly hierarchial) who can likewise escape the worst rigours of reconstituted protein. But for most people it is Chicken Little, hanging a great pulsating cancerous growth from which slices are cut, to be shaped, flavoured and sent to identical consumers all over the world.

As with most writing of this kind, the energy of the authors seems to have gone mainly into the construction of the background; the plot (an attempt to frustrate the exploitation of the as yet unravished planet of Venus) is thin and the characterisation weak. But it must be one of the most likely and convincing pictures of the future we are facing that has been written in the last few decades. Another such picture, George Orwell's *Nineteen Eighty-Four*, with its mixture of 1944 shabbiness and Stalinist terror and its total ignoring of the population-resources crisis, seems to be an unlikely guess at what will happen by that date. On the other hand, Orwell's analysis of the destruction of language and sensitivity in the interests of political uniformity is a profound one and his forecast that technology will be used to limit freedom will, it seems, inevitably come true—at least if we can judge from the television cameras already in use watching the Chiswick Flyover and the streets round Hatton Garden. Aldous Huxley's *Brave New World* is a better guess (and is also better written), but it refers to a period some six or seven centuries ahead and it assumes that the problems of over-population and pollution have been solved, as Huxley himself acknowledged in his *Brave New World Revisited*. But here, too, it is disturbing to see how many of his forecasts made in 1931 have already come true or are about to.

A criticism that could be made about *The Space Merchants* is that the authors put their prophecies too far in the future and did not foresee the enormous speed of change in the fifties and sixties. Only twenty years later we have almost the full catalogue: uncontrolled population; almost uncontrolled pollution; space flight as an escape from real problems (and artificial ones created instead); dehumanisation by machines, drugs and urban living; the slow, inexorable drying-up of resources; the destruction of natural things. Although we are not yet ruled by admen, what of the multi-national companies and the stories one hears about their revenues bigger than those of some states, their almost sovereign areas patrolled by private armies, the loyalty they evoke and their growing power? Even "Coffiest", the synthetic substitute with its mild habit-forming additive, does not seem very far off.

*The Space Merchants* is classified as science fiction. Contrary to a common belief, the genre is not overwhelmingly based on crude technological optimism. Perhaps half the books written see space-travel, time-travel and freedom from physical labour as bringing a glorious future for mankind. The other half—and probably now becoming the greater proportion—convey a warning that some kind of ecological disaster could come from human arrogance in science or technology or from an accident unrealised until too late. Two examples of this type, the themes of which are apparent from their titles, are J. G. Ballard's *Drought* and John Christopher's *The Death of Grass*. Two others, *Earthworks* by Brian Aldiss and *The Wanting Seed* by Anthony Burgess, are concerned mainly with overpopulation. Some look further into the future and see another civilisation succeeding the present one. In Walter Miller's *A Canticle for Leibowitz*, civilization and learning have retreated into monasteries from the barbarism outside. Richard Jefferies' *After London* is one of the earliest of this type and, considering its date (1885, in the full flush of Victorian confidence), it is a remarkable book. After an unspecified disaster England has reverted to forest and to what it must have been in early mediaeval times. Semi-feudal communities treasuring their precious heirlooms of a few plates and books shelter in tiny fortified towns from the fierce nomads outside. The Thames Valley is a vast deserted marsh which the hero of the story follows until it ends at the site, now poisonous and almost impenetrable, where London once stood.

For one of the most attractive and convincing portrayals of a stable society—again very mediaeval in atmosphere—we can go to William Morris's *News from Nowhere*. Until recently Morris has been rather neglected as a social critic and prophet. Even among the Left, few people seemed to care for his designs or for his somewhat bogus mediaevalism (London, as many have pointed out, was never quite so small and white and clean as he claimed). Above all they have distrusted his advocacy of handicrafts in place of machine production. They felt, as they did with Gandhi's similar teaching, that it was impossible in practice, as hand production could never deliver enough goods to ensure even a moderate standard of living for

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an exploding population. A mere aesthetic preference for hand-made articles of furniture, clothing and ornament seemed a flimsy basis for the reversal of the Industrial Revolution. But recently there have been signs of a revival of interest in his writings, especially of his later romances like *The Well at the World's End* which appeal to young people influenced by Tolkien's *Lord of the Rings*. Another reason for renewed interest in him is, of course, his distrust of industrialisation, a distrust which has now taken on quite a different aspect now that such further industrial and technological advance seems to be impossible without grave ecological and social consequences. His advocacy of simpler life-styles will gain him a better hearing than he has hitherto had, one suspects. He may well turn out to be a better guide than many a more plausible and flashy thinker.

In the book an old man, Hammond, acts as a mouthpiece for Morris's ideas; plot and characterisation are, as usual, of little interest. He explains how the revolution has brought about a society in which contentment has largely replaced greed, co-operation rivalry, and equality envy. The revolution is of a Marxist kind—although Morris did not think very highly of Marx and he, in turn, has been despised by Marxists as "utopian" and "unscientific". The economic system, explains Hammond, which prevailed before, forced more and more people to produce goods they did not really need in order to keep itself going. This ever-growing burden of unnecessary production distorted men's lives. The happiness of the workman at his work, "his most elementary comfort and bare health, his food, his clothes, his dwelling, his leisure, his amusement, his education—his life, in short—did not weigh a grain of sand in the balance against this dire necessity of 'cheap production' of things, a great part of which were not worth producing at all." A never-ending series of sham necessities had to be produced to keep the wretched system going. The result was that Britain and especially North America "suffered so terribly from the full force of the last days of civilization, and became such horrible places to live in, that they are now", Hammond explains, "very backward in all that makes life pleasant". No, that was not written in 1972 but in 1890.

Released from the tyranny of what Morris calls "the World Market" and what we would call growthmania, people are freer to express their personalities in the arts and sciences, in friendship, and in services to their fellows, work now being quite voluntary. Machinery has been retained for the really unpleasant and indispensable work. For the rest, handicrafts provide quiet joy and satisfaction to producer and user. In the egalitarian atmosphere and in the absence of greed, crime against property has been almost entirely eliminated. So, too, has social alienation, although here and there are mild grumblers, one of whom we meet in the book, who lament the passing of the old days. Any crime there is comes usually from sexual jealousy and when it occurs the whole community is small enough to feel some responsibility for the wrongdoing and for its rectification. In this matter of crime Morris comes close to sharing Samuel Butler's view in his *Erewhon* that it is a kind of disease. In the instance of murder described in Morris's book, the guilty one is helped to settle overseas. Here Morris shows some anthropological insight for, as is well known, ostracism is a common and very effective means of punishing offenders against the *mores* of many primitive societies.

The dismantling of all but the most essential industrial activity has produced an England that is uniformly clean and beautiful. The enhanced visual sensitivity of a people no longer compelled to carry out uninteresting and meaningless work in uninteresting and ugly towns ensures that old buildings of merit are cherished and any new ones erected to not harm the character of their surroundings. What we in 1972 through our amenity societies have to fight so bitterly for comes naturally to the aesthetic imagination of people brought up in such an environment. Wild areas are, of course, preserved and wildlife flourishes in the absence of persecution and urban development, especially birds of prey, which have greatly increased in number. Morris's vision is one of harmony, social and ecological.

Its critics have not been slow to point out its faults and weaknesses. Morris has been charged with having a too sanguine view of human nature, with creating a society without stimulus and challenge and, above all, with having an inadequate grasp of realities when he supposes that England with such a high level of population still (that of the late nineteenth century, though now stabilized) could maintain such a standard of living, modest though it is, on so little industry as he shows. And it is true that the amount of technological and industrial underpinning needed for even a low standard of living generally tends to be underestimated. There are, too, a number of questions one would like to ask. What would happen, in the absence of modern medical treatment, to the sick, even if the stress diseases of urban life have been largely eliminated and that the chronically ill cared for at home instead of allowed to become institutionalised?

These are valid criticisms of any stable society with limited technology and they ought to be faced. What is not a valid criticism is the one sometimes heard from so-called practical people, that it is "only" a work of the imagination. Never before has imagination been so needed. Imagination, thought Shelley, is the great instrument of the moral good. When guided by scientific fact and probability it can show us the long-term consequences of our decisions, give us an ideal at which to aim, help us clarify our values. At present, it seems to have atrophied among most of our leaders in politics and industry. Like the frog in the fable which puffed itself up until it burst, our leaders do not seem to stop and make an imaginative assessment of where our kind of society is likely to end. The next balance sheet, the next by-election, are all that matters; and the intervals between elections is an eternity. On the Clapham omnibus, too, one can hear the myopic and irresponsible. "The system will last my time." We need the imagination as much as we need a comprehensive scientific assessment of the world and its potentialities, for only the imagination can tell us what it will be like to live in the future. Morris offers us one future, flawed though it is; *The Space Merchants* another. Which will it be? Shall we aim at Nowhere? Or drift into the world where our descendants, soot-plugs in nose, try to avoid their fellow consumers in a crowded urban desert with here and there a few simulated trees?

*Geoffrey Syer*

# Reports

## The Logicians of Pest Control

If you want to hear a one-sided myopic, prejudicial view of a subject go and hear it discussed by "reasonable" men giving "balanced" views which aim to put the whole thing "in perspective".

For example, the meeting in London of the British Pest Control Association last November, addressed by World Health Organisation consultant, Dr R. A. E. Galley, on "Perspectives in Pesticides".

The main burden of Dr Galley's address was, I think, beyond dispute. DDT had done more than anything else to control the mosquitoes that carry malaria. DDT was the cheapest of the possible insecticides—its nearest rival malathion, would cost eight times as much—and since international organisations and the governments of malaria-stricken countries tended to operate on shoe strings it was important to keep costs down.

Biological control of the malaria mosquitoes was possible in some instances—some fish ate the aquatic larvae, for example—but could not, at present, make a big enough impact. And Dr Galley could have added that to drain waterways and swamps—which robs the mosquitoes of their breeding ground and is possibly the best way of controlling them—was almost as dubious an exercise from a conservation standpoint as spraying DDT.

So, Dr Galley concluded, anyone calling for world-wide ban on DDT must take responsibility for the 500 million people now free from malaria who might otherwise have died from it.

On slightly less firm but still reasonable ground Dr Galley argues that, were it not for modern pesticides, high production agriculture and long-term food storage would be impossible: and the result of a world-wide ban on pesticides would again cause widespread hardship.

These arguments are convincing. The trouble is that proponents of such arguments—and this includes Dr Galley—assume that because their case is strong then it must be complete. Their argument, fairly stated, is this: that in many instances the withdrawal of pesticides would cause obvious and predictable ill effects which would out-weigh any known or likely side effects from their continued use. Therefore in those instances—regrettable though it might be—use of pesticides is justified.

But Dr Galley, for all his emphasis on "perspectives", accepts no such limitations. Instead he goes on to argue that because pesticides are justified in some instances they must, in general, be good. And even though there are faults in this logic that a six-year-old could drive a coach and horses through, he accuses all objectors of muddled thinking. "Unscientific" was a term he applied sweepingly to his real or imagined detractors—who, he added irrelevantly, "could not do a decent experiment if they tried".

A speaker from the floor said he accepted that pesticide was essential in some instances but did Dr Galley sanction the sale of highly toxic pesticides—DDT, dieldrin, and the rest—to amateur gardeners, to use willy-nilly?

Why not, replied Dr Galley. If they followed the instructions carefully, they could not do themselves harm. The only recorded cases of human injury from insecticides were due either to gross misuse or to deliberate suicide.

It should not have escaped the attention of Dr Galley that not even farmers, whose livelihood can depend on the correct use of various chemicals, follow instructions carefully: the temptation is always to use twice the recommended dose, in the hope it would be twice as effective. How many gardeners do follow instructions carefully?

And what exactly would such careful following achieve? In theory, it should ensure that a known and preferably minimal dose of pesticide is deposited on a particular surface. But how often is this possible? Even assuming that the insecticide solution is made up to the correct strength—a very big assumption—then wide variations in dose can still be produced through the method of application. I spray once and give the correct dose: I give the plant "a good going over" and I give ten times the correct dose. Wind direction, rain, sun, the kind of sprayer used, all affect the concentration remaining on the leaves. So much for instructions: they instruct in the impossible.

What of the argument that the person applying the spray could not be harmed? A dubious argument even taken at its face value: "could not" are big words for a scientist to use. But the whole point, as Dr Galley seems totally to have overlooked, is that we are not interested simply in the welfare of the gardener, but in that of the whole environment; not just in killing nasty greenfly, but in protecting bees, spiders, moths. A nice garden, achieved without undue effort, is an indulgence: a sound environment is vital.

Voice from the floor; would it not be safer to allow pesticides to be used only under licence—by professionals, for instance, or people who could prove they had a definite need for them?

This, of course, brings out the true-blue "freedom of the individual" speech from the pesticide men. Razor blades were not licensed, so why should pesticides be? A man could hang himself on a lavatory chain: why not sell them under licence?

So fallacious, these arguments. Man is not granted freedom to murder or rape his fellow human beings, why should he be allowed to rape the countryside? Is not the "freedom of the individual" argument used to justify indiscriminate firearms sale in America? And we admit that razor blades and even lavatory chains can be dangerous, but we also know that they could not be dangerous unless grossly misused. We can have no such certainty about pesticides.

And we know the possible dangers of razor blades; the slashed wrist, the scarred face. We have little knowledge of the long-term effects of pesticide; we know only that some pesticides have been dropped into the environment like pebbles in a pond and that the ripples have spread outwards, through all the food chains and through every cubic foot of land or sea.

Two more pro-pesticide fallacies were raised at the meeting by various representatives of the pesticide industry. The first was the rhubarb

# Reports

argument: that the oxalic acid contained in that plant is as lethal as any pesticide and that you could die from a surplus of rhubarb fool as surely as any laboratory rat succumbed to BHC. So if you ban the organochlorines, why not ban rhubarb? There are at least two major flaws in the argument: first, that I can control the amount of rhubarb I eat, but I cannot control my intake of DDT if it impregnates every glass of milk and every frozen sprout. Second, I have evolved safety mechanisms that enable me to resist the surplus of oxalic acid, or of common salt: nausea sets in before death. I can expect no such warning from dieldrin—or if I can, I do not know of it.

The second pro-pesticide fallacy, designed to comfort or at least beguile, was that the levels of pesticide found in the environment are extremely low. One part per million, for example. What a very little. No more than a second in a fortnight.

This argument was applauded by pesticide men present. The objections are clear. First, a very little can be a lot. Some poisons kill at concentrations less than those at which DDT has been found in penguin eggs. Secondly, organochlorine pesticides characteristically accumulate: low levels in the grass become higher in the rabbit that eats it, and higher still in the eagle that takes the rabbit. Thirdly, one is not necessarily worried about being poisoned by, say, the DDT in a penguin's egg: what is worrying is that this material, used in America, Africa, Asia, Europe, Australia, should have found its way to Antarctica. The spreadability should make one at least take note of the fact that the long-term effects of applying pesticide cannot be predicted, and have not been predicted in the past. The most worrying thing is that the pesticide men did not seem worried.

Finally, it was agreed, to smiles and nods, that the public must be "educated" about pesticides, to counteract the "propaganda" circulated by "popular" science magazines and such heinous bodies as the Soil Association.

The suggestions as to how this might be done illustrates the narrow vision of these so reasonable men. The first was that a film be shown on television, depicting "the effect that insects have upon human life." Excellent in principle—but what did the proponent have in mind? "A discussion by health authorities, agriculturalist—everyone concerned."

That's it, then: the usual dreary diatribe about locusts and codling moth. There are getting on for a million species of insect in the world. Each directly or indirectly contributes to the human condition. But these men know only a short catalogue of "pests".

The second grisly suggestion was that the word "pesticide" was wrong. It put people off. "Should we not call ourselves conservators?—for that is what we are. We aim to destroy undesirable species so that the desirable ones may live".

Who is it that needs the education?

*Colin Tudge*

## Population stabilisation

One recent and encouraging revelation has been the result of a National Opinion Poll survey showing that more than 8 in 10 people feel that overpopulation in Britain is now a problem; 56 per cent of those interviewed regard it as a serious or very serious issue. 65 per cent even went as far as to say that birth control should be freely available on the National Health Service, revealing a significant shift of opinion over the last few years.

Theory and practice, however, are still worlds apart. Under the Family Planning Act of 1967 provision of birth control facilities is left to the discretion of local authorities, and few have been enthusiastic to provide them. Those people familiar with local government know that councillors do not often consider the *long-term* effects of social and economic planning and are extremely sensitive to cries of "Sex on the Rates!" from their electors. Population Stabilisation, (the recently formed British equivalent of the Zero Population Growth movement in the States) decided to take action on this front. Of course PS members recognise that free birth control will not permanently stabilise population by itself—it is only a first step towards the norm of two children per family needed to bring us nearer a long-term optimum of around 30 million people.

PS chose as its first "pilot borough" one with a strong Catholic contingent and with a council which they knew would be difficult to persuade—the London borough of Southwark. The Health Committee had already rejected a call from the local Women's Liberation group for free birth control for social reasons and PS felt the strongest argument would be the economic one—family planning pays! Research into health and welfare finance and local birth rates showed that, at a conservative estimate, Southwark ratepayers could save £148,000 a year by providing free, comprehensive and well-advertised birth control service to prevent unplanned pregnancies.

Predictably, the Health Committee remained unmoved, ignoring both the financial incentives and the social need. Even the case for birth control reducing the abortion rate did not elicit anything from them. The Committee's view that those most in need would not be reached did not take into account the fact that the PS cost estimate included a generous allowance for advertising. Domiciliary family planning services have also been designed to meet this need. The councillors seemed to take a defeatist attitude and believed that education was the main problem. PS agrees heartily, but what is the council doing about it?

For the second stage of the campaign PS has divided the borough into small residential areas and individual members are canvassing support from the ratepayers. Having just been hit with rate increases, why should they support a council which refuses to save £148,000? Education surveys are being conducted at the same time and the third stage of the campaign is to pressurise schools and colleges in the area to provide a complete education on sex, contraception and population/resource/environment studies.

Experience gained from this pilot project is being used by PS branches to set up campaigns in other local authority areas. It's going to be hard work, but the results should make it worthwhile.

*Rosamund McDougal*

# Gulliver in Automobilia

## The Author discourseth of Beasts and Men

The Automobilians often pride themselves on their wondrous Partiality for the Animal Creation. They keep great Numbers of pet Dogs and Cats, which they suffer not to forage at large, nor feed upon the Leavings of their Tables, but nourish them up fat with choice Viands such as many a poor Blackamoor would think himself blest to dine upon. In popular Shews and Entertainments, it is agreed that not even Bawdry can draw in such Crowds as gather to behold the Doings of any Manner of Beasts. One Day, wearied with the vain Anticks of my Hosts, I bethought me to pass an idle Hour at a Bear-baiting, or lay out a few Pence upon a Fighting Cock: but on asking where such Amusements were to be found, I was informed that they have been these many Years forbidden throughout the Land. Such barbarous and unseemly Pastimes, I was assured, would ill become so civil and polished a Nation as themselves: they had outgrown these Cruelties, and the Law did but set its Seal to the Inclinations of the People.

I could not find it in me to reproach these Scruples: indeed, in a While I so reconciled myself to them, that I began to praise the Automobilians. Surely here, I declared, is Eden restored, and Man reconciled with his brutish Subjects, to rule them as Adam did, not as a Tyrant, but as a just and benevolent Lord! Alas, far otherwise did this matter reveal itself upon my closer Investigation. For it then became apparent that their Love of Animals ends where it begins, at Home. Throughout Automobilia and the Lands dependent thereon, the wild Beasts diminish and dwindle away: nay, so determined has been the Assault upon them, and delivered from so many Quarters at once, that if it continue unabated no Creature larger than a Coney will long survive elsewhere than in a few Parks and Menageries.

This Destruction, begun in Malice and Wantonness, is now continued rather by mere Absence of Mind. In their Fathers' Time, the Automobilians went forth into all Lands to kill for Sport, and none was held in greater Honour than the Hunter, upon whose Walls the Heads of his Victims hung thick as those of Traitors upon Temple Bar. Nowadays, the very Facility of Killing hath brought it somewhat into Disfavour: and this reform'd and humane people kill Beasts no more, save for Use, or for Profit, or to be rid of them, or by Neglect, or for some other Reason.

In Truth Man was ever, as the Poet saith, "of half that live the Butcher and the Tomb"; the Automobilians resemble their fellows in this, but are as much more rapacious and predatory as their Power to hurt is greater. Nor is their Greed limited by any Jot of Prudence. I have seen our silly Peasants sometimes stock a Common so full of Beasts that half perish and the Rest are lean and sickly, until by Each seeking more than his just Share of the general Wealth, All are at length brought to Destitution: thus do the Automobilians abuse without Stint this great Common, the Earth, in such Wise that their Children will live to curse them for their Improvidence. The Elephant for his Tusks, the Whale for his Blubber, the Rhinoceros for his Horn are well-nigh extirpated; the Leopard is slain by a Foe more insatiate than himself, as if he wore his Spots for no other Reason than that the Wife of some rich Merchant might use them to conceal the Lack of her proper Beauty, and to make Boast to the World of her Husband's Wealth.

The Earth, I suppose, was not made to be enjoyed by Man alone, but by the whole animate Creation. The Automobilians, however, leave no Part of their Land as Nature disposed it; they render it unfit for any Creature but themselves, like the Yew Tree, within whose baneful Shade no other Plant can thrive. Thus, where they do not murder outright, they kill instead by robbing their Victims of the Means of Livelihood. It is painful to see that Diversity, with which God hath embellished the World, reduced to universal Dullness, and a single Generation annihilating what all Posterity will be powerless to recreate. Those who destroy fine Buildings, burn Books, or deface Paintings, incur the deserv'd Execration of Mankind: yet what Man hath once made, he may make again. But no human Art can recall the Dodo to Life, that not long since teemed upon the Isle of Mauritius: and in Automobilia there are few Beasts but seem likely to travel the same Road. Nor then, perhaps, will Men themselves prove immune from Extinction; for the Prosperity of all Creatures is mutual, and, as Mr Pope hath lately writ,

"From Nature's Chain whatever Link you strike,
Tenth or ten thousandth, breaks the Chain alike."

*Nicholas Gould*

## In the next issue of The Ecologist

*Education and the environment* by Dr Walter P. Fenwick. The story of the attempts that have been made to introduce environmental studies into school curricula.

*Leading question* by Lawrence D Hills. If we recycle urban wastes and sewage can we solve the problem of heavy metal contamination?

*One dimensional Ecology* a detailed criticism by Paul R. Ehrlich and John P. Holdren of Barry Commoner's book *The Closing Circle.*

*York in a ring road* by Peta Rée.

# Ecotechnics

*by Arthur J. Puffett*

## Glass-fibre from one-trip bottles

After reading about the Friends of the Earth protest over non-returnable containers at Cadbury-Schweppes last Autumn, Mr James Fenton, managing director of Versil Ltd., the Yorkshire glass-fibre company, decided to research the possibilities of using one-trip bottles.

Mr Fenton conducted laboratory and production tests which proved that most non-returnable bottles could be processed into first class glass-fibre. However, the company wish to make it absolutely clear that supplies of glass will have to be delivered in minimum five-ton loads, and also graded into types of cullet. This rider has been found necessary as "local vicars have been ringing up, offering crates of nondescript empties".

Versil estimate that the new process will save money and Mr Fenton added: "But the money we save could be given to suitable environmental organisations for the clearance and landscaping of some ugly slag heap, for example, or some other worthwhile Yorkshire project."

Obviously the recycling of any waste is a step in the right direction, although with bottles the ideal solution would be to return them for their original use.

## FOE at the DOE

Continuing in the packaging vein, I have put together a number of interesting points which emerged from the "Packaging and Litter" conference held by the D. of E. as a direct result of the F.O.E./Schweppes confrontation.

(1) The Province of British Columbia has imposed a two cent deposit on all plastic, glass and metal beverage containers. Oregon will impose a five cent deposit in October, 1972. The State of New York has imposed a two cent tax on all plastic containers.

Ref. CPRE and Committee for Environmental Conservation.

(2) Processing and distribution costs are significantly cheaper in the case of returnable bottles compared with either one-trip bottles or tin cans.

Ref. Pira Report, Statistical Review of the Packaging Industry, July 1969.

(3) To quote one manufacturer, "disposability is item No. 27 on my check list of factors in new packaging development—the lowest priority".

Chairman of GLC Public Services Committee.

(4) Nearly two million tonnes of waste paper are recycled annually, approximately one-third of its (the paper industry) raw material requirements. Two thirds of waste paper usage is consumed by mills producing packaging boards. The saving to the national economy, by eliminating the need for further imports of raw materials, and finished products, is well in excess of £100 million per annum.

Consumption of paper and board in the UK now totals approximately 7 million tonnes annually, of which $4\frac{3}{4}$ million tonnes are produced domestically. Of this total consumption, it has been estimated that $4\frac{1}{2}$ million tonnes could potentially be recovered and recycled if suitable collecting systems were set up, and further demand created for paper and board with a waste paper content.

Waste paper consumption has been growing at an average rate of 3.5 per cent per annum, and is expected to maintain this growth for at least the next decade.

Ref. British Paper and Board Makers' Association.

(5) Fibreboard cases represent about 31 per cent by value of all the pulp-based products used in packaging. These in turn account for 46 per cent of the nation's total expenditure on packaging materials. In 1970, total production of packaging materials in the UK was valued at £1,027 million, of which pulp-based materials accounted for £473 million and fibreboard containers £147 million. In 1971, output of fibreboard cases increased to around £158 million.

Only a very small proportion of all fibreboard produced in this country is coated or impregnated with plastics, waxes, bitumen or other substances, the rest is all easily repulpable.

A new symbol, used on all packaging which can be recycled, is now extensively used in America by the Fibre Box Association, and other industries that recycle are being encouraged to make use of the symbol. This symbol is now being used by the Fibreboard Packing Case Manufacturers' Association.

Ref. Fibreboard Packing Case Manufacturers' Association.

(6) The designer and fabricator of the package, and the manufacturer and distributor of the product should have regard for:

(a) Using the minimum amount of material (plastics are not cheap) consistent with protection and preservation.

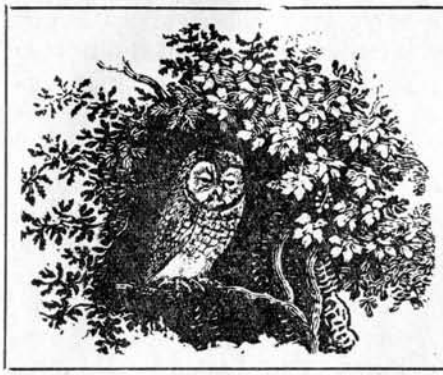
(b) Wherever practicable, making packages re-usable or returnable (this may apply particularly to the probable growth of rigid and semi-rigid containers in sizes up to 15 gallons).

(c) Making packages more suitable for re-processing or for disposal (e.g. designing the package so that it can be easily crushed after use; avoiding multi-material packaging; using only those materials which present no disposal problems; investigating the possibilities of a colour or similar identification code).

(d) Labelling the package not only with the type of material from which it is made but also with clear instructions for disposal after use.

Disposability must rank with barrier effectiveness, cost, machinability and merchandising impact as the main elements in the development of a packaging design. If the additional factor of disposability increases the cost of a package this must be taken into account in assessing the possibility of increased competitiveness from overseas manufacturers not similarly concerned with environmental aspects.

Ref. The Plastics Institute—Guidelines for future packaging design.



# Towards a unified science

## Trial and error?

In line with empiricist theory, the tendency has been to explain behaviour in terms of the influence of the environment, i.e. as responses dictated by external stimuli, and there has been a corresponding neglect of the influence of the inherited set of instructions or innate releasing mechanisms (I.R.M.), as Lorenz calls them, that determine the generalities of an anergic pattern.

An organism is not born with a blank mind—the *tabola rasa* of the empiricists—but with a general set of instructions and a corresponding general model reflecting the experience of its unit of philogy as a whole, which will be differentiated as a result of its experience, so as to adapt them to the needs of its specific environment.

This fact is apparent from a number of experiments on different types of animals. Fantz experimented on a sample of 1,000 chicks. He found that they pecked 10 times more often at sphere-shaped objects than at pyramidical-shaped ones. The chicks were hatched in darkness and tested on their first exposure to light, from which it must follow that this behaviour can only be explained on the basis of innate tendencies. Tinbergen found that newly hatched herring gulls preferred pecking at objects which resembled the bill of the parent from which they were fed. Marked preferences for certain specific objects were also established among baby chimps. Fantz conducted similar experiments with children. In one of these, 49 children aged from 4 days to 6 months, were presented with . . .

". . . three flat objects, the size and shape of a head. On one we painted a stylized face in black on a pink background, on the second we re-arranged the features in a scrambled pattern, and in the third we painted a solid patch of black at one end, with an area equal to that covered by the features . . . The results were about the same for all age levels: the infants looked most often at the real face, looked slightly less often at the scrambled face, and largely ignored the control pattern."

Fantz concluded:

"Lowly chicks as well as lofty primates perceive and respond to form without experience if given the opportunity at the appropriate age of development. Innate knowledge of the environment is demonstrated by the preference of newly-hatched chicks for forms likely to be edible, and by the interest of young infants in kinds of form that will later aid in object recognition, social responsiveness and spatial orientation." (1)

The modifications brought about to this general model during behaviour are normally referred to as "learning". Its role is not to alter innate behavioural tendencies so much as to enable them to be satisfied with ever-greater precision.

Thus an embryo will develop not merely because its environmental conditions are correct, but also because it contains a complex set of general instructions that, as a result of interaction with its environment, will be slowly differentiated. The same is true of all behavioural processes.

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

If a rat is put into 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. Strictly random behaviour does not occur in a system whether it be an organism, a society, or an eco-system. These all display varying degrees of order, and hence of limitation of choice, or of non-randomness.

Looked at slightly differently, if a rat finds it 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 make one rather than any other?

All the actions of an animal, whether it be an earthworm, a rat or a man, as Craik was the first to show, must be regarded as based on hypotheses as to the nature of their environment, or, rather, *of their relationship with their environment*. Thus, supposing that the first move made by the rat, rather than lead it towards the opening, on the contrary led it into a further cul-de-sac, the model responsible for this error would have to be modified. Thus, when the rat made its next 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 systemic situation in which the rat had found itself, and one furnishing an evermore precise representation of the system for the purpose of finding it way out of the maze. In other words, each action would be regarded as a correction of an error, and if these were taken as forming a series then the latter would be 'damped', in the sense that the errors would be progressively reduced, i.e. the sub-system would be tending towards four-dimensional equilibrium or along a 'creode', i.e. towards ever-higher stability. The rate at which this process would be occurring would depend on the sub-system's ability to postulate hypotheses leading to adaptative behaviour.

*Edward Goldsmith*

**Reference**

(1) Fantz, Robert L. '*The Origin of Form Perception*' in S.A. May 1962

# Friends of the Earth Newsletter

## FOE fights dirty

Since September 1970, FOE has grown from an original membership of three, to better than 3,000. Membership is spread through the UK in forty militant groups, all now carrying the fight on all manner of local issues: proposed transport schemes, derelict land, recycling projects, air and water pollution, population studies, education programmes. People are meeting, exchanging ideas, researching, and acting; but most important of all, they're beginning to feel responsible. Disregarding financial circumstances (conveniently,) FOE is in a very strong position indeed to bring about a more rational approach to a broad spectrum of environmental matters.

So now FOE is truly national, not merely international. (It's easier sometimes to put capital cities on your letterhead than to build a national movement.) A register of 1,500 professional people, ready to give advice, 40 active, enthusiastic groups, a membership of over 3,000, an income of £500 per month (three months' life expectancy if *this* resource dries up!), a staff of eight, and a strong sense of commitment, is FOE in a nutshell. Where do we go from here?

Our three major campaigns (Schweppes/packaging, Mining in National Parks, Endangered Species) provide adequate work in the form of research for a long time to come. We'll continue to give advice where possible, meet up to 75 people a week at our one-room office, publish books, and answer 150 letters a day, but it's apparent that the largest area for development (excuse the borrowed terminology) is in the regions.

The first thing we must do, hopefully implemented by the time this article is printed, is to set up a firm line of communication between the various groups, which will take the shape of a bi-monthly newsletter, designed to become a regular forum for the groups to exchange ideas. This decision was brought about by pressure from many quarters, notably from Rick Walker, FOE Cheshire, and will give groups a chance to exchange ideas, communicate research projects and generally find out what's going on and where.

Here then, is a list of groups up and down the country. They need *your* help, if they are to be as effective as their potential suggests. Many of the following consist of a hard-core of people, only three or four strong, whose enthusiasm demands support and encouragement. If we are to see any change brought about, the responsibility lies with every concerned individual to do his utmost to add weight to the growing demand for urgently needed legislation and education in defence of our environment.

### Cheshire

Rick Walker, 253 Pensby Road, Heswall, Wirral; Phone: 051 342 3283. 3283.

### Devon

Richard Jennings, St. Clare, St. Andrews Road, Exwick, Exeter or 24a North Street, Exeter; Phone: 0392 73954.

### Dorset

Jim Payne, David Bowie, "Walden", Heslop Road, Colehille, Wimbourne.

### Co. Durham

Colin Clews, 45 The Oval, Ouston, Chester Le Street; Phone: Birtley 4495.

### Cornwall

Roy Bennett, 6 Bostennack Terrace, St. Ives or The Workshop, 4 Lower Green Street, Newlyn, Penzance.

### Essex

Alan Martin, 37 Rigby Gardens, Chadwell St. Mary; Phone: Tilbury 4593.

John Matthiessen, 237 Eastern Avenue, Redbridge, Ilford; Phone: 550 2003.

Roger Anderson, 134 Temple Grove, Bakers Lane, W. Hanningford, Chelmsford; Phone: Chelmsford 62421.

Simon Dodson, N.E. Essex Technical College, Endsleigh Annexe, Colchester.

### Hampshire

John Mickerson, 51 Westwood Road, Southampton SO2 1DJ.

Philip Chandler, 13 Sycamore Avenue, Chandlers Ford.

John Worley, 16 St. George's Avenue, Havant; Phone: 07012 3217.

### Hertfordshire

Arthur Puffett, 56 Pondfield Crescent, Marshalswick, St. Albans; Phone: St. Albans 58913.

### Ireland

David J. Paul, Queens University Belfast, N.I.

### Kent

Charles Alexander, 18 Blyth Road, Bromley; Phone: 460 1008.

### Lancashire

Stephen Harvey, c/o Fylde College, University of Lancaster, & Nick Hanley.

Geoff Kerr, 160 Norwood Road, Southport; Phone: Southport 42184.

### Leicestershire

Bob Maloney, Leicester Poly. S.U., Newarke Street, Leicester; Phone: Leicester 27652.

### Lincolnshire

John E. Jackson, 16 Wyredale Road, Ashby, Scunthorpe.

### London

Simon Birch, 264 Trinity Road, S.W.18: Phone: 242 3366.

Pat Rosenwald, 9 Bracken Gardens, Barnes, SW13.

Helen Nixon, c/o 4 Nutley Terrace, N.W.3.; Phone: 794 9320.

Maureen Grieves, Top Flat, 20 Kildare Gardens, W2; Phone: 229 9423.

Geoff Francis, 65 Regents Park Road, NW1; Phone 800 4008/800 0727.

Ian Goffe, 29 Love Walk, SE6.

### Norfolk

David Powell, 10 Belmore Close, Thorpe, Norwich; Phone: Norwich 35488.

Mr. & Mrs. D. W. Hicks, 7 St. Albans Way, Thetford, Norfolk.

### Nottingham

Brian Grout, Dept. of Zoology & Botany, University of Nottingham.

## Oxfordshire

Anthony Cheke, 16a Sweetmans Road, N. Hinskey.

## Scotland

Ann Cohen, 19 Dundas Street, Edinburgh; Phone: 031 556 1872.
Geoff Kemsley, University of Glasgow, Glasgow W2; Phone: 041 339 8855 x 213.

## Somerset

Brian Price, Martin Hillier, c/o University of Bristol Union, Queens Road, Bristol; Phone: 0272 35035.

## Suffolk

Linda Silk, Ray Mumford, 1 Thatched Cottage, Great Finborough; Phone: 01 623 1964.
Mr. & Mrs. M. Kiddell, The Gatehouse, Marsh Lane, Carlton Colville, Lowestoft; Phone: Norwich 22255 x 6263.
Clive Lippiatt, Maytrees, Station Road, Claydon, Ipswich.
Mr. Tim Bell, The Mill House, Cavendish, Sudbury; Phone: Clare 463.

## Sussex

Wendy Marlar, c/o Active Recovery Ltd., Martins, Thakeham, Nr. Pulborough; Phone: W. Chiltington 2704/2252.
Mrs. Pamela Johnson, Bryckden Place, Waldron; Phone: Heathfield 3094.
Mr. D. Poore, 215 Pavilion Road, Worthing; Phone Littlehampton 3227.
Mr. M. Beale, Rise Holding, Rise Farm, Lewes; Phone: Lewes 3619.

## Warwickshire

Joel Johnson, David Powell, 64 Grassmoor Road, Kings Norton, Birmingham 30; Phone: 021 458 2681 and 021 449 0439.

## Wiltshire

Stephanie Tyler, Field Cottage, Lanhill, Chippenham; Phone: Chippenham 2956.

## Yorkshire

David Wilson, 21 Duncan Avenue, Otley.
Paul Grimwood, 9 Southlands Grove, Bingley.
Robin Ramsey, Stewart Hildred, 113 Coltman Street, Hull.

## Recent campaign developments

National Packaging Day succeeded in what it set out to do: to bring to the attention of the public and Government via press, television and poster display, the crucial issues behind the campaign, immediately before the Department of the Environment's Conference on "Packaging and Litter". It appeared that such a title to a Conference demanded some form of action which would enable FOE to focus attention on resource depletion and cost to the consumer, rather than a throw-away by-product of inappropriate packaging, which is litter.

Armed with 8,000 signatures (thousands more were sent direct to the Department of Environment) and the dossier of research we had carried out on packaging, Graham Searle and Oliver Thorold represented FOE at the Conference. After much brouhaha on the finer points of litter appreciation, Graham presented our case in ominous detail. It didn't make pretty listening!

The outcome? Eldon Griffiths, Under Secretary at the Department of the Environment, promised to establish the working party we had originally requested. Our job now is to ensure the terms of reference under which this Party will work are specific and to the point; and of course, to continue our research in depth.

It only remains for us to thank everyone who took the time and trouble, to make National Packaging Day such a success and to convey our best wishes to you all.

On March 27th, Anthony Grant, Under Secretary of State for Trade, announced that from midnight on March 27th, the importation of furs, skins, rugs and coverlets obtained from the tiger, snow and clouded leopard would be prohibited.

This is a marvellous first step, but the Government, of course, has closed the stable door after the horse has bolted. There are probably fewer than 2,500 tigers and no more than 500 snow leopards in existence today. It is no skin off the furriers backs either, as these creatures are virtually extinct, and thus no longer used by the trade.

A FOE Deputation to Anthony Grant was arranged by James Johnson, MP on 27 March and Graham Searle, Oliver Thorold and Angela King represented FOE at the meeting. The most important point made by Grant was that the Government would ban the products of other animals threatened with extinction, if the necessary scientific evidence were submitted. This evidence is in existence and FOE will make sure that Mr. Grant is presented with it.

The Department of Trade and Industry chose one of two methods to ban the importation of the skins in question. It banned them by removing these products from the open General Import Licence and added them to the First Schedule of the Import Licence, giving them a "W" classification. This means that these goods "may not under any circumstances be imported under the Licence".

This procedure does not require an Act of Parliament. Mr. Grant has shown, as with the vicuna in October 1970, that any product can be added to this list. FOE would like to see products from the leopard and cheetah (the products of which can now only be imported if they have been legally exported from the country of origin), the La Plata and Giant otters, jaguar, ocelot and whale immediately added to this list.

The method Grant did not choose, is the one we would like to see implemented. That is, for the introduction of an Endangered Species Act, which would ban the importation of all products of listed Endangered Species. Under this Act, an advisory committee would be set up, whose function it would be to inform the Secretary of State when an animal should be added or deleted from the list. Mr. Wolf, at the Department of Education and Science, Curzon House, Curzon Street London W1, is reviewing the question of introducing such an Act. We know he will be pleased to hear from you!

Finally, thank you for writing to the Department of Trade and Industry and to your MP. The pressure you put on them made the DTI act much more quickly than otherwise. We have only won a very small battle and there's a long uphill struggle ahead. We know you'll keep up the pressure on the DTI, your MP and Mr. Wolf!

*Peter Wilkinson*

Postscript: We hope to build up a film library on environmental topics, including endangered species. Would anyone who is interested in helping us with this task and has material which they think we could use, please write to Stephanie Lenz, Film Library, Friends Of The Earth Ltd., 9 Poland Street, London W1V 3DG.

# Books

## Getting our Deserts

JUST CONSEQUENCES, edited by Robert Waller, Charles Knight & Co., 1971, £2.50.

Ever since reading *Why Blame sugar?*, I have been convinced of the danger of eating sucrose, and have limited its consumption in our household. After reading this book I have stopped buying white bread. Ever since the seond world war, when those old enough will recollect that sucrose acquired a different flavour, I have not taken it in tea. I now find myself disliking it in cocoa. The recent publicity given to the correlation between smoking and lung cancer did not persuade me to give up cigarettes.

Diabetes, obesity, coronary thrombosis, dental caries, varicose veins and diverticulosis were almost unknown a century ago. They are rare in so-called primitive communities where traditional food is still eaten, although they are as common in the same races as in Western civilisation when they eat a Western diet. It is suggested that these diseases are caused by eating refined food, particularly sugar and white flour. In order to consume the 5 oz. per day of sugar which is the average consumption in this country, one would have to eat 2½ lb. of sugar beet. The 30 per cent of the grain which is discarded when white flour is milled contains much of the protein and most of the fibre. Disease is caused not so much by the poisonous nature of the sugar or white flour, but by the lack of fibre which would satiate our appetites. The removal of fibre greatly lengthens the intestinal transit time. Pressure of an overloaded colon on the external iliac veins are said to cause such complaints as varicose veins, femoral thrombosis and haemorrhoids.

*B. coli* infections are rare in communities living on unrefined carbohydrates and in breast-fed infants. Perhaps, as a start, if we are to try to cut sugar consumption, the addition of sugar to baby foods could be prohibited, since this is not only bad for the babies, but must play a part in engendering a liking for sweet things as they grow up. Perhaps also, fresh fruit or cheese and biscuits could be served after school dinners instead of high sucrose puddings, and wholewheat bread could be served in hospitals.

Although several references are cited in the book, no mention is made of Professor Yudkin's[1] work, nor of Dr T. H. Grenby's.[2]

I am not one of the nine out of ten women that cannot tell a certain brand of margarine from butter. I have never eaten margarine because I do not like its flavour. Added to this I have always had a feeling that a chemically hardened product could not correspond to a naturally occurring fat and was therefore potentially dangerous. It is gratifying to find Hugh Sinclair, in his contribution, drawing attention (although not very clearly) to the difference between "useful" and "harmful" fats. If, as he contends, deficiency of essential fatty acids causes the formation of faulty cell-membranes, thus increasing our susceptibility to infectious diseases, then a clear statement of which foods contain essential fats would be appropriate. T. L. Cleave does mention sunflower seed oil as being unsaturated, but does not see the sense in eating it since it comes from the New World and we evolved in the Old.

I am astonished to learn that lard is artificially hardened: the dictionary still defines it as the internal abdominal fat of pigs. It would be interesting to see what the food regulations say about it. I have often wondered what the difference is, apart from price, between "American" lard and "Danish" or "English". (Is it not made in Wales or Scotland?) I never buy anything American because of an unaccountable prejudice.

In his introduction, Robert Waller cites Dr Sinclair as associating the rise in chronic heart disease and lung cancer in 1943 with the arrival of three foodstuffs from America—hydrogenated margarine (was the margarine I remember before 1943 not hydrogenated?), very fat bacon and tinned meat containing a high proportion of saturated fat.

Dr Sinclair attributes the lack of correlation between smoking and lung cancer in Spain and Japan to the high level of unsaturated fatty acids in the diets there, but he fails to tell us what they are. Any chemist can, of course, look them up, but this is surely a book aimed at the general public. Dr S. J. L. Mount tells us that linoleic, linoleric and arachadomic acids are unsaturated and essential, and that they are found in higher concentration in wholemeal than in refined white bread, but I was unable to ascertain this by reference to the index (neither are "cats" or "margarine" mentioned).

T. W. McSheehy leaves open the question "Is there a correlation between the health of a population and the method of husbandry used to produce its food?", but if others find the book as frightening as I do, there should be a good market for a booklet telling where naturally produced foods can be bought, or there's an idea for all the unemployed chemists!

Dr D. B. Long outlines "some of the research that could be done into the nutritional value of food according to the way it is grown". Those with influence in the SRC please note that the Soil Association wants to do this, but has not the money.

My husband often used to ask me why I paid twice the price for free range eggs. I could never tell him, until I found some analysis figures that show

they contain twice the amounts of vitamins A and D that battery eggs do. This convinced him. I do not believe our diet is deficient in vitamins A and D, but I shall continue to prefer free range eggs until research indicates that they are harmful.

Dr Innes H. Pearse describes some striking work with cats carried out by F. M. Pottinger Sr. in the USA. Not only were those fed on raw meat healthier than those fed on hospital food scraps, but plants grew better in their pens. She also describes McCarrison's experiments with rats, demonstrating the relation between diet and disease.

Michael Blake's contribution ought to be compulsory reading for all those in the inorganic fertilizer industry, agricultural analysts and anyone who happens to be a member of the Fertilizer Act Advisory Committee. Perhaps, those in the sugar refinery industry will get a guilty conscience, although I do not quite see what they will do about it. Those in the flour industry might start an advertising campaign extolling the virtues of wholewheat bread. Sir Keith Joseph might be persuaded to provide a subsidy so that wholewheat flour can be sold for the same price as white. Perhaps someone will send him a copy of the book. At any rate we can all recommend that our local public libraries buy a copy, so that it is available for everyone to read.

*Vera Hartley*

**References**
[1]John Yudkin, *Chem. and Ind.*, 1967, 35, 1464.
[2] "Some Aspects of Food and Dental Caries", *Chem. and Ind.*, 1968, 38, 1266.

## Population control in Britain

A BIRTH CONTROL PLAN FOR BRITAIN. (The Grange Press, Southwick, Sussex)

Traditionally British politicians of all parties, like their opposite numbers in other countries, have tended to eschew matters of population and birth control. Such topics, they believe, are highly personal and their airing on the hustings might prove embarrassing and could conceivably have a salutary effect on the ballot box. Fortunately there is now some evidence that these deeply entrenched political attitudes are in the process of change, and the admirable publication *A Birth Control Plan for Britain*, prepared by members of the Birth Control Campaign, could accelerate such a metamorphosis.

The linchpin of the report is the proposal that the Government should establish with all possible speed a comprehensive family planning service on a truly national basis. Few would deny the need for the provision of such facilities. Ours is a highly overpopulated island, the population density of the UK ranking ninth in the world league and that of England and Wales being third after Bangladesh and Taiwan. Demographic projections for the UK for the end of the century and beyond strike notes of deep foreboding. Our population is now approaching 56 million; the projection given by the Government Actuary for A.D. 2000 is 66.5 million and for A.D. 2010 70.9 million.

Each year in Britain there are 300,000 or more unwanted pregnancies, many of them ending in abortion. The 150,000 unwanted live births which do occur are extremely expensive, costing the taxpayer a staggering £300,000,000 each year. But quite apart from the purely economic factor, unwanted children frequently present society with poignant human problems, and this has been clearly demonstrated in recent British and Scandinavian studies.

The present situation in Britain with respect to birth control facilities gives no ground for complacency. The report states that of the 8 million women who are at risk from pregnancy each year, only about half are suitably protected by reliable forms of contraception. Government expenditure on family planning, although slowly increasing, remains exiguous and, furthermore, birth control facilities throughout the country are spread in an uneven and erratic manner depending mainly on the whim of the particular local authority.

The report makes some radical suggestions as to how the overall situation could be improved. It strongly supports the viewpoint that comprehensive birth control facilities should be fully integrated within the National Health Service. It stresses the key role of the family doctor and it recommends that the oral contraceptive pill be routinely prescribed free of charge on the E.C.10 form. It is in favour of a massive expansion of population education utilising the mass media to the full, and it makes sensible recommendations with regard to administration and finance.

The Birth Control Campaign will not lack for allies. The major tenets of its "credo" will undoubtedly receive wholehearted support from other pressure groups with similar aims such as the Conservation Society, Population Stabilisation and the Doctors and Overpopulation Group. How long must we wait before the Government heeds the warnings of these bodies and institutes a population policy for Britain? It must act soon for if it does not the quality of life in these islands will have deteriorated beyond repair.

*Dr John A. Lorraine*

## Woods and Hills

MAN AND THE MENDIPS, edited by W. G. Hall, The Mendip Society.
WOODLAND BIRDS, by Eric Simms, Collins New Naturalist Series, £3.00.

Readers of this journal are familiar with the alarming behaviour of exponential growth statistics. Here is a new one for their collection: if the expansion of quarrying in the Mendips continues at its present rate, by 2060 the Mendip Hills will be a hole in the ground. Such figures carry a built-in reductio ad absurdum—obviously such an expansion will collapse before the final point is reached. But they are valuable as indicating how *temporary* modern trends must be.

Temporary or not, they are destroying in a few years the work of centuries. Mendip today, though designated an Area of Outstanding Natural Beauty, is really (like most such areas in Britain) not the work of nature at all: as a contributor to *Man and the Mendips* points out, human influence on the area's landscape began 5,000 years ago, and has continued steadily ever since—tree-felling, open-cast mining, quarrying, agriculture. But all previous activities have left their marks alongside and overlapping one another; some were ugly at first, but time has mellowed them; "these layers of the past combine to make the fourth dimension of our present Mendip. . . We now have the power . . . to wipe out for ever all these past layers . . . Are we going to increase the depth of the fourth dimension with our own additions, or are we going to flatten it out of extinction?"

Mendip, in fact, is a microcosm of

Britain. And in this book, the Mendip Society have done what every similar local group should do: they have assembled the facts without which no conservation campaign can succeed. History, natural history, industries and recreation are all considered; the devil's advocates, in the form of the Amalgamated Roadstone Corporation and the A.A., are allowed to have their say: and the cumulative effect is to press the conservationist case far more effectively than any avowedly propagandist work could do.

From a general survey of a small area to a specialised study of one aspect of the national scene. But *Woodland Birds*, as those familiar with the *New Naturalist* series would expect, is not *narrowly* specialised. Indeed, it is an excellent introduction to the woodlands of Britain in general, their history and their present state. Under natural conditions much of Britain would be covered with deciduous forest: but for the last million years the British ecosystem has never been static, and it is only comparatively recently that man has begun to rival the climate as a major agent of ecological change. Since about 2000 B.C. the work of clearance has proceeded fairly steadily; and we have reduced 40 million acres of largely deciduous woodland to 3.5 million, of which 94 per cent is plantations of alien conifers. Yet our land bird fauna remains predominantly a forest one: and until recently human activity, paradoxically, operated in favour of woodland birds, for it is not the deep forest but the woodland edge which provides their most populous habitat. The small remaining woods and, even more important, the hedgerows (Wordsworth's "little lines of sportive wood run wild") shelter a more diverse and numerous plant and animal community than nature's unbroken blanket of mature trees. So, at least where birds are concerned, do the gardens of suburbia: there are five times as many birds to the acre in Dollis Hill as in the virgin forests of northern Europe! But the hedgerows are dwindling—by 10 per cent or 20 per cent in the last twenty years; and in other respects too, modern farming methods are creating an increasingly unstable environment. The towns, a safer refuge, are only exploited by a handful of adaptable, opportunist species: Berkeley Square is fine for starlings, but nightingales are more choosy. Eric Simms has given us an exhaustive and fascinating account of what, despite everything, is still a rich and varied bird population: but unless present trends are halted, our grandchildren are likely to find his book of purely historical interest.

*Nicholas Gould*

## Friend of the Earth

THE STOCKHOLM CONFERENCE: ONLY ONE EARTH—by Friends of the Earth, Earth Island Ltd., £2.25.

UN conferences don't usually create much of a stir outside the enclaves in which they are held, and it must be something of a novelty for the UN to find itself the centre of attraction. All the same, apart from those who've managed to make it to Stockholm, most people will probably remain ignorant of the intentions of the conference and what it is likely to achieve. Hence the need for books to clarify the subject.

*The Stockholm Conference*, written by Amory Lovins for Friends of the Earth, should appeal to those who have neither the time nor inclination to follow all the ins and outs of the Stockholm conference, but yet who feel passionately about the environment. It is therefore a book for the committed FOE follower rather than for the sceptic who still doubts that there is any such thing as an environment.

The book is nicely done, and those who appreciate the exquisite beauty of nature will find those views endorsed by some fine illustrations. As for the text, we are first taken through a readable account of the global environment and the multitude of ways it is being threatened and degraded by man, and then through some of the more important measures and resolutions that are being proposed at the conference. The book takes neither a particularly pessimistic nor optimistic view, but seeing the extent of the problems now facing man, one does wonder whether the UN's proposals in any way match up to them.

Of course, a book which tries to cover so much ground in a very short space is fair game for the critics, and it is a pity that a good account is sometimes spoiled by overstatement. Thus Amory Lovins is rightly concerned with nuclear waste, but to claim that "in the height of stupidity, many nations have also been dumping into the oceans casks of seething wastes from reactors . . ." is to invite attack. For it is a fact that greater care is now taken over radioactive wastes than has ever been dreamed of for other pollutants. Mind you, nuclear wastes are a special case because of their extraordinary toxicity, and how we shall be faring with them in a century or two, when power stations will be nuclear rather than fossil fuelled, is not something I like to think of.

The message of the book is by no means new. The earth is round, finite and everything we do will ultimately catch up on us in some form or another. There is no escaping our own actions. How close we are to the limits is a moot point, and people will undoubtedly go on arguing about it until the bitter end. But even if it were true that we had the resources to develop along industrial lines to our heart's content, I very much doubt whether we'd end up with a world worth living in.

So, there must be alternatives, and as inexplicit on this point as it is, I'll go along with this book by Friends of the Earth, that we must pursue new objectives and discover new life-styles. This is where FOE and the UN secretariat part company, for the latter is more concerned with maintaining the status quo, than in transforming the industrial society. But like FOE I would agree that the resolutions in front of the secretariat are better than nothing, and therefore that they must be supported.

*Peter Bunyard*

# Feedback

## 1 Heavy Metals in British Coastal Waters

In a paper published by *Nature* and Doctors Abdullah, Royle and Morris, (of the Department of Oceanography at Liverpool University and the Marine Science Laboratories, Menai Bridge) have recorded elevated levels of copper, lead, cadmium and zinc in seawater of Liverpool Bay, Cardigan Bay and the Bristol Channel. In part these are due to natural run-off from the mineralised areas of North Wales and North Devon, but it is evident from the distribution of the metals that pollutants discharged into rivers also make substantial contribution to the high metal concentrations in coastal waters.

The River Mersey is an important source of copper and zinc, while both the Mersey and Ribble (and also activities on the Isle of Man) contribute lead. A large area of Liverpool Bay is characterised by high zinc concentrations (up to 47.6 g/l, with a mean of 11.86 g/l) which is 5-10 times that in open seawater in the region.

High levels of copper and zinc are also found in Swansea Bay and the eastern part of the Bristol Channel; these, too, are thought to be attributable to industrial and domestic wastes.

But more seriously the Bristol Channel has the doubtful distinction of having the highest cadmium level of any coastal waters in the Irish Sea, rising to 4.2 g/l, or 30-40 times the concentration in the open sea. The main source of this is the Avon and Severn effluent and is presumably industrial in origin because there are no known natural deposits of cadmium in the area.

A group headed by Dr A. Preston at the Fisheries Radiobiological Laboratory of the Ministry of Agriculture, Fisheries and Food, have also been examining concentrations of heavy metals in British coastal waters (Environ. Pollut. 3: 68-82, 1972). They scanned all regions of the British coast but, like Abdullah, Royle and Morris, paid greatest attention to the north-east Irish Sea. This is because of the radio-ecological interest of the area with the Windscale reactor discharging effluent there. As well as sampling seawater, Preston's group measured heavy metals accumulated in two seaweeds (Fucus vesiculosus and Porphyra) and limpets (Patella) at a number of coastal sites.

The results of this survey support those of Abdullah, Royle and Morris, and confirm the elevated concentration of heavy metals in the eastern Irish Sea and Bristol Channel. In addition, high levels of zinc were recorded in the western Irish Sea, and of cadmium in the North Sea. Copper concentrations in seaweed are locally high (20.5 g/l) at Barry in South Wales because of industrial pollution and there are also high levels of cadmium, nickel and zinc. Seaham Harbour on the north-east coast of England has high zinc, lead and cadmium values; Hunterston in the Firth of the Clyde has high manganese, copper, nickel and zinc; and Hoylake has high zinc and copper values. All these represent localised peaks suggesting that the source of metal contamination is in the immediate vicinity, and in both surveys it is evident that there is a marked fall-off in concentrations of heavy metals in seawater with increasing distance from the coast.

Source: *Marine Pollution Bulletin*, March 1972

## 2 The Vanishing American Father

Since the dawn of time in most civilisations the family has been the basic social unit, and the father the dominant head of that unit. As earner and dispenser of food or money, he controlled the destiny of his family with a firm hand. The woman was considered to be too emotional and too impractical to do anything but bear and rear children. By Victorian times the father had emerged as a stern, forbidding and almost frightening figure. Now, according to E. E. LeMasters of the University Wisconsin, this child-frightening man has been changed into a family court jester.

In the January-March issue of *Impact of Science on Society* LeMasters reports that in the typical American family the father is no longer assuming enough responsibility. The mother is taking over his position.

As reasons, he cites three events between 1900 and 1950. First was the economic depression of the 1930s which took away from men their position as principal breadwinner. *Next was the war in the 1940s*, which took the man out of the home and left family management in the hands of women.
This gave the woman a position she is not ready to relinquish, as evidenced by current *women's lib* movements. The final blow to the supremacy of the husband/father was the emergence of a powerful adolescent peer group that could challenge his authority and values.

Source: *Science News*, 17.4.72

## 3 Pollution Can Pay

The Metropolitan Government of Tokyo is planning to class the entire city as a polluted area and to pay medical fees incurred by citizens suffering from pollution-induced illnesses. The new plan comes into effect in April.

Teachers working in schools in air-polluted areas of Kawsaki are to be paid more or promoted earlier than other teachers.

Source: *Materials Reclamation Weekly*, 15.1.72

## 4 Plastic Waste Recycled

A system that turns all kinds of waste plastics into plastic pellets for re-cycling as new plastic material is announced by the Japan Steel Works.

A pilot plant has worked so well that the remanufactured products have proved good enough for making pipings and containers, claim the company.

Used containers, bottles, pipings, bags and other plastic goods are collectively smashed into pieces, washed, melted and made into pellets by the equipment. Pieces of iron commonly found mixed with plastics in domestic waste are magnetically removed before crushing. Aluminium and other non-ferrous metals are removable from thermoplastic types in water after crushing because such metals sink and plastic floats.

Thermosetting and vinyl chloride types of plastic will also sink together with such metals, and these are pulverised by a separate process. The particles are channelled back to the extrusion nozzle and mixed into the pellets as a reinforcing agent.

Two big drawbacks to such re-cycled plastics, weakness against shock and pull, have been overcome by the addition of special adhesive and bonding chemicals during the pelletising process.

Source: *Ibid*, 29.1.72

## 5 Urine Difficulties?

Water vapour detected on the Moon last year could have come from urine dumped in orbit by Apollo 14, a US computer study showed.

Source: *Financial Times*, 3.3.72

## 6 Less Energy, same standard of living

Two researchers at the University of California at Berkeley report that studies they have done show it is possible to reduce per capita energy consumption in the United States to 62 per cent of current levels and maintain the same standard of living.

A. B. Makhijani and A. J. Lichtenberg of the UC College of Engineering recommend a five-point programme for reducing energy waste and for utilising now unused available forms of energy:

1. Use of solar energy for household heating and other purposes, a potential which could be realised "if the necessary funding for the R & D were to become available."
2. Implementation of a "total energy" concept, the use of now-wasted heat from nuclear and fossil-fuelled power plants for operating turbines, for preheating, drying, space heating or desalination.
3. Materials reuse and recycling (for instance, instead of using energy-intensive aluminium for throw-away beverage containers, the beverage industry would go back to the use of returnable bottles).
4. Improving transportation efficiency, through rapid transit, through smaller automobiles, through the use of recycled materials in automobile manufacture and through partial replacement of truck hauling with rail hauling.
5. Improving the thermal efficiency of power plants, through such devices as magnetohydrodynamics (MHD) topping cycles or an increase in maximum operating temperatures of power plants.

Source: *Science News*. Vol 101, No. 11.

## 7 10,000 Council Houses Nobody will live in

Thousands of council houses and flats—including new ones complete with central heating, picture windows, and stainless steel kitchen fittings—have been empty for the past six months or more. The exact figure is not known, for the Department of the Environment says that it has no official statistics on empty homes.

But a check has disclosed at least 10,000 such homes, which are empty either because they have been built where people do not want to live or because they are the wrong size. They are therefore of little use to homeless families—officially listed at 23,500 though Shelter says that the true figure is more than 100,000.

The picture is one of anomalies, confusion, and miscalculation by Whitehall, and to a lesser extent by town councils, and of huge sums of public money being wasted.

Ministries have grossly underestimated the number of people wishing to buy their own homes rather than rent. High rise blocks of flats are still being built despite public disenchantment. Estates are still being built on the outskirts of cities although people refuse to live there because of inadequate local employment and high public transport costs. And, as industry has postponed development plans because of the economic situation, the number of people moving to new towns has fallen sharply.

As a result, maintenance costs and interest charges on the empty homes are costing ratepayers and taxpayers millions of pounds a year. Edinburgh pays out £70,000 and Dundee is losing £210,000 a year in rent and rates. Meanwhile, the buildings deteriorate. In some towns the lower windows of empty homes are boarded up as a deterrent to vandals and estate managers have complained that this discourages prospective tenants.

The problem is concentrated in bigger towns and cities and in the new and the expanding towns. Bradford, Leeds, Halifax, and Glasgow all have surpluses, mostly of the larger type of house which tenants find too expensive.

There are also 2,800 unlet homes in "overspill" housing estates being developed by the Greater London Council in expanding towns. Of these 1,537 are in the East Anglian towns of Brandon, Mildenhall, Thetford, Bury St Edmunds, Haverhill, Sudbury, and Great Concord.

But Mr Maurice Ash, chairman of the Town and Country Planning Association executive committee, said: "We've been trying for too long to disguise from ourselves how great an urban upheaval must be faced." He said that authority had tried to suppress the idea that empty council flats and industrial wastelands were taking over the inner city.

Source: *The Sunday Times*, 20.2.72.

## 8 Pollution creates bad visibility

The telescope of the Hamburg observatory will be moved over to Spain because of the polluted air which prevents clear observations.

Source: Council of Europe, *Nature in Focus*, Vol 72-4

## 9 Up with Brazil!

In a statement made in the UN the Brazilian Government has declared that economic growth is more important than pollution control and that underdeveloped countries have a right to the benefits that industrial settlements bring, even if they pollute. Brazil stated that pollution of its vast areas of unspoiled resources will not be a problem for some time.

Source: *New York Sunday Times*, 13.2.72

# Letters

## "Nature" and the Environment

Sir,

On April 28th I went to the Royal Institute's *Conference on The Environment*, organised jointly with Nature, in order to see the other side of the coin, so to speak.

The first session consisted of a series of four speakers, one of whom was Kenneth Mellanby. The first, a medical demographer, explained the futility and impossibility of forecasting population, which apparently led him to shelve the whole question in despair!

Mellanby merely reiterated all the advantages of DDT and other pesticides touching on the dangers to wildlife but inviting us to compare today's situation with that of the last century when many species were exterminated (as opposed to decimated) by shooting. In fact he spent most of his allotted half hour praising the "vigilance" of the Government and its advisory bodies in dealing with toxic pesticides.

Dr Kingsley Dunham made a more realistic contribution, on the subject of diminishing metal and fossil fuel resources, but I found his complete faith in nuclear energy from breeder reactors in solving the latter problem somewhat disturbing!

The last speaker merely read aloud a paper on changes in the CO content of the atmosphere and its possible consequences, and inevitably concluded that we don't know enough to judge, i.e. wait and see till it happens.

After tea John Maddox chaired a discussion. Strangely enough, the speaker on population had had to go, but Maddox himself stepped into the breach to answer on his behalf. However, after deftly turning aside several questions, he decided to retreat and maintain neutrality as chairman which caused not a little laughter. Eventually someone managed to pin him down and ask by what criteria he would assess whether or not Britain was over-populated. Maddox replied (hesitantly, as though he had never thought about it before) to the effect that the situation needed attention when one could no longer obtain seats at the National Film Theatre, because so many other people wanted them. He added that traffic jams on roads to the coasts were signs of possible over-population, but the answer was to build more roads, or alternatively, more beaches, and to arrange easy transport to foreign resorts.

Need more be said?

Yours sincerely,

*Deborah Elton*,

3 Alisa Road, Twickenham, Middx.

## The need for change

Sir,

Familiarity with some aspects of the case that has been submitted for an urgent change in man's technological behaviour would appear to lead to the following conclusions:

1—that the progress of the industrial revolution has brought in its train two particularly menacing human abuses of the environment that have now reached global dimensions. These are:

increasing densities of urban populations often well beyond the limits of their respective *national* food producing capabilities;

a swiftly intensifying *international* invasion of the environment by semi-permanent or permanent noxious human waste materials;

2—that the aetiology of these abuses lies in the adoption of a technological behaviour based upon a more or less tacit assumption that the healthy progress of human civilization lay in an increasing accumulation of individual wealth, amusement and leisure; and that this object could best be achieved by increasing technological sophistication through the exploitation of adventitious non-recurring sulphur-bearing, carbonaceous and atomic-energy-yielding materials present in the earth's crust;

3—that unless some ameliorating change can be urgently brought about in the domain of current human technological behaviour, the environment will suffer irreversible damage and the ecosystems will be rendered increasingly unsuitable for the support of human life;

4—that in determining an order of priority for dealing with the problems involved in such a change, an examination of the validity of our concepts of wealth, amusement and leisure arising out of the ever-increasing economic exploitation of industrial technological sophistication, as constituting viable criteria of a healthy form of human behaviour, should receive first consideration;

5—that the principles of bioenergetics should be inexorably applied at all echelons to the examination of these problems. Professor Lehninger points out that "at no point in our examination of the molecular logic of living cells have we encountered any violation of known physical laws, nor have we needed to define new ones". This conclusion would seem to support the view that an attempt should be seriously made to analyze human environmental relationships in the quantitative bioenergetic terms of the interrelated steady state systems involved, with the object of revealing the real, rather than the "economic" profits and losses that arise under different patterns of human behaviour.

Yours sincerely,

*D. K. Jardine*

Hotel Mariénia, Guéthary, Bidart, France.

## Eco-Religion?

Sir,

It is often maintained that only religion can give the necessary inspiration to jerk man out of the mess he is making. Bishop Montefiore argues the point well in your April issue. But the Bishop's Christianity is no answer as this religion, together with the Judaism from which it sprang, has been the inspirer par excellence of the view that humanity is something special in the universe, that history is moving to some glorious, meaningful climax (so why worry about the present?) and that women, who tend to have a softening effect on the aggressive male ego, are somehow second-rate. It is not chance that has caused 90 per cent of scientists, technologists and innovators of all kinds to have been men of Jewish or Christian upbringing.

A return to religion, yes, but current problems will not be solved by a return to the religion that has so ably helped produce the problems. Could it be that a goddess-centred religion is the antidote?

Yours faithfully,

*A. J. Robinson*,

17 Cromwell Place, London N.6.

# Zambia

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