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PLANT POWER
Biological Sources of Energy
DENIS HAYES

A NOTICE TO OUR READERS

Seven years has always been recognised as a period of mystical significance; a crucial point in the survival of marriages, projects and philosophies. *The Ecologist* having arrived at this stage in its life has taken a long hard look at itself.

Criticism is the life blood of a periodical; so long as our readers care enough to write to us and tell us we are barking up the wrong tree we shall be viable; so long as the criticism is constructive there is a niche for us and we shall endeavour to survive the vicissitudes of increasing production costs in every field.

While there is no room for complacency about our present image, the seven year look has revealed some interesting facts which must govern our future planning. The most significant of these is that there is no such creature as 'the typical Ecologist reader'. We appeal to a huge variety of readers from learned professors to dedicated organic gardeners; from those deeply concerned with ethics and ideologies to those mostly looking for practical solutions. It follows therefore that the criticism we receive reflects diametrically opposite views of the changes we should make and the policies we should pursue. One view is that The Ecologist is long winded, repetitive and too heavy, while readers of a different type consider its importance to lie in its being the only periodical in the field which is *not* afraid to devote a lot of space to a single issue or to give contemporary thinkers as much room as they need to expand their ideas.

This was the dilemma that faced the Editor of *The Ecologist* and his colleagues this autumn. The solution we have proposed in order to meet the requirements of all our readers is to provide two separate periodicals.

THE NEW ECOLOGIST will be published six times a year, keeping the present format. It will contain more topical material, more reports, more ecopolitics, more critical analysis and more suggestions for practical solutions and contributions from people personally involved in all the different aspects of the struggle. It will remain serious, philosophical and committed to the ideal of an ecologically orientated post-industrial society.

THE ECOLOGIST QUARTERLY will continue to be the forum for thinkers who question the basic assumptions that underlie conventional wisdom and who are trying to work out the philosophical, scientific and ideological foundations for the ecological societies that must eventually emerge from the debris of industrialism.

From January 1978 all subscribers will receive both these periodicals until their subscriptions run out. After that they may if they wish elect to subscribe to only one of the new titles. See order form and subscription rates on insert.

EXTRACTS FROM LETTERS

I have recently had a bout of catching up on some issues of The Ecologist which you kindly sent us and felt I must write and say what an excellent magazine it is. Not only is it of course clear and competent on its own subject but it seems to treat all subjects in a thoroughly logical way which is so much missing in other publications today. I really do compliment you on a really excellent magazine.

R.C. Grinham, *Assoc. Editor, Land & Liberty, London.*

Most sincere congratulations on your recent assessment of Canada (in The Ecologist latest issue to arrive here). Never have I seen such concentrated, meaty and profound analysis. It makes me wish you could do one study per country world wide. Is it possible to send copies of the article to Canadian politicians, etc. and try to get the newspapers to make it into a national debate? It is so important that it must not be permitted to sink out of sight. Can you get some Canadian ecologists to review it locally or write to their local press or ask their elected MP's for reaction?

R. Goodland, *Ecologist, The Cary Arboretum of the N.Y. Botanical Garden, U.S.A.*

So far as the contents are concerned it is essential for it to contain environmental ecological notes and a news section on current developments. The magazine is ideal for this and has occasionally tried something like it — Nicholas Gould's 'Notebook' for example. At the moment there is nothing. Such a section, by definition, would not be repetitious. At present much of the material is tedious and monotonous.

H.W. Bull, *Selly Oak, Birmingham.*

In this issue

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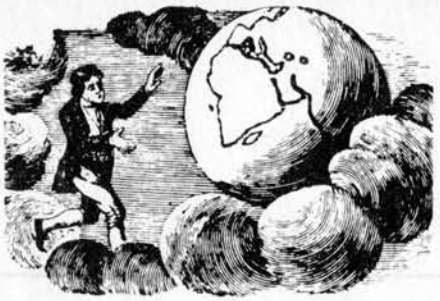


Editorial

Dedeveloping the Third World

The United Nations Conference on Desertification has come and gone. What good has it done? Perhaps more people are now aware that a third of the world's agricultural land is rapidly being turned into desert. But no one can really believe that, as a result of any decisions taken at this conference, the tide of global desertification is likely to be stemmed.

Consider the measures proposed to counteract this terrible process. Many of them are little more than high-technology games. Governments were exhorted, for instance, to 'compile desertification maps', to use 'satellite data', to adopt a 'computerized resource inventory system for management and planning' and to utilise 'reference systems for remote sensing imagery.'

But what can all this do other than divert attention from the real issues involved, and delude the public into believing that something constructive is really being done? The solution does not lie in documenting the progress of desertification but in *reversing it.* If one jumps out of an aeroplane, it is not an altimeter that one needs, as Robert Allen puts it, but a parachute.

Consider now some of the other proposals. Governments are urged to 'ameliorate degraded range-land', to introduce 'improved systems of livestock and wild life management', to develop 'diversified and integrated systems of production' and to 'improve the welfare of pastoral communities.'

But just how these things are to be done, we are not told. They are but vain exhortations which everybody knows will never be implemented. The reason why is simple. The basic cause of desertification is *development.* The object of this process is to increase the level of material consumption. If people are to *consume more* they must also *produce more,* and this, especially in the dry and arid tropics, must have very serious consequences.

This means, for instance, that pastoralists must increase the size of their herds, thus causing overgrazing and soil erosion. Eventually they must settle and pursue an agricultural way of life even if the land is not suitable for this purpose, and this will give rise to even more soil erosion. Also, to increase productivity, they must irrigate their land. Vast numbers of wells must be dug, consequently the water-table will fall, and as a result more land will turn to desert. Alternatively, vast permanent irrigation systems must be constructed causing the water-level to rise, and soil salinization to ensue.

There is a further problem. The inevitable consequence of the early stages of development is a population explosion. This, among other things, increases the need for firewood — the main source of fuel in much of the Third World. Further marginal land is thereby deprived of its protective cover, which can only mean still more soil erosion and so the process goes on. But is there any means of stopping it? Since the processes involved are precisely those that are necessary to increase the standard of material consumption, which is what development is all about, we have to face the unpleasant reality that desertification can only be prevented by *reversing the process of development* i.e. *by dedeveloping.*

This, of course, the delegates to the United Nations Conference could not admit. Industrial countries are firmly committed to developing the Third World from which they derive a high proportion of their resources and which is a necessary market for their manufactured goods. Third World leaders, however, have a still greater stake in it.

A politician from the Upper Volta, for instance, who last year attended a preparatory meeting for the Desertification Conference, was told of the results of a case study that showed that intensive development was turning an area of the Sudan into a desert. 'We cannot accept such conclusions' the politician said, 'and if the UN Conference reaches such conclusions we cannot accept them either.' His country, he said, intended to increase its population from 6.5 million to 30 million, all of whom, he insisted, would have the same standard of living as the inhabitants of California.

It is essential, before it is too late, that politicians of this sort be made to understand that not only is such an enterprise totally impossible, it is also equally undesirable.

Indeed, it is not only to prevent desertification that dedevelopment is required but to combat poverty itself. Poverty, in the Third World, is not material deprivation, caused by a shortage of consumer goods and technological devices — as many people think it is. It is, above all, biological deprivation. Indeed, everywhere one finds ever more massive populations trying desperately to scratch an ever more precarious living from land that looks more and more like the surface of the moon. That is why they are poor. Yet, in their efforts to develop, they continue to divert key resources from the countryside — where they are directly or

indirectly essential to agriculture — to the expanding cities.

In this way, valuable agricultural land is cemented over, forests are cut down for timber with all sorts of ecological consequences that must inevitably affect agricultural production, and above all, increasing quantities of water are used up for industrial and domestic purposes.

Let us not forget that it is neither tractors nor fertilizers nor pesticides that provide the principal limitation on food production in most of the Third World. *It is water.* It is considered that 1500 litres of water are required to produce a kilo of wheat, 4500 litres for a kilo of rice, and 30,000 litres for a kilo of prime beef. In the dry tropics, because of the high evaporation rate, very much more is needed than in temperate areas, ten times more in the Sahara for instance, than in Morocco, and thirty times more than in Southern Italy.

Still more stupendous amounts of water are required, however, for industrial purposes. A ton of steel, for example, requires 150,000 litres, and a ton of streptomicine, 4 million million litres, while, at the same time, domestic consumption increases dramatically once development gets under way and people start installing flush-toilets and washing machines.

In non-industrial cities, a daily consumption of 40 litres per person is probably the norm. Once they become industrialized, however, this can increase by a factor of 20 or even 50. In Chicago, for instance, daily consumption is said to be 1000 litres, and in San Diego, California about 2400.

Indeed, it seems certain that if we were to industrialize the cities of the Third World, the amount of water that would have to be diverted from agricultural to urban uses *would be sufficient to cause famine on an unprecedented scale.*

In addition, in order to develop, Third World countries require foreign exchange. Unless they possess oil or other such sought-after commodities, they can only get this by exporting the produce of their soil, either food-crops such as cocoa, coffee, tea, sugar etc. or non-food crops such as timber, rubber, jute, cotton or copra, much of which occupy valuable land that could be producing food for the local population.

In San Domingo, for instance, 25 per cent of the land is devoted to the production of cash crops largely for export. In the Philippines the figures is 55 per cent, and everywhere the money earned in this way is spent on building motorways and office-blocks and on acquiring he rest of the paraphernalia of a modern consumer society — all of which has remarkably little relevance to solving the real problem of the Third World — which is how to feed its exploding population.

On these grounds alone, and there are many others, development cannot be regarded as a sensible goal for the countries of the Third World. It is little more, in fact, than a means of exchanging the *indispensable for the superfluous;* — and for the West to encourage them in this direction, is to provide them with what can only be regarded as *negative aid.*

Dedevelopment provides a much more realistic goal. By phasing out their cities, and their capital-intensive industries, neither of which they can afford, the countries of the Third World can concentrate instead on building up a healthy rural economy capable of coexisting with its environment rather than systematically destroying it. Material prosperity will never be within their grasp, but what they can develop is another type of prosperity — probably a more satisfying, certainly a more durable one, based on a more subtle exploitation of the vast capital that Nature has put at our disposal.

Kenya, site of the Desertification Conference, has its share of drylands, as this recent picture at North Horr on the edge of the Chalbi Desert, indicates.

BREAKDOWN OR BREAKTHROUGH: Modern Society at the Turning Point

by James Robertson

Modern society is at a turning point. Powerful trends are combining to create a breakdown in existing values, existing lifestyles and existing institutions. These trends include: domination by big technology, exhaustion of natural resources, pollution, unemployment, inflation, a general paralysis of institutions, widespread personal helplessness, and so on. Meanwhile, many new growth points are emerging which could converge to create the breakthrough to a new and better society. These new growth points include; a new emphasis on self-help, self-reliance and self-sufficiency; a new balance between the sexes; a growing interest in social, economic and political structures which serve people rather than dominate them; a growing commitment to appropriate technologies which do the same; a growing feeling that we are all inhabitants of the same planet, citizens of the same world; a growing ecological consciousness; and an increasing interest in a spiritual and cosmic approach to life, summarily described by the terms supernature and supermind.[1]

Now, the idea that an old form of society is breaking down and that our task is to break through to a new one, is nothing very startling in itself. Virgil and Tennyson and countless others in the past have been aware that "an old order changeth, yielding place to new." But this idea does encourage us to do two useful things.

First, it encourages us to seek relevant insights from the past. Is the era that is now ending 200 years old? Will the coming post-industrial revolution be the counterpart of the industrial revolution? Or do we have to look back 500 years — to the Renaissance and the Reformation — to find the beginning of the individualist, masculine, expansionist, rational, European age that is coming towards its end? Will the transition which we face be like the transition from the Middle Ages to the Renaissance? Or should we look back even further, to the end of the Roman Empire and the coming of the Dark Ages, for a comparable milestone in history? Or even further still, to the beginning of the Age of Pisces and the era which took its character from the Hebrew, Greek and Roman civilisations? Later in this paper we shall look at a possible parallel to the industrial revolution, but otherwise I shall leave these historical questions for further discussion elsewhere. So let me simply say here that I think we can learn a good deal about our present situation, from all these historic examples of transition from one age to another.

Second, the idea that the old is breaking down and the new may be breaking through, helps us to clarify our minds about what action, as individuals, we can usefully undertake. There are, I suggest, at least five different ways in which we can usefully act.

1. **Lifestyle.** We can live in a way more consistent with the future we want to create.
2. **New Frontiers.** We can work at whichever of the new growth points we feel we can best contribute — alternative medicine, appropriate technology, energy conservation, community politics, creating new opportunities for socially valuable work, and very many others.
3. **Management of Collapse.** We can work to ensure that the many millions of people who are inextricably involved in the existing systems of government, industry, money, jobs, health care, social services, and so on, suffer minimum damage as and when those systems break down; and to enable people to learn to cope by helping themselves and one another.
4. **New Vision.** We can help to bring into existence and to communicate a more coherent vision of a new future, and a clearer understanding of how to make the transition to it.
5. **Evolutionary Transformation.** By learning to appreciate the value of all these ways of helping to create the future (and not just the value of the contribution which we ourselves are capable of making), we can help to ensure that the process of breakdown and breakthrough turns into a reasonably smooth and peaceful process of evolutionary transformation, a historic transition consciously understood and consciously undertaken.

Each of those five ways of acting is important; and all are mutually reinforcing. But in this paper I shall be concentrating mainly on the middle three, those I have called new frontiers, management of collapse, and new vision. I think of them also as:

liberation, or creating the breakthrough,

decolonisation, or managing the

breakdown,

and, with acknowledgement to Dr. Schumacher[2] the task of metaphysical reconstruction.

I shall discuss all three of them in subsequent sections of the paper. But first I want to say something about the post-industrial transition and the exploration of consciousness.

The Post-Industrial Transition and the Exploration of Consciousness

I must make it clear that the new and better society — the post-industrial society — to which I believe we can break through is very different from the hyper-industrial society envisaged by futurologists like Herman Kahn[3] and Daniel Bell.[4]

They conceive the future in the image of professors at MIT (the Massachusetts Institute of Technology) and of other male North Americans like themselves. They foresee the expansionist, high technology, knowledge-based society; meritocratic, authoritarian, dominated by a technically sophisticated elite; a society whose principal end will continue to be economic growth, and whose means will include space colonisation and the worldwide development of nuclear power. In other words, they still see the new frontiers as predominantly geographical and physical; and they believe that economic and technical strength will enable us to break out of any geographical or physical limits that might otherwise close in.

The post-industrial society which I envisage is very different. Its prevailing ethic will be an ethic of ecology, social responsibility and self-realisation. Its underlying aim will not be expansion but balance — balance between people and nature; between people and people; and between the body, mind and spirit of each individual person. It will recognise, with Ivan Illich, that "scientific discoveries can be used in at least two opposite ways. The first leads to specialisation of functions, institutionalisation of values and centralisation of power, and turns people into accessories of bureaucracies or machines. The second enlarges the range of each person's competence, control and initiative, limited only by other individuals' claims to an equal range of power and freedom."[5] The kind of post-industrial society which I envisage will choose the second of those ways. It will recognise also that the most important new frontiers are no longer geographical and physical but social and psychological, and that the most important limits to the further development of mankind today are not the outer material limits but the inner limits imposed by the present state of our social and psychological capabilities. It will be the kind of society that Willis Harman of the Stanford Research Institute has called trans-industrial.

We must develop new concepts of wealth and work and power and public service. These will not be based on the need for money and goods and services and jobs and position provided by the institutionalised economy, the labour market and the bureaucracy. They will be based on resources and activities which can liberate people from over-dependence on money and jobs and goods and services and positions of that kind.

I now want to quote what Harman says in his recent book, *An Incomplete Guide to the Future*, about the exploration of consciousness. He says, "Essentially there are two quite different forms of knowing, and we all use both daily. One form is knowing about things in the manner of scientific facts; it is based on rational and empirical processes. The other form is knowing by intuitive identification with, as in knowing another person; it is based to a considerable extent in unconscious processes . . . Both kinds of knowledge are subject to the possibility of error. The scientific way of 'knowing about' involves meticulous testing to ensure that what is claimed as fact can be validated by other scientists making similar experiments or explorations. But 'intuitive knowing' also demands careful testing to prevent self-deception. . . . In opening up the exploration of consciousness, scientists are forced to confront questions that, throughout most of the history of scientific activity, they have managed to set aside for the philosophers to puzzle over. What are the ultimate capabilities of the mind as an observing instrument in discerning intuitive knowledge of the universe and of the mind itself? What are the ways in which intuitive knowledge is best shared and validated?"[6]

The first point I want to stress is that the dichotomy between two kinds of knowledge is precisely paralleled in other important spheres — for example in politics and government, economics, the professions, and religion. In each case there are two quite different forms of activity, as there are with knowledge. One is structured and institutional; the other is unstructured and personal. Thus we have:

* representative government *and* community politics,
* the money economy *and* the gift and barter economy,[7]
* an arm's length relationship (between professional and client) *and* personally shared experience,
* organised religious activity *and* personal spiritual experience.

The second point is that in each of these different spheres the same kinds of questions are now arising. They are about domination and liberation, about rigidity and creativity, about the overdevelopment of old structures and the upsurge of new aspirations, and about how to reconcile the two opposed forms of activity. Both forms seem to be valid. Yet, as Raimundo Pannikar has put it "Applying *logos* to the myth, amounts to killing the myth: it is like looking for darkness with a torch."[8] Applying laboratory tests to spiritual healing, bureaucratic scrutiny to community self-help, or cost-benefit analysis to social innovation, may destroy the conditions in which spiritual healing, community self-help, or social innovation may take place.

The Dual Economy

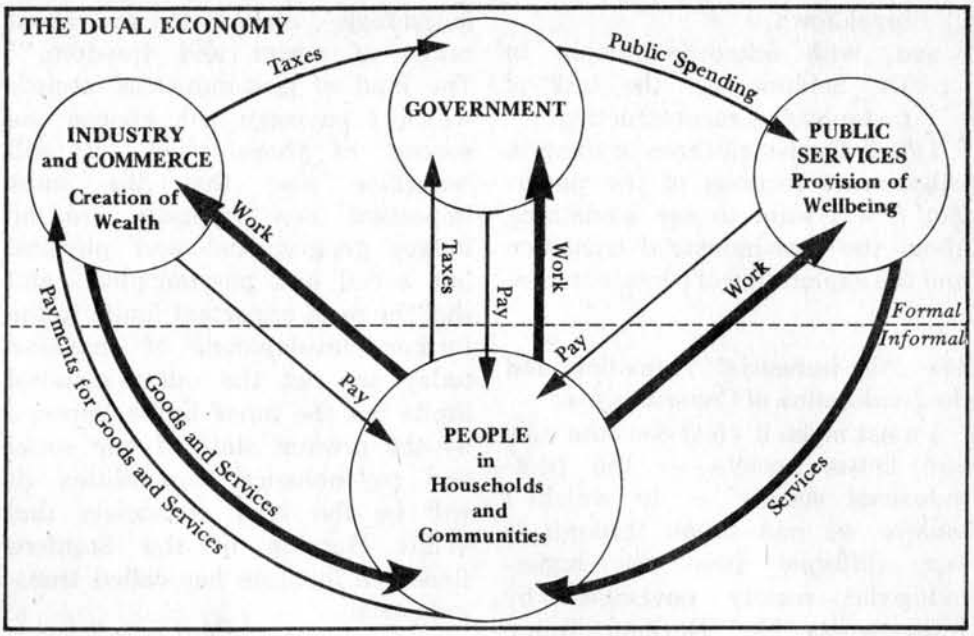
Let us now look a little more closely at the economy, as an example of the kind of dichotomy I have mentioned, and of the kind of

questions that are now arising.

The diagram shows two different forms of economic activity. Above the horizontal line is the structured and institutional part of the economy; below the horizontal line is the unstructured, personal part. I hope that, as I discuss some of the questions that are now arising about these two kinds of economic activity and about the links between them, comparable questions will come into your minds about knowledge, about politics and government, about medicine and health care, and about religion.

The institutional part of the economy is the part in which people work for money in jobs generated by the labour market; the goods they make and the services they provide are purchased for money or otherwise financed, for example by taxation. This part of the economy consists of the primary (farming, forestry, mining), the secondary (manufacturing), and the tertiary (services) sectors. The informal part of the economy consists of the domestic (household) sector and the marginal (community) sector. In this part of the economy the labour market does not operate (people don't have jobs), work is mainly unpaid (like housework), and goods and services are mainly given away or exchanged. The informal part of the economy is sometimes described as the gift and barter economy, as opposed to the money economy, though it also includes many unrecorded cash transactions. People work in it for themselves, for their families and their friends, and for the local community; in the formal part of the economy they work for an employer.

In industrialised societies attention is normally concentrated on the institutional part of the economy, the part in which business corporations, government agencies and other organisations operate and in which individuals make and spend money. The prevailing concept of wealth is of something created in the institutionalised part of the economy by the "economic" activities of industry and commerce and then spent, partly on the consumption of goods and services which people purchase from industry and commerce, and partly on the provision of "social" wellbeing by



public services. These public services are financed as a spin-off from the economic activities of industry and commerce, which are therefore seen as the "wealth-creating" activities of society. The prevailing concept of work is of jobs provided by employers.

The orthodox view is that the production of economic goods and the provision of social services by the institutionalised sectors are the only kinds of economic production and social provision that really matter. Economists and statisticians, politicians and civil servants, trade unionists and bankers, are concerned only with the kind of goods and services which cost money and with the kind of work which is done for an employer for money — jobs in the so-called labour market. Work which is done in the household or marginal sectors, such as housework, does not count in the employment statistics; and goods which are produced there, such as fruit and vegetables grown in gardens and allotments, do not count in the Gross National Product (GNP).

The thrust of industrialisation, and the momentum it has developed in industrialised society in the past 200 years, has driven people increasingly out of the informal part of the economy into the institutionalised part. It continues to do so. For example, a recent paper by the Vanier Institute of the Family in Ottawa notes an increasing tendency to remove from the domestic and community sectors "activities carried out in a sharing and non-monetary or non-credit context of exchange and gift and to develop these activities into jobs and professionalised specialities which operate within the cash/credit-oriented service sector of the economy. Such a trend has, of course, done no less than increase the financial and economic burdens of us all, adding, in all likelihood, to the inflationary and unemployment problems of our country.

"The current proposed governmental policy orientation which seeks to pressure single-parent mothers and fathers to move out of their homes and into jobs in the labour market is one timely example. In this case, we see that the replacement of an essential non-cash economic activity involves the creation of costly cash-based substitute child-care services which usually do the task less well. A further likely result is the placement of most of these persons in jobs which can do little to enrich their lives and may even be further destructive to them and their children."[9]

There is increasing evidence that the institutionalised economy may now be reaching — or may already have reached — the limits of its capability. I am referring particularly to limits imposed by psychological discontent, institutional congestion, and conceptual disarray.

Psychological discontent. As more and more people in an industrialised society come to depend for more and more aspects of their life on the institutionalised economy rather than on the household and local community, their sense of alienation

and dependence grows greater. They therefore feel entitled — indeed compelled — to make greater and greater demands for jobs, for pay, for goods and commercial services, and for public and social services. Sooner or later the time is bound to come when these demands will outrun the economy's capacity to meet them, and at this point rising unemployment (too big a demand for jobs) and rising inflation (too big a demand for money) become systemic. Peter Jay, until recently Economic Editor of *The Times* and now British Ambassador-designate to the United States, described this situation last year as "the contradiction of existing political economy" in a published paper called *A General Hypothesis of Employment, Inflation and Politics*.[10] He reached "the depressing conclusion that the operation of free democracy appears to force governments into positions (the commitment to full employment) which prevent them from taking the steps (fiscal and monetary restraint) which are necessary to arrest the menace (accelerating inflation) that threatens to undermine the condition (stable prosperity) on which political stability and therefore liberal democracy depend. In other words, democracy has itself by the tail and is eating itself up fast."

Institutional congestion. As the institutionalised economy developed, it inevitably became increasingly complex and congested. It has now reached the point where the supposedly wealth-creating activities of industry and commerce are generating such great social costs, and the interrelations between industry, finance, government, trade unions, and the public services have become so intertwined, that the workings of the system are grinding towards a halt. The American economist, Hazel Henderson, describes this as "the entropy state" which, she says, "is a society at the stage when complexity and interdependence have reached such unmodelable, unmanageable proportions that the transaction costs generated equal or exceed its productive capabilities. In a manner analogous to physical systems, the society winds down of its own weight and the proportion of its gross national product that must be spent in mediating conflicts, controlling crime, footing the bill for all the social costs generated by the externalities of production and consumption, providing ever more comprehensive bureaucratic co-ordination, and generally trying to maintain 'social homeostasis', begins to grow exponentially or even hyper-exponentially. Such societies may have already drifted to a soft-landing in a steady state, with inflation masking their declining condition."[11]

Conceptual disarray. There may have been a time when concepts like profit or Gross National Product (GNP) gave a useful measure of economic performance. But that time has now gone. Take GNP.

GNP simply represents the money value of all goods and services produced in the economy. It does not differentiate between desirable and undesirable economic activity; nor does it differentiate between activity which is undertaken to treat disease, clean up pollution, salvage accidents and mitigate damage caused by other economic activities. Some analysts actually suggest that rising GNP in industrialised countries now mainly measures the rising costs of pollution, environmental degradation and human suffering.

However that may be, the concept of GNP is losing its credibility. As Hugh Stretton said in one of his 1974 Boyer Lectures (the Australian equivalent of our Reith lectures), "How easily we could turn the tables on the economists if we all decided that from tomorrow morning, the work of the domestic economy should be paid for. Instead of cooking dinner for her own lot, each housewife would feed her neighbours at regular restaurant rates; then they'd cook for her family and get their money back. We'd do each other's housework and gardening at award rates. Big money would change hands when we fixed each others' tap washers and electric plugs at the plumbers' and electricians' rates. Without a scrap of extra work the gross national product would go up by a third overnight. We would increase that to half if the children rented each others' back yards and paid each other as play supervisors, and we could double it if we all went to bed next door at regular massage parlour rates. Our economists would immediately be eager to find out what line of investment was showing such fabulous growth in capital/output ratio. They'd find that housing was bettered only by double beds and they'd recommend a massive switch of investment into both. Don't laugh, because in reverse, this nonsense measures exactly the distortion we get in our national accounts now."[12]

There is, in fact, plenty of evidence that the institutionalised economy as we know it today is beginning to break down. Continuation of existing trends can only make things worse. Neurotic concentration of effort to strengthen the conventional "wealth-creating" sector of the economy (i.e. industry and commerce) at the expense of everything else, will only make things worse still. The fact is that the under-lying assumptions of the industrial/institutional economy are losing their credibility. The old paradigm is on the way out.

So where does the future lie? In other words, how can we liberate ourselves from the institutionalised part of the economy, and develop the alternative informal part? How can we decolonise the institutionalised economy, and manage its collapse? And how can we develop a new economic vision — or paradigm — based on new concepts of wealth and work?

Before turning to these questions, however, let us look briefly at the comparable situation in politics and government. There too a possible breakdown of the conventional system and a possible breakthrough to new forms of politics and new structures of government are apparent. The kind of nation state and party politics which grew up in the 19th century have become congested and inadequate to modern demands upon them, as has the institutionalised economy. We discussed these questions at a Turning Point meeting held in London in the Spring on "The Politics of Tomorrow." Here are a few of its conclusions.

* "Just as the feudal church-state Europe of the Holy Roman Empire was succeeded by the nation-

state Europe created by kings and the bourgeoisie, so now another Europe is emerging — a Europe of the regions in which places like Scotland, Northern Ireland and Wales will be able to develop an identity of their own.

* Governments, political parties, churches, the army and the paramilitaries have all been totally unable to solve the problems of Northern Ireland. The Peace People are an exciting model for community politics, by-passing the blockages in the existing political system. As the old order breaks down, the peace movement may provide the breakthrough on which the foundations of a new society can be built.

* The old order of politics and government may also be breaking down in Britain as a whole, though so far less violently than in Northern Ireland. We may need a new upsurge of non-violent community politics — the politics of the volunteer — to by-pass the blockages in the old system and break through to new patterns of political stability.

* In the third world also it is community politics which increasingly provides clean water supplies and creates peasant co-operation. There may be a general need to re-think the whole concept of sovereignty — not as something trickling down from the apex of society, but as something welling up from the people.

* At the same time, some of us will need to continue to work the existing system of politics and government: for example, to contest the London Borough Council elections in 1978; or to squeeze money out of government for job creation and common ownership schemes; or to co-operate with the devolutionists in continental Europe, so that ultimately the worldwide influence of European culture will help to spread decentralism; or to sign letters to U.S. presidents about the threat of nuclear holocaust and other such global issues.''[13]

The parallel with the dual economy is very clear.

Liberation, or Creating the Breakthrough

We *can* all liberate ourselves — to a greater or lesser extent — from the institutionalised economy, and develop alternatives to it. We can decide to do more of our work and more of our living in and around our households and local communities — to create use value rather than exchange value by our work. We can become part of a widespread movement towards greater economic self-reliance, alternative technologies, alternative health, rural resettlement, and so forth. Similarly, we can liberate ourselves from dependence on conventional forms of politics; we can take part in community (or Do-It-Yourself) politics; and we can help D.I.Y. politics to spread. Many people in countries like Britain are already doing these things.

As this liberation movement grows, I believe it will come to be seen as the post-industrial counterpart to the industrial revolution which occurred in Britain in the late 18th and early 19th centuries. This post-industrial revolution will be predominantly social and psychological in character, whereas the industrial revolution was predominantly technical and economic. So let us examine briefly now some features of the industrial revolution which may help us to understand the post-industrial revolution upon which we are now embarking. I shall rely heavily on Peter Mathias' book *The First Industrial Nation*[14] for that purpose.

One of the main pre-requisites for the industrial revolution was the existence of sufficient economic resources to develop new dimensions to the economy. In 18th century Britain plentiful coal and iron were conveniently placed for water transport in many parts of the country, and a strategic river system, based on the rivers Trent and Severn, stretched into the heart of industrial England. I suggest that a corresponding pre-requisite for the post-industrial revolution will be the existence of sufficient social and psychological resources to develop new social and psychological dimensions to our economic and political lives. These social and psychological resources could include: large numbers of active people leisured or unemployed; large numbers of active people socially and psychologically aware; a widespread understanding that psychological and social drives now provide the leading edge of change, not economic and commercial drives; and the existence of systems of education, information and communication not wholly closed to new ideas, not wholly mesmerised by conventional fashion, and not wholly dominated by economic and political forces committed to the status quo.

Another factor in the industrial revolution was inventiveness, a readiness to use other people's ideas and skills, and the capacity to generate an increasing flow of technical innovations through which physical production and economic productivity could be increased. The post-industrial revolution will also need inventiveness — to generate an increasing flow of social innovations through which the social and psychological equivalents of production and productivity can be increased.

Again, a new breed of entrepreneurs played a special part in the energetic experimentation and technical innovation which marked the industrial revolution. These were the men, to quote Mathias, ''under whose charge new sectors of the economy could be developed and new inventions brought into productive use. Such men were the

shock troops of economic change." Where are the entrepreneurs of social change today, who will facilitate new types of social activity and help to bring social innovations into widespread use? What sort of people are they; and where are they to be found?

Innovation in industry in 18th century Britain also required the investment of financial capital in the productive process. New channels had to be created, through which money could flow to the people who wanted to use it from the people who had savings (i.e. surplus money) to invest. In due course there developed a linked national network of financial institutions, including the country banks, and the bankers, billbrokers and other specialist intermediaries in the City of London, to handle the transfer of credit from one part of the country to another; and the habit of productive financial investment became established. What are the post-industrial counterparts to financial capital, to the banking networks, and to the habit of productive investment? Instead of money, I suggest, we are mainly concerned with psychological and social energy. There are many of us now who wish to invest our surplus psychological and social energy in other people's projects. We want to receive a psychological, rather than a commercial, return on our investment. What new channels will come into existence to link us with the social entrepreneurs and social innovators who need our backing? Will networks like the Scientific and Medical Network and Turning Point, provide such channels? Will activist minorities, linked by networks in this way, provide the shock troops for social change?

The industrial revolution was a process of industrial innovation which became cumulative and self-sustaining. It was centred upon what Mathias calls the "new matrix of industries, materials and skills", in which steam power, coal, iron machinery, and engineering skills played the dominant part. This new matrix gave increasing freedom from the old traditional limitations of nature, which had held back economic activity in all previous ages. How will the post-industrial revolution similarly become a self-sustaining process? What new matrix of psycho-social resources, techniques and skills, corresponding to Mathias's matrix of industries, materials and engineering skills, will give increasing freedom from the limitations of personal and institutional behaviour which have held back psychological and social growth hitherto?

In the next few years many of us will no doubt be exploring some of these questions much more deeply. In some respects it will be an exploration of consciousness, and simply by taking part in it we shall be assisting in the post-industrial transition.

Voluntary Decolonisation, or Managing the Breakdown

We can choose to stay, at least to some extent, in the institutionalised system (of government, politics, the economy, etc.), and to work constructively in it — to manage its collapse. To take the economy as an example, I suggested that we regard the development of alternative forms of economic activity as a process of liberation from the institutionalised economy. It follows that we should see managing the breakdown of the institutionalised economy as a process of decolonisation. The constructive task for people who work in government, business, finance, trade unions, public services, the professions and other areas of the institutionalised economy, is thus to reduce the economic dependence of other people upon it — i.e. to reduce people's dependence on jobs, on money and on goods and services provided by industry, commerce and the public services. The aim should be to enable people — as citizens, customers, workers, patients, pupils, and so on — to develop their own autonomy. The aim of managers, professionals, public servants, and so on, should be to work themselves out of a job — to make themselves redundant.

There is, in fact, some evidence that professional and managerial people are increasingly trying to develop an enabling role, in which they help their clients to become less dependent on them. For example, I quote the following views expressed in a conference held three years ago in Ottawa on *The Serving Professions?* Professionals should share rather than monopolise their privileged knowledge, give people a chance to learn while they are healing . . . Until a conscious majority brings about economic and social changes to provide a basis for a truly human society, a sane society, we all can only do our best, wherever we are, to demystify, expose, act *with* people on problems, not *for* them . . . If poverty is basically the absence of power, social action must involve giving peole part of this power back. We lawyers should be training people to understand the law and apply it to represent themselves . . . This 'Me God, you stupid' attitude of the doctor towards the patient, which stems from professional insecurity, is a kind of refined violence . . . The question we must seriously ask ourselves is to what extent are we as physicians prepared to disappear? What we should be asking in our relationships with patients is 'What have I done so this person can manage to do without me in the future?' . . . Among the social pitfalls fostered by the professions is the trend towards overdependency which verges on helplessness. Among the questions we professionals must ask ourselves is whether we are helpers or hinderers. Are we creating an endless production of services that

draw us further into a trap? Do we, through the framing of laws and other structures create barriers that we then must spend valuable time breaking down again?''[15]

This idea that the managerial and professional role is to help people to help themselves — that managers and professionals should give away their powers and teach others to use them, rather than to monopolise them and hire them out — is spreading. I could quote specific examples from fields ranging from psychoanalysis through banking to environmental planning. But let me simply try to indicate the kind of thing this idea might mean for business and government.

Take the oil companies as an example. Oil companies have traditionally aimed to sell increasing quantities of oil. The time could come — indeed, it may be coming already — when they will aim to help their customers to buy less oil, by reducing their dependence on it. In other words, the nature of the business may change from producing and selling oil, to helping people to meet their energy needs more independently. Similarly, pharmaceutical and food manufacturing firms have traditionally aimed to sell increasing quantities of drugs and convenience foods. The time could come when they would be helping their customers to reduce their dependence on these products. The nature of the business would then have changed from producing and selling health products and food products, to helping people to meet their own health needs and food needs in a more self-reliant way.

So far as governments are concerned, instead of continuing to build up capital-intensive industry, centralised energy systems, and bureaucratic public services — and increasing people's dependence upon them for their work, for their material needs and for their social wellbeing — governments would shift the emphasis to policies which helped people to become more self-sufficient and autonomous. For example:

- support for *decentralised energy* production and conservation;
- *job creation programmes,* started as a centralised policy for providing more jobs, but subsequently used to prime the economic pump at the local community level;
- *investment in housing and other local facilities* (including gardens, workshops, etc.) which would help to develop the economic and social self-reliance of households and local communities;
- *research and development* support for a wide range of advanced, small-scale technologies which would also contribute to the economic and social self-reliance of households and local communities;
- *rural resettlement* and small-scale agriculture.

There are, of course, daunting difficulties and problems about this kind of voluntary decolonisation.

For a start, there is the problem of domination and dependence. For many of the people in managerial, professional and governing positions their personal identity and their lifetime's energy are invested in the importance of their present role and in the sense of other people's dependence on it. They will feel threatened by the possible loss of their existing position and their existing power, and they will cling to them neurotically. It has been said of the logical and mathematical models of society which so many social scientists try to use: ''Such models . . . may represent for some shrunken souls the essence of society. But rather I suspect they represent a retreat from a reality that is too alarming to contemplate. They represent a proper Laingian case of schizophrenia, in which a real world that is frightening and obviously out of control is replaced by a more comforting fantasy world in which the planner is master.''[16] As the old system continues to break down, many managers, professionals, politicians, trade union leaders and other established leaders are likely to make increasingly authoritarian attempts to bolster the importance of the knowledge and skill, experience and power, which they have built up within it. At the same time, there will be many citizens, consumers, workers, patients and other clients of the existing structures who will cling to their dependence. They too will feel threatened, in their case by the thought of having to take power and responsibility to themselves.

There will also be a genuinely altruistic reluctance to abdicate from responsibility. Many people believe that the decolonising imperial powers abdicated their responsibilities in the 1950s and 1960s, and in some places decolonisation has certainly been followed by a reversion to disorder, violence and tyranny. There will be many genuine fears that to decolonise the present institutions of industrialised society would be to abandon millions of people — who now depend on those institutions for physical, material and psychological security — to the tyranny of local rulers, the exploitation of local tycoons, the domination of local patriarchs, and the magic of local charlatans and witch doctors.

Again, there will be a real problem about how to justify enabling policies, according to the criteria used by governments, business managements and the professions today. For example, suppose that a government decided to invest public money in a housing programme providing garden and workshop facilities. The aim would be to enable the occupants to become significantly less dependent on the shops for much of their food and many of their household items, and significantly less dependent on the labour market for their work. In other words, the government would be helping people to liberate themselves, at least to some extent, from dependence on the money economy. The problem is: not only would the direct financial return on the investment be ''uneconomic'' (according to conventional criteria about rates of return), but the investment would actually reduce the level of measured GNP. So, although a housing policy of this kind might be very successful and valuable in social and human terms, it would be quite unjustifiable according to conventional criteria. No doubt there are many examples in spheres such as education and health, where enabling policies would seem to run counter to the conventional criteria used to evaluate new proposals today.

However, without underestimating the difficulties that will arise, I comfort myself with two reflections. The first is a general

reflection, well put by Abraham Maslow: "The more we understand the whole of Being, the more we can tolerate the simultaneous existence and perception of inconsistencies, of oppositions, and of flat contradictions. These seem to be products of partial cognition, and fade away with cognition of the whole."[17]

My second reflection is more directly related to the history of imperial decolonisation. It is a historical fact that decolonisation was carried out more competently and successfully by some imperial powers than by others. Moreover, it is a fact that voluntary decolonisation actually became the accepted policy of the governing establishment in at least one of the imperial countries. Here is how the senior British administrator in one part of Africa wrote confidentially to his colleagues in 1951 at a time of local crisis. "One thing which is quite certain is that we are following the policy which is the British contribution to world political history . . . We need to recapture our mission, and to remember what we came to this country to do: to work for the wellbeing and progress of the people . . . not to seek too much for ourselves, but to be the instruments of carrying out our country's policy loyally and tirelessly. And that policy is to lead these people onwards to govern themselves, and eventually to decide for themselves what their future status as a country is to be . . . We have instilled democratic ideals into them; we have taught them to wish to govern themselves; the growth in political consciousness and in critical attitudes to the actions of government is what our own education and our own outlook on life and affairs have given them."[18] The best among the colonial administrators always knew that they were working towards the achievement of their own redundancy. The roots of this policy went back many years to the Durham Report on Canada in 1837. Its culmination was marked by Mr. Harold Macmillan's "wind of change" tour of Africa in 1960, as British Prime Minister. I suggest that, as we face the transition which we call the post-industrial revolution, we shall have something to learn from the successes and failures of British colonial policy in the 19th and 20th centuries.

Metaphysical Reconstruction

As Dr. Schumacher has said, "the task for our generation is one of metaphysical reconstruction."[19] In the economic and political sphere, this task compares historically with what was done by Adam Smith and John Locke two and three hundred years ago. It will involve developing new philosophical and ethical concepts — a new paradigm of political economy, as Thomas Kuhn[20] and his followers would call it.

Among these new concepts will be new concepts of wealth and work and power and public service. They will not be based on the need for money and goods and services and jobs and positions provided by the institutionalised economy, the labour market and the bureaucracy. They will be based on resources and activities which can liberate people from overdependence on money and jobs and goods and services and positions of that kind.

Here are a few examples of that kind of re-thinking that is already beginning to take place about wealth, work and power.

Wealth. In a recent paper called *The New Wealth* Tom Burke (of Friends of the Earth) says: "The new wealth might count as affluent the person who possessed the necessary equipment to make the best use of natural energy flows to heat a home or warm water — the use which accounts for the bulk of an individual's energy demand. The symbols of this kind of wealth would not be new cars, TV's or whatever, although they would be just as tangible and just as visible. They would be solar panels, insulated walls or a heat pump. The poor would be those who remained dependent on centralised energy distribution services, vulnerable to interruption by strike, malfunction or sabotage, and even more vulnerable to rising tariffs set by inaccessible technocrats themselves the victims of market forces beyond their control. The new rich would boast not of how new their television was but of how long it was expected to last and how easy it would be to repair. Wealth might take the form of ownership of, or at least access to, enough land to grow a proportion of one's food. This would reduce the need to earn an ever larger income in order to pay for increasingly expensive food. Wealth would consist in having access to most goods and services within easy walking or cycling distance of home thus reducing the need to spend more time earning more money to pay for more expensive transport services. A high income would be less a sign of wealth than of poverty since it would indicate dependence on the provision by someone else of a job and a workplace in order to earn the income to rent services. Wealth would consist in having more control over the decisions that affected wellbeing and in having the time to exercise that control."[21]

Work. In a recent report called *Re-working the World*,[22] Gail Stewart and Cathy Starrs of Ottawa have discussed changing concepts of work. As they say, "The enormous intellectual and social ferment of our own times (whether we label it as future shock, or the transition to post-industrial society, the emergence of Consciousness III or the stable state, or childhood's end) is the context for changing concepts of work. Changing concepts of work, whether at the personal or at the community or social level or both, are inescapably related to a changing sense of purpose — of what it is useful to do. The labour market cannot much longer elicit credibility as an organising device for the activity of working. The concept of work as something that must be socially productive in the eyes of the beholder is coming to be used to sort meaningful from empty jobs. A whole new concept of work is emerging which will dismiss as work much which now passes for it and will embrace as work much which is not now included in it. We are going to need to rely increasingly on individuals and communities to define their own concepts of work."

Power. Just as the new concepts of wealth and work will focus on the degree of control which people have over their own lives, so too with the new concept of power. And just as in the new paradigm, people cannot be given wealth and work, but have to create it for themselves — so, too, people cannot be given power, but

they have to take it for themselves. As people have to learn the autonomy of adulthood for themselves, or as they have to learn to be healthy for themselves, so people hitherto dependent in any way have to generate their own power to control their lives and to share control in their community.

The dependence of women in a patriarchal society can be seen as a model which applies to most citizens, consumers, workers, patients, pupils and other clients of the political, managerial and professional establishment in modern industrial societies. Here is how the Boston Women's Health Book Collective came to see the situation. "Talking to each other, we realised that many of us shared a common perception of men — that they all seemed to be able to turn themselves on and to do things for themselves. We tended to feel passive and helpless and to expect and need men to do things for us. We were trained to give our power over to men. We had reduced ourselves to objects. We remained children, helpless and giving other people power to define us and objectify us. As we talked together, we realised that one of our central fantasies was our wish to find a man who could turn us on, do for us what we could not do for ourselves, make us feel alive and affirm our existence. It was as if we were made of clay and men would mold us, shape us, and bring us to life. This was the material of our childhood dreams: 'Some day my prince will come.' We were always disappointed when men did not accomplish this impossible task for us. And we began to see our passive, helpless ways of handing power over to others as crippling to us. What became clear to us was that we had to change our expectations for ourselves. There was no factual reason why we could not assert and affirm our own existence to do and act for ourselves."[23]

These women felt they had been trained to give their power over to other people to define them. So, for example, until the Peace People came into existence in Northern Ireland, the people there had become conditioned to give their power over to the government, the political parties, the churches, the army and the paramilitaries.[24] And so we, in the rest of Britain, have become habituated to give our power over to politicians and governments and bureaucracies. The new concept of non-violent power, of sovereignty peacefully welling up from all the people, is relevant for us all.

Conclusion

Let me conclude with two final thoughts. First, the turning point is not far off. Second, we in this country should feel able to face it with confidence.

On the first point, I will quote Willis Harman again. "All we have learned of psychotherapy suggests that it is at the precise time when the individual most feels as if his whole life is crashing down around him that he is most likely to achieve an inner reorganisation constituting a quantum leap in his growth towards maturity. Our hope, our belief, is that it is precisely when society's future seems so beleaguered — when its problems seem almost staggering in complexity, when so many individuals seem alienated, and so many values seem to have deteriorated — that it is most likely to achieve a metamorphosis in society's growth toward maturity, toward more truly enhancing and fulfilling the human spirit than ever before. Thus we envision the possibility of an evolutionary leap to a trans-industrial society that not only has know how, but also has a deep inner knowledge of what is worth doing."[25]

On the second point, we in this country are as well equipped as any people in the world to make the evolutionary breakthrough to a new future. We inherit the traditions and experience of the industrial revolution, of peaceful decolonisation at the end of empire, and of the last great metaphysical reconstruction carried out by John Locke and Adam Smith. Temperamentally, we seem to have a high tolerance of the kind of inconsistencies, oppositions and flat contradictions we are going to have to live through. As a cautious American observer of our situation wrote last December, "It is too soon to insist that the new Jerusalem will never be built in Blake's green and pleasant land. Indeed, there is some reason to think the leisurely Britons may have already laid the corner stone."[26] Most of us would probably go along with that, and look forward to the work of construction that lies ahead.

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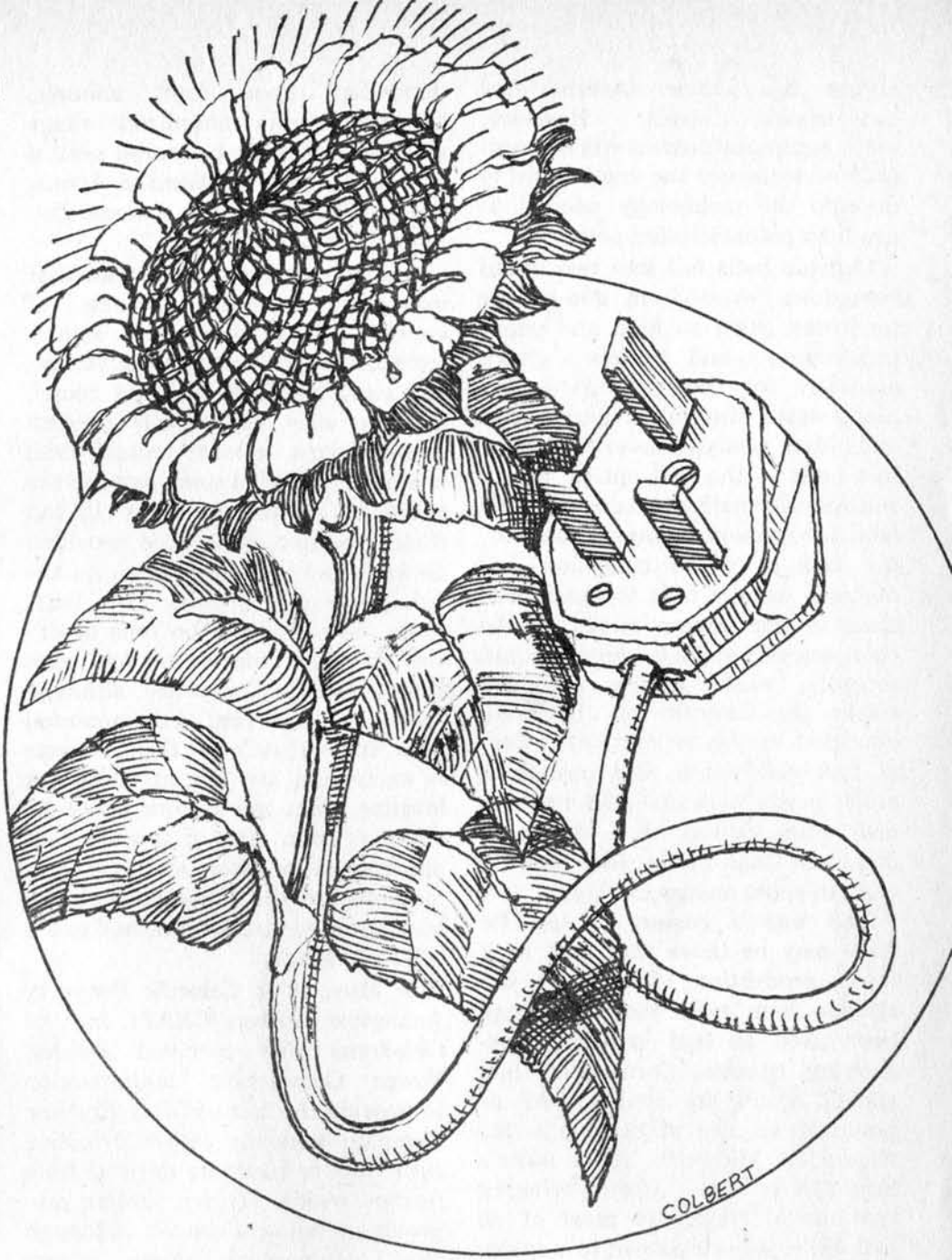
Plant Power:

Biological Sources of Energy

by Denis Hayes



However powerful the argument against nuclear energy may be, there is little hope of deflecting the hastening drift into the nuclear age unless practical alternatives can be offered. In this extract from his book *Rays of Hope* (W.W. Norton 1977) Denis Hayes discusses the feasibility of organic sources of fuel, from the conversion of industrial, agricultural and natural waste, to the production of "energy crops". So long as they are wisely managed such sources are renewable and need cause no damage to the environment.

Green plants began collecting and storing sunshine more than two billion years ago. They photosynthesize an estimated one-tenth of one percent of all solar energy that strikes the earth. Somewhat more than half of this fraction is spent on plant metabolism; the remainder is stored in chemical bonds and can be put to work by human beings.

All fossil fuels were once biomass, and the prospect of dramatically shortening the time geological forces take to convert vegetation into oil, gas, and coal (roughly a third of a billion years) now intrigues many thoughtful persons. Dry cellulose has an average energy content of about four kilocalories per gram — 60 percent as much as bituminous coal, and the hydrocarbons produced by certain plants contain more energy than coal does. Biomass can be transformed directly into substitutes for some of our most rapidly vanishing fuels.

Because green plants can be grown almost everywhere, they are not very susceptible to international political pressures. Unlike fossil fuels, botanical energy resources are renewable. In addition, biomass operations involve few of the environmental drawbacks associated with the large-scale use of coal and oil.

The ultimate magnitude of this energy resource has not been established. Measuring the earth's total photosynthetic capacity poses difficulties, and estimates vary considerably. Most experts peg the energy content of all annual biomass production at between 15 and 20 times the amount humans currently get from commercial energy sources, although other estimates range from 10 to 40 times.[1] Using all the vegetation that grows on Earth each year as fuel is unthinkable. But the energy that could reasonably be harvested from organic sources each year probably exceeds the energy content of all the fossil fuels currently consumed annually.

Two important caveats must be attached to this statement. The first qualification concerns conversion efficiency. Much of the energy bound in biomass will be lost during its conversion to useful fuels. These losses, however, need be no greater than those involved in converting coal into synthetic oil and gas. The second catch is geographical: the areas with the greatest biomass production are wet equatorial regions — not the temperate lands where fuel use is highest today. The full biological energy potential of the United States, calculated liberally, probably amounts to about one-fifth of current commercial energy use; in contrast, the potential in many tropical countries is much

higher than their current fuel consumption levels. However, many equatorial nations will be hard-pressed to secure the capital and to develop the technology needed to use their potential plant power.[2]

Organic fuels fall into two broad categories: waste from non-energy processes (such as food and paper production) and crops grown explicitly for their energy value. Since waste disposal is unavoidable and often costly, converting waste into fuels — the first option — is a sensible alternative to using valuable land for garbage dumps. However, the task of waste collection and disposal usually falls to those who cling to the bottom rungs of the economic and social ladder and, until recently, waste seldom attracted either the interest of the well-educated or the investment dollars of the well-heeled. But change is afoot, partly because solid waste is now often viewed as a source of abundant high-grade fuel that is close to major energy markets.

The wastes easiest to tap for fuels may be those that flow from food production. Bagasse, the residue from sugar cane, has long been used as fuel in most cane-growing regions. Corn stalks and spoiled grain are being eyed as potential sources of energy in the American Midwest. And India's brightest hope for bringing commercial energy to most of its 600,000 villages is pinned to a device that produces methane from excrement and that leaves fertilizer as a residue.

Wastes as Fuels

Agricultural residues — the inedible, unharvested portions of food crops — represent the largest potential source of energy from waste. But most plant residues are sparsely distributed, and some cannot be spared: they are needed to feed livestock, retard erosion, and enrich the soil. Yet, wisely used, field residues can guard the soil, provide animal fodder, *and* serve as a fuel source.

Agricultural energy demands are highly seasonal, and usage peaks do not always coincide with the periods during which residue-derived energy is most plentiful. In agricultural systems still largely dependent upon draft animals, this problem is minimized: silage and hay can easily be stored until it is needed. On mechanized farms, energy storage poses a somewhat more difficult problem.

Animal excrement is another potentially valuable source of energy. Much undigested energy remains bound in animal excrement; and cattle feedlots, chicken coops, and pig sties could easily become energy farms. Indeed, animal dung has been burned in some parts of the world for centuries; in the United States, buffalo chips once provided cooking fuel to frontiersmen on the treeless Great Plains. In India today, about 68 million tons of dry cow dung are burned as fuel each year, mostly in rural areas, although more than 90 percent of the potential heat and virtually all the nutrients in excrement are lost in inefficient burning.[3] Far more work could be obtained from dung if it were first digested to produce methane gas; moreover, all the nutrients originally in dung could then be returned to the soil as fertilizer.[4]

In May, 1976, Calorific Recovery Anaerobic Process (CRAP), Inc., of Oklahoma City received Federal Power Commission authorization to provide the Natural Gas Pipeline Company annually with 820 million cubic feet of methane derived from feedlot wastes. Other similar proposals are being advanced. Although most commercial biogas plants planned in the United States are associated with giant feedlots, a more sensible long-term strategy might be to range-feed cattle as long as possible and then to fatten them up, a thousand at a time, on farms in the midwestern grain-belt.

Cow dung could power the farm and provide surplus methane, and the residue could be used as fertilizer. In addition, methane generation has been found to be economically attractive in most dairies — an important point since more than half of all U.S. cows are used for milk production.[5]

Collectible crop residues and feedlot wastes in the United States contain 4.6 quadrillion Btu (quads) — more energy than all the nation's farmers use.[6] Generating methane from such residues is often economical. However, developing a farm that is totally energy self-sufficient may require a broader goal than maximizing short-term food output.

Human sewage, too, contains a large store of energy. In some rural areas, particularly in China and India, ambitious programs to produce gaseous fuel from human and animal wastes are underway. Unfortunately, toxic industrial effluents are now mixed with human waste in many of the industrialized world's sewage systems, and these pollutants make clean energy-recovery vastly more difficult. If these pollutants were kept separate, a large new energy source would become available.

The residues of the lumber and paper industries also contain usable energy. A study conducted for the Ford Foundation's Energy Policy Project found that if the U.S. paper industry were to adopt the most energy-efficient technologies now available and were to use its wood wastes as fuel, fossil fuel consumption could be reduced by a staggering 75 percent. The Weyerhaeuser Company recently announced a $75 million program to expand the use of wood waste as fuel for its paper mills; "We're getting out of oil and gas wherever we can," commented George Weyerhaeuser, the company's president. Sweden already obtains 7 percent of its total energy budget by exploiting wastes of its huge forest-products industry.

Eventually, most paper becomes urban trash. Ideally, much of it should instead be recycled — a process that would save trees, energy and money. But unrecycled paper, along with rotten vegetables, cotton rags, and other organic garbage, contains energy that can be economically recaptured. Milan, Italy, runs its trolleys and electric buses partly on power produced from trash. Baltimore, Maryland, expects to heat much of its downtown business district soon with fuel obtained by distilling 1,000 tons of garbage a day.

American waste streams alone could, after conversion losses are subtracted, produce nearly five quads per year of methane and "charoil" — about 7 percent of the current U.S. energy budget. Decentralized agrarian societies

could derive a far higher percentage of their commercial energy needs from agricultural, forest, and urban wastes.

Energy Crops

The second plant-energy option, the production of "energy crops", will probably be limited to marginal lands, since worldwide population pressures are already relentlessly pushing food producers onto lands ill-suited to conventional agriculture. Yet, much potential energy cropland does exist in areas where food production cannot be sustained. Some prime agricultural land could also be employed during the off-season to grow energy crops. For example, winter rye (which has little forage value) could be planted in the American Midwest after the fall corn harvest and harvested for energy in the spring before maize is sowed.

Factors other than scarce land can limit biomass growth. The unavailability of nutrients and of an adequate water supply are two. Much marginal land is exceedingly dry, and lumber and paper industries will make large demands on areas wet enough to support trees. The energy costs of irrigating arid lands can be enormous, reducing the net energy output dramatically.

Yields from energy crops will reflect the amount of sunlight such crops receive, the acreage devoted to collecting energy, and the efficiency with which sunlight is captured, stored, harvested, transported and put to work. Ultimately, they will also depend upon our ability to produce crops that do not sap the land's productivity and that can resist common diseases; pests, fire, and harsh weather.

The most familiar energy crop, of course, is firewood. A good fuel tree has a high annual yield when densely planted, resprouts from cut stumps (coppices), thrives with only short rotation periods, and is generally hardy. Favored species for fuel trees are eucalyptus, sycamore and poplar — an intelligently planned tree plantation would probably grow a mixture of species.

Forests canopy about one-tenth of the planet's surface and represent about half the earth's captured biomass energy.[7] A century ago, the United States obtained three-fourths of its commercial energy from wood. In the industrialized world today, only a small number of the rural poor and a handful of self-styled rustics rely upon fuel wood. However, the case is emphatically different in the Third World. Thirty percent of India's energy, and 96 percent of Tanzania's comes from wood.[8] In all, about half the trees cut down around the world are burned to cook food and to warm homes.

In many lands, unfortunately, humans are propagating faster than trees. Although much attention has been paid to the population-food equation, scant notice has been given to the question of how the growing numbers will cook their food. As desperate people clear the land of mature trees and saplings alike, landscapes become barren; and, where watersheds are stripped, increasingly severe flooding occurs. In the parched wastelands of north central Africa and the fragile mountain environments of the Andes and the Himalayas, the worsening shortage of firewood is today's most pressing energy crisis.[9]

A variety of partial solutions have been suggested for the "firewood crisis." In southern Saudi Arabia, some tribes impose the same penalty for the unauthorized cutting of a tree as for the taking of a human life. China has embarked upon an ambitious reforestation program, and many other nations are following suit. Some forestry experts advocate substituting fast growing trees for native varieties as a means of keeping up with demand.[10] However, the vulnerability of forest of genetically similar trees to diseases and pests calls the application of such agricultural techniques to silviculture into question.

Improving the efficiency with which wood is used would also help alleviate the firewood shortage. In India, using firewood for cooking is typically less than 9 per cent efficient. The widespread use of downdraft wood-burning stoves made of cast iron could, S.B. Richardson estimates, cut Northern China's fuel requirements for heating and cooking by half.[11] Other efficient wood-burning devices can be made by local labor with local materials.

Wood can be put to more

sophisticated uses than cooking and space heating. It can fuel boilers to produce electricity, industrial process steam, or both. The size of many prospective tree-harvesting operations (about 800 tons per day) is well tailored to many industrial energy needs. Decentralized cogeneration using wood would also fit in well with current worldwide efforts to move major industries away from urban areas. In particular, the creation of forest "plantations" to produce fuel for large power plants at a cost comparable to that of coal has been recommended.[12] However, some researchers argue that the cost of transporting bulk biomass should lead us to think in terms of energy "farms" of a few thousand hectares or less.[13]

Trees are not the only energy crops worth considering. A number of other land and water crops have their advocates among bioconversion specialists. Land plants with potential as energy sources include sugarcane, cassava (manioc), and sunflowers, as well as some sorghums, kenaf, and forage grasses. Among the more intriguing plants under consideration are *Euphorbia lathrus* and *Euphorbia tirncalli,* shrubs whose sap contains an emulsion of hydrocarbons in water. While other plants also produce hydrocarbons directly, those produced by *Euphorbia* resemble the constituents in petroleum. Such plants might, Nobel laureate Melvin Calvin estimates, produce the equivalent of 10 to 50 barrels of oil per acre per year at a cost of $10 or less per barrel.

Moreover, *Euphorbia* thrives on dry, marginal land.[14]

Several different crops could be cultivated simultaneously, a report by the Stanford Research Institute suggests, and side-by-side cropping could allow year-round harvesting in many parts of the world. Such mixed cropping would also increase ecological diversity, minimize soil depletion, and lower the vulnerability of energy crops to natural and human threats.[15]

Enthusiastic reports by NASA National Space Technology Laboratories have focused attention on the energy potential in water hyacinths. Thought to have originated in Brazil, the fast-growing water hyacinth now thrives in more than 50 countries; it flourishes in the Mississippi, Ganges, Zambezi, Congo and Mekong rivers, as well as in remote irrigation canals and drainage ditches around the world. The government of Sudan is experimenting with the anaerobic digestion of thousands of tons of hyacinths mechanically harvested from the White Nile. However, a recent Batelle Laboratory report discounts the potential commercial importance of water hyacinths in the United States, in part because of their winter dormancy.[16]

Algae is another potential fuel. Some common types of this scummy, nonvascular plant have phenomenal growth rates. However, current harvesting techniques require large inputs of energy, the use of which lowers the net energy output of algae farming. Although solar drying would improve the energy balance, engineering breakthroughs are needed before impressive net energy yields can be obtained.

One of the more fascinating proposals for raising energy crops calls for the cultivation of giant seaweed in the ocean. As Dr. Howard Wilcox, manager of the Ocean Farm Project of the U.S. Naval Undersea Center in San Diego, points out, "most of the earth's solar energy falls at sea, because the oceans cover some 71 percent of the surface area of the globe." The Ocean Farm Project, an effort to cultivate giant California kelp to capture some of this energy through photosynthesis, presently covers a quarter-acre. But the experimental operation will, Wilcox hopes, eventually be replaced by an ocean farm 470 miles square. Such a sea field could theoretically produce as much natural gas as the U.S. currently consumes.[17]

Biomass Technologies

Biomass can be transformed into useful fuels in many ways, some of which were developed by the Germans during the petroleum shortages of World War II. Although one-third to two-thirds of the energy in biomass is lost in most conversion processes, the converted fuels can be used much more efficiently than raw biomass. The principal technologies now being explored are direct combustion, anaerobic digestion, pyrolysis, hydrolysis, hydrogasification and hydrogenation.

In the industrialized world, organic energy is often recovered by burning urban refuse. To produce industrial process steam or electricity or both, several combustion technologies can be employed: waterwall incinerators, slagging incinerators and incinerator turbines. Biomass can also be mixed with fossil fuels in conventional boilers, while fluidized-bree boilers can be used to burn such diverse substances as lumber mill wastes, straw, corn cobs, nutshells, and municipal wastes.

Since trash piles up menacingly in much of the urban world, cities can afford to pay a premium for energy-generating processes that reduce the volume of such waste. Urban trash lacks the consistency of coal, but its low sulfur content makes it an attractive energy source environmentally. Following the lead set by Paris and Copenhagen 50 years ago, several cities now mix garbage with other kinds of power-plant fuel to reduce their solid waste volume, to recover useful energy, and to lower the average sulfur content of their fuel. A $35 million plant in Saugus, Massachusetts, burns garbage from 12 towns, producing steam that is then sold to a nearby General Electric Factory that hopes to save 73,000 gallons of fuel oil per day on its new fuel diet.

The next easiest method of energy recovery is anaerobic digestion — a fermenting process performed by a mixture of micro-organisms in the absence of oxygen. In anaerobic digestion, acid-forming bacteria convert wastes into fatty acids, alcohols, and aldehydes; then, methane-forming bacteria convert the acids to biogas. All biomass except wood can be anaerobically digested, and the process has been recommended for use in breaking down agricultural residues and urban refuse.[18] Anaerobic digestion takes place in a water slurry, and the process requires neither great quantities of energy nor exotic ingredients. Anaerobically digested, the dung from one cow will produce an average of ten cubic feet of biogas per day — about enough to meet the daily cooking requirements of a typical Indian villager.

Many developing and some industrial nations are returning to this old technology, anaerobic digestion, for a new source of energy.

Biogas generators convert cow dung, human excreta, and inedible agricultural residues into a mixture of methane and carbon dioxide that also contains traces of nitrogen, hydrogen and hydrogen sulfide. Thirty thousand small biogas plants dot the Republic of Korea; and the People's Republic of China claims to have about two million biogas plants in operation.[19]

India has pioneered efforts to tailor biogas conversion to small-scale operations. After the OPEC price increases of 1973, annual gobar (the Hindi word for cow dung) gas plant sales shot up first to 6,560 and then to 13,000. In 1976, sales numbered 25,000. "We've reached take-off," says H.R. Srinivasan, the program's director. "There's no stopping us now."

In addition to methane, other products can be derived from the biogasification of animal wastes and sewage. The residue of combustion is a rich fertilizer that retains all the original nutrients of the biomass and that also helps the soil retain water in dry periods. At Aurobindo Ashram in Pondicherry, India, wastes from cows, pigs, goats and chickens will be gasified; the residue will be piped into ponds supporting algae, aquatic plants, and fish grown for use as animal fodder; and treated effluents from the ponds will be used to irrigate and fertilize vegetable gardens. Experience with biogas plants in "integrated farming

systems'' in Papua-New Guinea, suggests that the by-products of such controlled processes can be even more valuable than the methane.[20]

In developing countries, decentralized biological energy systems like that planned in Pondicherry could trigger positive social change. For small, remote villages with no prospects of getting electricity from central power plants, biogas can provide relatively inexpensive, high-grade energy and fertilizer. Ram Bux Singh, a prominent Indian developer and proponent of gobar gas plants, estimates that a small five-cow plant will repay its investment in just four years.[21] Larger plants serving whole villages are even more economically enticing. However, where capital is scarce, the initial investment is often difficult to obtain. In India, the Khadi and Village Industries Commission promotes gobar plant construction by granting subsidies and low interest loans. The Commission underwrites one-fifth of the cost of individual plants and one-third of the cost of community plants. In the poorer areas, the Commission pays up to 100 per cent of the cost of co-operative plants.

In efforts to hold down the cost of gobar plants and to conserve both scarce steel and cement in developing lands, researchers are producing new materials for use in digester construction. For example, a large cylindrical bag reinforced with nylon and equipped with a plastic inlet and outlet, can be installed in a hole in the ground and weighted down in about one hour. The total cost can be as little as 15 per cent of that of conventional digesters. Other experimental models are now being made out of natural rubber, mud bricks, bamboo pipes, and various indigenous hardwoods. In general, the ideal biogas plant for poor rural communities would be labor-intensive to build and operate and would be constructed of local materials.

The principal problem plaguing Third World biogas plants are temperature shifts, which can slow down or halt digestion. Low temperatures are particularly troublesome in Korea and China, where gas production slumps in winter when energy demands are highest. Possible remedies include improving insulation, burying future facilities to take advantage of subterranean heat, and erecting vinyl or glass greenhouses over the digesters to trap solar energy for heating. Alternatively, some of the gas produced in the digester could be used to heat the apparatus itself.

Alan Poole, a bioconversion specialist with the Institute for Energy Analysis at Oak Ridge, estimates that methane produced at the rate of 100 tons per day in a U.S. biogas plant would cost less that $4.00 per million Btu, which approximates the expected cost of deriving commercial methane from coal.[22] In industrial countries, however, the recent trend has been away from anaerobic digestion. In 1963, this process was utilized in 70 per cent of the U.S. wastewater treatment plants, but today it is being replaced — especially in smaller cities and towns — by processes that use more energy than they produce. The switch, which is now taking place at a capital cost in excess of $4 billion annually, was prompted largely by digester failures. Although poor design and operator error can both lead to pH imbalances or temperature fluctuation, the principal cause of unreliability appears to be the presence of inhibitory materials — especially heavy metals, synthetic detergents, and other industrial effluents.

These same industrial contaminants can also cause serious problems if the digested residues are used as fertilizer in agriculture. Some of these inhibitory substances can be separated routinely, but some will have to be cut off at the source and fed into a different treatment process if the excrement is to be anaerobically digested.

Anaerobic digestion produces a mixture of gases, only one of which — methane — is of value. For many purposes, the gas mixture can be used without cleansing. But even relatively pure methane is easy to obtain. Hydrogen sulfide can be removed from biogas by passing it over iron filings. Carbon dioxide can be scrubbed out with lime water (calcium hydroxide). Water vapour can be removed through absorption. The remaining methane has high energy content.

Biogas plants have few detractors,

but some of their proponents fear that things are moving too fast and that large sums of money may be invested in inferior facilities when significant improvements may wait just around the corner. A recent report to the Economic Social Commission for Asia and the Pacific said of the Indian biogas program that ''the cost should be drastically reduced, the digester temperature controlled during the winter months through the use of solar energy and the greenhouse effect, and the quality of the effluent improved,'' before huge amounts of scarce capital are sunk in biogas technology. To these misgivings must be added those of many in the Third World who are afraid that the benefits of biogas plants may fall exclusively or primarily to those who own cattle and land — accentuating the gap between property-owners and the true rural poor.[23]

To quell the fears of those with reservations about biogas development, most government programs stress community plants and cooperative facilities; and many countries are holding off on major commitments of resources to the current generation of digesters. But, whether small or large, sophisticated or crude, fully automated or labour-intensive, privately owned or public, biogas plants appear destined for an increasingly important role in the years ahead.

While hundreds of thousands of successful anaerobic digesters are already in operation, many other energy conversion technologies are also attracting increased interest.

Hydrolysis, for example, can be used to obtain ethanol from plants and wastes with a high cellulose content at an apparent overall conversion efficiency of about 25 percent. The cellulose is hydrolized into sugars, using either enzymes or chemicals; the sugar, in turn, is fermented by yeast into ethanol. Though most research on hydrolysis has thus far been small in scale, Australians have advanced proposals for producing prodigious quantities of ethanol using eucalyptus wood as the base and concentrated hydrochloric acid as the hydrolyzing agent. Ethanol so produced could substitute for a large share of Australia's rising oil imports.[24]

Pyrolysis is the destructive distillation of organic matter in the absence of oxygen. At temperatures above 500°C, pyrolysis requires only atmospheric pressure to produce a mixture of gases, light oil, and a flaky char — the proportions of each being a function of operating conditions. In particular, this process recommends itself for use with woody biomass that cannot be digested anaerobically.

True pyrolysis is endothermic, requiring an external heat source. Many systems loosely termed "pyrolysis" are actually hybrids, employing combustion at some stage to produce heat. Three of the dozen or so systems now under development are far enough along to warrant comment. The Garrett "Flash Pyrolysis" process involves no combustion, but its end product (a corrosive and highly viscous oil) has a low energy content. The Monsanto "Langard" gas-pyrolysis process can be used to produce steam with an overall efficiency of 54 percent. The Union Carbide "Purox" system, a high temperature operation with a claimed efficiency of 64 percent uses pure oxygen in its combustion stage and produces a low-Btu gas.[25]

Hydrogasification, a process in which a carbon source is treated with hydrogen to produce a high-Btu gas, has been well-studied for use with coal. But further research is needed on its potential use with biomass since, for example, the high moisture content of biomass may alter the reaction. Similarly, fluidized bed techniques, which work well with coal, may require a more uniform size, shape, density, and chemical composition than biomass often provides. Experimental work on the application of fluidized bed technologies to biomass fuels is now being conducted by the U.S. Bureau of Mines in Brucetown, Pennsylvania.

Hydrogenation, the chemical reduction of organic matter with carbon monoxide and steam to produce a heavy oil, requires pressure greater than 100 atmospheres. The U.S. Energy Research and Development Administration is paying for a $3.7-million pilot plant at Albany, Oregon; at the Albany plant, hydrogenation will be used to tap the energy in wood wastes, urban refuse, and agricultural residues.

Choice Fuels and Fuel Choices

The selection of energy systems will be partially dictated by the type of fuel desired: the ends will specify the means. In a sense, the development of biological energy sources is a conservative strategy, since the products resemble the fossil fuels that currently comprise most of the world's commercial energy use. Some fuels derived from green plants could be pumped through existing natural gas pipelines, and others could power existing automobiles. Nuclear power, in contrast, produces only electricity, and converting to an energy system that is mostly electric would entail major cultural changes and enormous capital expenditures.

Biomass processes can be designed to produce solids (wood and charcoal), liquids (oils and alcohols), gases (methane, hydrogen), or electricity. Charcoal, made through the destructive distillation of wood, has been used for at least 10,000 years. It has a higher energy content per unit of weight than does wood; its combustion temperature is hotter, and it burns more slowly. However, four tons of wood are required to produce one ton of charcoal, and this charcoal has the energy content of only two tons of wood. For many purposes — including firing boilers for electrical generation — the direct use of wood is preferable. Charcoal, on the other hand, is better suited to some specialized applications, such as steel-making.

Methanol and ethanol are particularly useful biomass fuels. They are octane-rich, and they can be easily mixed with gasoline and used in existing internal combustion engines. Both were commonly blended with gasoline, at up to 15 to 25 percent, respectively, in Europe between 1930 and 1950. Brazil recently embarked upon a $500 million program to dilute all gasoline by 20 percent with ethanol made from sugar cane and cassava. Meanwhile several major U.S. corporations are showing keen interest in methanol. These alcohols could also fuel low-polluting external combustion engines.[26]

The gaseous fuels produced from biomass can be burned directly to cook food or to provide industrial process heat. They can also be used to power pumps or generate electricity. Moreover, high quality gases such as methane or hydrogen can be economically moved long distances via pipeline.

A "synthesis gas" consisting of hydrogen and carbon monoxide was manufactured from coke in most U.S. towns at the turn of the century; known popularly as "town gas", it was piped to homes for lighting and cooking. A similar "local brew" might make sense today for areas rich in trees but poor in the biomass needed for anaerobic digestion. Synthesis gas can be further processed into methane, methanol, ammonia, or even gasoline.

The price in constant dollars for oil-based fuels declined during the 1950s and 1960s, partly because uses were found for more and more of the by-products of the refining process. Similarly, as the residues of biological energy processes find users, the production of fuels from biomass will grow more economically attractive.

Many biomass schemes reflect the assumption that energy crops can supply food as well as fuel. Even the plans to cultivate islands of deep sea kelp include schemes for harvesting abalone in the kelp beds. Many energy crops, including water hyacinths, have proven palatable to cattle and other animals, once solar dryers have reduced moisture to appropriate levels.

More sophisticated by-product development has also been planned

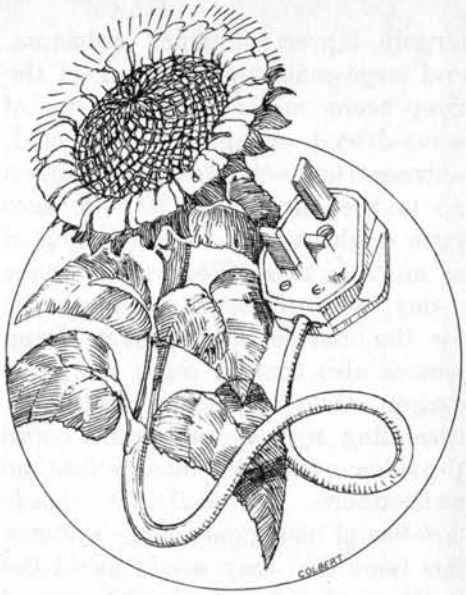
by students of chemurgy, the branch of applied chemistry concerned with the industrial use of organic raw materials. In the 1930s, George Washington Carver produced a multitude of industrial products from peanuts, while Percy Julian derived new chemicals from vegetable oils. And, for the record, the plastic trim on the 1936 Ford V-8 was made from soybeans.

Organic fuels can bear many different relationships to other products. Sometimes the fuels themselves are the by-product of efforts to produce food (e.g., sugar), natural fibers (e.g., paper), and lumber or wood chemicals (e.g., turpentine). Sometimes the residues of fuel-producing processes may be turned into plastics, synthetic fibers, detergents, lubricating oils, greases, and various chemicals.

Biological energy systems are free of the more frightening drawbacks associated with current energy sources. They will produce no bomb-grade materials nor radioactive wastes. In equilibrium, biological energy sources will contribute no more carbon dioxide to the atmosphere than they will remove through photosynthesis; and switching to biomass conversion will reduce the cost of air pollution control since the raw materials contain less sulfur and ash than many other fuels do. Indeed, some biological energy systems would have positive environmental impacts. Reforestation projects will control soil erosion, retard siltation of dams, and improve air quality. One type of biomass, water hyacinths, can control certain forms of water pollution while others remove many air pollutants.

Without wise management, however, biological energy systems could engender major environmental menaces. The most elementary danger associated with biomass production is robbing the soil of its essential nutrients. If critical chemicals in the soil are not recycled, this "renewable" energy resource will produce barren wastelands.

Recycling nutrients can, alas, bring its own problems. First, if industrial wastes are included in the recycled material, toxic residues may build up in the soil. Some evidence suggests that certain contaminants — especially such heavy metals as cadmium and mercury — are taken up by some crops. Second, some disease-causing agents, especially viruses, may survive sewage treatment processes. Many of these potential infectants found in wastes can be controlled simply by aging the sludge before returning it to the soil — but, during out-breaks of particularly virulent diseases, human excrement will have to be treated by other means, such as pasteurization, before being applied to agricultural lands.



Because of the relatively low efficiency with which plants capture sunlight, huge surfaces will be needed to grow large amounts of biomass. If biological energy farms significantly alter existing patterns of surface vegetation, the reflectivity and the water-absorption patterns of immense tracts of land could change. Moreover, new demands for gigantic tracts of land may eventually intrude upon public reserves, wetlands, and wilderness areas.

Ocean farming can go overboard too. The surface of the deep ocean is

largely barren of plant nutrients, and large-scale kelp farming of the deep ocean might entail the use of wave-driven pumps to pull cold, nutrient-rich water from the depths up to the surface. A 100,000 acre farm might require the upwelling of as much as two billion tons of water a day, with unknown consequences for the marine environment. Deep waters also contain more inorganic carbon than surface waters do; upwelling such waters would entail the release of carbon dioxide into the atmosphere. (Ironically, a classic defense of biological energy systems has been that they would avoid the build-up of atmospheric CO_2 associated with the combustion of fossil fuels.) All these effects might be somewhat mitigated if ocean farms were located in cooler regions to the north and south, where the temperature difference between surface waters and deep waters is less.

If the quest for energy leads to the planting of genetically similar crops, the resulting monocultures will suffer from the threats that now plague high-yielding food grains. Vulnerability to pests could necessitate widespread application of long-lived pesticides. An eternal evolutionary race would begin between plant breeders and blights, rots and fungi. Moreover, biological energy systems are themselves vulnerable to external environmental impacts. A global cooling trend, for example, could significantly alter the growing season and the net amount of biomass an area could produce.

Using biomass conversion requires caution and respect for the unknown. If the expanded use of biological energy sources in equatorial countries resulted in the spread of harvesting technologies designed for use in the temperate zone, dire effects could follow. If the biomass fuels became items of world trade instead of instruments of energy independence, the sacking of Third World forests by multinational lumber and paper companies could be fatally accelerated.

The broad social effects of biological energy systems defy pat predictions. Biological energy systems could, for example, be designed to be labor-intensive and highly decentralized, but there is no guarantee that they will evolve this way of their own accord. Like all innovations, they must be carefully monitored; like all resources, they must be used to promote equity and not the narrow interests of the elite.

Photosynthetic fuels can contribute significantly to the world's commercial energy supply. Some of these solid, liquid, and gaseous fuels are rich in energy; and most can be easily stored and transported. Plant power can, without question, provide a large source of safe, low-polluting, relatively inexpensive energy. But all energy systems have certain intractable limits. For photosynthetic systems, these include the availability of sunlight and the narrowness of the radiation range within which photosynthesis can occur. Access to land, water, and nutrients will also set production boundaries. And, at a more profound level, we must ask how much of the total energy that drives the biosphere can be safely diverted to the support of a single species, *homo sapiens*.

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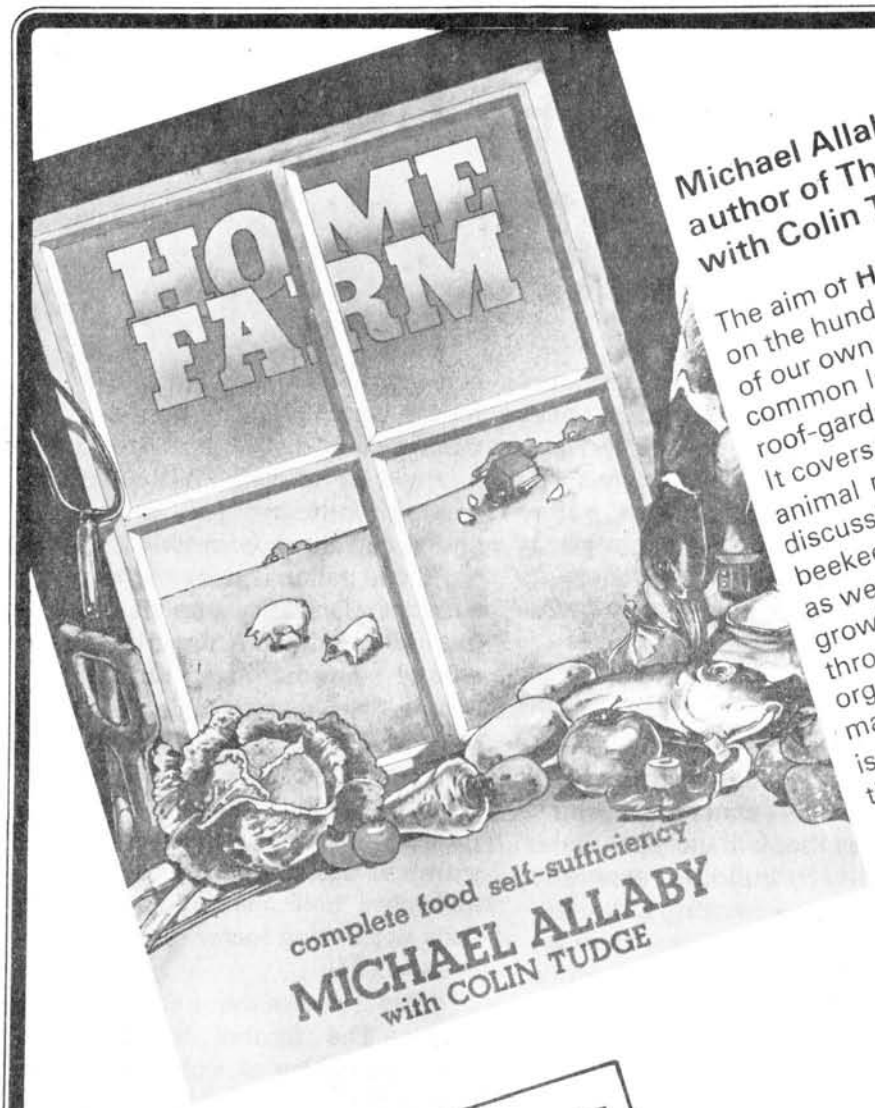

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Water Supply in the UK: An Alternative Strategy

by Keith Humphries

1. Introduction

The recent publication of the Government white paper *Water Services in England and Wales, the Next Steps* outlines a plan to constitute a National Water Authority (NWA). One of its purposes will be the preparation of a national water strategy. This strategy will form ". . . the essential framework for the regional policies, plans, investment programmes and operations of the industry."

Up to the present time the water authorities have seen their role as forecasting future demand and increasing supply in order to satisfy that demand. This philosophy is exemplified by the considered response of the National Water Council (NWC) to the drought, published in their report *The 1975-76 Drought*. Here the two main ways of coping with water shortages in the future were stated to be the flexible deployment of resources and their augmentation from new sources. If past history is a guide, the strategy adopted by the NWA is a foregone conclusion. With increasing demand there will be increasing pressure to build more reservoirs, estuary storage facilities and perhaps a national grid to ensure adequate water supplies whatever the climatic conditions.

The purpose of this article is to argue the old-fashioned case of economy of water use and suggest that instead of increasing supply at an ever increasing cost without questioning the way water is used, priority should be given instead to seeking ways of reducing demand.

The ideal would be to achieve significant water savings at the minimum cost, with no reduction in hygiene and public health standards and the minimum of inconvenience to users.

This attitude should form the basis of a fresh approach to water resources and water supply in the UK, an approach based on more efficient use of our existing supplies combined with a greater adaptability to climatic fluctuations. *The Water Authorities, the future National Water Authority, and the Government have a responsibility to fully consider this option before embarking on major projects to increase supply.*

The Water Resources Board in a recent report concentrates on strategies that will increase water availability by building reservoirs; by artificial recharging of underground storage; estuary storage; desalination; river transfer and a national grid — all of them expensive schemes. Keith Humphries argues that priority should be given to methods of conservation through a determined effort to reduce domestic and industrial use by introducing realistic water-use economies and eliminating the current enormous loss through wastage.

The first step to achieving this must be to change the public's attitude to water use. It must no longer be taken for granted but instead regarded as a valuable and scarce resource as people were encouraged to regard it in the summer of '76.

2. Water consumption in the UK

The now defunct Water Resources Board (WRB) classified demand into two types:

1) Public water supply. Used by households, shops, offices and hospitals and some industry and agriculture.

2) Direct industrial demand. This is met independently of the public supply drawing water from rivers, canals and aquifers.

Table 1 gives the data on water consumption in England and Wales for the year 1971. The figure of 14.1 million cu.m.d. (cubic metres daily) is made up of 5.22 million cu.m.d. used by industry. This is metered and at current rates costs 43.5 pence per 1,000 gallons, averaged over the country. Domestic supplies, at 8.88 million cu.m.d. are unmetered, the charge being based on the rateable value of the property. Fig. 1 shows the growth of population and of water demand since the turn of the century. Total demand on the public water supply has on average grown at 2% compound per annum, and since 1945 has increased 100% for a population increase of approximately 12%.

Table 2 shows the domestic water usage. The figures highlight the large quantities of water consumed by the flush toilet (7.5 litres), and by washing and bathing. Each bath, for instance, consumes between 56 and 95 litres. The only further point to mention is the 18.53 litres appearing in the category 'waste in distribution'. The National Water Council in their report *Paying for Water* estimate that water that is unaccounted for varies between 6-40% of the daily total. These figures reveal how very rudimentary is the art of water-accountancy.

Industrial use of water is predominantly for cooling i.e. condensing steam at power stations, temperature regulation of chemical processes and quenching, but water is also used for transporting materials and waste products.

Table 3 gives some idea of the vast quantities of water required for cooling purposes. (The question of whether we can afford to go on wasting over 50,000 MW of heat energy every year is clearly an important one, which the Government should consider very seriously). The total daily freshwater requirement for industry would be 140 million cu.m. were it not for recycling in

closed systems, internal and external re-use, and the use of saline for cooling.

3. The UK Climate

The fundamental determinant of water-availability is climate. The average rainfall per annum based on rainfall figures since 1825 is 912 mm, as shown in Fig. 2. (Data supplied by the Met. Office). Figures available before 1825 are considered by the Met. Office to be too low. For the year ending 31st March 1976, the average rainfall in England and Wales was 674 mm compared with the 1916-50 standard average of 904 mm. This is a continuation of the steady decline in rainfall since the 1920s. The weather pattern last year was officially regarded as within the normal range of variability though only likely to occur once in 250 to 500 years. However, a different view was expressed by Professor Lamb, Director of the Climatic Research Unit, University of East Anglia. He stated that the country is experiencing a shift in climate towards longer drier spells with periods of heavy rain. The evidence to support this view is outlined in several of his more recent papers (Lamb 1969, 1973, 1974) but the two main points are the decreasing incidence of westerly winds (Fig. 3) and the increase in atmospheric pressure over the UK compared with the first 40 years of this century. Both factors are associated with lower rainfall levels.

At a Royal Meteorological Society Conference earlier this year Mr. Craddick from the Climatic Research Unit, stated that the pattern of rainfall through the last years was similar to a change which took place 240 years ago and which lead to severe droughts in 1740, 1749 and 1760. The evidence for this statement was based on historical records from a site in the East Midlands where rainfall had been recorded since the 1720s.

Where there is more agreement, however, is on the phenomenon known as 'blocking', in which the whole pattern of circulation in the Northern Hemisphere becomes 'locked in' to a stationary pattern. The 16 month drought last year, the severest winter on record in Eastern United States and now the severe drought in Western United States

TABLE 1: WATER CONSUMPTION IN ENGLAND AND WALES

	Total demand (million cu.m.d)	per capita demand (l/per head/per d)
Public water supply Metered (industrial)	5.22	107
Unmetered (domestic)	8.88	183
Total	14.10	290
Direct Industrial Demand (From rivers, canals and underground sources)	28.00	

TABLE 2: DOMESTIC WATER USAGE.
(l/per head/per d)

Lavatory	46.56
Washing & baths	46.56
Laundry	13.63
Dishwashing	13.63
Cooking & drinking	4.54
Waste in distribution	18.55
Gardening	4.54

TABLE 3: CEGB USE OF WATER FOR COOLING. 1971
(Million cu.m.d)

Once through cooling	
Seawater	47
Freshwater	18
Recirculation through cooling towers	40
Total throughput	105

Fig. 1

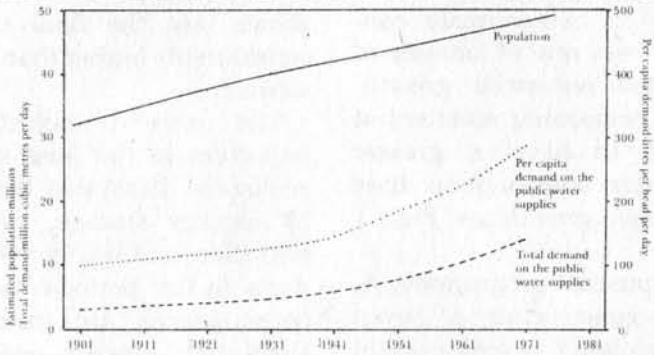

Fig. 1: Water consumption in England and Wales.

Fig. 2

Fig. 2: 5 year mean totals (millimetres) of England & Wales rainfall.

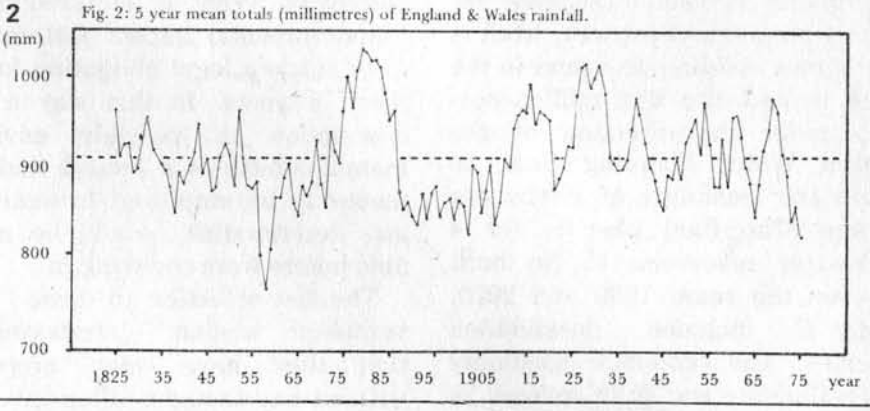

Fig. 3

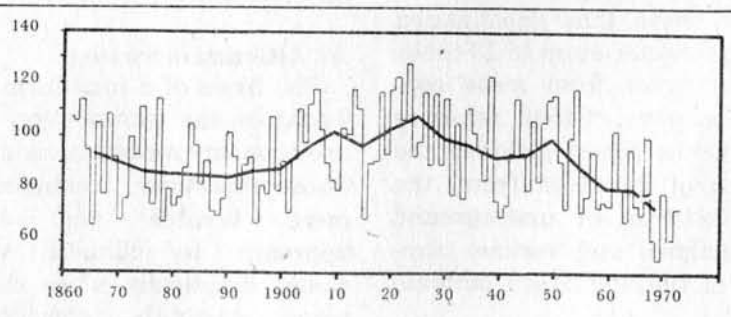

Fig. 3: Number of days per year of general westerly type over the British Isles (1861-1972) Ten-year means plotted at five year intervals.
(Reproduced with permission. H.H. LAMB (1973) Nature, 224, 395-397).

are manifestations of this phenomenon.

4. "Conventional Wisdom" Strategies

The Water Resources Board in its publication *Water Resources in England and Wales* stated that there was no shortage of water. The problem was one of uneven distribution throughout the country and variations during the year. The strategies outlined in the report were based on an average rainfall of 900 mm per annum and were designed to satisfy an expected demand on the public supply system of 28 million cu.m.d. by the early part of the 21st century. The National Water Council's comments on this report were published in their own report (1975). Their conclusion was that the figure given for demand was an overestimate considering the lower rate of increase of population and industrial growth. However, an increasing standard of living seems to have a greater effect on water consumption than does population growth as Fig. 1 indicates.

The minimum cost programme, A, involved the construction of seven new reservoirs and the enlargement of three existing ones for a total cost of £1,358 million at 1972 prices. Programme B was a scheme for estuary storage. At present, work is in progress building an island in the Wash as part of a £1.8 million project, under the direction of the Central Water Planning Unit, to assess the feasibility of freshwater storage. The final plan is for 4 freshwater reservoirs to be built between the years 1980 and 2020. Plan E included desalination schemes. The economic feasibility of desalination was fully covered in a report published by the WRB. Its conclusions were that desalination would supply water at up to 13 times the cost of water from more conventional sources. Other schemes proposed in the report included the reclamation of the river Trent, the artificial recharge of underground storage facilities and various combinations of the strategies outlined above.

Two further possibilities, which have been discussed elsewhere, are the building of a national grid and river transfer. The former would be a system of pipelines and pumping stations which, in effect, would transfer water from Scotland and North Wales to East Anglia and South and South West England. The latter would use existing river systems to transfer water from reservoirs during dry periods. This is already carried out on the Ely-Ouse and plans are advanced for transferring water from the Kielder reservoir into the Tyne, the Tees and the Wear. The most ambitious scheme, that of extending the Graig-Goch reservoir in the Elan Valley and regulating the Wye and the Severn awaits approval.

The first objection to these projects is their enormous cost — as reflected in the WRB estimates. It must be remembered that with practically all large and expensive undertakings, recent history has shown that the final cost is very considerably higher than the original estimate.

The second objection, more important in the long term, is the ecological disruption brought about by estuary storage, reversing the river flow and using rivers as aqueducts in dry periods. Generally the consequences are unknown or if suspected, glossed over, with the result that the ecological balance is permanently affected and at worst destroyed. What is required is an "environmental impact statement" to be made a legal obligation for all these projects. In this way a full description of possible environmental effects of a project and the means to be employed to minimise any deterioration, would be available before work could begin.

The last objection to these "conventional wisdom" strategies is that they have been proposed without any thought being given to the more efficient use of water.

An Alternative Strategy

The basis of a long-term strategy would be the introduction of water use economy measures as a priority. These measures, combined with a more flexible and adaptable approach to climatic variations would drastically alter the future plans currently considered as essential to maintain living standards and the economic well-being of the country.

This strategy would entail the implementation of the following proposals:

i) The introduction of domestic metering

The National Water Council has already discussed aspects of domestic charging and metering in their report *Paying for Water* and it is worthwhile stating a few of the comments made there.

At present a householder's water charges are based on the rateable value of the property. The advantage of this method of charging is that it is simple to administer. The disadvantages are firstly that the correlation between rateable value and water use is very low, 0.31, and secondly that there is absolutely no incentive for the consumer to use water wisely. The report goes on to state that the effect of metering in two schemes already in existence in Britain, those in Fylde and Malvern, show reductions in consumption of between 6 and 24%. An economic evaluation concluded that metering was marginally more expensive than providing facilities to supply the extra water which would be consumed without metering. Several points need to be borne in mind when considering this result. The first is that there is a great deal of uncertainty in the cost accounting for this type of analysis and secondly the cost of metering is that applied to existing dwellings, the cost of installation in new dwellings would be lower. Elsewhere in the report an estimate of the cost of a ten year programme to install 18.6 million meters is given as between £65m-£95m per annum over the period.

Taking into account the huge sums of money at stake a suitable programme would initially concentrate on metering water supplies in all new dwellings, at a cost of about £10m per annum, so that within five years sufficient information would be available to come to solid conclusions about the cost effectiveness of domestic metering.

ii) The introduction of low water use domestic appliances

An article under the title "Reducing domestic consumption" appeared in the November issue of *Water*, the journal of the NWC. The authors, Webster, Ball and Rump, are workers at the Building Research Establishment and have been researching into means of reducing

water consumption in the home; concentrating on the two main uses, WC flushing, 35% of the total, and personal washing and bathing, 35%. The appliances described range from user-controlled flushing units, showing a saving of 60% compared with current models, to atomiser showers, which may use only 5% of the water and energy required for a bath. The most important statement made by the group, however, is that, and I quote ". . . successful development and application of cost effective methods could reduce household consumption by 50%, representing a reduction of about one-quarter in the public water supply and *sufficient to counter expected growth in demand for many years.*"

iii) The encouragement of domestic collection of rainwater

An average house with approximately 45 sq. metres roof area and in a region of rainfall of 800mm per year could collect 36,000 litres, about 20% of current consumption. Without any form of processing this water could be used for watering the garden or other non-potable uses. However, a more satisfactory arrangement would be to incorporate the water collected from the roof into the existing plumbing system or a secondary system for low grade uses, such as flushing and use in washing machines. On a longer term basis rainwater could be used for all purposes including drinking. The sterilisation process would be obligatory but also great care would be required in ascertaining the levels of atmospheric pollution in the vicinity. Collecting water near lead or cadmium processing plants would certainly be a risk (Harrison *et al*, 1975). Much more information is needed on this subject particularly on how to incorporate the collecting system into existing plumbing, on the maintenance of health standards, and on minimising costs. It is interesting to note that a construction company, John Laing Ltd., is actively involved in this line of development with the publication of a paper by David Stephens in the *Architect.*

v) Increase of recycling of water for industrial cooling purposes

Larger companies have had to recycle water in order to operate their respective processes. However, according to one company that specialises in water recycling units, Carter Cooling Towers, the medium and small size companies have neglected water conservation even though evidence from two independent companies that have installed cooling towers, points conclusively to the economic sense of this course of action. It is hoped that the water shortage last summer, the increasing cost of metered water and perhaps a joint DoE/Industry 'save it' publicity campaign could persuade companies to install recycling equipment which could reduce industrial demand by as much as 25%.

v) A consistently funded research effort to achieve a 12-month forecasting capability

Particularly striking, in the summer of '76 was the extent to which not only laymen but also experts at the Meteorological Office took the weather for granted. During the last few thousand years, the weather has indeed been relatively stable, but this does not mean that it always will be. In fact, evidence suggests that we are in for a period of serious climatic changes. (See Reid Bryson *The Ecologist*, Vol. 3 No. 10, Oct. 1973, and H. Lamb, *The Ecologist*, Vol. 4 No. 1, Jan. 1974).

Even with the resources available to a high technology society climatic changes are forces to which we must adapt ourselves. To do this a greater knowledge of climatology is required. As a start in this direction the pace of research in this field should be stepped up, with the medium term objective of achieving a 12 month weather forecasting ability. This would give the flexibility needed by farmers to sow crop varieties which would thrive in the conditions of the next growing season. Water economy measures both domestic and industrial, could then be introduced in good time.

5. Conclusion

The Government has recognised the need for a national strategy for water services, and has proposed in the white paper *Water Services in England and Wales: The Next Steps* that a National Water Authority be set up to prepare such a strategy.

It would be in the national interest for the Government to include as part of the Authority's tasks the full investigation of the effect of water conservation measures on future demand and to assess the environmental and economic advantages of a strategy based on conservation as opposed to one based on the accommodation of current trends towards even higher levels of water consumption. This is the fundamental decision that has to be made.

Up to the present time the decision has always been in favour of growth, but the pendulum is swinging. The sooner the Government decides to make better use of our existing resources the better the prospects for our environmental and economic well-being.

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YOUTH ENVIRONMENTAL ACTION

Affiliated to Friends of the Earth; Conservation Society; I.Y.F.

Youth Environmental Action (formerly the Schools Eco-Action Group) announces that it has a new co-ordinator and a permanent address. From October, the group can be contacted via Stephen Joseph at 173 Archway Road, Highgate, London N.6. (Telephone 01-348-3030). YEA hopes to expand its activities in the next year, by setting up new groups in schools (it already co-ordinates and helps the activities of several around the country), and by getting youth groups and clubs interested. Groups can get from YEA general help and advice; and (more specifically) information (including YEA's own Action Theme series) on likely campaigns, speakers, and a regular newsletter. Those interested, whether "youth" or adults, are invited to get in touch.

Atherosclerosis and the Refined Carbohydrates

by

David Greenstock

Although it is now widely accepted that much disease is caused by eating the wrong foods, the complexity of the problem is still little understood.
The currently fashionable culprits are saturated animal fats and cholesterol, but in this paper one of the most distinguished biologists working in the field of nutrition shows that this is based on a misconception.
It is, he suggests, in the disfunction of those organs of the body that would normally deal satisfactorily with these substances, that the trouble may be found, a disfunction that he relates to the excessive intake of refined carbohydrates — especially of white sugar and flour — which an unwary public consumes in a whole range of manufactured foods.
This affects not only our own health, but seriously undermines programmes designed to help Third World Countries where imported refined carbohydrates instead of relieving the problem of famine are increasing the incidence of ill health.

In view of the world situation with regard to food and hunger surely it is time to review the standards of adequate nutrition as established in the highly developed countries because, in their efforts to help the hungry in the Third World, they tend to apply those standards, and so very often do more harm than good.

The theme has many aspects, and it would be impossible to cover them all in one article, even in a summary fashion. The bibliography is there to show the importance of this subject, but it is usually only read by scientists. There have been excellent articles in *The Ecologist* recently which point out the dangers to health of food additives and the harmful effects of the extraction from natural foods of some of their essential elements.

Those who object to these adulterations of natural products are at once given the name of 'cranks' by Big Business, because of the need to promote sales and increase shelf-life of certain products. However, the evidence against them increases to such an extent that the World Health Organisation and other bodies concerned with this matter are now prepared to discuss it at a high level. In other words, there is something here which demands investigation, not merely from the point of view of the under-developed countries, to which these products are being exported, but also because of our own nutritional problems.

The medical profession is a 'closed shop' (rather like a religion), which has its dogmas and also its heresies. We have only to remember the life story of Pasteur to see how true this is. In the field of nutrition this has reached its climax. Very few medical schools or universities give full courses in nutrition, the training being limited to the usual carbohydrate-protein-lipid theory of many years standing. The science classes in schools neglect the subject and Government Departments, with few exceptions, do not help much, because little is done to counter this dietary confidence trick by means of a programme, destined to teach people what they should eat and why. Instead, the line of approach has been almost entirely biochemical, with the consequent limitations.

The result has been a 'global' view of nutrition, rather than an individual one which could take into consideration the characteristics of metabolism, which can, and nearly always do, vary from person to person. In its turn, this has led to an over-simplification of the basic concepts of nutrition and to a neglect of certain factors which are very important. Modern technology convinces the consumer that, if a product tastes and looks nice, it must be good for you. The truth is that some of these products have little nutritional value, some none at all, and others are harmful sooner or later. These products are being introduced into the under-developed countries, with disastrous effects. The worst offenders are the refined carbohydrates, but the same is true of many processed foods introduced into those countries as part of the campaign against hunger.

The object of the present article has to be a limited one, through lack of space, and is confined to a brief discussion of the relationship between the over-consumption of the refined carbohydrates, especially white sugar and flour in all their forms, and the whole gamut of cardio-vascular diseases, especially artherosclerosis and coronary thrombosis.

The medical profession admits the importance of the dietary factors in these diseases. The difference of opinion arises when the various elements in the diet are brought under consideration. The fashionable theory puts all the blame on the saturated fats and cholesterol, since these substances have been found as major components in the atheromas formed on the walls of the arteries, both within and beneath the intima, accompanied by hyperplasia and reduction or obliteration of the lumen of the vessels. Laboratory animals, fed on a high cholesterol diet, have shown similar lesions. From these facts it has been deduced that the cause of these diseases has at last been discovered — hence the rise in the sales of polyunsaturated fats of vegetable origin and the idea of prevention by reducing the consumption of food high in cholesterol.

Those who have pointed out that this line of reasoning contains several fallacies and passes over certain facts which militate against

the theory have either been ignored or ridiculed. One thing is certain — that few scientists have bothered to ask what could easily be the fundamental question: Why are these fats and cholesterol deposited on the walls of the blood vessels instead of being excreted? One could go a stage further and ask why those organs of the body which normally deal with the levels of fats and cholesterol fail to exercise this important function of excreting these substances when their levels are dangerous? One could push the issue still further and ask how it is that some people with a low level of cholesterol in blood serum nevertheless develop ischaemic heart diseases?

Before we condemn it out of hand as the villain of the piece we would do well to realise the importance of cholesterol in the human body, where it can be found in almost every type of cell, but especially in the brain and nerve tissues, adrenal glands and gonads, both in the free form and esterified with various fatty acids. It is essential for the biosynthesis of steroid hormones in the gonads and adrenal glands, together with the production of the estrogenic hormones which are used in the *treatment* of atherosclerosis. Any surplus which the body does not need can normally be converted into cholestanol and coprostanol, which are easily excreted. It contains Provitamin D_3 and other trace elements which the body needs.

It would seem strange, to say the least, that such a necessary and useful substance should be blamed for causing the very diseases which its derived components, some of which are cardio-tonic agents, can prevent. This makes it all the more important to seek a definite reply to the questions we have posed above. If this substance is deposited on the walls of the blood vessels, there must be an underlying cause for this error in its biological manipulation. It is our contention that, with a few exceptions, this cause can only be the over-consumption of the refined carbohydrates and that we now have evidence enough to present this as a working hypothesis.

The reasons for this statement are not easy to explain or to understand, because they imply at least three lines of argument, not all of which are logical from the biochemical point of view. However, with the risk of over-simplification, they can be reduced to these:-

a) The lack of fibre in the refined carbohydrates causes a delay of 24 hours in the elimination of waste products from the body, and thus allows time for the assimilation of certain cholesterol by-products which are toxic. This can be confirmed by simple laboratory experiments on animals and humans without risk.

b) The process of manufacture of these refined carbohydrates eliminates from the diet practically the whole of the Vitamin B Group, especially Vitamin B_6, which, in the form of Pyrodoxine, is an excellent preventive against ischaemic heart disease, and also Vitamin E, (Alpha-tocopherol), normally found in the germ of wheat and other cereals, which can control the balance of lipids in the blood serum and certain functions of the cells which line the walls of the arteries, without any other medication. This fact is too well known to be ignored, even by the biochemists. It is significant that, since the introduction into our diet of the refined carbohydrates, the normal intake of Vitamins is less than that advised by specialists in nutrition, especially where the Groups B and E are concerned. Yet it is these refined carbohydrates which we export to the under-developed countries in terms of aid to the hungry, but which, in the long run, will only lead to disease.

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Before we leave this part of the argument it should be noted that, as every dentist knows, the main cause of dental caries is the consumption of white sugar and other refined carbohydrates in every form. No scientists worthy of the name will refuse to admit this established fact. Now, the human body is made up of various types of cells, and it is not unreasonable to suppose that what is harmful to one type of cell may also be harmful to others. This statement may be considered as a mere hypothesis, but in fact the possibility of its truth is great, as we can see from the evidence concerning metastesis.

c) The third type of reasoning to support this theory of the relation between the refined carbohydrates and ischaemic heart diseases is based, not on strict logical argument, but on biological observations carried out in many countries over a long period of time. It has been eported from many independent sources that the incidence of cardio-vascular diseases in countries where these substances do not form part of the staple diet is very low indeed. owever, as soon as those same inhabitants begin to consume the refined carbohydrates in any quantity, the number of such diseases rises steadily, until it reaches the levels observed in the developed countries.

There are many facts of this kind which have been reported from all over the world and the literature concerning them is growing day by day. The statistics for war periods, during which these substances are not produced, or are severely rationed, show the same relationship, even though the consumption of high-level cholesterol foods is higher during these periods, owing to the increased use of eggs in all forms.

It is mainly on these three types of argument that the case against the refined carbohydrates and their effects on ischaemic heart diseases is based. If we add to them the other facts which have come to light during recent research into the causes of these diseases we can see that it would be wise to reconsider the cholesterol theory, no matter how firmly it may be grafted on the minds of the medical profession. Again, a brief summary of these facts may be useful.

Apart from the now established fact that laboratory animals fed on a

diet rich in refined carbohydrates do not live as long as others of the same species used as controls, and that the former show signs of atherosclerosis together with other cardio-vascular diseases, we are now in a better position to judge the results of these substances on certain organs of the body, with the consequent effects on the blood vessels and coagulation in particular.

Obviously, as we have already pointed out, it is highly dangerous to come to any decision based entirely on what happens to laboratory animals, whose metabolism is different from that of human beings, but at least it is an indication of the lines future research should take, especially with regard to nutrition, both in the young and old. We mention these two stages of growth especially, because they are the ones in which the consumption of refined carbohydrates is higher, for obvious reasons.

Doctors in civilized countries, where the usual carbohydrate-protein-fat standards are more than sufficient, are now coming up against cases of malnutrition among the very people who are presumed to be eating more than sufficient to provide all they need. This discovery is mainly due to the fact that modern laboratory techniques enable us to study the various stages in metabolism in greater detail than before. So far, there is no real explanation for this phenomenon except the ever-increasing consumption of refined carbohydrates at the expense of proteins and fibre.

There are now many cases of children under the age of 12, which show clearly a defect in the metabolism of refined carbohydrates, with significant changes in the blood sugar curve which, in former times, would have led us to suspect cases of incipient diabetes. The same is true of old people who have to live on a reduced pension. Many of them show the same symptoms, which are usually attributed to old age. The cheapest diet to satisfy hunger is one rich in refined carbohydrates, but it is not the best by any means.

It is interesting to note that, in the majority of cases, once these substances are eliminated from the diet, most of the patients, both young and old, show a normal blood sugar curve within a week or so. Those who do not react favourably show signs of other diseases of the liver, pancreas or intestines.

There is also evidence to make us suspect that the so-called Sudden Infant Death Syndrome (SIDS), usually attributed to glandular failure, is really due to the fact that mothers who do not breast feed their infants tend to increase the ration of refined carbohydrates, because they want a nice, fat, well-fed baby. Blood samples, taken from these infants, reveal that there is an inability to deal with highly concentrated carbohydrate foods, especially when they are refined and administered in large doses. The inability to breast feed may also be due to the fact that the mother has included these substances as an important part of her diet. This last statement needs further research, but the statistics show that SIDS is less common in breast fed infants. In itself, this is significant.

At the other end of the scale we have the old people, those living on a small pension and very often alone. Here again, the laboratory comes up with significant data, because this class of person tends to feed mainly on the refined carbohydrates, while their intake of protein is deficient. It is the 'jam-butty' mentality which stems from childhood. The 'sweet tooth' is one of the great enemies of this age group, because it is the cause of many diseases, previously classified under the heading of old age diabetes.

It would be easy, and perhaps more convenient, to bring this article to a close at this point; but in our opinion, it would not be fair. Apart from the statistical arguments we must supply biological data to explain why the over-consumption of the refined carbohydrates in all forms leads to atherosclerosis and other ischaemic heart diseases, especially of the thrombosis type. Valvular lesions of the heart are another problem altogether and do not enter into the scope of this article.

It is reasonable to suppose that, if any of the organs of the body are submitted to excess work, they will not be able to cope with it all, and the result will be a deficient metabolism. This is exactly what happens in the case of the refined carbohydrates. The body is not geared to deal with them in this form because they do not exist as such in Nature — they are unnatural, manufactured.

When the main organs of the body, such as the liver, kidney, pancreas and intestines are faced with the problem of dealing with these highly concentrated substances together with other foods, the result is a defective action all along the nutrition-metabolism line. It is just as if we over-loaded an electric circuit. The result is a blow-out or a fuse. As a result, substances get into the blood stream which should not be there, the intake of essential vitamins and enzymes either does not take place at all or is at least greatly reduced, while the lack of fibre makes the passage of food through the intestines so slow that it is easier for toxins to get into the blood.

Because of all this over-loading there may be damage to the walls of the blood vessels, whose normal methods of repair have been reduced. Nature has to use emergency methods to effect the repairs — and the result is the artheroma. According to this theory, these plaques are formed because the other organs and cells of the body have been over-worked in dealing with the refined carbohydrates, with the consequent breakdown of the ormal repair system.

This is not as odd as it may seem if we take into consideration the highly complex mechanism which the human body has at its disposal as a protection against damage to the whole circulatory system (the main element in the life cycle) and against certain types of thrombosis. This mechanism ranges from the *Mast* cells, of which we know so little, most of which can be found in the liver and along the walls of the blood vessels; the balance between the endoperoxides and prostacycline; the assimilation in adequate quantities of Vitamin B Group, especially B_6 and a host of other factors which it would take too long to describe.

It is this delicate mechanism which is thrown out of gear by the excess strain on the organs of the body through the over-consumption of the refined carbohydrates. When this gives rise to damage to the walls of the blood vessels the atheroma is a logical defence, even though it

may not be a beneficial one from other aspects.

There is evidence to show that the high density lipoproteins, which are an important factor in this defence against ischaemic heart diseases, can be converted into low density ones (which are dangerous) by a diet rich in the refined carbohydrates, and possibly, by some of the additives used in the production of other processed foods. This is a factor which needs more attention than it has received up to now, but one thing seems to be certain, namely that a diet which is low in these refined carbohydrates increases the index of the high density lipoproteins, with the consequent greater defence against atherosclerosis and thrombosis.

In this connection it is interesting to note that the extracts of certain plants, especially garlic and the Allium species in general, increase the index of these high-density lipoproteins, at the same time as they increase the assimilation from food of the whole Vitamin B Group by at least 12%. If we take into consideration the beneficial effects of these extracts on the production in the body of prostocycline and other anticoagulants (something which has now been definitely established as a fact), it would seem that more research is needed into the way in which these substances work and the enzymes they produce in body metabolism, as an important factor in preventive medicine — the great hope for the future.

In view of all this it would seem that it would be wise indeed to rethink our policy with regard to the exportation of these refined carbohydrates to the third world countries, and also perhaps to eliminate them in their present form from our own diet in favour of whole-meal flour and unrefined cane sugar (or honey, which is better). This would be cheaper for us all, better for our health, both of body and mind, and also would reduce the expenses of the National Health Service, especially as a preventive.

What is needed at the moment in all countries is a Ministry of Nutrition, run by people who have no connection with Big Business interests, and which could instruct the people concerning all aspects of nutrition, and which would take its part in all investigations with regard to the processed foods presented to the consumer.

We have to admit that, although the evidence for the relationship between the over-consumption of these refined carbohydrates and ischaemic heart diseases is growing daily, the final proof is still missing. For that reason this article presents a valid hypothesis — nothing more.

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Sex Boost for GNP

James Robertson (*this issue*) mentions a rather novel way of boosting GNP without increasing output one iota: simply make housewives do their neighbours' housework for a wage. This way their work is accounted for, and Britain's growth rate leaps dramatically — perhaps by 33% overnight.

The South African Supreme Court has, it seems, got wind of this challenge, and has taken it seriously. Apparently not content, however, with the modesty of the proposal, it has laid the ground for an even more radical programme of economic recovery. Wives, it has ruled, can charge their husbands for sex.

The ruling came after a husband had objected to his wife invoicing him for making love. But the Supreme Court was having none of this uneconomic behaviour. "Bed is the poor man's opera", said Justice Margo quoting Aldous Huxley, and went on to suggest that men might be glad to pay wives for sex as an 'acknowledgement of the wife's sexual adequacy.'

Clearly mindful of fair trading laws, and the need to curb inflation, the Judge's only other comment was that wives should not overcharge.

The Times 2.9.77

On the Tomato Treadmill

"I spent the day driving round the farm of a man in the Sacramento Valley who was typical of the farmers there except that he had seen the light. He farmed 1600 acres, 1400 of them down to tomatoes. Just tomatoes after tomatoes, every year, with massive injections of liquid artificial fertilizers and endless poison sprays of one kind or another to keep the plants alive. We drove for miles along a straight road on this flat plain with tomato rows stretching to the horizon as far as we could see on both side of us. Here and there, there would be a few rows almost blank: the tomatoes were nearly dead. "That's where the fertilizer spouts were blocked" said my friend. "This land will grow nothing without massive fertilizer injection."

He showed me a tomato-picking machine he had bought three years before for 30,000 dollars. It stood abandoned and useless, in a huge shed. He then showed me the new tomato-picking machine he had bought the year before for 40,000 dollars. "But that will join the others — I have already ordered a new machine for 60,000 dollars which we shall be using this season. That one will never be used again."

"Why?" I asked.

"That one needs 25 Mexicans riding on it to colour-sort the tomatoes. The new ones only need 5 Mexicans — they have an electronic eye which can tell red from green."

"Why can't you make do with the old one for another year or two?"

"I still haven't paid the money I owe for the machine before last," he said. "Labour costs have shot up this year. I can't afford to pay 25 Mexicans to ride the picking-machine. If I am going to pay the interest on the loans I had to make to buy the last two machines I have got to have the latest thing there is . . . All we medium-sized farmers are the same. We are all in debt and have given up all hope of ever getting out of it."

John Seymour, Resurgence Aug/Sept 1977

Down with the Piggeries

Three 14 storey flats in Liverpool, known locally as the Piggeries, are to be pulled down after only 11 years of use. All the inhabitants have already been evacuated, and the buildings have been abandoned to the vandals. Indeed it was the upsurge in vandalism that prompted the council into taking such drastic action — and their example is being followed by several other authorities. The execution order has also been passed on 8 neighbouring blocks in Kirkby, on 6 in North Tyneside, and 11 in Birkenhead.

The councils' desperation is shown by the enormous cost of demolition. Liverpool estimates that the cost of pulling down the Piggeries will be about £1 million. And all the councils face up to fifty years of loan charges which will have to be paid even though the buildings no longer exist. When all has been taken into account, the destruction of the Piggeries alone will cost Liverpool's ratepayers about £12 million. As one director of housing put it, "Why the hell did we build buildings like this?" It's a very good question.

Sunday Times 25.9.77

Malaria's Vicious Comeback

The worldwide resurgence of malaria has now reached such proportions that even the World Health Organisation are in despair. Fifteen years ago, they were confidently predicting that the disease would be swept away in a cloud of DDT. Now they admit: "We are in strategic withdrawal. The days of euphoria are over."

The resurgence of malaria has been most dramatic in India, where the number of reported cases has soared from an all time low in 1966 to 5.8 million last year. On one day this September in New Delhi, 9000 new cases were reported. The upsurge has been equally disturbing elsewhere in the world, with the overall total of malaria victims rising to some 120 million. Interestingly Great Britain is also having its malaria troubles. Once confined to only a few exiles returning from service in the colonies, the number of cases has increased from a modest 60 or so in the early 1960s to well over 1000 in 1976. And if the present rate continues, there could be over 2000 by the end of this year.

Although it is widely accepted that the failure of the WHO eradication schemes is the rapidity with which mosquitoes develop immunity to pesticides, the health authorities are trying to stem the tide of new cases with new chemicals. Needless to say, all evidence points to the mosquitoes becoming immune to these too. Will old dogs ever learn new tricks?

Time 12.9.77 and Doctor 14.7.77

Mad Cats and Cripples Come Out of the DDT

Whilst on the subject of anti-malaria campaigns, one might note some of the side-effects of the sprays being used. In Mexico, where DDT spraying still goes on, poor cam-

pesinos in the Oaxaca district have named the malaria eradication men, *los matagatos* — the cat killers. The reason? The cats lick the DDT off their paws and die of a disease of the nervous system. The result is that rats in the area have multiplied, are eating all the food and leaving the peasants hungrier than before.

And in Southern India, untouchables have been hit by an odd bone disease which causes a crippling deformity of the knee and hip joints. The disease, which has only emerged in the last seven years, has been positively linked to pesticide spraying in the area. Already, after the rice fields have been sprayed, en masse deaths among local fish, crabs and frogs have become a common event. Moreover, the paddies themselves are seriously polluted. Since the staple diet of the local poor is rice, supplemented in times of food shortages by the crabs and fish from the paddy fields, the locals are now subjected to massive intakes of pesticides. Tragically, they are finding that the modern road from the belly to deformity is all too short.

Time 12.9.77 and New Scientist 18.8.77

Youth for Ecology

Fed up with the political chicanery of the traditional parties, and with their refusal to come out against nuclear power, French youth is mustering around the ecological banner. A recent poll in the daily, *Le Figaro*, gives an indication of the strength of their commitment. Out of a sample of 5000 male and female students, 33% said they would vote for an ecological candidate, should one be presented, at the forthcoming presidential election. It would appear that the ecologists really have become the heirs to the Movement of May.

Le Figaro Sept 1977

Epitaph on the Green Revolution

The final words on the failure of the Green Revolution came last month from the Asian Development Bank. In a report it warned that food production is failing dismally to keep up with population growth, and in consequence a quarter of mankind is condemned to continue living in a state of poverty, hunger and malnutrition. 'In some countries, the per capita cereal production actually fell over the past decade,' claimed the Bank. It went on to point out that by 1985, Asia as a whole could face a deficit in rice, wheat and maize of 24 to 30 million metric tons. 'Overall, the most optimistic view which can be taken is that the region is not much worse off now than it was ten years ago.'

The Bank's view was also confirmed by the International Food Policy Research Institute. Projecting food shortages in some 82 Third World countries (containing roughly half the earth's population) the Institute warned that in total, there would be a grain deficit of some 70-80 million tons by 1990. If one remembers that the deficit was 12 million tons in 1975, one begins to get some idea of the starvation and misery that this will involve.

The Times 6.9.77 and Nature 6.10.77

Coming to the Obvious Conclusion

In the last four years, 280,000 American women have had breast x-rays in a programme sponsored by the National Cancer Institute. Last month, however, the NCI made a sudden volte-face. Having spent thousands of dollars persuading everyone that x-rays were safe, and routine breast check-ups essential, they have finally come to realise what the majority of us knew already i.e.: that they were wrong. In their statement they conceded that the potential risk that x-rays themselves cause cancer could outweigh the benefits of detecting a malignancy early. As a result, they have recommended that routine x-rays should be restricted to women over fifty and younger women who stand a high risk of developing breast cancer. How long before they too are excluded?

Newsweek 3.10.77

TUC into Breast Feeding

The TUC too are, it seems, playing the game of coming to conclusions that most of us reached long ago. At their conference in September, Miss Shirley Goodwin successfully moved a resolution for a campaign to promote breast feeding, matching in strength the sales promotion effort of the milk industry. She pointed out that breast-fed babies were less susceptible to serious infection, and possibly cot death and battering, whilst the mothers were less likely to get breast cancer. Sadly only 33% of women still breast feed their babies at the end of the first month, and even fewer do so after three months. ''Yet it comes in ready made, easy to clean, and, let's face it, attractive containers which don't have to be thrown away after use'', said Miss Goodwin. It's a sound argument.

The Guardian 10.9.77

Is this Cut Necessary?

Further confirmation for John Powles' thesis that modern surgery really does little good in many cases (see *The Ecologist*, October 1977) came in a report from the Harvard Medical School. During the last decade, it has become increasingly fashionable to operate on patients suffering from angina. Last year alone, some 70,000 Americans had such operations, at a total cost of 1 billion dollars. But for many of them, it will all be a waste of money and a needless risk: the patients live no longer than those treated with conventional drugs. The study's author, Dr. Eugene Braunwald, writes ''The findings put a damper on the almost explosive rise in this operation.'' He guesses that about half the patients undergoing surgery would be better off on drugs — and would save about 500 million dollars in medical bills.

Newsweek 3.10.77

Quotes of the Month

'One of the best things about modern surgery is that a surgeon can only operate on one patient at a time.' *Johan Galtung*

''Of course closing nuclear power stations will cause unemployment. But, then, so did closing Hitler's concentration camps.'

Alain Hervé

Books

A Box of Fudge

ENERGY OR EXTINCTION? THE CASE FOR NUCLEAR ENERGY. Fred Hoyle, Heinemann, £1.50.

"This short important book is unashamedly provocative", or so it says on the back cover. And so it is, but it is also a compound of minor inaccuracies, factual errors, confusing analogies, gross omissions and glaring contradictions — but more of that later. What Sir Fred Hoyle has done, and done in a hurry by the look of things, is to argue the case for the Canadian CANDU unenriched uranium reactor, and to hypothesise that the anti-nuclear campaigners, Friends of the Earth in particular, are the agents, perhaps unknowingly, of the Kremlin.

To take the second point first: Friends of the Earth, UK branch formed in 1970, exist mainly on donations; they are permanently short of money, although they had surprisingly little difficulty in raising the money to contest the Windscale Enquiry; and their sponsors have included the Town and Country Planning Association and the Rowntree Trust. In fact there is so little evidence to support his suggestion that, after prodding from F.O.E., Heinemann have had the good sense to issue a disclaimer saying that the publishers and Fred Hoyle regret that people may have interpreted what he wrote as implying that F.O.E. were in any way influenced by the Russians.

But, by his hypothesis, whether the West is to escape creeping Russian control of world energy sources by developing nuclear power, or by developing, say solar cells as part of a comprehensive alternative technology package, as some environmentalists desire, is immaterial. So on what, if anything, does his proposition rest, if not on memories of the Cold War?

It rests on the inference that nuclear energy, probably from the CANDU reactor, is the only promising source of energy that can be developed in time to replace rapidly depleting hydrocarbon fuels without our having to revert to a non-energetic dark-age. Unfortunately, it is in the comparisons of the relative merits of alternative technology and nuclear power that the deficiencies referred to at the beginning of this review begin to accumulate at an astonishing rate.

One of the more obvious deficiencies occurs when the performance of the CANDU reactor at Pickering (Canada), which is central to his argument, is discussed: "although it is usual for such first-off-the-line projects to give teething troubles, Pickering ran well from the beginning." Until, presumably, 10th August, 1974, two years after going critical, when three of the pressure tubes in Pickering 3 were found to be leaking — after 2 tonnes of radioactive heavy water coolant, costing $66 per kilogram, had escaped into the space around the cooling circuit. Several months later Pickering 3 was still closed as the identification, removal and replacement of faulty tubes continued. The same problem kept Pickering 4 out of commission from May 1975 to April 1976. The CANDU reactor has performed better than most, so it would not seem necessary for Sir Fred Hoyle to distort facts to suit his argument. Perhaps this glaring omission occurred by oversight?

But then the discussion of the dangers of nuclear weapons proliferation that may result, and have resulted, from the spread of nuclear energy are dealt with in an equally misleading manner: "The association in their minds (of nuclear energy) with nuclear bombs is strong, and they tend to think the two are really the same thing. Logically this attitude is not very sensible, any more than it would be sensible to say that because eating a piece of chocolate and exploding a hand grenade are both manifestations of chemical energy, the two are the same." This analogy is backed up by a footnote that says: "Both TNT and chocolate are made up from atoms of hydrogen, carbon, nitrogen and oxygen. If one wanted to go to the trouble, the chocolate could be made into TNT." Is this meant to imply that the danger of nuclear energy encouraging nuclear proliferation is as remote as the likelihood of using chocolate to make hand grenades? The analogy would be less disingenuous, but for the fact that nuclear reactors, from the time of the Manhattan Project to the Indian explosion of 1974, have been used as the principle source of plutonium for atom bombs. Indeed, as Sir Fred Hoyle forgets to point out, the CANDU reactor produces plutonium at twice the rate, for a given power output, of nuclear reactors using enriched uranium. The author seems to be in the position of someone advocating playing with fire; only to be surprised when subsequently they have their fingers burnt.

When considering alternative sources of energy he appears to begin from the *a priori* belief that there can't be "any serious debate over the statement that the only alternative energy source *presently known to be technically viable* is energy from the nuclear fission of uranium and thorium." Thus begins the chapter on non-nuclear alternative energy sources, and so it is hardly surprising they receive a rather dismissive treatment, even though, for example, the Danish Gedser windmills were technically and economically feasible until the arrival of cheap oil in the '50s.

Energy or Extinction might have been an important work, if Fred Hoyle had been less ready to select only information favouring his point of view, or to introduce red herrings like Russia motivating the anti-nuclear campaigns. Similarly, arguments to the effect that spending money on research into alternative technology is a waste of money because very little money has been spent on this so far, apart from being fatuous, if applied to nuclear power, would have prevented its development.

It turns out that the book is annoying, rather than provocative, because it fails to give a balanced view of the merits and demerits of alternative technology *viz-à-viz* selected nuclear reactors. Sir Fred Hoyle, by his one-sidedness, may have done nuclear power a dis-

service in the long run. But then, Heinemann may be the principal offenders, in having made such great haste to join the nuclear publishing race.

Dave Smith

The Good Earth

SOILS: AN INTRODUCTION TO SOILS AND PLANT GROWTH by Roy L. Donahue, Raymond W. Miller and John C. Shickluna. Prentice-Hall Inc. £13.55.

Any farmer will tell you that soils are almost infinitely variable. This makes them forbiddingly complex to study, and since their composition and biological activity involve so many geological, physical, chemical and living processes, the soil scientist must have a good working knowledge of many different disciplines.

Having said that, the study of soils falls properly within the range of the earth sciences and for this reason most textbooks on the subject place heavy emphasis on soil geology. This book is the exception, concentrating more on agriculture and other soil uses, yet retaining as much geological information as most students will need. The gain is in a very wide coverage of, for example, water conservation and management, soil erosion and its prevention and cure, the role of organic matter, and agriculture generally. It describes tropical and subtropical soils and the unusual soils — such as the polders formed by land reclaimed from the sea — that call for special treatment, and it contains the almost obligatory chapter on world food supplies. The book's greatest contribution to a general understanding of soils may be its full and lucid explanation of the new system of soil classification, which is almost Linnaean in the way it arranges soil types into a logical and consistent hierarchy, but formidable in that it describes more than 10,000 soils.

The book is not without its faults, however. Its overwhelmingly American orientation leads it to a view of agricultural development in the Third World that is politically naive. Although it deals fully and very usefully, with the role of organic matter in improving the structure of soils and in supplying crop nutrients, it deals cursorily and, in my view, unfairly with organic farming. The authors even go so far as to reproduce the results of trials that show organic methods to be so disastrously unsuccessful that no intelligent person could possibly waste time with them. These results differ so widely from the results of countless other trials that I wonder whether something went drastically wrong with the experiment or whether it was intended to prove that chemical fertilisers are all that stands between us and starvation? They produce figures, too, for average cereal yields in several countries that bear no relation to any figures I have ever seen. Those for the UK, for example, cannot be reconciled with the official figures.

For all that, the book is good value provided you accept what is clearly fact and discount some of its opinions. Do not be put off by the price. £13.55 is a lot to pay for a book, but with about 550 pages plus a long glossary, and many illustrations, it is good value and it will not date quickly.

Michael Allaby

By the Seaside

COASTAL ECOSYSTEM MANAGEMENT by John Clark (ed.). John Wiley & Sons Ltd. £28.90.

Designed as a technical manual for those engaged professionally in the management of coastal areas, this book could be of interest and value to a much wider readership. Indeed, students, amateur naturalists and geologists, as well as environmentalists, might welcome it as a permanent reference work on their shelves. It is very comprehensive, describing lucidly and simply the main ecological concepts relevant to coastal zones and the ecology of those zones in more detail. It describes the main threats to the physical fabric and to the flora and fauna dependent upon it, and proposes many ways in which these threats may be contained. It lists the main methods of treatment for many industrial effluents that, all too often, find their way into surface waters, and it tells how the quality of the water and of the coastal environment is usually assessed. Throughout the book is well illustrated with line drawings and halftone photographs.

Its readership is bound to be restricted, however, by its very high price. This is regrettable, but it may not be necessary, at least for readers outside the United States. Considerable space is given to specifically US management programmes and legislation, which have no relevance to, say, European readers and while the entire book deals exclusively with the United States, it is only these sections that are affected: elsewhere, an oceanic coastline or an estuary is subject to similar threats and responds to similar treatments throughout its particular latitude, at least in general. If these particularly American chapters were omitted, together, perhaps, with those describing North American tropical and subtropical coastlines, it might be possible to retain the rest and produce a smaller, but cheaper edition. This could prove very popular.

Michael Allaby

Growing and growing and growing . .

HOME FARM: Complete food self-sufficiency. Michael Allaby with Colin Tudge. Macmillan. £5.50.

If worthwhile changes in Agriculture and food distribution are to be made it is necessary that the general public should have a much clearer understanding of the processes involved. Although interest in the possibilities of family and also of *National* self-sufficiency is increasing rapidly, most laymen still display an almost frightening ignorance of the real sources of their food supply. The gap between those who live in rural communities and their urban brethren is still enormous. Despite the natural conservatism of most farmers changes are often swift and when reported in the farming press or in TV programmes are not always in a format easily understood by anyone outside the dwindling and ever more scientifically orientated elite.

In *Home Farm* Michael Allaby and

Colin Tudge cover the whole range of modern farming from giant agribiz enterprises to backyard smallholdings and from greenhouses to roof gardens. Here is a cool and detailed look at the practices and malpractices of recent years, always with due consideration given to the pressures which have shaped these events. There has been a tendency to level at farmers accusations of outright profiteering at the expense of the environment. Accusations which the authors point out are not usually justified. More and more farmers are forced into a situation where to stay in business they *must* look to short term profits. Farmers know that farmyard manure is good for the land, but there isn't enough of it. Monoculture and the use of chemicals have become the economic alternatives to the old fashioned mixed farming and balanced rotations.

The book includes a synopsis of farming activities in different regions of Britain and takes a look at some future trends. One of the most promising and least developed as yet is fish farming. The development of both fresh and sea-water fish farming enterprises is hampered at present by many regulations and a lack of sympathy from planners and other government departments. There is hope that the laws governing the raising and harvesting of the fish will soon change, aided by pressures from the Fish Farmers' Union which is affiliated to the N.F.U., and also as new Common Market proposals come to be accepted.

Home Farm is divided into five main sections covering just about every method of producing food in this country, including extraction of leaf and microbial protein, the bioplex and its more practical counterpart the city farm; in addition it describes most known temperate food crops and livestock, both the expected and the surprising (llamas) that may be turned to good use. The authors raise the vegan argument, questioning whether we really need animals in our food production cycle. They point out that although it would not be to the taste of the majority, it is certainly true that we could be amply self-sufficient in food if we adopted such a policy. They suggest, however, that a more likely trend for the future will be a gradual decrease in the numbers of animals on farms, thus freeing our farmers from their present dependence on imported grains. A return to mixed farming with its ability to cope economically with the vicissitudes of local and world markets, and a wider range of food crops for both on and off farm consumption is their prediction for the future of farming in this country.

The book is well illustrated and contains a useful list of organisations, services and literature. If you are considering the possibilities of a rural way of life, or if you want more information about the areas of self-sufficiency available to the urban dweller, or if you just want to be better informed about food production and farming, then *Home Farm* is a good book to consult.

Trevor Lawrence

Misleading and False Information

We are increasingly shocked by the shameless way in which 'experts' acting for Government departments and private industries are willing to publish purposefully misleading and often demonstrably false information in order to defend environmentally damaging industries that they wish to promote. Particularly shameless examples are — a book entitled 'Why Additives?' published by the British Nutrition Foundation, also British Nuclear Fuel's testimony at the Windscale Public Inquiry.

In order to help people in the Ecological Movement to deal with these 'enemies of the earth' we would like to publish a handbook that would expose and discredit the publicity put out by them.

We would be very grateful indeed to any of our readers who would send us material that would help us in the compilation of this handbook.

This Month's Authors

James Robertson . . .
is an independent writer, lecturer and consultant. His books include *Reform of British Central Government* (1971), *Profit or People?* (1974) and *Power, Money and Sex* (1976. Most of his current work — in France and the USA and Canada as well as in Britain — is concerned with the practical implications of the post-industrial transition.

Denis Hayes . . .
is a senior researcher with Worldwatch Institute and author of *Energy — The Case for Conservation,* and other titles published in the Worldwatch series and available from *The Ecologist.* 'Plant Power' is an extract from his recent book *Rays of Hope.* His research encompasses alternative global energy strategies, energy conservation and nuclear proliferation.

Keith Humphries . . .
is a physics graduate of Essex University and after post graduate studies at Sheffield is now working as a senior medical physicist at Southgate General Hospital. He has been involved in Friends of the Earth recycling campaigns and is co-author of the pamphlet "Waste Not". His main concern at present centres on means of achieving a sustainable economy.

David Greenstock . . .
is a biologist, a disciple of Professor A.S. Balachowsky and Vice-Chairman of H.D.R.A. He is Director of a laboratory dedicated mainly to Biocontrol methods in agriculture, to avoid the use of toxic chemicals; primary and secondary Myotoxicosis diseases and other fact ors which influence plant and animal nutrition. For ten years or more he has studied the effects of processed foods, especially the refined carbohydrates, on human metabolism. He is the author of several articles on these subjects, mainly in *Ceres.*

Letters

The Academics and the Environment

Dear Sir,

Considering environmental education as a whole, most commentators point to its critical importance in formulating new attitudes and behaviours for survival tomorrow. The Ecologist from time to time has followed this theme. In the issue of March this year (Vol. 7, No. 2) Carey and Abbs propose the formation of a New Ecological College.

Anyone aware of the need for changes in education, particularly environmental education, is cognisant of the gap that exists between our present system and our future needs. I feel the bridging of this gap is as much the duty of educators in schools such as my own, as of the philosophers of the eco-movement, who publish in The Ecologist.

I have been aware throughout my course in Environmental Sciences at the University of East Anglia (which I originally saw as a prime vehicle for increasing my environmental awareness), of the constricting nature of our academic institutions. The course at U.E.A. does offer potential in that a thorough grounding in the environmental sciences is offered. There are also future hopes for the development of the intermediate technology side. But for the moment, the bias most of us feel, is to turning out environmental technocrats, more able to monitor the ablutions of industry, than to develop divergent thinking on environmental matters. In fact, in practice the gap between environmental knowledge, atttitude and behaviour has never been more poignantly exposed than in the members of the School.

It is difficult to teach environmental science outside our present academic institutions, and it is these which can often be faulted. The academics, one must remember begat and nurtured by the present system, look for work that neatly quantifies and isolates environmental problems, because undergraduate courses are mainly geared to sifting out the five per cent who will go on to do research. The multi-faceted nature of many environmental problems emphasises the particular waste of this process. For example, high marks are often given in projects which correctly identify the spatial occurrence of trace elements in crabs, but not those who set themselves the difficult task of bringing together many diverse elements in an environmental plan. The lecturers were bred in pure science, and this is what they seek to perpetuate and foster.

Richard Sanbrook, formerly of F.O.E., and now working with Barbara Ward on the U.N. Habitat programme, in a recent talk at U.E.A., admitted that the recognition of environmental constraints is now at least acknowledged by governments. Recent years have brought some important, if not totally far reaching, environmental legislation. Sanbrook now sees economic circumstance, as much as eco-activists, stimulating environmental change.

The potential of the School of Environmental Sciences is not recognised at present, except by a few deviants. So much could be achieved with the present coherent faculty under one roof, in formulating sustainable strategies for tomorrow. Instead the faculty often lose themselves in some comparatively obscure research topic. Students leaving the School fulfil their potential, little more; two thirds or more of environmental graduates leave for careers in non-environmentally associated matters.

Rather than setting up new institutions as Carey and Abbs suggest, modifications in the ethic of our present schools might achieve similar results. But their notion of an 'economic approach' could be followed. The Ecologist should ask on behalf of all environmentally interested citizens, "are we getting good value from our environmental academia?"

Yours faithfully,
Simon Lewis,
School of Environmental Sciences,
University of East Anglia.

Soft Defence?

Dear Sir,

There is one aspect, at least, of ecological policy which has not received the elaboration it deserves. It is defence policy. Yet it would seem to be crucial to the chances of any ecological programme.

If we believe that a stable self-regulating society can only be achieved by way of decentralization and a maximum of participatory democracy, these principles must surely also apply to defence. But in that case today's large centralized armies with all their heavy offensive weaponry, and particularly their nuclear arsenals, are an anomaly. Are we not once again witnessing the military establishment's propensity to keep on preparing for yesterday's wars? Surely the way to prevent a nuclear war is not by arming for one. It is only a country that feels its survival threatened, that is likely to use nuclear weapons. And the more nuclear arms proliferate, the easier it becomes for the military to convince the public that such a threat exists. But today's threats come from a different quarter — from internal disruption. It is precisely these which an Ecological Programme is designed to eliminate at their source.

Throughout history and all over the world, democratic societies have become totalitarian when they abdicated their right to self-defence to military cliques. The only way to preserve participatory democracy is to actively involve the whole population in every aspect of life, not excluding the defence of society from all threats, be they internal or external. It is also the only effective way of defending a country without arousing the spectre of nuclear destruction. When a society is cohesive and all citizens feel they have a stake in it, it is also possible to train all its able-bodied men and women in guerrilla methods and arm them with sophisticated light weapons if needed. Such a country could be invaded, but never subdued.

Now the pattern of our defence policy determines that of our energy policy. Firstly because, whether they admit it or not, governments foster nuclear power programmes at least partly in order to build up their nuclear strike capability. And also because the capital absorbed by heavy conventional and nuclear arms and the associated R & D effort, is consequently not available for the development of a new "soft" energy base. We must, therefore stress that

1. Heavy armaments are unnecessary and diminish rather than increase national security. Instead, there should be effective self-defence training and a provision of sophisticated light arms for the whole able-bodied population.

2. Renewable energy sources are adequate even for our present rates of consumption, but their development requires the sort of effort presently channelled into nuclear energy. A reliance on nuclear energy would be ruinous economically and would spell almost certain destruction, if not for ourselves, then for our children.

3. To ensure a society not prety to internal disruption, a participatory democracy based on de-centralization must be built up and some of the resources presently channelled to defence [both internal and external] devoted to providing a better quality of life for all.

4. The fetish of "growth" must be exposed for the chimera it is. This, combined with a drive for ever increasing exports, guarantees the early depletion of resources and international conflict.

I feel there is a certain consistency in the above policies, which are after all no different from the ones outlined in "A Blueprint for Survival". But, for them to gain a wide acceptance, a great amount of work needs to be done. The scientific community will need well documented arguments to convince it and a vanguard of activists will have to be created from the strong nucleus which already exists, to mobilize the general public — including the Trade Unions, Politicians and civil servants will be the last to embrace policies which go against all their preconceived ideas and are contrary to the advice of the military establishment.

Yours faithfully,
Frank Kras
L'Odeon,
Paris.

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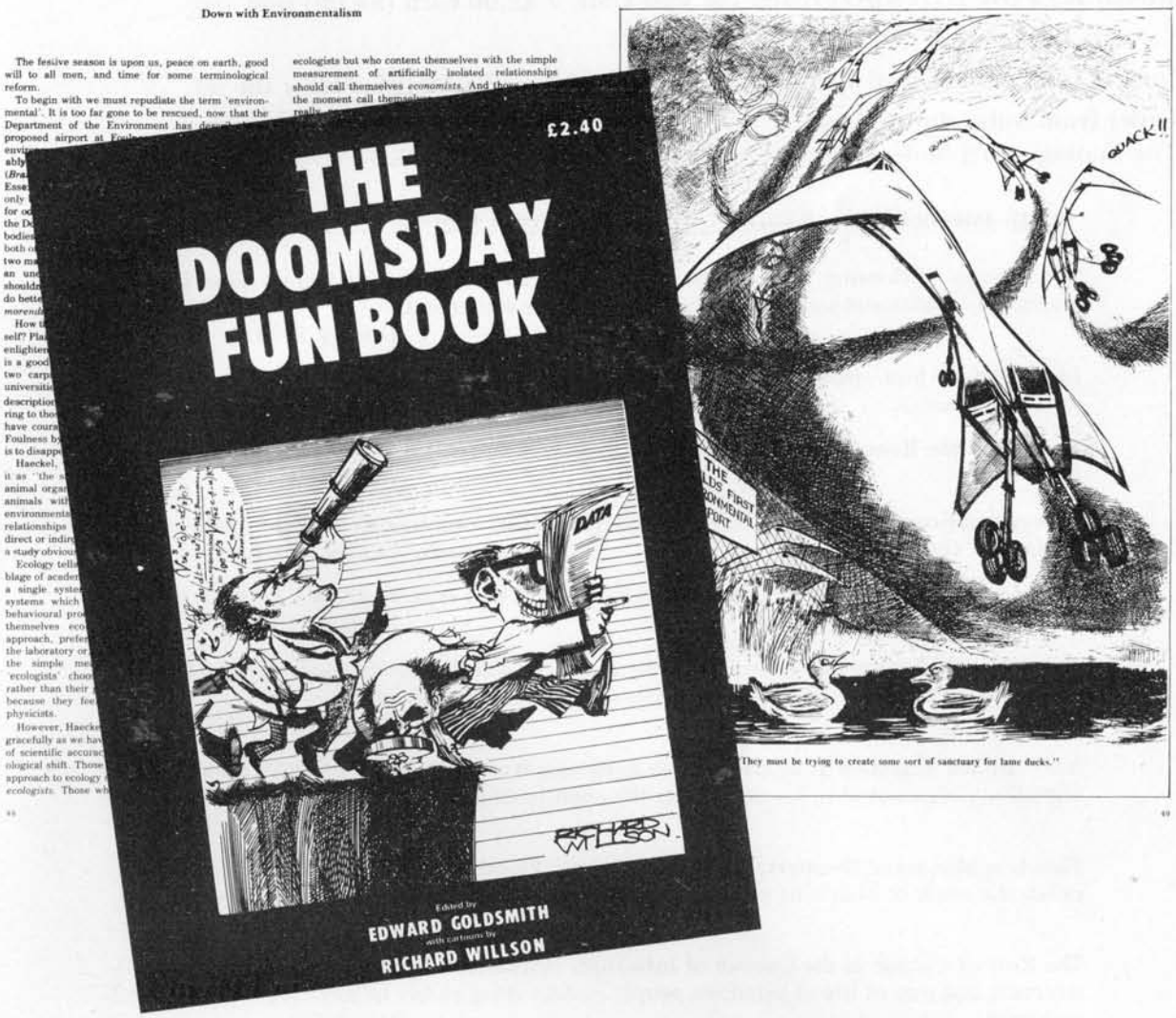

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