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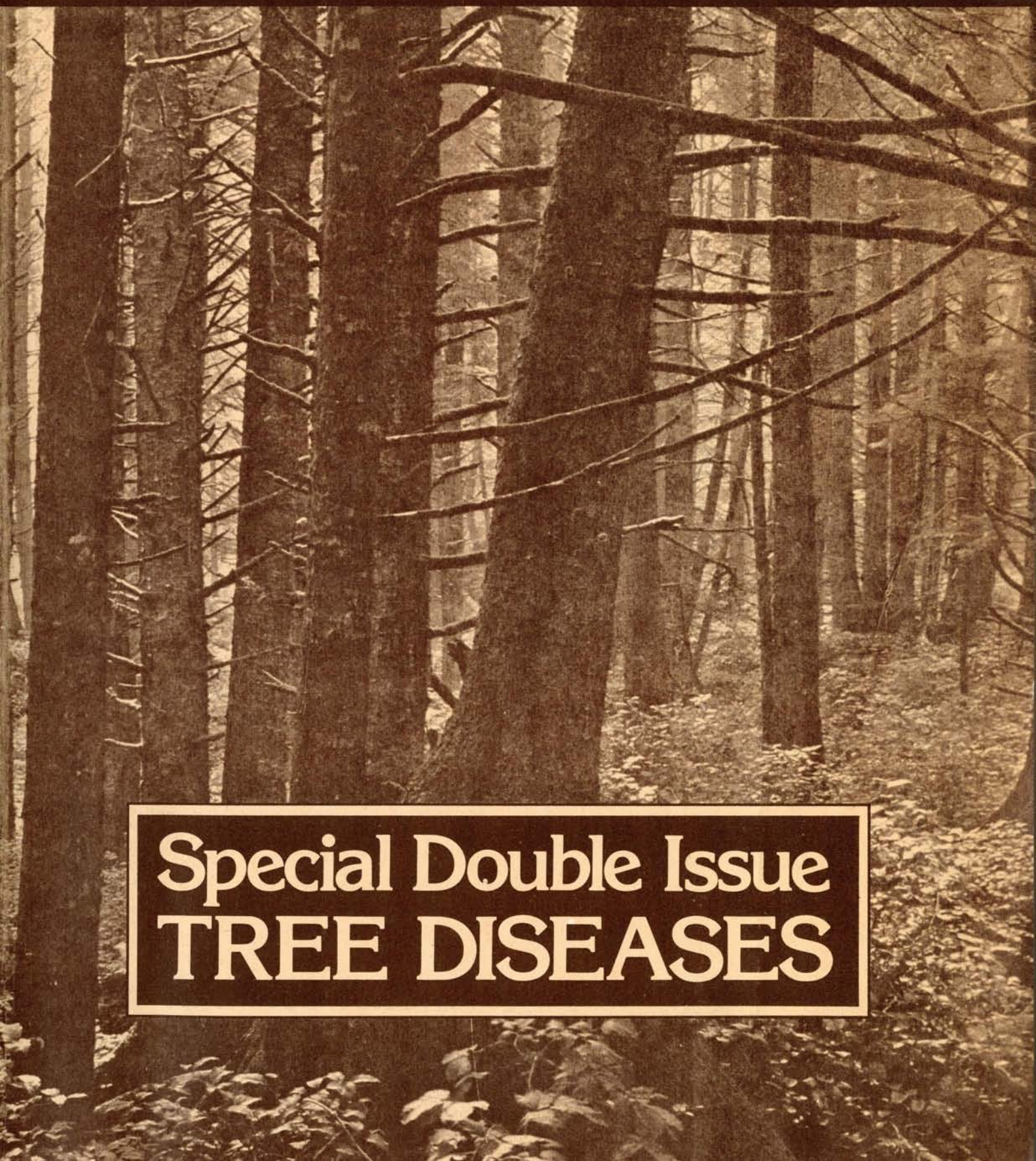

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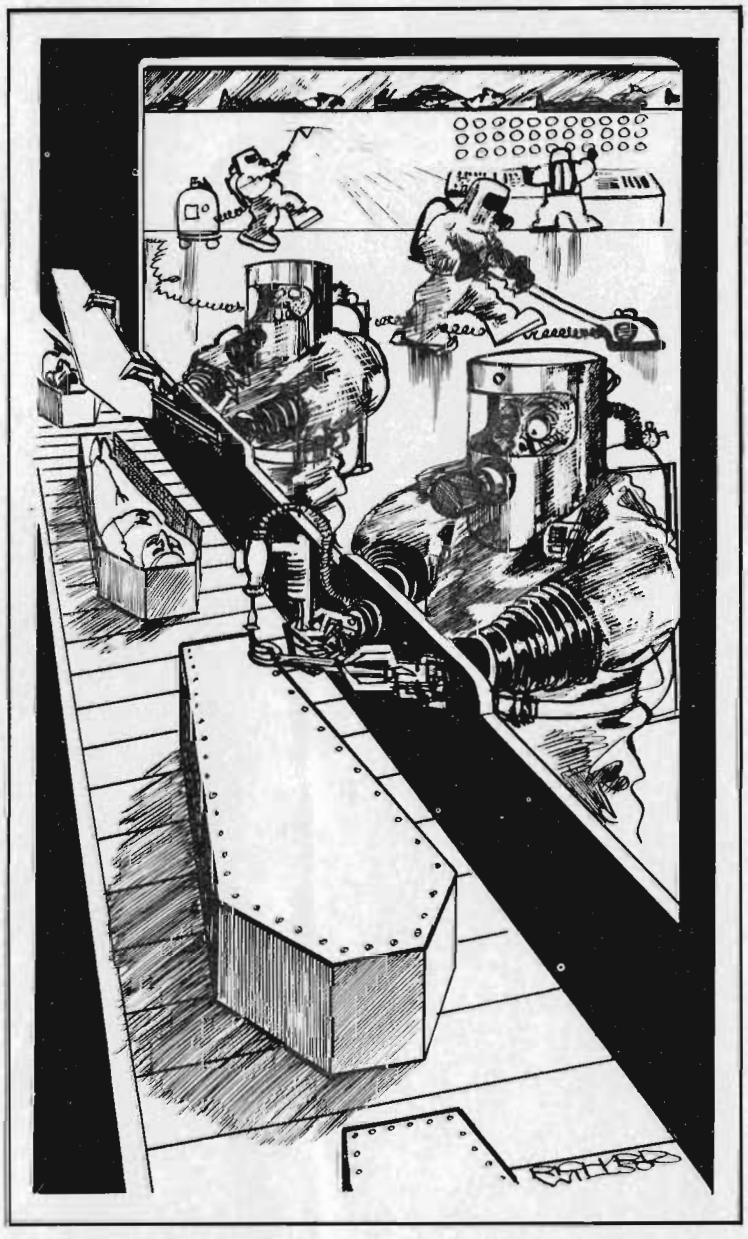

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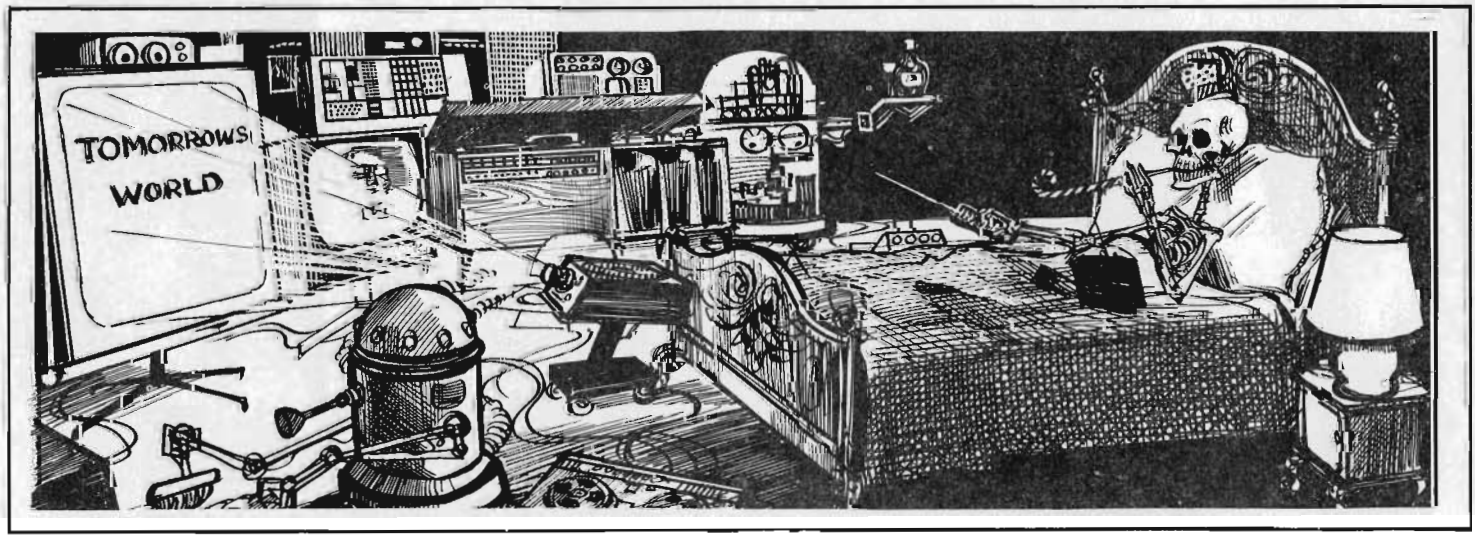

The
Ecologist

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Report

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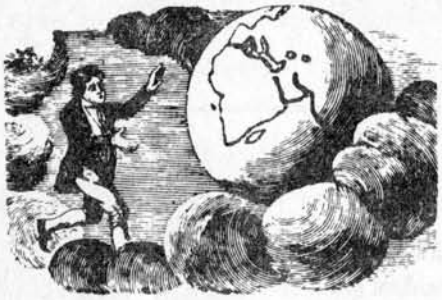
Editorial



The Illusion of Power

The main argument against Britain's membership of the EEC is that it must impinge on our national sovereignty. People seem alarmed that we should be run by Brussels rather than Westminster. But is this fear justified? I do not think it is. If one considers the very important changes that have occurred in this country over the last thirty years, one finds that none were brought about by conscious decisions made at Westminster. The operative factors were of a very different order. As Polanyi showed in his key book 'The Great Transformation', once a society is caught up in the market system things cease to be done because they are desirable on biological, ecological, social, or purely aesthetic grounds, but *because they are 'economic'*, in other words because they best satisfy the requirements of the market.

The form of our settlements, the shape of our houses, the type of food we eat, the clothes we wear, the work we do, indeed almost every aspect of our lives, have now come to be determined by market forces. If our cities have been transformed into urban waste lands, our countryside deprived of its trees and hedgerows, and if our food has become increasingly highly processed, more devitalised and more tasteless, this is largely the result of our frenzied efforts to satisfy the exigencies of this ever more exacting task master.

The second factor that has transformed this country is the technology that has been developed so as to further increase the throughput of goods and services via the market. Technology, contrary to what we are told, is not neutral. Once a new technological invention is commercialised it must affect our society regardless of decisions taken by politicians. For instance, few things have changed society more than the invention of the motor car. Our cities have been reshaped to accommodate it. So have our lifestyles. Increased mobility has had a dramatic effect on social relations, reducing the power of the family and of the community which once effectively controlled, as they must do, the behaviour of their members. Television has had a similar effect. While the automation of our manufacturing — and increasingly of our service industries — has not only transformed the working life of a vast sector of our society but has further transformed our social structure and our lifestyles. As Mathes and Gray pointed out in *The Ecologist* (May 1975) the engineer has a far greater influence in shaping society than does the politician.

A third factor has been our burgeoning bureaucracy. The expansion of the market system was found to create all sorts of serious problems. As Polanyi pointed out, it transformed a settled people into a nation of 'shiftless migrants'. People were torn away from their families and communities so as best to fulfil their economic functions wherever they happened to be required. What is more, the material benefits they derived from the market failed to compensate for the social capital of which they were thereby deprived. To internalise these social costs there grew up a vast state bureaucracy whose function was precisely to solve the problems generated by the operation of the market. As the latter expanded so was it necessary for the former to do so as well. As Galtung points out, there is a perfect symbiosis between industry and bureaucracy. Industry creates the problems, bureaucracy tries to solve them. Industry would not be tolerated if there was not a bureaucracy to fulfil this function and there would be no bureaucrats if industry did not create the problems they are engaged to solve. Today perhaps half of our GNP is spent on supporting this bureaucracy. Its effect on society is devastating. Indeed what remains of our social fabric — that which survives the destructive impact on it of the market system and of modern technology — must inevitably succumb to the possibly even more disintegrating effects of an all-pervasive bureaucracy which, by usurping all those functions that should be fulfilled at a family, community and regional level, must inevitably assure the breakdown of these essential but now redundant units of social organisation.

Our politicians at Westminster have done nothing to reverse these obviously intolerable trends. On the contrary, in order to obtain electoral support, they have done everthing to accommodate them. The principal role of the Westminster parliament has been, in fact, that of a catalyst for social disintegration. When the Westminster parliament does take action, it is usually but to mask the less tolerable symptoms of the disease whose spread it is doing its utmost to accelerate.

Thus in answer to rising inflation, successive governments have adopted no more daring a policy than to set up a Price Commission, which all thinking people must realise cannot in any way contribute towards reversing the trends that are causing prices to rise. At least Mrs. Thatcher's government has had the honesty to abolish this particular form of humbug.

When, a decade ago, environmental degradation, resulting from the consequences of our economic and bureaucratic activities, became too apparent, our government responded by changing the name of the Ministry of Housing and Local Government to that of the 'Department of the Environment', thereby hoodwinking the public into thinking that something was really being done to preserve what remained of our

devastated countryside and of our mutilated cities, and to undertake positive measures to prevent the further contamination of our rivers, our estuaries, the food we eat and the air we breathe.

Overall effective action to reverse these trends has never been undertaken.

Today, of course, our society is at a crossroads. During the next decades our society will be changed out of recognition by forces of whose very existence the government at Westminster is only beginning to be aware, forces whose effect it must be to force us in the opposite direction to that in which we have been blown by previous winds of change.

Among other things, we are now having to contest economically with an increasingly industrialised world. We know that an industrial society can survive in a non-industrial world from which it can obtain its resources and to which it can sell its manufactured goods, but there is no precedent whatsoever for an industrial society surviving in an industrialised world in which every country requires the resources it produces for its own industrial development, and is increasingly capable of producing itself those manufactured goods that Britain once provided. The problem is exacerbated by our growing inability to compete with these new industrial countries, probably because we were the first to enter the industrial game and are now bored with it. Also just as private industry generates a new set of values and social attitudes so does bureaucracy, and those that the latter generates have had time in this country to permeate all sectors of society with a disastrous effect on the spirit of enterprise required to maximise commercial competitiveness. Against these factors, the Westminster parliament has attempted to do little. On the contrary, it has proved politically expedient to encourage them and so further reduce the competitiveness of our industrial enterprises.

But even if we were as competitive as Taiwan or South Korea, this would probably have little effect in shaping our society in the next decades. The real forces from now onwards will be the growing energy and resource shortages that our wasteful industrial system has given rise to and the present translation of biological, social and ecological costs, incurred as a result of our industrial activities, into economic costs that we must find ever less possible to meet.

Our choice today, as we pointed out in our 'Blueprint for Survival' seven and a half years ago, is either to reduce the impact of our destructive activities on the natural systems that make up the biosphere, thereby reducing at the same time our dependence on energy and resources that cannot possibly be available i.e. bow to the forces that we cannot control; or to continue pretending that they are not operative or, more naively still, that we can control them, and thereby 'delegate to disaster'.

If we are to adopt the first course, then it is more likely than not to be as a result of political and economic pressures exerted on us from outside this country. In this way the International Monetary Fund (IMF) forced the last Labour government to cut down on the increasing government expenditure required to finance our growing state bureaucracy. In the same way too the Organisation of Petroleum Exporting Countries (OPEC) is now forcing the present government to reduce our oil consumption and hence the scale of our economic activities. Perhaps the European Parliament at Strasbourg might influence us to adopt other policies that would help adapt us to world realities. On the other hand, if it is left to Westminster, we can predict, on the basis of past experience, that political expediency will remain the determining factor, and so as best to serve it, we must continue to move as we are at present, in the direction of economic and social catastrophe.

Edward Goldsmith

The Zirconium Connection

by Daniel M. Pisello

The vast majority of nuclear reactors are operating with a fatal design flaw. The reactor fuel must be sheathed in cladding, and the material currently used in Light Water Reactors is an alloy of the metal zirconium. This alloy has the dangerous property of reacting explosively with water. Yet there is no other material that can replace it.

The inherent dangers of zirconium cladding have been the object of a massive and insidious cover-up on the part of the American nuclear industry and the United States Nuclear Regulatory Commission (NRC). The recent accident at the Three Mile Island reactor in Harrisburg Pennsylvania has brought to light both the design flaw and the extent of attempts to conceal it. All Light Water Reactors (LWR) — both the Pressurized Water (PWR) and Boiling Water (BWR) types — are affected by this flaw. According to the World List of Nuclear Power Plants published in *Nuclear News,* February 1979, all but one of the 68 plants in the United States are LWRs. The same source indicates that 85% of the nuclear power plants in the world outside of Great Britain are LWRs. Great Britain has currently no LWRs, since its own powerful nuclear establishment has so far resisted the world-wide marketing efforts of the American nuclear industry.

Three Mile Island

The dangers of zirconium are well illustrated by the events at Three Mile Island. Mechanical difficulties, the details of which are not of crucial importance here, led to a partial loss of coolant, and a partial meltdown of the reactor core (see *The Ecologist*, May/June 1979). As an emergency measure, reserve cooling water was sprayed onto the dangerously exposed and overheated core. Several days later it was reported that a huge bubble of flammable hydrogen gas had formed unexpectedly inside the reactor vessel. This bubble not only interfered with efficient cooling of the damaged core but also presented the frightening possibility of a hydrogen explosion whose likelihood increased hourly as the oxygen concentration in the bubble approached a critical level. Such an explosion would have ruptured the containment vessel, precipitating a meltdown and resulting in large scale and long term contamination of the atmosphere and the Susquehanna River valley. Spokesmen for the utility company and the NRC claimed ignorance on the subject of the origin of the hydrogen bubble, referring to it as a "new twist" and "something that had not been foreseen when the reactor was designed". The next day the bubble shrank and disappeared. The American media carried the story of the disappearance but gave no explanation, indicating only that its disappearance had been more rapid than expected.

Lying their way out of Trouble

The claims of ignorance and the pretension of mystery on the part of both the utility company and federal experts in regard to the appearance and disappearance of the hydrogen gas are quite simply lies. Explanations for these occurrences are commonly available in the literature on nuclear engineering and safety, and centre around the use of zirconium alloy cladding.

Experts within the American nuclear establishment are admitting privately that they are certain that the hydrogen was produced by the reaction of tons of zirconium cladding with the steam formed in the reactor vessel during the early stages of the accident. Weeks after the event the only public reference to the role of zirconium in the production of the hydrogen bubble was in the British press. (Recall that of all the major nuclear powers only the United Kingdom has no LWRs.) The April 12 issue of *Nature* magazine referred to a recent letter to *The Guardian* by Sir Martin Ryle of the Cavendish Laboratory in Cambridge, who stated that a highly dangerous hydrogen bubble should have been predicted as a matter of "A-level textbook knowledge". The following excerpt is taken from a standard textbook on reactor safety and is part of a report dated February 1969:

> The chemical reaction of the cladding with steam, which is supplied by the water remaining in the bottom of the primary vessel after the blowdown has three important effects. First, it

furnishes *energy*, which can increase the heating rate of the core. Second, *hydrogen*, a reaction product is released to the containment structure. Third, the reaction also *changes the character of the cladding* (i.e., the metal cladding is converted to an oxide), which can effect its behaviour on quenching.*

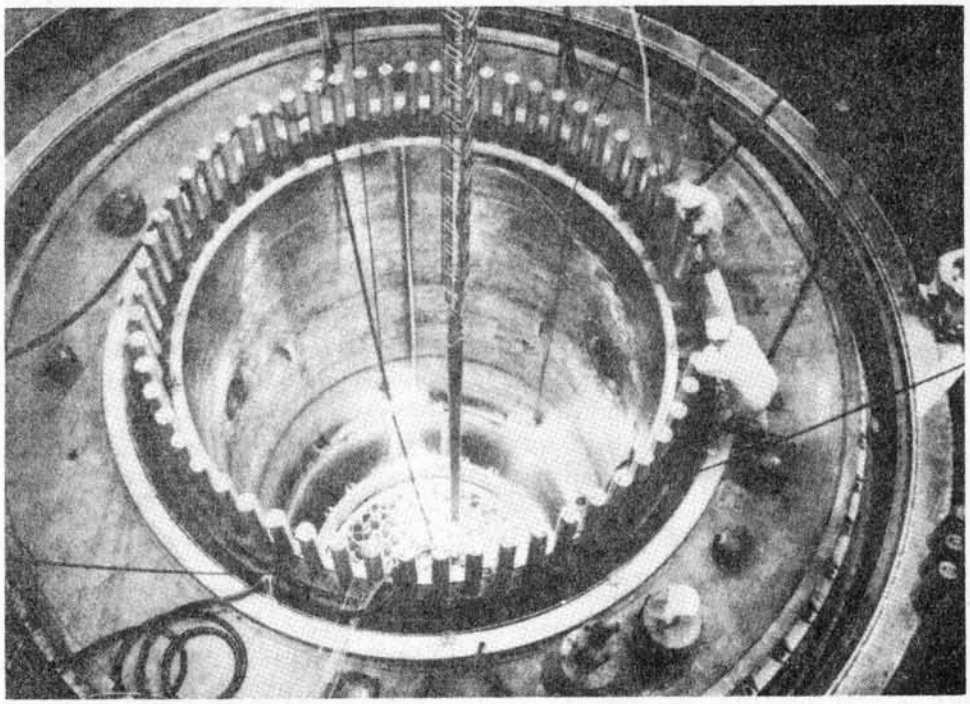
The water-zirconium reaction

$$Zr + 2H_2O \quad ZrO_2 + 2H_2$$

is exothermic, releasing about 121 kcal per mol of metal compared to the analogous sodium-water reaction

$$Na + H_2O \quad NaOH + \tfrac{1}{2}H_2$$

familiar from high school chemistry which releases about 43 kcal per mol. While sodium metal combines vigorously with water at room temperature, the zirconium catches fire in steam at about 2000°F, well below the 5000°F achieved in a meltdown.



Fuel rods being loaded into the reactor: but is the cladding safe?

Full Knowledge of the Hazards

We cannot accept the statements of ignorance by the nuclear industry. These men know full-well the hazards of zirconium fuel cladding. But they also know there is *no alternative* to zirconium in light water reactors, and for this reason they have concealed the truth concerning the catastrophic events at the Pennsylvania reactor. In an effort to protect the nuclear industry as a whole, the NRC is putting the blame on individual operators, faulty procedures and insufficient regulations. The power company (Metropolitan Edison) and the reactor manufacturer (Babcock and Wilcox) are to be the scapegoats.

The entire American nuclear power industry is committed to the Light Water Reactor. The fact that any loss-of-coolant or power excursion accident in these reactors will necessarily result in zirconium steam fires in the core, releasing enormous quantities of flammable hydrogen and heat and causing extensive damage to the cladding and fuel has been proven by the Three Mile Island disaster. The suppression of this information has been going on for a number of years prior to this accident, since it is clear that public awareness of the use of explosive materials in the construction of nuclear power plants present an intolerable challenge to their continued existence.

Early Protest Ignored

At the time of writing, the only public protest by a qualified scientist against the use of zirconium in power reactors was made by Earl A. Gulbransen, a materials scientist at the University of Pittsburg. Soon after his retirement from Westinghouse, where he had worked as a research scientist for 35 years, Professor Gulbransen wrote a letter which was published in *Bulletin of the Atomic Scientists* (June 1975). The following are excerpts:

> "After 25 years of research and development work on the chemical and metallurgical properties of metals and alloys used in nuclear power plants, I have come to the conclusion that the current design and materials cannot give us a safe and well-engineered nuclear power plant."
>
> "The use of zirconium alloys as cladding material for the hot uranium oxide fuel pellets is a very hazardous design concept since zirconium is one of our most reactive metals chemically."
>
> "At the operating temperature of nuclear power reactors zirconium cladding alloys react with oxygen in water to form an oxide layer which partially dissolves in the metal embrittling and weakening the metal tubing. Part of the hydrogen formed in the zirconium metal reaction dissolves in the metal and may precipitate as a hydride phase also embrittling and weakening the metal tubing."
>
> "At temperatures above 1,100° Celsius (1980° Fahrenheit) zirconium reacts rapidly with steam with a large evolution of heat and the formation of free hydrogen, with most metals to form intermetallic compounds and with other metallic oxides to form its own oxide. Once zirconium is heated to 1,000° Celsius, which could occur in loss of coolant accidents, it is difficult to prevent further reaction, failure of the tubing and of the reactor."
>
> "There appears to be no way to overcome the inherent material problems associated with zirconium alloys and the current design of the reactor."
>
> "Greater wall thickness for cladding and lower operating temperatures of the fuel may help but the chemical and metallurgical behaviour of zirconium alloys cannot be overcome. No back-up or alternative design is available if the present design and materials prove unreliable."

His warnings went unheeded by industry and government. The controversy was kept out of the news media.

The extent of oxidisation

From my own calculations, based on the reported size, pressure and temperature of the hydrogen bubble at Three Mile Island, I estimate that about twenty per cent of the approximate 20 tons of zirconium cladding in the core of the reactor had been oxidized in the steam-

* *The Technology of Nuclear Reactor Safety*, Vol II, eds. Thompson and Beckerly. (Cambridge MIT Press 1973.)

zirconium reaction. The enormous amount of heat released by this reaction added to the fission product decay heat, increasing the likelihood of meltdown. Fortunately, decay heat was only about one fifth of what it would be in a mature core since this reactor had been in commercial operation for only three months at the time of the accident. Even so, there is today still sufficient decay heat being generated in the core to produce meltdown in a matter of hours if all cooling were to cease. This danger will persist for several months.

Why Did the Bubble Disappear?

Another matter which needs discussion is the disappearance of the hydrogen bubble. The uptake of hydrogen by the coolant water, even under the high pressure prevailing in the reactor vessel, can account for only a small fraction of the bubble. On the other hand, there was more than enough unoxidized zirconium cladding left in the core to take up all the hydrogen in the form of zirconium hydride ZrH1.95. The dissociation pressure of the hydride is only a few millimetres of mercury at the reported temperatures, so that the formation of hydride was thermodynamically favoured. The oxide film on zirconium is transparent to hydrogen so that the reaction cannot be ruled out from a kinetic point of view. If all the hydrogen had been taken up by the zirconium, another twenty per cent of the cladding would have been chemically consumed.

A total of forty per cent of the zirconium in the core converted to oxide or hydride tallies with the NRC's statement that the cladding had been "devastated". The formation of oxide and hydride leads to severe crumbling of both cladding and fuel pellets. The resulting massive exposure of fuel to coolant water drastically increases the rate at which radioactive contaminants are leeched out of the core and multiplies greatly the amount of radioactivity released in an eventual meltdown. The extensive damage and crumbling in the core also altered and inhibited the flow of coolant through the core, presenting the danger of local hot spots.

In addition the danger of hydrogen explosion in the reactor is by no means over. The slow reaction of zirconium and zirconium hydride with the coolant water continues to release hydrogen from the hydride and also to produce additional hydrogen. Unless this hydrogen is constantly monitored and removed new bubbles will accumulate and possibly explode. The process of removing the hydrogen is slow and dangerous involving the release of more radioactivity to the atmosphere unless costly liquid hydrogen or liquid helium traps are employed to remove inert gases like krypton and xenon. The complete removal of hydrogen from the reactor is likely to take two years.

The nuclear industry cannot afford to admit that it has made a mistake. Instead it has systematically suppressed information on the danger of zirconium cladding.

New Cooling System Aggravates Problems

Cooling water is currently being pumped through the damaged core by one of the four main coolant pumps. These are huge 9000 horsepower pumps which run normally with a pressure differential of about 120 psi. Plans are now afoot to switch to a natural cooling system. Natural cooling refers to moving water through the core by means of convective flow which operates with about one per cent of the pumping force of the current system. Switching to natural cooling would save the cost of running the giant pump but it means a greater likelihood that hot spots will develop in blocked portions of the damaged core or in the crumbled debris piling up on the bottom of the vessel. Such local heating could achieve the temperature necessary to rekindle the exothermic steam-zirconium reaction releasing hydrogen rapidly, resulting in an explosion and the rupture of the containment vessel. It must also be borne in mind that the steel containment lining as well as all the piping has been weakened by the absorption of hydrogen from the saturated coolant which has been circulating through the system for several weeks. Switching to natural cooling means lower flow-through of water and therefore a slower rate of dissipation of hydrogen and heat. Both effects increase the chance that new bubbles of dangerous hydrogen will form.

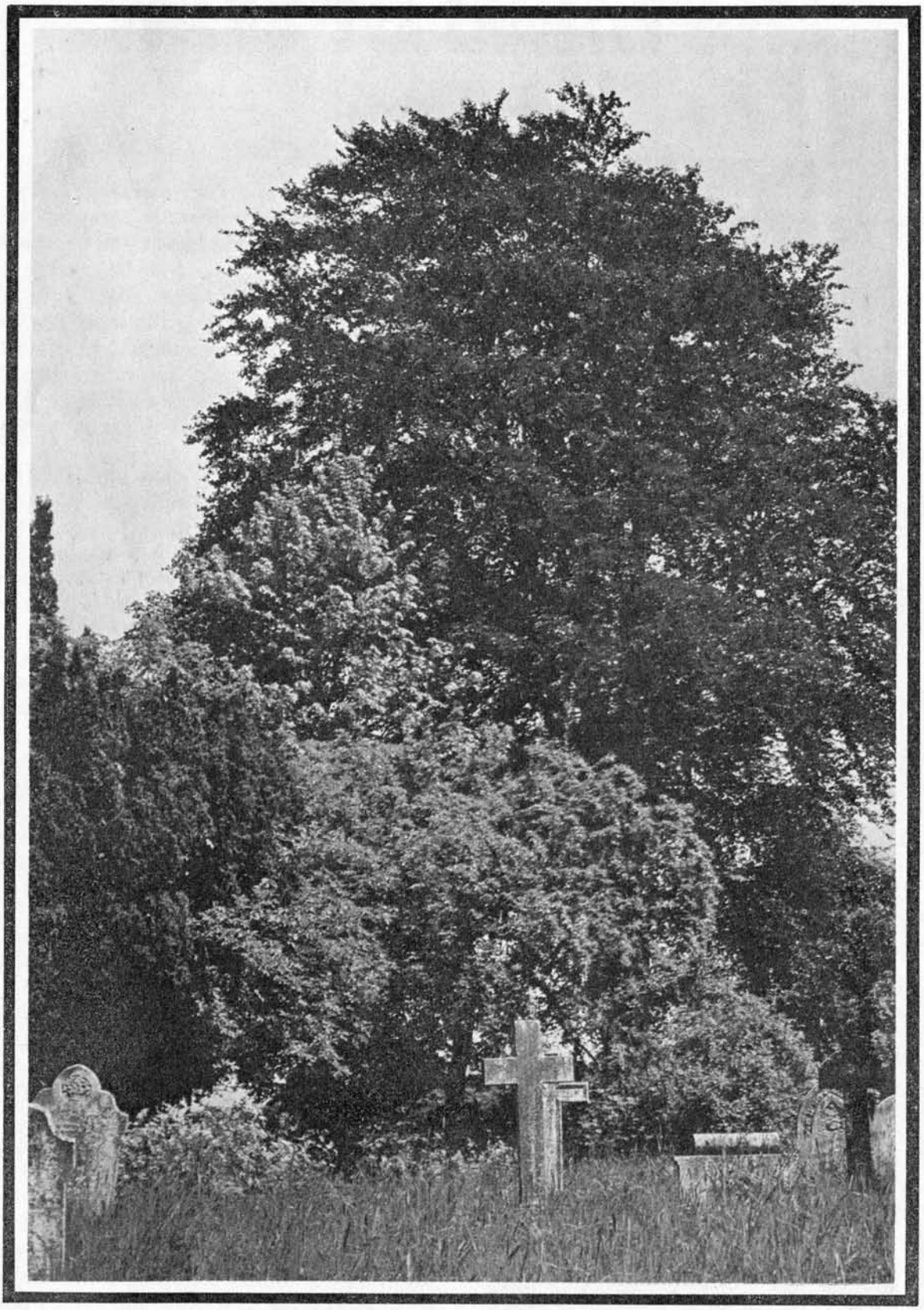
Spent Fuel Rods

Finally we must face the grim reality of the storage of spent fuel rods. Today's nuclear reactors all produce waste in the form of spent fuel rods, thin zirconium tubes filled with radioactive waste including plutonium. These rods are stored on the plant site under water in circulating pools designed to carry off the decay heat. A typical pool may contain a ton or more of relatively volatile plutonium oxide. Only a few feet of water separates the flammable zirconium from air in which it may ignite at around 1400°F. A zirconium fire in a spent fuel rod storage pool is one of the worst conceivable disasters because tons of plutonium would be released into the atmosphere. Every year nuclear reactors in the United States produce ten tons of deadly plutonium packaged in a thin cladding of flammable zirconium.

An Immediate Halt

The use of zirconium is the result of a major design fault, yet without a material that can safely replace it, the nuclear industry cannot afford to admit they have made a mistake. Hence the systematic censorship of information concerning the behaviour of zirconium in nuclear reactors. The result is that throughout the world, people are living next to death traps that present an immediate and terrifying danger. Sooner or later a loss-of-coolant accident in an LWR will destroy its zirconium cladding, causing a chemical explosion in which the reactor vessel is ruptured, a meltdown occurs and massive quantities of radioactive materials are released into the environment. We must insist on the immediate closure of all such reactors both in the USA and abroad. Not to do so would be to court disaster.

Requiem for our Trees?



S. Leathart

Trees, it has been said, are committing suicide. Having been ravaged by the woodman's axe, they are now succumbing to a whole range of diseases, apparently without putting up any resistence. In the following articles, The Ecologist looks at the effects of specific diseases: the role Man is playing in spreading them: and asks, what future is there for trees in an industrial society?

Spreading Tree Diseases: the hand of Man

By David R. Houston

US Forest Service

Trees have been our friends probably from that moment when our primordial ancestors first hungrily gnawed at tender twigs and roots or tore down fruit-laden branches. And our friendship — beginning with those first encounters — has been a one-sided affair, with trees literally getting the short end of the stick. As millennia passed, we humans learned to express our tree-love in words, songs and images. Ironically, our ability to articulate our adulation developed co-incidentally with our ability to insult the objects of our affection.

Our insults to trees have multiplied in number, kind, magnitude and complexity. Not only have we found a plethora of new ways to injure trees accidentally (by means of lawnmowers, automobiles and construction work) or purposefully (by pruning, boring, tapping, graffitti, etc.) we have also acquired a marvellous arsenal of ways to poison, drown and desiccate our arboreal friends. Meanwhile, largely as a result of our ever increasing mobility, we have ourselves carried many of their most dreaded enemies from one country to another.

Investigating the devastating consequences of thrusting highly infectious disease-causing agents into highly susceptible host tree populations has been the main concern of forest pathologists this century. In the United States the spread of diseases such as chestnut blight, white pine blister rust, Dutch elm disease, and recently, perhaps, of Sclerroderis canker, bespeak the long-term consequences of our unwitting actions. In each of these cases we were responsible for the direct introduction of a primary pathogen.

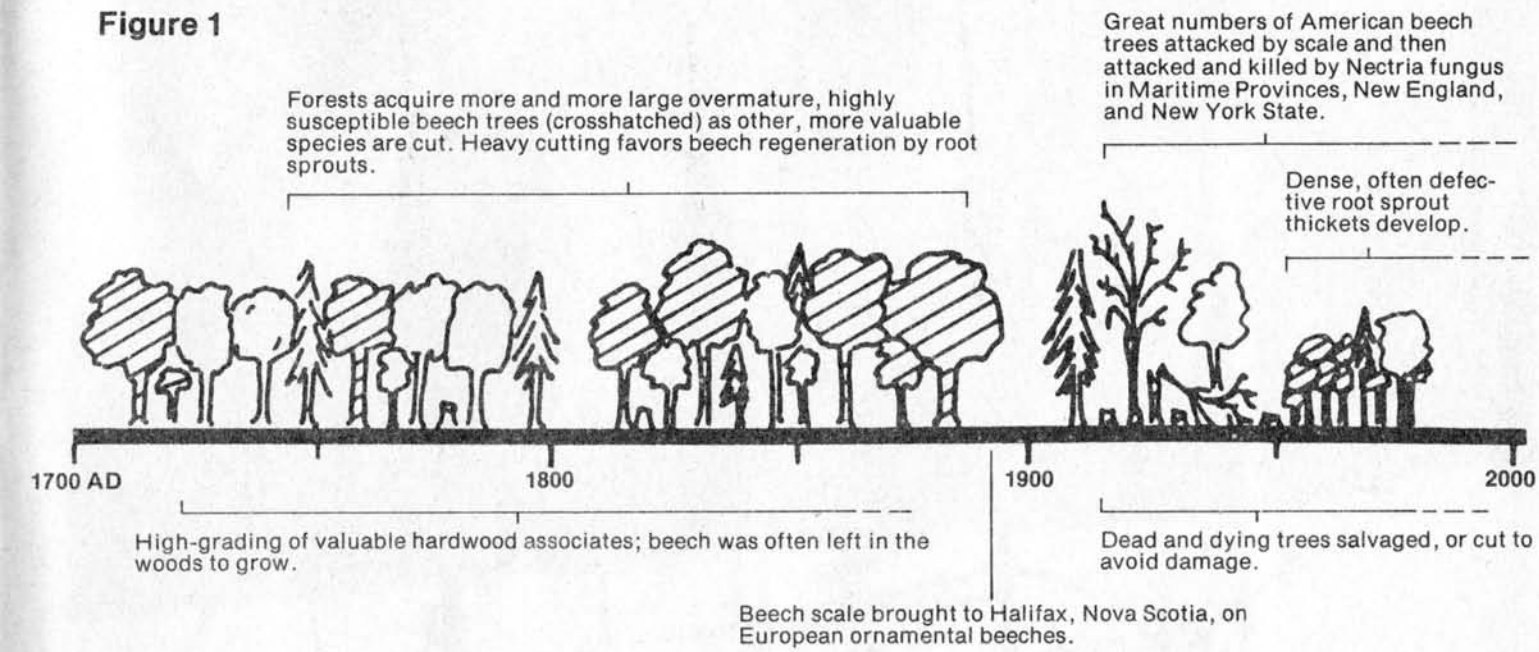
But in many other cases great damage has resulted from human influences that are less direct. The luxury of hindsight has helped place some seemingly unrelated past events in perspective with respect to the onset and development of tree diseases.

In this paper I will discuss three tree diseases — or more precisely — disease complexes — beech bark disease, oak decline and basal canker of white pine. Each occurs through the interaction of insects and fungal pathogens in environmental conditions that favour the spread of the disease. In each case neither the predisposing factor, nor the spread of the disease would occur without the agency of man.

Case One: Beech Bark Disease

Beech bark disease occurs in North America when American beech (*Fagus grandifolia*) is first infested by

Figure 1



the beech scale insect (*Cryptococcus fagisuga*) and then infected by a canker fungus, *Nectria coccinea* var. *faginata* (Ehrlich 1934, Shigo 1964). In this causal complex the fungus is the active agent; while the role of the insect is to predispose the tree to its fungal infestation.

The beech scale was inadvertently introduced to this continent from Europe about 1890, when infested ornamental European beeches were brought to Halifax, Nova Scotia. This tiny, wingless insect found a home here on the great numbers of highly susceptible American beech trees in the northern hardwood forests of northeastern North America.

We do not know whether the fungus associated with beech bark disease in North America was also introduced from Europe. Studies have shown it to be a variety of *N. coccinea,* the fungus associated with the disease in Europe. If *N. coccinea* var. *faginata* is native to North America, it certainly is of little importance without the beech scale. Indeed, searches for it in uninfested North American forests have thus far been fruitless. But, since it has not been found in Europe, the question of its origin still remains obscure. If it was native to North America, perhaps residing in some remote area, or being present on some unsuspected host, then the human contribution to beech bark disease would be to introduce part only of its causal complex — the predisposing agent. In other cases, of course, the converse occurs; an unsuspected pathogen is introduced by human agency into an area containing a previously unknown predisposing agent.

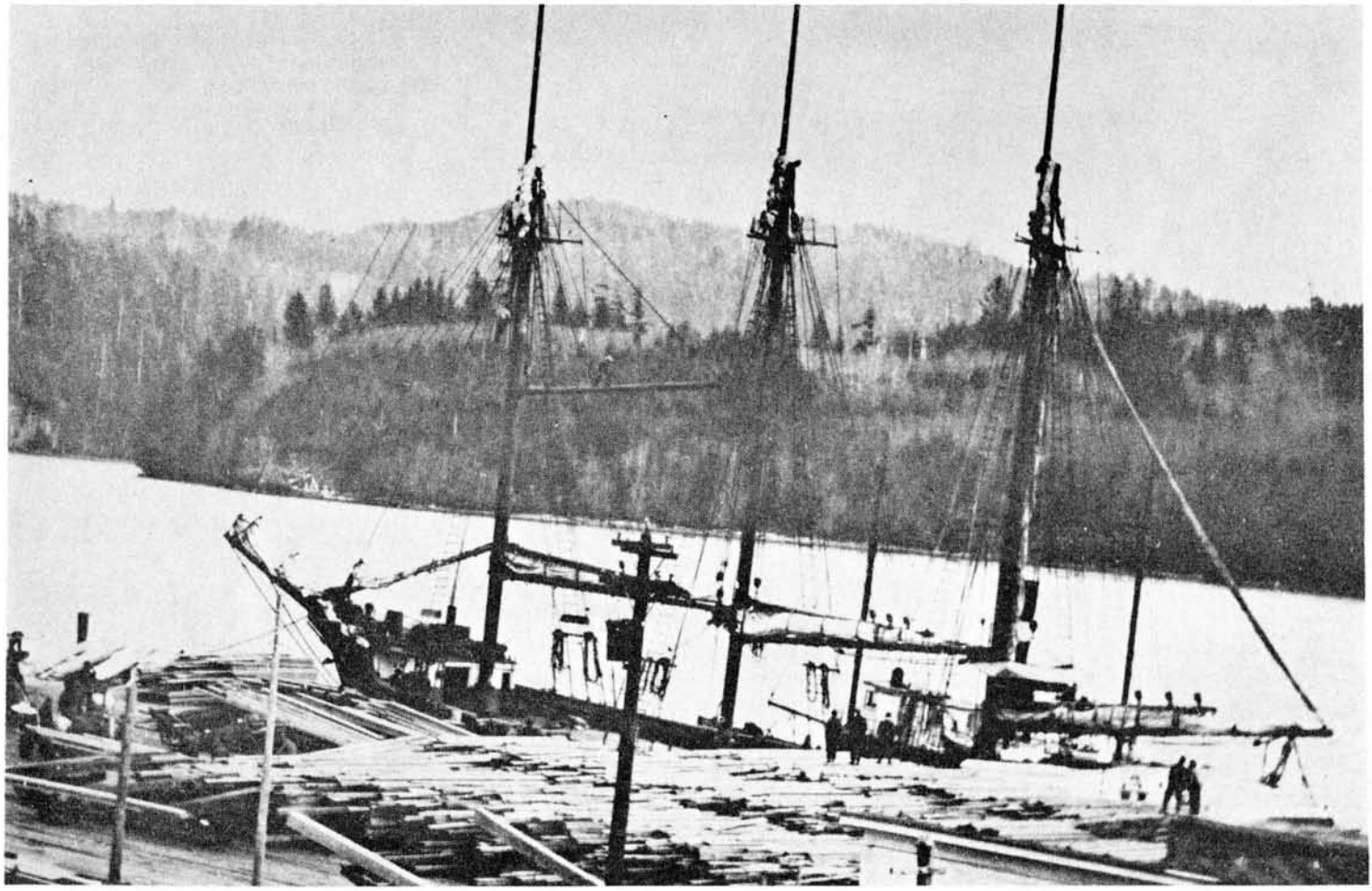
But beech bark disease has been influenced by more subtle human actions as well — actions that contribute to an extreme rate of tree mortality when forest and causal complex first encounter each other (Fig. 1). American beech traditionally has been held in low esteem by forest industries — the consequences of its poor seasoning qualities. Discriminant harvesting of its more merchantible hardwood associates, sugar maple (*Acer saccharum*) and yellow birch (*Betula allegheniensis*), has resulted in the creation of forests that are overly rich in large, mature, and overmature beech trees. Such trees are especially susceptible to beech scale infestations and to *Nectria* infection, and their large size and great numbers in turn contribute to massive buildups of inocula — a factor, no doubt, that has contributed to the perpetuation of the outbreak.

In the face of an actual or imminent outbreak, the usual action has been to salvage dead and dying trees and in some cases to harvest all merchantible beeches in advance of the disease. These measures, coupled with the tendency of trees of this species to sprout prolifically from their roots, have given rise to many forests with dense beech-sprout thickets. These forests, thereby composed of a great number of genetically susceptible stems, provide a potential setting for a renewed outbreak (Houston 1975).

In summary then (Fig. 1), people have influenced this disease directly by bringing to this continent the insect predisposing agent and indirectly by actions that encouraged the development of forests highly vulnerable to the initial encounters and potentially susceptible to even more catastrophic outbreaks in the future.

Case Two: The Oak and the Gypsy Moth

Oak decline and mortality, another complex, occurs when oak trees that are stressed by insect defoliations, drought, or late spring frosts, are attacked and killed by weakly pathogenic opportunistic organisms (Houston 1971, Staley 1965). In recent decades, oak decline and mortality has developed in the forests of northeastern United States following severe defoliation by the gypsy moth (*Lymantria dispar*) (Baker 1941, Campbell and Sloan 1977, Kegg 1973). Trees weakened by defoliation are attacked and killed by the twolined chestnut borer, *Agrilus bilineatus,* and the shoestring root-rot fungus, *Armillaria mallea* (Dunbar and Stephens 1975, Wargo 1977), whose actions would otherwise be relatively innocuous. As in beech bark disease,the predisposing agent (the gypsy moth) was introduced by man and like the beech scale, the gypsy moth is spreading south and west from its point of entry, in eastern Massachusetts. But, unlike the beech



Lane County Pioneer Museum

Beech scale: imported to the US in the late nineteenth century

scale, the gypsy moth was brought to this country *intentionally* (in a naive attempt to laboratory-rear a hardy silkworm.) Unfortunately it escaped into the forests of eastern New England — forests that proved to be exceptionally favourable for its development and survival.

Ever since we intentionally brought this pest to our shores, we have just as intentionally attempted to eliminate it from our forests; we have not succeeded. Indeed, in spite of concerted efforts to poison it with chemicals, confuse its sex life, attack it with other insects and mammals, and sicken it with its own plagues, the gypsy moth has thrived and continued to spread west and south.

Since adult female gypsy moths do not fly, its spread into new territories has been relatively slow — the consequence of passive aerial dispersal of its tiny first stage larvae. The general pattern of dispersal, therefore, is similar to that of the beech scale whose dissemination, aside from a limited amount of vectoring by various animals, is primarily by wind-borne wingless nymphs. But isolated population explosions of gypsy moths continue to occur in places far distant from the general area of high infestation. Such outbreaks are usually triggered off by man — when larvae, pupae, or egg masses are unwittingly transported from infested areas on motor vehicles.

In New England, gypsy moths and forests have interacted for over a century (Fig. 2). Some forests there have proved to be very susceptible and have been defoliated repeatedly. Others, more resistant, have had only rare encounters with the insects (Bess et al. 1947). Many observations have shown that outbreaks of gypsy moths usually occur when the forest is disturbed. In nature, sites that are affected by fires, wind and ice storms, and moisture shortages often support highly susceptible forests. Such forests contain trees that are favoured as food by gypsy moths and that possess structural features such as bark flaps, deep bark fissures, holes or wounds, crooked stems, etc. all of which provide the insect with protective refuges (Bess et. all. 1947, Houston and Valentine 1977). Resistant forests, by contrast, are those whose development has not been affected by such disturbances and that have had adequate moisture available to them. Resistant forests usually possess mixtures of preferred and nonpreferred food species; trees that are straight and fast growing and bear relatively few protective refuges.

Often, disturbance to forests by people has indirectly influenced their resistance or susceptibility to gypsy moth defoliation, and in turn, to oak decline.

Repeated heavy logging and frequent man-made fires in New England in the early 1900s rendered many normally resistant forests (Bess et al. 1947 Campbell and Sloan 1977) susceptible to the disease. These disturbances effectively checked the forest's annual evolution or worse still forced it to remain at an earlier, and less stable stage of development. From around 1920 until quite recently, a lessening of such disturbances resulted in development of forests that were more resistant to the gypsy moth. However increased human activity in recent years on forests of New England, especially in housing developments, has

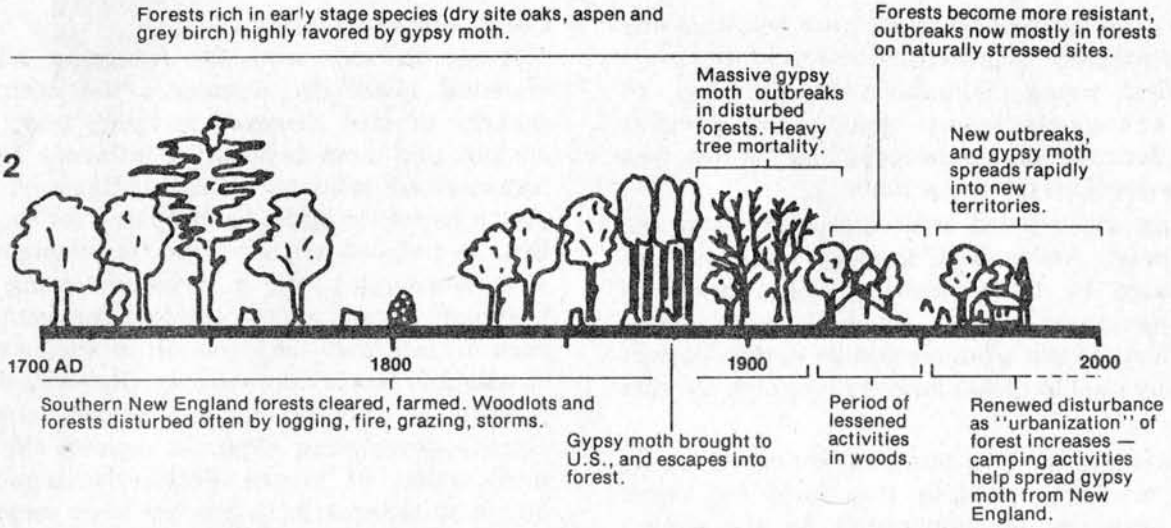


FIGURE 2

again increased forest susceptibility. It appears that people's actions affect forested backyards as the forces of nature affect forests on adverse sites. Opening up forests to make lawns, raking up leaf litter, and keeping pets help, to discourage natural predators of gypsy moth; and walls, woodpiles, and other objects in peoples backyards provide the insect with a host of suitable refuges (Campbell et al. 1976).

Thus, people have influenced gypsy moth-initiated oak decline primarily by influencing the insect predisposing agent. Not only did we intentionally introduce a potentially dangerous insect and then pay little heed to its escape, we have continued to aid and abet its spread. And its success seems related, at least in part, to the past and present ways in which we have disturbed our forests and forested home sites.

Both beech bark disease and oak decline are complex diseases that occur over large areas of deciduous hardwood forests of the northeastern United States. They will probably continue to spread until the insects that initiate them occur throughout the range of susceptible host species. The third disease discussed in this paper represents a sharp contrast to these diseases because, although greatly influenced by people, its occurrence is limited by environmental factors.

Case Three: Basal Canker of White Pine

Basal canker of eastern white pine (*Pinus strobus*) develops when bark-cankering fungi (especially *Pragmopara pithya*) invade the lower stems of young pines through either lesions made by ants (especially *Formica fusca*) or wounds caused by snow and ice (Houston 1969). The disease occurs in a number of places in the northeastern United States, but by far the most spectacular development is in plantations on Tug Hill, an upland plateau in north-central New York (Houston 1969, 1972). Basal canker also occurs, but to a lesser degree on certain sites in central Maine (Houston 1975). Both of these areas have short, cool growing seasons, long, severe winters, and heavy accumulations of snow. The proliferation of basal canker on Tug Hill is related intimately to the actions of people as they cleared, settled, abandoned, and then reforested this unique region (Fig. 3).

The climatically inhospitable Tug Hill plateau, which rises to the west of the Black River Valley, was but lightly settled on its margins before the mid-1800s (Barber and Howe 1841). Completion of a canal to the Black River about 1840 (French 1860) brought a wave of settlement, still confined to the plateau margins, by Irish and Welsh canal workers, and later by German and Polish homesteaders. Clearing of land was at its peak by the mid-1800s.

At first, farming on Tug Hill succeeded in spite of the short growing seasons and severe winters. But in time, the adverse environment took its toll. The closing of economically marginal markets for farm produce and of small local schools, triggered the abandonment, over a relatively short time, of lands cleared and settled over the course of a century (Krueger 1967).

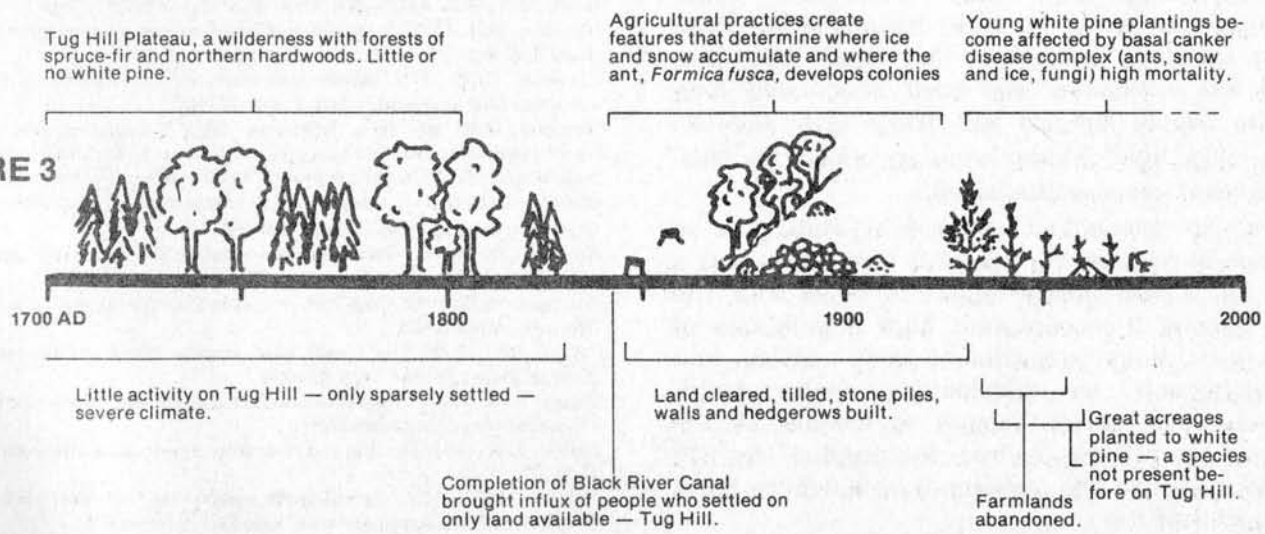


FIGURE 3

Large areas of abandoned farmland were subsequently planted to forest trees — primarily eastern white pine.

It is in these young plantations of white pine, on sites with a uniquely severe climate and peculiar topographic features, both man-made and natural, that basal canker develops (Houston 1969).

Very young white pines often die solely from the effects of ants. Ant-injured tissues, however, are readily invaded by bark-cankering fungi, and one species, *Pragmopara pithya*, is highly pathogenic. The association of such a fungus results in the death of trees normally too old or too large to be killed by ants alone.

Injuries to stems made by abrading ice crusts, or by small branches being partially torn away by heavy snow, also serve as infection courts for the canker fungi. The gently rolling, poorly drained topography and rocky soils result in tillage patterns that leave undisturbed fringes of soil around swales, drainage ditches, stone piles and access roads. In such undisturbed sites, colonies of ants build their mounds. In areas planted to trees soon after abandonment, ant mounds and trees damaged by ants are centred about such topographical features.

Concentrated damage by snow and ice is also related to topography and to past cultivation practices. Frequently, those features that permit establishment of ant mounds (e.g. swales, hedgerows, rock piles, field borders) contribute also to the accumulations of snow and ice.

In Maine, basal canker occurs in young pine plantings established as living snow fences along highways (Houston 1975). As on Tug Hill, canker fungi invade bark injured by ants or snow and ice. The former agricultural lands bordering the highways support numerous colonies of *Formica fusca*, and injuries caused by snow and ice occur in young pines planted in the lee of snow fences oriented perpendicular to prevailing winter winds.

Thus, through a sequence of seemingly unrelated moves, people have strongly influenced the development of basal canker. In upper New York, a sudden influx of people in search of land prompted the clearing and settling of parts of the available, but inhospitable, Tug Hill Plateau. History suggests that much of this activity was ill-advised, for nearly all that remains of these communities are stone walls and home foundations that stand in mute testimony to long-forgotten dreams. Ironically, the canal that precipitated the settlement was itself abandoned long before the people left the hill. (Only time will tell whether, in the light of today's energy crises, the closing of the canal was also ill-advised!)

History also reveals that selection of white pine as the species to reforest the deserted farm lands was a mistake for it was poorly suited to cope with the peculiar factors it encountered: high populations of *Formica fusca*, huge quantities of snow and ice, and highly pathogenic, wound-colonizing canker fungi. Should we have known enough to wonder at the absence of this tree species from the original Tug Hill flora? Probably not. The question now is will we know enough next time?

Conclusion and Summary

It can be seen from the foregoing accounts that mankind materially influences the occurrence and severity of tree diseases in many ways. The most obvious and most devastating influence has been the transport of primary disease pathogens from their native haunts to arenas unprepared for their invasion. But, as pointed out here, the introduction of *part* of a causal complex into an arena containing susceptible hosts and organisms to complete the complex, (beech bark disease and oak decline); or the introduction of susceptible hosts into settings that contain the components of a causal complex (basal canker) can be equally devastating. And, of course, the intentional introduction of known destructive agents without adequate safeguards to prevent their escape into new arenas is fraught with danger (gypsy moth).

More difficult to cope with, however, are actions by people that may influence the course of a disease decades later. It is unlikely that we shall ever achieve enough wisdom and sophistication to predict the long-range influences on tree diseases of actions that inadvertently retard or hasten natural forest development, or even of those actions purposefully designed to do so. But, perhaps through hindsight we can begin to appreciate the complex consequences of our actions and choose our future courses more carefully.

SOURCES:

Baker, W.L. 1941. Effects of gypsy moth defoliation on certain trees. J. For. 39: 1017-1022.

Barber, J.W. and H. Howe. 1841. Lewis County. *In* Historical collections of the State of New York. 608 pp. Published for authors by S. Tuttle, 194 Chatham Square, New York.

Bess, H.A., S.H. Spurr, and E.W. Littlefield, 1947. Forest site conditions and the gypsy moth. Harv. For. Bull. 22.

Campbell, R.W. and R.J. Sloan. 1977. Forest stand responses to defoliation by the gypsy moth. For. Sci. Monogr. 19 (Suppl. to For. Sci. 23(2)).

Campbell, R.W., M.G. Miller, E.J. Duda, C.E. Biazak, and R.J. Sloan. 1976. Man's activities and subsequent gypsy moth egg-mass density along the forest edge. Environ. Entomol. 5(2):273-276.

Dunbar, D.M., and G.R. Stephens. 1975. Association of twolined chestnut borer and shoestring fungus with mortality of defoliated oaks in Connecticut. For. Sci. 21: 169-174.

Ehrlich, J. 1934. The beech bark disease, a *Nectria* disease of *Fagus* following *Cryptococcus fagi* (Baer.) Can. J. For. Res. 10:593-692.

French, J.H. 1860. Lewis County. *In* Gazetteer of the State of New York. 739 pp. R. Pearsall Smith Pub.

Houston, D.R. 1969. Basal canker of white pine. For. Sci. 15(1): 66-83.

Houston, D.R. 1971. Noninfectious diseases of oaks. *In* Oak Symposium Proceedings. U.S. Dep. Agric. Northeastern For. Exp. Stn. pp. 118-123.

Houston, D.R. 1972. The use of large-scale aerial color photography for assessing forest tree diseases. I. Basal canker of white pine: A case study. U.S. Dep. Agric. For. Serv. Res. Pap. NE-230. 7 pp.

Houston, D.R. 1975. Occurrence of basal canker of white pine in Maine. Plant Dis. Rep. 59:74-76.

Houston, D.R. 1975. Beech bark disease: The aftermath forests are structured for a new outbreak. J. For. 73(10).

Houston, D.R. and H.T. Valentine. 1977. Comparing and predicting forest stand susceptibility to gypsy moth. Can. J. For. Res. 7:447-461.

Houston, D.R. 1975. Occurrence of basal canker of white pine in Maine. disease: Patterns of spread and development of the initiating agent, *Cryptococcus fagisuga*. Can. J. For. Res.

Kegg, J.D. 1973. Oak mortality caused by repeated gypsy moth defoliation in New Jersey. J. Econ. Entomol. 66:639-641.

Krueger, H.E. 1967. Tug Hill — a place and a legend. The New York Conserv. 21(4):18-22.

Shigo, A.L. 1972. The beech bark disease today in the northeastern United States. J. For. 70(5):286-289.

Shigo, A.L. 1964. Organism interactions in the beech bark disease. Phytopathology 54(3):263-269.

Staley, J.M. 1965. Decline and mortality of red and scarlet oaks. For. Sci. 11:2-17.

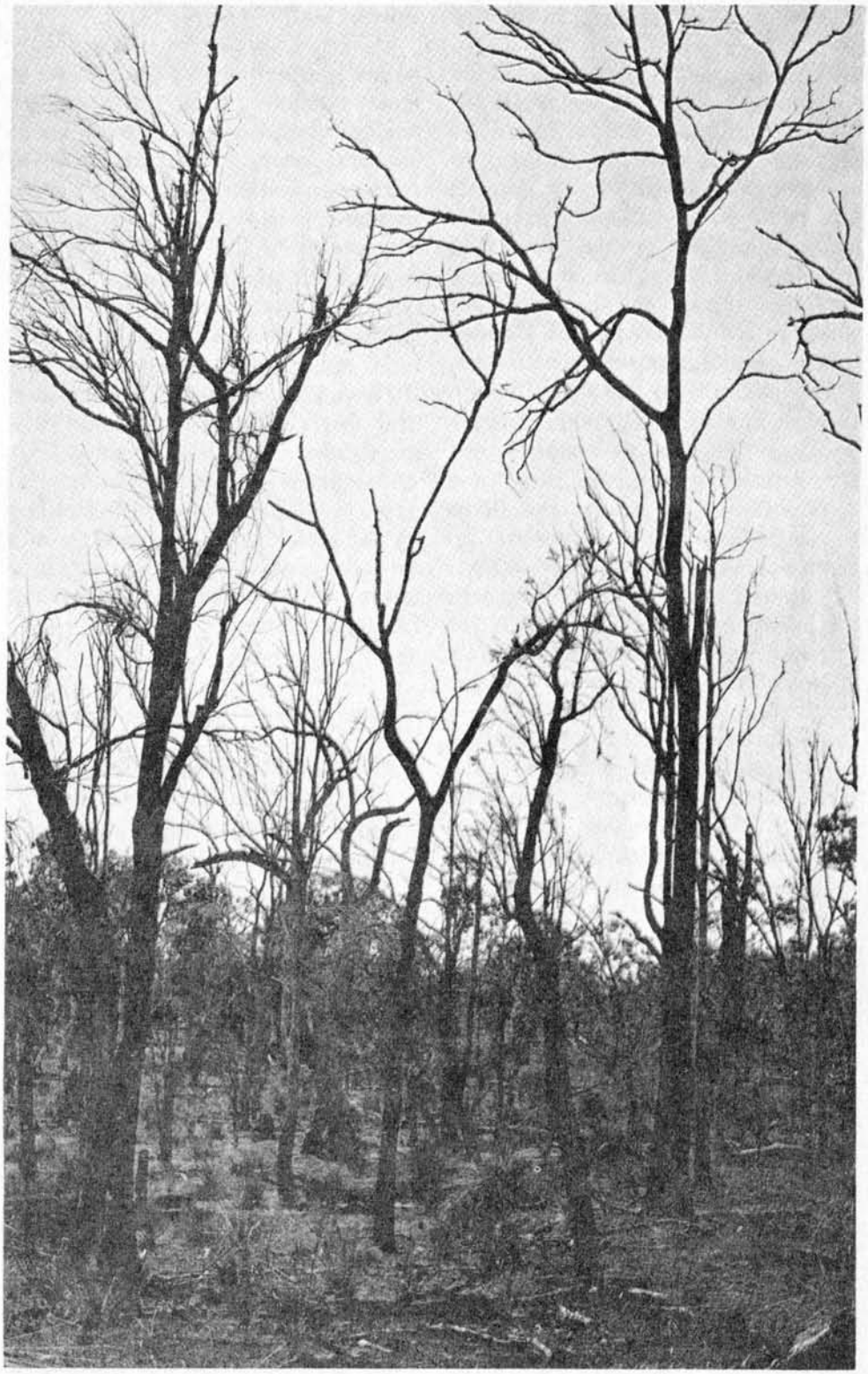
Wargo, P.M. 1977. *Armillariella mellea* and *Agrilus bilineatus* and mortality of defoliated oak trees. For. Sci. 23:485-492.

Tree Disease: 2

The Versatile Tree Killer

by
Lawrence D. Hills

Phytophthora cinnamoni, a relation of the potato blight, has wrought havoc with the world's forests and orchards from Australia to Britain — attacking eucalyptus, avacadoes, pines, sweet chestnuts and hundreds of other species. Can it be halted before it creates a disaster story of science fiction proportions?



The first and fiercest of the plant diseases to be spread across the world by man was the Potato Blight, *Phytophthora infestans* which starved two million Irish people to death in the Potato famine of the 1840s, and left plant pathology, as we know it, as a legacy from the frantic struggles of 19th Century science to combat a disaster of science fiction proportions.[1]

Potato Blight attacks only two members of the order Solanacea, but the tree disease that is now writing Chapter One of a new science fiction story across the world's forests, orchards and plantations is *Phytophthora cinnamoni* which has so far attacked four hundred species in 48 orders, including avocado pears in Australia and California, Eucalyptus in Australia, pine trees in New Zealand, pineapples in Hawaii, and sweet chestnuts in England, where it was first reported in 1930.[2]

It began as a minor problem for cinnamon growers in Western Sumatra, where it was described in 1922 by the Dutch authority R.D. Radd,[3] and every year the references to it in scientific literature increase almost as fast as the fungus itself. It is a water mould, closely related to Potato Blight and the increasingly common storage rot of apples, *P. syringae,* which was first recorded in Ireland in 1922, only appeared in England in the 1973-74 season and is now reaching epidemic proportions.[4] Generally speaking, *P. cinnamoni* is the swift killer of tropical and sub-tropical climates, and the other species, like *P. syringae, P. cactorum* which causes collar rot in Coxs grafted on certain apple stocks and *P. citricola,* now known to be responsible for bleeding canker in horse chestnuts[5], are diseases of colder countries, but the original *P. cinnamoni* is now attacking rhododendrons and chamaecyparis in British nurseries as it does in New Zealand.

It is not yet certain how this versatile, microscopic soil fungus with its thick-skinned resting bodies or "chlamydospores" which can survive almost indefinitely, but only in *moist* soil, has managed to leap over the plant quarantine

regulations and spread so far so fast. One possibility is that these spores, or the sexual type called "oospores", can float on moist air like those of Potato Blight. There are still old countrymen alive who refer to thick cloud on still moist days in late summer as "Blight" from the conditions that spread the first *Phytophthora* from Ireland across Wales, England and Scotland, for these were blamed for the disease before the fungus was discovered. There is still no cure for Potato Blight which costs tomato and potato growers millions of pounds for preventative sprays, and despite a constant breeding programme, there is no hybrid yet that resists all strains of even the first *Phytophthora.*

It is well known that the oospores of the apple storage and collar rot causing species can pass safely through the digestions of slugs, snails and birds. The last show a preference for fruit form infected trees and their droppings are the commonest British spreading agent.[4] Rain, splashing soil on to fruit on low branches, is the second most common spreader and this is one of the reasons why clean cultivation could help to increase *Phytophthora.* So far no airborne oospores have been found blowing on the wind.

An International Problem

The wide distribution of *P.cinnamoni* and its relations in so many countries, however, suggests that it is international like most soil fungi, and present like the tuberculosis bacteria in our mouths at all times, but attacking only when health or environmental conditions deteriorate.[6] We may well have altered the conditions by monoculture or pollution that has upset the delicate balance of the soil. The swift and disastrous spread of the disease in Australia and New Zealand, attacking first the native undergrowth species in virgin forests, supports the theory that spores floating high in moist air or carried on damp dead leaves sucked up by a whirlwind, have crossed the deep gulf between the Indonesian islands and Australia that parted prototype tigers from potential kangaroos in remote geological time.

Spread by Bulldozers

Theories are of importance only so far as they help us combat, or at least contain, what could be an ecological catastrophe. We can spare avocado pears, a luxury fruit of minor importance compared with potatoes as a food, but we rely on the forests of the world to keep us breathing; and the loss of forest cover is already threatening climatic changes. Rain forests are the world's most endangered environment, and if *Phytophthora* reaches the Amazon and the Congo it will find ideal conditions for rapid spreading. Australia is already a country of grey, ghostly dead trees, ringbarked by the pioneers so that grass would grow for sheep feed. Can Australians spare still more of their dwindling heritage of trees?

Forests are the worlds most endangered environment and if Phytophthora reaches the Amazon, it will spread like wild-fire

In Gippsland (Victoria) over four hundred thousand hectares (about a million acres) of silvertop (*Eucalyptus laevopinea*) and stringy bark (*E.macrorrhnchia*) has been devastated, and forests of these species supply forty per cent of the State's timber requirements. Four of the worst outbreaks have been in National Parks, all beside roads where heavy earth moving equipment has been used. The evidence is that the disease has been introduced within the last fifty years and is spread in the mud on the giant tyres of these machines, and those of cars and trial motor cycles. The danger is played down by the timber and wood pulp industries according to local popular newspapers.[7]

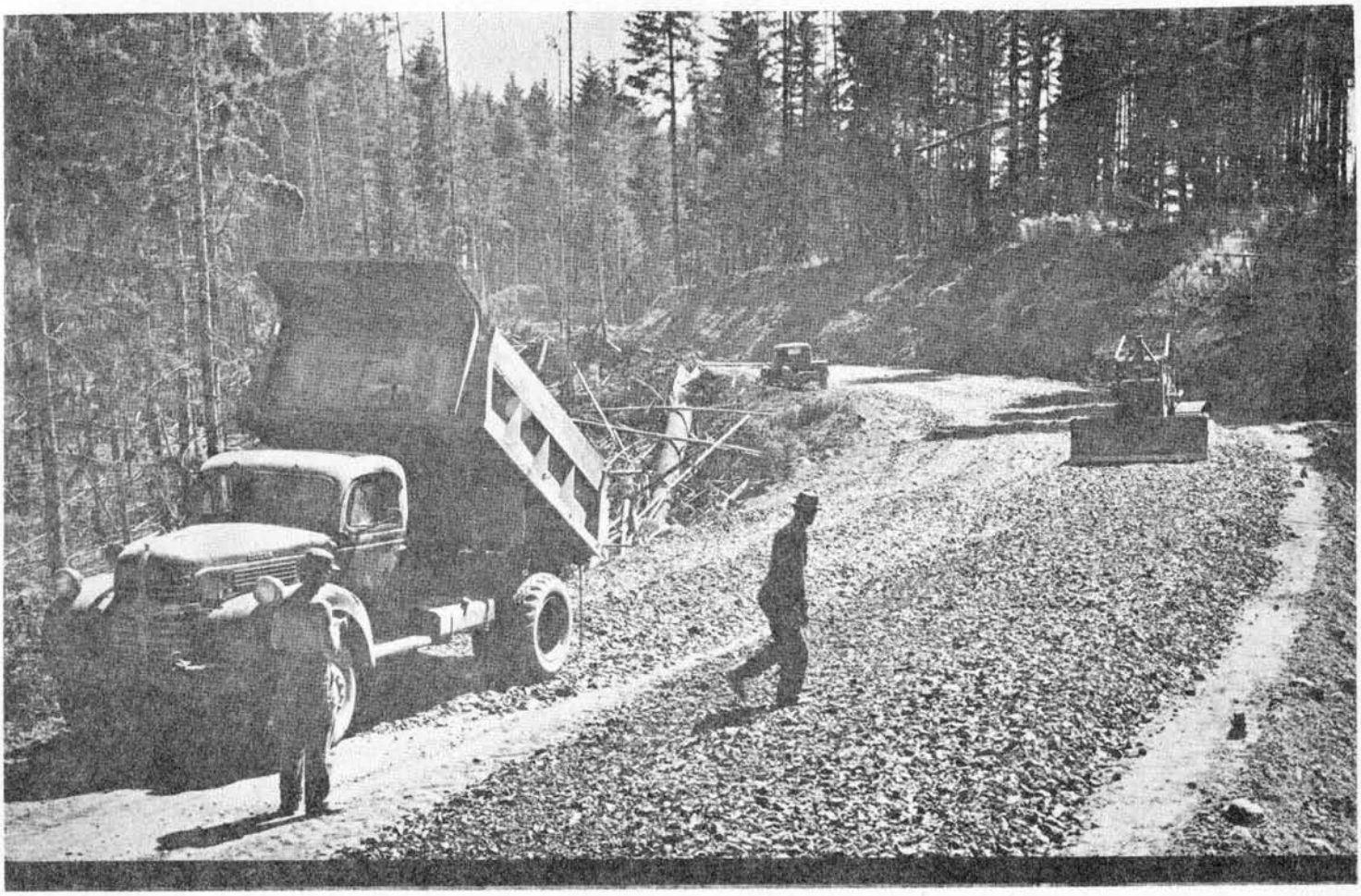
Jarrah Dieback

The Jarrah (*Eucalyptus marginata*), which can produce timber enough to build twenty-nine average bungalow homes from every hectare of trees up to 184 feet high, is the tree in peril in Western Australia. They grow on infertile laterite soils under desert conditions from December to March, with roots that can drive down over fifty feet through the hard caprock to ground water below, and are specialised to survive burning either by lightning or by intent. The aborigines fired the forest to clear the undergrowth and increase the spread of the grasses eaten by kangaroos, and, by accident or design, Australians continue the practice. The oil fired from eucalyptus leaves by the heat can burn like napalm in the air, jumping roads and firebreaks in blue flashes that can cut off cars and kill fire fighters when a burn gets out of hand. Jarrah seeds germinate after every fire and they can remain for twenty years as a tuberous rooted shrub that is highly fire-resistant before they soar into mighty trees.

Death from *Phytophthora* comes first to the lovely *Banksia grandis* a "second storey" tree up to forty feet high with foot long yellow spires and friendly symbiotic fungi in its roots that reach out and make phosphates available for the forest complex from the rocks far below. The big leaves turn yellow and die as the feeding roots are destroyed and the water supply lost. Then the Zamia palm and the strange thick stemmed grassy leafed black boys (*Xanthorrohe hastilis*), flag and die and the whole web of interlocking life, from spider orchids, to the tiny marsupial dormouse opposum, which make up a jarrah forest, collapses round the tall trees. These die slowly from the shoot tips giving *P. cinnamoni* the popular name of "die-back" from this first step along the road to a forest of skeletons.[8]

Four hundred Years to cleanse the Water

One immediate effect is on town water supplies, for jarrah forest catchment areas supply eighty per cent of the fresh water for the million people of Western Australia who live mainly in Perth and Fremantle. Over thousands of centuries, small quantities of salt in rain water or blown inland from waterspouts and sea spray, have been concentrated by vegetation. When the forest dies, this is



The disease is spread on the tyres of earth-moving equipment

released and suddenly the streams are running salt as the roots decay. Unless the trees come back, it is calculated that it will be four hundred years before the water runs fresh again.

New Strains for Revival

So far, research has found three species of pine and at least eight Eucalyptus, including *E. diversicolor* the karri which is almost as good timber as jarrah, which will survive despite the presence of the lasting spores of *Phytophthora* waiting like unexploded bombs for the roots of new plantings to reach them. The problem will be to replace the phosphates provided by the Banksias and renew the network of ecological relationships that have been destroyed.

The West Australian Forestry Department is concentrating on quarantine measures, for no fungicide is a possible answer against an underground enemy infesting millions of hectares. The department's quite effective methods and the potential biological controls that the avocado growers of Queensland have discovered, both depend on an understanding of the life cycle of the fungus and of how trees feed.

Of Trees and Men

Trees and men differ in that we have our feeding roots on the *inside* of our intestines, while they have theirs on the *outside* of their ordinary roots. We both feed through these temporary roots which last about three days, but while we digest our cast-offs, trees use the carbohydrates, proteins and other nutrients in theirs to support a host of bacteria and fungoid hangers-on, in the "rhizosphere". These include a number that live on worn-out main roots, recycling them for plant foods, and fungi that can trap nematodes,[9] like the one controlling the oak tree eelworm (*Criconemoides*) which has made it possible for Sussex to grow oak forests ever since the last Ice Age, although to grow five successive potato crops in the same field is to court disaster from *Heterodera roschiensis*, the potato eelworm.

These are apart from the symbiotic friendly fungi like those of the Banksia, the lupin, and other species that make phosphates available, or the better known fungi that fix nitrogen in the roots of pea tribe plants. There can be as great a range of life under soil as in the forest above it, eating and eaten, growing, dying and decaying in balance through the sunlit centuries, all depending for energy on that sunlight falling on the crown of leaves far above or that which filters down to the undergrowth.

When the spores of *Phytophthora* arrive in this "closed shop" under the surface, they grow into a mycelium, a spreading mat of miroscopic tubes, which feeds first on the discarded feeding roots and then the living ones as they grow, slowly starving the trees. They invade first the softer large roots of the Banksias and black boys, so these are the first to die.[10]

How the Fungus picks its Victim

When the soil is warm and moist the mycelium develops fruiting bodies of "sporangia" which are the water mould equivalent to the familiar toadstools that grow from a spreading circle of mycelium under a lawn or field in a "fairy ring". The sporangia discharge "zoospores"

which swim through the film of moisture round the soil grains in quest of new rootlets to attack. Trees and plants all produce root secretions that are partly gastric juices, but mainly carbonic acid, which help them to etch the minerals they need from rock fragments in the soil or even solid rock. These secretions vary. This is how the clubroot fungus "knows" the difference between cabbages and potatoes and the *Phytophthora* zoospores can "tell" jarrah from the karri which is safe. They must have wet soil and can travel far in soil water trickling down hill, but uphill or on the flat the zoospores can only spread in inches a year.

The sporangia produce two other spore types, the long lasting chiamydóspore and the oospore, which is a sexual stage that allows for variations that could, some day, produce an "Asiatic Flu" strain fungus that could attack even the karri and the seven other resistant Eucalyptus, or become a "Cold Climate Cinnamoni", that could spread to the pine forests of Russia, and the maples of Canada.

Spreading to Pines

The West Australian Forestry Department have clamped a rigid three year quarantine on the jarrah forests, restricting all activity to the dry months between December and March. Furthermore, all tyres must be washed, for only a gram of wet soil is enough to spread the disease, but the spores die quickly on the dry rubber, which is why it has not been carried far and wide on the feet of budgerigars, though kangaroos with muddy paws may be responsible for carrying the spores far into the forests from the infected roadsides.

Most conifers feed with the help of mycorrhizal fungi, like those of the Banksia, but supplying a wider range of nutrients, and these appear to be able to defend their hosts to some extent. The "little leaf disease" of conifers varies in its severity with the health of the friendly fungi in the roots, and in New Zealand it has been found that phosphate fertilisers improve their activity and help the trees, though according to other authorities, this is merely making more food available to the remaining roots. Here it is worst in *Pinus radiata*, widely planted for paper-making and in shelter belts, *Pseudotsungar mensiesii*, and the native kuari pine, *Agathis australis*, while in the U.S.A. it has slaughtered *P. echinata* the short leaf pine which it also attacks in New Zealand.

Pine trees die slowly, like jarrah, with extra small needles[11] first, yellowing foliage, dead tops and, especially in *Chamaecypari Lawsoniana* and *C. macrocarpa* foliage brown at the edges. In England there is far more *P. cinnamoni* than we think, for we blame the damage which it does on the honey fungus (*Armillaria mellea*) which only attacks trees weakened by poor drainage or other causes. The increase in this disease in recent years is probably not from deteriorating drainage but the silent spread of *Phytophthora* species.[12]

Attacking Avocados

In 1949 *Phytophthora* began its attack on Australia's avocado pear in Queensland, spreading fast to Northern New South Wales. Unfortunately for the growers the damage does not show until the third year after planting in most cases, so the nurseries went on supplying two-year-olds, and unknowingly dispersed infected stock. Here it also attacks the pawpaw and passion fruit as well as pineapples, and so far not one of the stocks on which avocados are grafted has maintained resistance. The custard apple, citrus, pecan and macadamia nuts are the crops to which growers turn when their avocados are destroyed by this ever increasing disease, though none are so profitable.[13]

An organic Solution

Mount Tamborine in Queensland is an avocado growing area, where two growers, Mr. Kidd and Mr. Ashburner have made history. They have orchards where the trees are recovering and though both are *organic* fruit growers, their methods are advocated by the Queensland Agricultural authorities. In January 1977 the *Queensland Agricultural Journal* contained the advice of Dr. N.T. Vock of the Plant Pathology Branch of the Department of Primary Industry. He advised the use of organic nitrogen sources, avoiding clean cultivation, growing cover crops throughout the year to maintain high organic matter levels, and maintaining a deep, open mulch around the trees.

The Australian Avocado Growers Federation,[14] give even more details. They recommend sowing maize or a sorghum hybrid with *Dolichus Lab Lab* (a powerful trailing legume), side dressing the maize with urea when it is well up, discing the bulk in late March then broadcasting ground dolomite and sowing annual lupins and planting the avocados with two buckets of fowl manure each as well as superphosphate. The full routine includes a final covering with a wide carbon-nitrogen ratio mulch such as wheat straw and plentiful poultry manure. The essential is to keep nitrate nitrogen out of the system, but to "use organic sources of nitrogen, or as a poor alternative, sulphate of ammonia and urea".

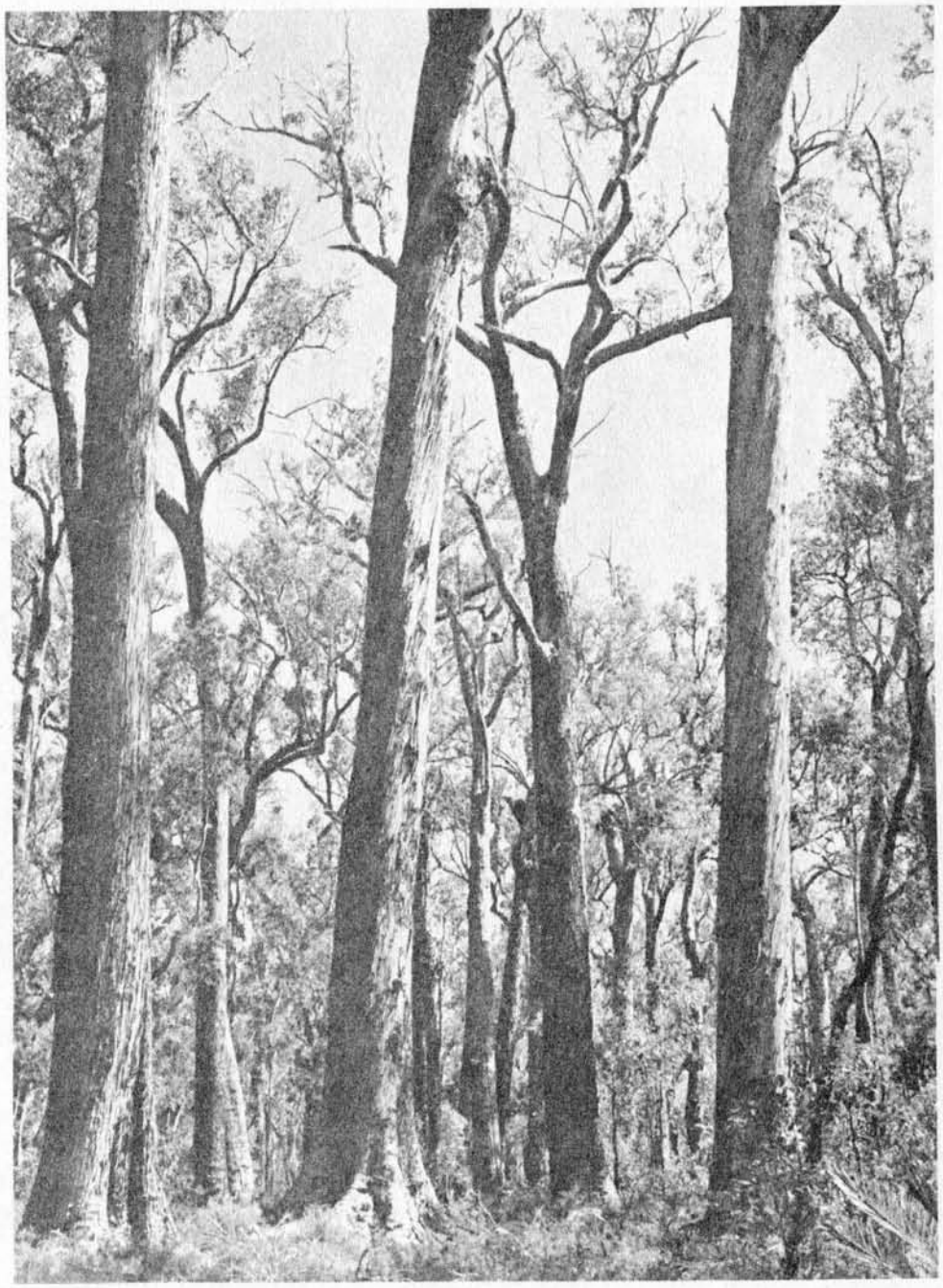
Their reasons for this unusual advice include the following: "In one particular plantation at Mount Tamborine where the fungus was present, diseased trees were removed, the suggested management practices initiated, the plantation replanted with pathogen free nursery stock and after three years we are still unable to recover the root rot fungus. The soil is now pathogen suppressive (is no longer conducive to root rot development), or the population of the fungus has been reduced to such a low level that we cannot re-isolate the pathogen". This victory for organic matter and roughly the methods used by the organic growers are scientifically described in *The Australian Journal of Agricultural Research*.[15]

The Answer lies in the Soil

The obvious explanation is that the extra humus is providing more energy food for the soil bacteria that can also eat mycelium; another theory is that the organic nitrogen and quickly decaying vegetable matter is supplying a better diet for the rootlets that survive. But the fact that all treatments so far involve more humus and fewer fertilisers has made the whole subject controversial. The theory that so far best fits the facts is that the addition of organic matter to the soil stimulates

the production of ethylene, which is a simple, unsaturated hydrocarbon used by plants as a growth regulator and responsible for, among other actions, the ripening of fruit, especially tomatoes. It can also, in quantities of 1 p.p.m., or less, inhibit fungal activity in soils, especially in the rhizosphere round the roots, slowing and stopping the growth of the mycelium, which gives the feeding roots a chance to grow again.[16]

The work of Dr. A.M. Cook of the Biological and Chemical Research Institute, New South Wales Department of Agriculture, and Dr. J.J. Cook of Washington State University U.S.A.[17] has established the importance of the oxygen-ethylene cycle in the soil, which is begun when small areas of soil are deprived of oxygen and the ethylene producing micro-organisms increase. This slows plant and fungoid growth, which releases more oxygen, and growth speeds up. This "stop-go policy" appears to stay at "stop" for *Phytophthora* with the right balance of humus, undisturbed soil and absence of nitrates. It is argued[18] that it is not bacteria but fungi that produce the ethylene, which is why the term "micro-organism" is used because this applies to both bacteria and fungi. So far, attempts to use ethylene injected artificially have failed, and dispersing such minute quantities through the soil would be impossibly difficult and costly. We cannot be sure whether the ethylene is merely the barometer that indicates some other condition that is the real cause, but it is certain that the world must afford further research in this field of soil micro-biology — for on it the future existence of our trees may depend.



The future of these trees may lie in a better understanding of soil micro-biology.

Bibliography

References:

1. *The Advance of the Fungi* E.C. Large. Jonathan Cape 1940.
2. "The Role of *Phytophthora cinnamoni* in Australian and New Zealand Forests" F.J. Newhook and F.D. Podger. *Annual Review of Phytopathology*, Vol.10 1972.
3. "New Records of Phytophthora on trees in Britain" C.M. Braisier and R.G. Strouts. *European Journal of Forest Pathology 6(1976) No. 3.*
4. "Birds Can Cause Phytophthora in Apples" *The Grower*, January 11 1977.
5. "Low Branches Touching Soil may be Primary Cause of Fruit Rot" *The Grower*, January 3 1977.
6. "Climate and Soil Type in Relation to Phytophthora attack on Pine Trees" F.J. Newhook. *Proceedings of the N.Z. Ecological Society* No. 7 1960 Pages 14-15.
7. "The Dying Forest Scandal" *National Times*, Sydney, Australia, January 10 1977.
8. "Focus on Jarrah Dieback — a threat to W.A.s unique Jarrah Forest" S.R. Shea. *Forest Focus No. 14* April 1975. Forests Department of Western Australia, 54 Barrack Street, Perth. The best popular account.
9. *The Friendly Fungi* C.L. Duddington. Faber and Faber.
10. "Nutritional Studies with *Phytophthora cinnamoni*" Kheng-Hoy Chee and F.J. Newhook. *New Zealand Journal of Agricultural Research* Vol. 8 No. 3 August 1965.
11. "Some Comments on the Relationship of Climate to Phytophthora Infection of *Pinus radiata*" F.J. Newhook. *N.Z. Journal of Agricultural Research Vol. 2* Pages 844-58.
12. "Phytophthora Cinnamoni in New Zealand" F.J. Newhook, in *Root Diseases and Soil Borne Pathogens*. University of California Press 1970.
13. *The Root Rot of The Avocado* Advisory Leaflet No. 1070, Division of Plant Industry, Department of Primary Industries, Brisbane, Australia.
14. *Avocado Field Day* Australian Avocado Growers Federation, K.G. Pegg, Senior Plant Pathologist, Queensland Department of Primary Industries, Indoorpilly, Queensland, Australia.
15. "Behaviour of *Phytophthora cinnamoni* in soils suppressive and conductive to root rot" P. Broadbent and K.F. Baker. *Australian Journal of Agricultural Research. 25*(1) 121-137. 1974.
16. "Ethylene in Soil Biology" A.M. Cook. *Annual Review of Phytopathology*, Vol. 14 1976.
17. "The Oxygen-Ethylene Cycle and the Value of Compost", R. James Cook, *Compost Science* Vol.17 No. 2 1976.
18. "Ethylene In Soil" J.M. Lynch. *Nature* Vol. 256 No. 5518 Pages 576-77 August 14th, 1975.

Those who are qualified to undertake the further research that the danger of *Phytophthora* demands are referred to the above references and the references the authorities cited give. Avocado growers in all countries who want to try Queensland Methods are referred to No. 14, obtainable from the Department of Primary Industries, Indoorphilly, Queensland.

M. Nimmo

Has the elm a Future?

by John Hedger

Dutch elm disease has left a lasting scar on the British countryside. Why has it spread so inexorably? And did government inaction aid its progress?

The sad sight of dead trees dotted on the landscape has become all too familiar. The English countryside will never be the same again; counties such as Somerset and Gloucester have changed beyond recognition, villages once enclosed in clusters of tall shapely elms now stand out stark and drear, whilst the rows of dead elms in the hedges of surrounding fields create winter in summer. The cause of this catastrophe has been the combined effect of the beetle and fungus involved in Dutch elm disease. Their partnership has enabled this disease to spread with unequalled devastation and speed amongst the tree population in Britain. A recent Forestry Commission estimation indicated that eighty per cent of the elms in Southern England would be dead by the end of 1978. There is no indication that the epidemic is slowing in any way. It continues to extend into Northern England, Scotland and Wales and has even arrived in the Channel Islands and Ireland. It is likely that over ninety per cent of elms in Southern England will be dead by 1980 and that other areas will follow inexorably along the same course. The tremendous decline in the elm population, amounting probably to more than thirty million trees, comes at a time when Britain's total tree population is in drastic decline in any case from other causes such as modern farming practices. In the Chairman's address to Forestry Section K in 1977, Laurence Roche pointed out that to replace each mature tree, six saplings need to be planted. The present rate of planting, as estimated by the Countryside Commission, is one sapling for each tree. Even without the losses from Dutch elm disease, this would mean that subsequent generations will live in a largely tree-less landscape, once the present mature trees of other species have died. To compound the misery, the advent of another tree disease of similar severity. Oak wilt, already mentioned by Dr. Burdekin, could bring this denuded landscape into our own lifespan. Unless the lessons learned from Dutch elm disease are taken seriously, this disastrous change may well be inevitable.

In this paper I shall be asking and attempting to answer some pertinent questions about the Dutch elm disease epidemic. Why is it spread so inexorable? Has it been aided by official mishandling of control measures? Is there any future for Britain's remaining elms? Is research producing any new control measures against the disease? The

answers to these questions are also highly relevant to the time when we must face the next threat to Britain's trees — Oak wilt.

The Biology of the Disease

Dutch Elm Disease, (D.E.D., so called because of its severity in the Netherlands in the 1930's) is caused by a fungus, *Ceratocystis ulmi* in partnership with two species of beetle — the Greater and Lesser Elm Bark beetle (*Scolytus scolytus* and *S. multistriatus*). The devastation caused by the disease is a reflection of the efficiency with which these two organisms work together. The bark of trees killed by the fungus can be used as breeding sites by the beetles. Flying beetles are attracted in summer to such trees. They bore out mother galleries in the bark. Larvae develop side galleries, feeding in the bark as they bore forwards. At the same time the fungus, carried into the bark by the beetles, also grows in the bark, forming sticky spores in the larval tunnels. These sticky spores adhere to the adult beetles which emerge from the bark, either the same summer, or the following spring. These beetles then fly to healthy elms where they feed for a while on sap exuded from wounds they make in the bark of twigs. During this period they become sexually mature. This feeding introduces the spores carried by the beetle into the wounds made in the twigs. Subsequently the fungus spreads rapidly through the tree. External signs of the infection are soon apparent as wilting and yellowing of the foliage, the twigs often twisting over in the form of a shepherd's crook. The outer sapwood of the tree is coloured by dark streaks.

Infected trees may take up to three years to die but few ever recover. The cause of death is not certain but is probably a combination of toxic substances produced by the fungus and the blocking up by the host itself of the vessels used for water transport from root to leaves (described in a recent *New Scientist* report as "committing suicide"). The dead and dying trees provide breeding sites for a new generation of beetles, which continue to spread the disease. In addition the fungus can directly spread to adjacent trees along the root systems, which are often grafted to each other in elms.

Historical Perspective

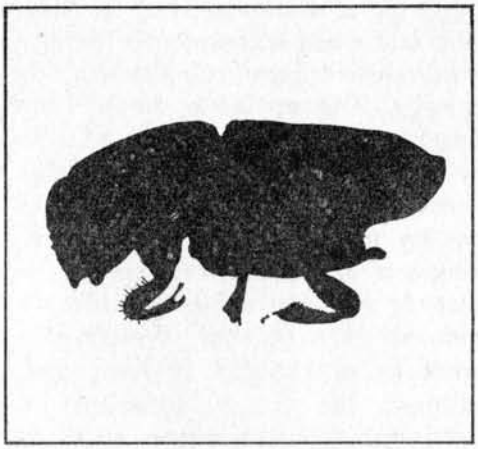
The history of D.E.D. in this country is tantalisingly obscure and it is only well-documented in this century. Whether it occurred before this time in Britain is open to doubt. Claims have been made for the detection of past infections of elm trees in Buff Wood, Cambridgeshire as far back as 1867. Prior to that we have no direct evidence. There is however indirect evidence that a large scale epidemic may have taken place about 3000 B.C. Prior to that date the quantity of elm pollen present in peat deposits shows elm was an important member of the forest flora of Britain. However at around 3000 B.C. throughout Europe the quantity of elm pollen declines drastically. The classical theory is that this elm decline is due to forest clearance by neolithic man. Such neolithic efficiency with stone axes throughout Europe is hard to believe. Analysis is now showing that the elm decline is not associated with human activity and opinion is now shifting to a rapidly spreading disease, such as D.E.D., as the cause. Presumably the present outbreak is causing a similar decline in elm pollen deposited in peat being formed now.

First Outbreaks in Europe

There is a possibility, therefore, that Dutch elm disease has occurred before in Europe but the balance of evidence indicates that the outbreaks that have occurred this century are due to the importation by man of new strains of the fungus. The first documented outbreak occurred in 1918 in France but the disease probably started earlier during the first world war, since it was widespread in N.W. Europe including Britain by this time. At first the responsibility of the fungus for the disease was not appreciated, and bacteria and even damage due to gases used in trench warfare were implicated. By 1927 it was clearly established that the causal agent was the fungus *Ceratocystis ulmi* and that it was transmitted from tree to tree by the elm bark beetles (*Scolytus scolytus* and *S. multistriatus*): There is a general belief that this outbreak of the disease was caused by a strain of fungus imported in some way from E. Asia. This strain has subsequently become known as the European strain of the fungus. The epidemic reached its height in the Netherlands and in Britain in 1931-1937 killing large numbers of trees (probably ten to twenty per cent of the elms in S. England were lost at this time). The disease was the subject of investigations by a number of very able workers in Holland, Britain and, latterly, the U.S.A. Classical investigations by workers such as Buisman, Fransen, Peace and others established much of present day knowledge of the disease cycle and possible control measures. Research activities were necessarily curtailed by the second world war but it is apparent from the surveys done for the Forestry Commission in this country that from 1938 onwards the disease became progressively less severe in southern Britain. Although many trees were killed in the initial phase of the outbreak, in many places the residual population of elms showed progressively less disease. At Faulden in Norfolk in 1949 although seventy-five per cent of the elms had been diseased at some time during the previous twenty-one years, only fourteen per cent had died. Although local "flare ups" of disease occurred, the last being at Sheppey in 1949-50, Peace was able to write in 1960 of Dutch elm disease as being "a minor nuisance but unless it completely changes its present trend of behaviour it will never bring about the disaster once considered imminent".

Dramatic Change in Behaviour of Disease

Ironically this change of behaviour and its accompanying disaster occurred within a few years of Peace's report being published. By 1965 people in certain areas of the country, especially Gloucester and Essex, were reporting disease outbreaks of unprecedented severity. At first these outbreaks were not taken seriously by the Forestry Commission, who considered them as local "flare ups" of the type described by Peace. I shall return to this point later in a consideration of the success, or rather lack of success, of control measures.



Scolytus scolytus

The Extent of Destruction

By the late 1960s increasing alarm was being expressed about the disease and in summer 1971 the Forestry Commission instituted a survey of the disease in Southern England within ten km squares. The survey revealed that of eighteen million trees in the area 409,000 had already been killed by the disease. By 1974 this figure had risen to 4.5 million. The gravity of the problem was underlined by the increased research effort of the Forestry Commission at Alice Holt; this revealed that Peace's prediction had been fulfilled: there was a change in the nature of the disease.

Kills approaching one hundred per-cent

Trees infected by the fungus were killed rapidly; large English elms were killed within one summer and showed none of the subsequent recovery described previously by Peace. Kills in some areas approached one hundred per cent and the disease was spreading rapidly, showing no signs of slackening in its progress. At first many explanations were offered for this change in behaviour including climate, radioactive fallout and general pollution. However in 1972 Gibbs and Brasier of the Forestry Commission published conclusive evidence that this severe disease was being caused by a new strain of fungus. This was quite distinct from that isolated from those elms mildly affected in the way described by Peace. The fungus isolated from severely diseased trees grew fast in laboratory cultures, had a fluffy appearance and when injected into elms killed even specially resistant types bred by the Dutch. The fungus isolated from mild outbreaks grew slowly in laboratory culture, had a waxy appearance and showed much lower infection of test elms. Further work confirmed that the epidemic of disease was in fact linked entirely to the fast growing strain, which was called the aggressive or fluffy strain. The other non-aggressive or waxy strain was presumably the same as that encountered by Peace in the pre-war outbreaks, that is the European strain of *Ceratocystis*. The origin of the aggressive strain was not clear. At first mutation from the non-aggressive type was felt to be a possibility but astute detective work by Brasier and Gibbs revealed the answer. Firstly they noticed that the initial severe outbreaks were centred around ports (Vale of Gloucester, Southampton and the London area) into which rock elm (*Ulmus thomasii*) from Canada was imported, mostly for use in boat building. Secondly, in 1973 they found rock elm logs imported into Southampton which had bark containing both bark beetles, and also a strain of fungus identical to the aggressive strain. Presumably beetles emerging from logs of this type landed at ports in the 1960s were therefore responsible for the initiation of the epidemic in surrounding elm trees.

The actual origin of this aggressive strain of North America remains a fascinating mystery, since, paradoxically, Dutch elm disease was imported originally into North America from Europe (to the U.S.A. in 1930, to Canada in 1944). Hence either the European strain became more aggressive during its stay in America or retained aggressiveness whilst the parent strain lost it. An alternative explanation offered by Brasier is that the aggressive strain arrived separately to the non-aggressive in the U.S.A., directly from E. Asia and was subsequently imported into Europe. This is a tangle of some complexity that may be resolved by work on the E. Asian strains of the fungus.

Existing Control Measures

We have seen that Dutch elm disease shows an annual cycle in which both fungus and beetle must be in the right place at the right time. Control measures are designed to disrupt this cycle and slow or halt disease spread. A multiplicity of points of attack on the cycle have been devised, with varying success. Broadly they can be categorised as follows:

A. Removal of the beetle breeding sites. Dead and dying trees are removed by felling, the logs being either burnt or the bark removed and burnt. This sanitation policy was first implemented in the Netherlands in the pre-war outbreak and has been the only effective eradication measure adopted during the present outbreak.

B. Protection of the tree by injection of fungicide. This method, developed in the U.S.A. and at Alice Holt, involves pressure injection of Benomyl fungicide into bases of trees. The fungicide is carried inside the tree to the branches and gives protection against infection fungus introduced into the twigs during feeding of the beetles but will not cure existing infection. It has been employed to protect important elm trees e.g. in city squares but its defect lies in the need for annual repetition and its cost (£20 per tree at the time of writing).

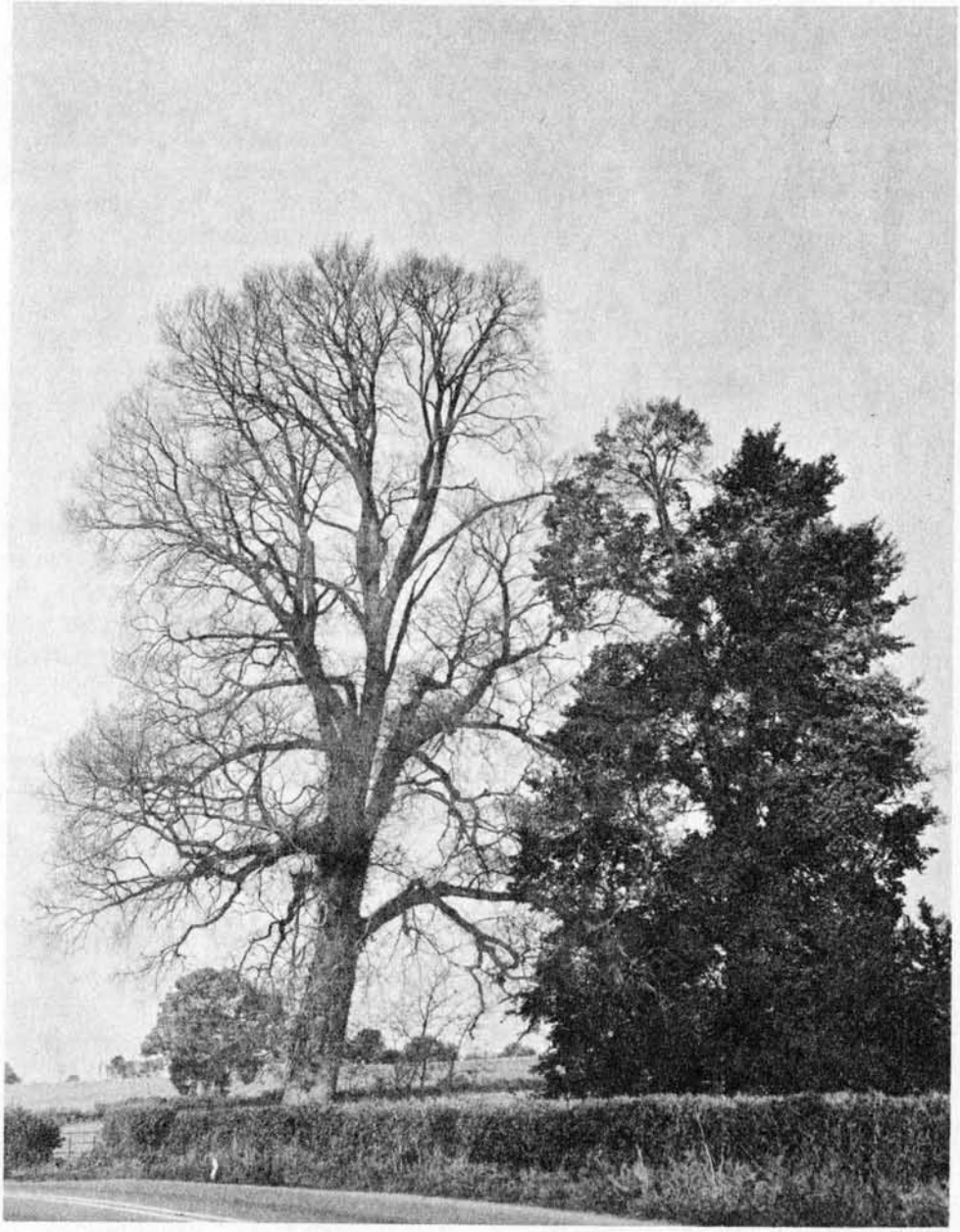
C. Insecticide treatment. Spraying of elms with insecticide to kill beetles feeding in the foliage has been carried out in the U.S.A. and Britain. However the difficulty of application to large trees and the disastrous side effects on wild life make it less than useful as a control measure.

D. Early Dutch experiments showed that elm logs attracted beetles and could be used as *traps.* However felling elms to trap beetles is self defeating. Work in the U.S.A. and here has moved on to identify and synthesise the substances which will attract beetles. Most progress has been made with pheromones, volatile substances released by the beetles themselves. These attract yet more beetles to trees which they are colonising. The success of preparations has varied, but with millions of beetles emerging from one dead tree even a trap ninety-nine per cent efficient will still leave thousands free.

New Approaches to Biological Control

This involves the use of an organism to destroy or inhibit either the beetle or the fungus. A number of attempts have been made to find such organisms. Most recently fungi have been found which might carry out this task. At the Applied Biology Department at Cambridge limited success has been achieved with the fungus *Beauvaria* which kills some beetles in the bark but it is as yet not a practical measure. At the Microbiology Department, Aberystwyth in research in conjunction with the Forestry Commission, a fungus called *Phomopsis* has been investigated. This was discovered growing rapidly in bark of dead elm trees. Experiments now show that this fungus is a good biological control agent. Trees infected with this fungus are not attractive to beetles and indeed most avoid breeding in them. Even those that attempt to breed in such trees are usually unsuccessful; the larvae die. The bark of such trees, even if it originally contains the Dutch elm disease fungus, no longer contains it after attack by *Phomopsis,* so that in the unlikely event of beetles breeding successfully, they carry no disease when they emerge and will not therefore start a new infection.

Surveys show that natural control of this type exists already in some areas. More work is now needed to assess whether this fungus could be used as a cheap control agent. It could be encouraged to colonise diseased trees and thus avoid the need for expensive sanitation felling.



M. Nimmo

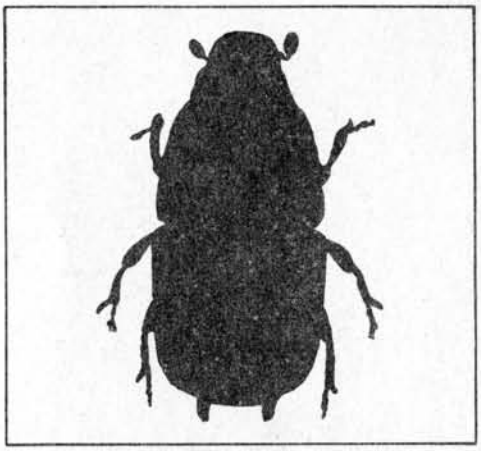
One dead and one dying — an all too familiar scene

The Control of the Epidemic

One might have expected that vigorous application of these control measures would have contained or at least slowed the rate of spread of the disease. In fact, with one exception, in most areas the disease has proceeded unchecked. One might ask why the record is so abysmal: other tree diseases such as fireblight have been contained, and surely Dutch elm disease is a simpler problem to contain than animal diseases such as foot and mouth? The answer is that a combination of circumstances, especially the changed nature of the disease, together with lack of strong Central Government involvement or even interest, combined with lack of expertise at the local level, has meant that the control programme was abortive from the start. It is not my purpose here to hold an inquest on the whole sad affair but I should like to point out some of the mistakes in the hope that they will not, indeed they must not, be repeated in the future. As a general point I think that Central Government made little or no attempt to issue strong directives to Local Authorities about control measures and was even less willing to finance such measures. I should suggest that it was wrong for the Ministry of Agriculture to be responsible for the disease legislation; the problem was environmental rather than agricultural. More motivation might have been expected if the Department of the Environment had been responsible for the control programme, since this Ministry has direct links with local authority Planning Departments who were, in the main, the agencies required to deal with the disease. As it is I suggest that there was little interest in the uneconomic elm tree at the Ministry of Agriculture, and indifference to polite suggestions from the Forestry Commission at the local level.

Local Action hampered by the Government's Indifference

It was at the local level that the battle against the disease was fought. In fact it was local authorities such as Gloucester who in the late 1960s were the first to be concerned about the disease and who pressed the Forestry Commission and Central Government to take action. The experience of such interested



Scolytus scolytus

authorities, keen to preserve the amenity of their area, was frustrating as year by year more and more dead and dying elms appeared. Yet their requests for directives, help or action of any kind seemed to have no effect. It was not until 1971, six years after the first reports of disease were received that the Forestry Commission initiated the legislative action under the Plant Health Act (1967) that had been requested: investment of statutory powers to local authorities to carry out a sanitation felling programme in Southern England and to be able to compel owners to remove diseased trees on their land. Such a sanitation programme might have succeeded early in the epidemic but by 1971 there were so many diseased trees in most areas that the task proved impossible. Many local authorities showed little or no interest, whilst of those that did, most were soon discouraged by the size of the problem they were expected to face. This is hardly surprising in view of the lack of financial support from Central Government, lack of expertise (most authorities have few, if any, forestry staff) and the lukewarm attitude of the Forestry Commissioners to the legislation.

Why did the Forestry Commission take so long to act?

I have up to now not directly analysed the role of the Commission. It is useful to ask why, as the body supposedly responsible for Britain's trees, they took so long to take action over Dutch elm disease, and indeed why they were so reluctant to allow legislation for a programme of sanitation felling. Indeed quite amazingly in 1972 the Commissioners promoted legislation which cancelled the 1971 Dutch elm disease order and removed the powers of intervention from the local authorities. This lack of enthusiasm by the Commissioners and Ministry of Agriculture communicated itself in a fatal way to the local authorities and led to dissillusionment in those who had been conducting elm disease campaigns. One local authority, East Sussex, deserves commendation here, since they decided to continue their campaign in spite of lack of Central Government support. I shall return to the success of their decision later.

Why vacillation by the Forestry Commissioners? Initially because they took some time to accept the changed nature of D.E.D. The very thoroughness of the 1960 report by Peace on this disease, in which he stressed its decline after an initial period of severity in the 1930s and commended *laissez faire* as the best course of action in dealing with it, predisposed the Commission in favour of a policy of sitting out the epidemic and hoping it would go away. Hence the initial lack of action by the Commission. I do feel that they failed to change their thinking and adapt to the characteristics of the present epidemic. The repealing of the preventative legislation in 1972 was hardly a positive step to take at a time when their own Research Branch had established the presence of a foreign pathogen within the country. Indeed by 1974 thinking had changed once again and the legislation was reintroduced at the request of twenty local authorities. As a result several local authorities in England and S. Wales have since been conducting campaigns against the disease and in 1977 six more were granted powers.

Delay and lack of strong government intervention has allowed the disease to spread rapidly throughout the country . . .

Delay and lack of strong Central Government intervention has been responsible for allowing the disease to spread rapidly throughout the country. That the disease was being introduced on logs moved about the country by timber merchants was very obvious early in the epidemic. Yet it was not until 1974, in response to requests by alarmed authorities in E. Yorkshire and Northumberland, where outbreaks were occurring around timber yards, that legislation restricting the movement of diseased elms was introduced. Not only did this legislation come too late but it was never enforced, only one prosecution having taken place to date in spite of the fact that numerous instances have been brought to the Ministry's notice. The irresponsibility of timber merchants is obviously difficult to deal with but the legislation itself is weak. Clauses such as "logs can be moved if treated with insecticide" are an obvious let out for the unscrupulous. There is no doubt that this type of movement has been responsible for the widespread introduction of the disease into N. England and Scotland and it continues unabated.

Control can be effective

Many people will ask however if the *laissez faire* attitude of authority is not in the final analysis correct. Do attempts at control have a chance of succeeding? The answer is I believe yes, providing the programme is efficiently organised by people with a knowledge of the disease and general forestry practice. Just such a programme has been successfully run by E. Sussex and Brighton local authorities. Here a highly organised campaign has been under way since and in spite of the 1972 revocation of the Dutch elm disease orders. The programme has been intelligently restricted to two control areas within E. Sussex and Brighton where a geographically separated elm population exists.

One of the reasons for the success of this campaign has been the fact that the Local Authority have borne the cost of felling and debarking trees. They have not needed therefore to employ any compulsory powers and public co-operation has been good. The disease has been contained. By 1976, nineteen per cent of the elms in the area had been lost but this must be compared to eighty per cent in nearby W. Sussex. In the future, once all the elms in the

surrounding area are dead, and therefore uninfective, this population of elms should be reasonably safe, given continued vigilance.

The Future for Dutch Elm Disease Control

The East Sussex campaign is a heartening example of what can be done. Such an approach could still be used in areas to which the disease is still extending, the Northern Counties, Wales and Scotland. The Northern Counties already have plans to set up control areas. In Wales the effort is patchy. Some counties have enthusiastic schemes which suffer from the unskilled nature of the Job Creation Scheme labour employed. My own county of Dyfed has the worst record; it has not applied for powers and is totally uninterested, even though a geographically separated site ideal for a control area exists in the north of the County.

Any such schemes must be backed up by prevention of illicit movement of diseased timber into such control areas. Here Central Government must play its role. Local authorities should co-operate — it is useless to have "dirty" counties next to ones attempting to clean up the disease.

A recent circular by the Department of the Environment Welsh Office *Trees and Forestry* (DOE Circular 36/78) Welsh Office 64/78) urges local authorities to attempt control measures where these are feasible. This is at least a step in the right direction. However, no financial aid is offered though it is suggested that Countryside Commission grants may be available for such sanitation campaigns and replanting with other tree species.

There is also the possibility that some elms may survive without the assistance of control programmes. Certain species seem rather more resistant to the disease than others, though all are susceptible. The E. Anglian population of smooth leaved elms (*Ulmus carpinifolia*) seems to be fighting back most successfully and the Wych elms (*Ulmus glabra*) of Wales and the North seem to go under more slowly too. Some of these may be able to survive. The English elm (*Ulmus procera*) will probably be totally wiped out though its suckers survive profusely. Mechanical hedgecutting will not allow those to grow up again into trees. Those that do escape the cutting to become trees will eventually succumb once again to the disease.

Conclusions

The loss of most of Britain's elm trees has been a serious blow. The attempts to control the disease have not been inspired or enthusiastic. Whether this catastrophe will be such a salutory lesson that it will not be repeated in future remains to be seen. Should a disease like Oak wilt arrive it seems doubtful if we will be any better placed to tackle it. Strong effective action by the authorities is essential. The author suggests the following common sense approach:

1. *Strict* ban on imported barked logs.
2. *Effective enforced* legislation on timber movement.
3. Preparations for a sanitation felling programme with sensible legislation. Landowners should not be compelled to fell trees: the cost should be borne by Central Government. The best solution is that adopted in Jersey D.E.D. campaign — all diseased trees immediately become the property of the Local Authority.
4. Early detection of the disease by monitoring trees around ports and timber yards.
5. Increased research on control methods.

It is alarming to note that the D.O.E./Welsh Office circular *Trees and Forestry*, although progressive in many respects, states categorically (p.17 para 36) "diseases of trees . . . none are likely to be as devastating as Dutch elm disease". Such a statement is highly misleading, conveying as it does a false sense of security to local authorities. It could result in fatal slowness in dealing with an outbreak of oak wilt. Surely it is best to assume that a disease like oak wilt *will* be devastating, take appropriate steps and thereby avoid the fatal indecision that condemned the elms. A mistake such as this could well see Britain's oaks following the fate of its elms.

Beech Bark Disease: one disorder or several?

by David Londsdale

In recent years there has been considerable mortality amongst Britain's Beech trees, particularly after the 1976 drought. This is not the result of a single parasite but of an unusual combination of circumstances.

In 1977 beech trees in many parts of Britain developed sap flow symptoms and, in some cases, die-back or yellowing of the crown. These symptoms are among those which characterise beech bark disease; a potentially lethal condition. The sudden appearance of these symptoms occurred mostly on large trees, many of which had high amenity value, and this led to widespread alarm. Soon, the idea of 'beech bark disease sweeping across the country' was being expressed in a number of press reports. This idea was understandable in the wake of the Dutch elm disease epidemic but it assumed two things that were not established facts. First, it assumed that the disorder was actually beech bark disease and second, it assumed that the causal agents were spreading so fast that outbreaks could occur over much of Britain during a single year. I hope that, by examining the nature of beech bark disease, I can test the validity of these assumptions and assess the risk of future damage.

What is beech bark disease?

Most of the thickness of beech bark contains living cells, the innermost layers of which are active phloem cells and constitute an essential part of the tree's vascular system. These cells, together with the under-lying cambium (whose cells repeatedly divide in order to lay down each year's layer of wood and bark) are killed in patches on the stem when beech bark disease develops. It is these dead patches which allow leakage and subsequent blackening of the sap, causing the sap flow and 'tarry spots' now familiar to the forester. The overall health of the tree may decline as shown by foliar yellowing and/or failure of the leaves to attain normal size and number. In severe cases the tree may die.

A variety of insects and fungi have been linked with this disease. Two of these organisms appeared with particular frequency in the literature of the nineteenth and early twentieth centuries and in 1934 John Ehrlich, working in N. America, published a detailed account which showed how these organisms operated. The first in the disease sequence was the beech scale insect or 'felted beech coccus' (*Cryptococcus fagisuga* Lind.) and it was the damage done by enormous numbers of these minute, wax covered, sap-sucking animals which allowed the second organism to cause damage. This organism was a fungus, *Nectria coccinea* var. *faginata* (Lohman, Watson & Ayers) and its role was the invasion and killing of the bark cells in the way just mentioned.

The epidemiology of the disease

Both the insect and the fungus can be disseminated by wind and it is in this way that previously disease-free areas of forest are being attacked in N. America. The insect has spread several hundreds of miles westwards and southwards into the USA and Canada since its presumed introduction by man to the east coast around 1890. This constitutes an epidemic, i.e. a colonisation of an uninfected host population by a pathogen (pathogens in this case) and, as with most epidemics, we can plot an advancing front on a map. In the areas of Britain and Europe where bark symptoms appeared in 1977 both the insect and the fungus were already endemic. Thus there was no question of an epidemic occurring unless one or both organisms had suddenly appeared in an aggressive form. Assuming no such forms to exist — an idea considered later — we are left with two possibilities; either that the condition so prevalent in 1977 was not the disease described by Ehrlich in America or that the disease had suddenly flared up *in situ*.

The true meaning of 'beech bark disease' : schools of thought

North American observations have benefited from the fairly clear cut phenomenon of an advancing epidemic front which over-shadows the under-lying complexity of symptom expression and the modifying effects of soil, topography and climate. In Europe the endemic nature of the disease has often prevented the underlying insect/fungus relationship from being

recognised. Also the fact that both the species of beech and the variety of *N. coccinea* differ between the two continents has prevented automatic acceptance of the relationship in Europe. At least, these are the views of those pathologists who recognise a basic similarity between the American and European forms of the disease. But these views do not exclude the possible existence of other forms; forms which should, perhaps, not be called 'beech bark disease'.

In Germany it was demonstrated by H. Zycha and other workers that a condition regarded as beech bark disease developed on many large beeches following drought years or very cold winters. This abiotic explanation persisted in Britain until 'N.American-style' beech bark disease was clearly recognised in the 1960s in young plantations and it still finds much favour in Germany. Adherents of the 'abiotic theory' have noted the presence of *C. fagisuga* and *Nectria* on diseased trees but they have regarded them as being of secondary importance. On this line of reasoning any outbreak of disease will always be related to extreme weather conditions. The drought of 1975/6 provided just such conditions, and the sudden appearance of bark symptoms in late 1976 and 1977 fits in well with the abiotic theory. If this theory is right there is clearly no reason to talk about the spread of pathogens.

Will the beech go the way of the elm?

No single explanation

The abiotic theory does not, however, fit the facts in many instances. Heavy infestation of beech by *C. fagisuga* and subsequent bark death associated with *N. coccinea* have occurred in the absence of extreme drought in many parts of Europe and N. America and all studies of these outbreaks have indicated no primary involvement of abiotic factors. If there seems to be a contradiction here between two different explanations of the development of beech bark disease, it may be that we have just not properly decided what we mean by that name. I have examined several hundred large beech trees which showed bark symptoms after 1976 and in no case have I found a heavy infestation of *C. fagisuga*. *Nectria*, on the other hand, has been present in many of the bark lesions. These observations, together with the timing of symptom expression, suggest very strongly that *Nectria* lesions indistinguishable from those occurring in the insect/fungus disease complex can develop following drought stress. It thus seems likely that the cause of the tree's predisposition to lesion development may not be the same in all cases.

My recent experiments indicate that the role of *C. fagisuga* in predisposing bark to *Nectria* infection is a lowering of the resistance to internal growth of the fungus. Various forms of stress could cause a similar lowering of resistance and it seems probable that severe attack by *C. fagisuga* happens to be the commonest of several possible factors predisposing trees to infection. Drought stress and root disease will, however, be important factors on old trees. The significant fact is that the 1977 outbreaks of 'beech bark disease' were not the result of the insect/fungus complex usually given that name. There is a problem of definition here and it is a problem which should not be allowed to generate unnecessary alarm.

The North American epidemic

I have attempted to explain why we do not — and almost certainly could never — have an *epidemic* of beech bark disease in Britain. Why, then, is there an epidemic in N. America? The answer seems to be the familiar one of a host population being exposed to a hitherto alien pest or pathogen. As I have mentioned, man is thought to have introduced *C. fagisuga* to N. America and although its natural role is that of an endemic organism, an epidemic has been artificially caused. This may have been exacerbated by another human activity: the selective exploitation of the natural mixed forests. American beech was, until fairly recently, little utilised for timber and its proportion in the stands thus increased as other species were removed.

Rapid build-up of *C. fagisuga* populations is not confined to the epidemic situation; it occurs in Britain when young plantations reach the age at which high susceptibility to infestation first becomes apparent (usually twenty to thirty years). But even in pure, even-aged plantations there is not often sufficient damage to cause serious concern about the prospects of the development of a mature stand.

Recovery and cure

During 1978 we have seen arrest of bark death on many of the trees suffering from the post-drought damage. Callusing has begun and could eventually lead to full recovery. Unfortunately the areas of dead bark may allow wood rotting fungi to enter and it may be that trees capable of repairing bark damage may yet succumb in this way. The treatment of excised lesions with a fungicidal paint has been attempted and, although the treatment has not been statistically evaluated, it may be worthwhile on valuable trees. The same considerations of natural recovery and treatment probably apply to a proportion of trees affected by 'true' beech bark disease (i.e. attack by *C. fagisuga* and *N. coccinea*) but any form of bark disease may in some cases be part of an irreversible decline in health. Such severe cases are usually identifiable due to progressive die-back in the crown of the trees.

Recovery may occur even before bark death occurs in the sense that *C. fagisuga* infestation on a stem commonly declines or fails to reach a dangerous density. It is normal for some degree of infestation to occur on British beeches. Artificial control is possible using scrubbing or insecticide sprays.

The future : possible changes in pathogen, host and environment

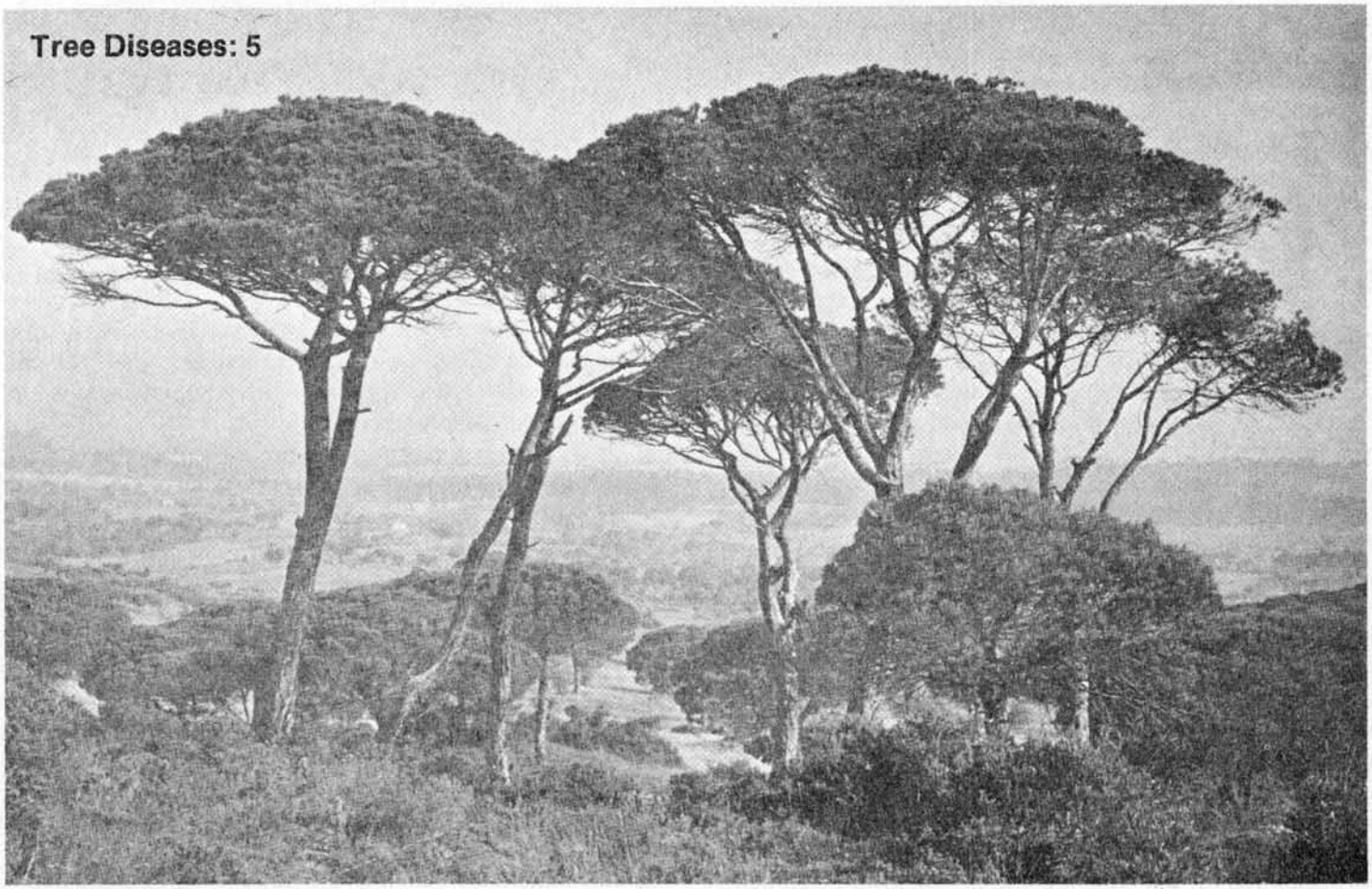
The result of the introduction of the aggressive form of *Ceratocystis ulmi* to Britain — the Dutch elm disease epidemic — demonstrates not only the hazards of man's tendency to set up new host/pathogen combinations but also the existence of variation in the pathogenicity of some micro-organisms.

In the case of beech bark disease we have already noted that the fungal pathogen is a weak parasite which depends upon an abnormal condition of the tree in order to cause serious damage. The existence of an aggressive form of such a parasite is scarcely possible because such a form would lie outside its mode of life. A limited degree of variation in pathogenicity amongst different strains of the fungus does, however, probably occur and there are also other species of *Nectria* which are more adapted to a parasitic mode of life than *N. coccinea*. Interestingly, one of these, *N. ditissima*, commonly attacks the twigs of beech but rarely occurs on the main stem. *Cryptococcus fagisuga*, unlike the fungal pathogen, seems to be well adapted to attacking healthy beeches and its very dense colonisation of some stems shows it to be normally 'aggressive'. In Britain this aggressiveness has clearly been tempered by other factors which can loosely be interpreted as 'resistance' of trees to infestation, although this is not necessarily an inherent genetic property.

If, as I suggest, alterations in the insect and the fungus will not alter the incidence of beech bark disease then 'resistance' of the host population is the only probable factor which could influence future trends. *C. fagisuga* infestation in Britain is now at a higher level than it has apparently been in past decades. This is probably due to the sudden availability of previously uninfested tissue in the many plantations established in the 1930s, '40s and '50s. Conversely the severe effects of the 1975/6 drought are partly a consequence of another population bulge at the older end of the age spectrum. As young trees pass through the peak phase of infection and as old trees die there will be changes in disease incidence, but there are many young stands which have not yet reached a peak phase. The present young and old 'bulges' perhaps emphasise the importance of a stable tree planting policy. Droughts may be unpredictable, but the susceptibility of old trees to drought damage should be appreciated.

Conclusions

There are a range of conditions which have earned the name 'beech bark disease' and of these the *Cryptococcus/Nectria* association is the most distinct. This association is epidemiologically complex and it is almost certainly incapable of causing a Dutch elm disease-type epidemic in areas where the insect and fungus are endemic. The American epidemic is the result of the artificial introduction of an alien pest.



The Future of Tree Diseases

by Edward Goldsmith

What has caused the epidemics that are currently decimating our trees? The factors involved are intimately linked to economic development — and the only hope for our trees lies in de-industrialisation.

Trees are threatened with extinction. Those that survive the woodman's axe and the developer's bulldozer are struck down or menaced by an increasing number of epidemics. At the beginning of this century the American chestnut (*Castanea dentata*) which once made up twenty-five per cent of the forests in the eastern half of the US was stricken by a fungus (*Endothia parasitica*). It has now virtually disappeared from the landscape. The loss is incalculable. Among other things its timber was highly prized for its beautiful grain and its resistance to dry rot. Thirty thousand million board feet of it are estimated to have been lost. The wood contained tannin that is used for making leather. The industry that extracted it is now bankrupt. The chestnut also provided a habitat for vast populations of squirrels and deer that fed on the nuts and great flocks of wild turkey. These have been decimated. What is more the fungus crossed the Atlantic where it is now wiping out European chestnut groves in Southern Italy. The loss was estimated twelve years ago at $1,000 million (Carefoot and Sprott 1967). But is money the right currency for expressing such a loss?

In 1930, forests containing 1,000 million American elms were struck with Dutch elm disease, which spread from the Atlantic along the St. Lawrence watershed around the Great Lakes, from Maine to Minnesota. Forty years later few survivors remained. Another five hundred million or so elms scattered on farmland, along country roads and city streets were also annihilated. The cost was estimated, twelve years ago, at $50,000, which included $12,000 million spent on cutting down the dead trees and burning them to kill the fungus; $3,000 million for replanting resistant trees; and $250 million a year to inject amenity trees with chemicals, (Carefoot and Sprott 1967).

In the forties, it was the turn of the oaks of which there were in America an estimated 12,000 million belonging to thirty-five different species. The disease was triggered off by a sap fungus which entered the tree through punctures in the bark mainly caused by an oak bark beetle. The disease is still spreading at the rate of about fifty miles a year. It is not as lethal as Dutch elm disease or chestnut blight, but is nevertheless decimating oak stands over a wide area. The cost of this damage is enormous. The oak forests of America represented, among other things, over a billion feet of timber. At the low price of $30 per thousand this would

mean $30,000 million, and at today's prices possibly as much as $100,000 million. But this is nothing compared to what would be the biological and ecological, not to mention the aesthetic costs of the destruction of America's oaks.

Only the Ash to remain?

I have mentioned the three tree epidemics that have attracted the most attention, but these are by no means the only ones that have broken out in recent years. For instance, a disease of the maple tree has been spreading southwards from Nova Scotia. A fungus associated with a tree scale insect is afflicting the hemlock, the red pine and the beech in New England and threatens to spread across much of America and possibly to Britain. Another fungus (*Ceratocystis ulmi*) is killing off the plane trees in the southern part of France, while yet another (*Coryneum cardinale*) is killing cypresses in south and central Italy. In California the Monterey cypress is in trouble. In South West Australia a particularly virulent disease is destroying vast tracts of eucalyptus forests. In New Zealand, willows are dying and in Jamaica and Florida the precious coconut palm, on which tens of millions of people depend for their livelihood, is being annihilated by Lethal Yellowing disease which is now spreading to the neighbouring Islands.

In Britain the countryside is studded with dead and dying elms, our beech trees appear to be affected (see Lonsdale's article in this issue of *The Ecologist*) by some yet unidentified ailment which may or may not be related to the disease affecting the beech trees in New England, while sycamores in certain areas are afflicted with Sooty bark disease.

Elm, beech, sycamore, oak and ash make up the vast majority of the larger deciduous trees in this country. If the first of these is already being annihilated, and the second and third are afflicted — no-one knows with what consequences — the prospect is indeed grim. If oak wilt were to cross the Atlantic, this would leave us with only the ash — a truly terrifying prospect.

Playing down the Problem

The temptation for foresters and plant pathologists is to play down the current epidemics. They like to think that things are much as they have always been. This leads to the comforting thought that everything they learned at university is as valid today as it was then, and that there is no need to bring about any radical change to current attitudes or current forest practices. Even Dr. Burdekin the tree pathologist of the Forestry Commission tries to convey this impression to the public. In an article in *The Times,* he quotes a letter that appeared on June 11th 1977 in the same paper lamenting the disappearance of elms from the British countryside and showing that identical sentiments were expressed forty years earlier — on November 11th 1930, also in a letter to *The Times.* This is supposed to justify his conclusion that "times do not really change". The opposite is in fact the truth. Times have changed, and very dramatically at that, and the question we must ask ourselves today is whether our trees will survive these changes?

The technological approach to tree disease

It is the object of this article to try and answer this question. To do this we must undoubtedly review the major diseases affecting trees today. But I propose to inquire more deeply into the subject. Tree diseases are merely instances of diseases in general and must be bound by the same set of principles. So it is 'disease' itself that we must consider. Now there are two very conflicting approaches to the study of disease. The first is the technological approach. A disease is empirically associated with a parasite. The parasite is taken to be the 'cause' of the disease, which it is assumed, can only be cured by eliminating it. The second approach is the ecological one which I shall consider later. The technological approach is very convenient since it provides the rationale for indulging in precisely what our society is organised and motivated to indulge in — economic enterprises, in this case, in the form of large-scale spraying programmes which contribute to GNP and provide research grants for scientists, development grants for technologists, profits for industrialists, dividends for share-holders and jobs for all. It also brings the rapid results which are required in a society that is so little concerned with medium to long term consequences.

Spray, spray and spray again

Systematic spraying is, of course, very irresponsible in that its effect on populations of insects, fungi and the various micro-organisms that inhabit the forest soil, cannot be predicted with accuracy. Even if it could, this would not necessarily help, as the exact ecological functions of the different populations in maintaining the fertility of the soil and contributing to the health of the trees and to the ecosystems as a whole is generally not known. What is known is that these populations will be significantly affected (Kuhnelt 1976). Populations of some species will increase, others will decrease. Since pesticides accumulate up the food chain, those at the top, i.e. predators, will be most adversely affected and it is these, it must be remembered, that in normal conditions, are responsible for controlling the population of target species. All sorts of micro-organisms live in the tree's roots, in symbiosis with the tree, contributing in all sorts of subtle ways to its long term health — these also can be affected.

Resistance, too, builds up very quickly among insects and micro-organisms to chemical poisons. Hundreds of insect species are already resistant to DDT and other pesticides. In any case insecticides can only really eliminate an epidemic if they can exterminate the pest population involved. But all they in fact do is thin it out, killing at most eighty to ninety per cent of it. As a result, the survivors, now in possession of an

ample food supply, will tend to proliferate. What is more, the pesticides will give rise to a new population which, being descended from the survivors, must display some resistance to the chemicals used and is likely to be tougher and more difficult to eliminate. More often than not, the plant pathologist faced with such a situation simply orders further spraying, which can only lead to a further increase in resistance to the chemical used, and of course to further biological and ecological deterioration. For these reasons attempts to control major plant pests by large scale spraying programmes have almost always failed. What is more, except in the worst cases, the outbreak, if allowed to take its course, would have died a natural death. Natural controls would have eventually restored ecological stability, as shown in the following examples.

The Douglas Fir Tussock Moth

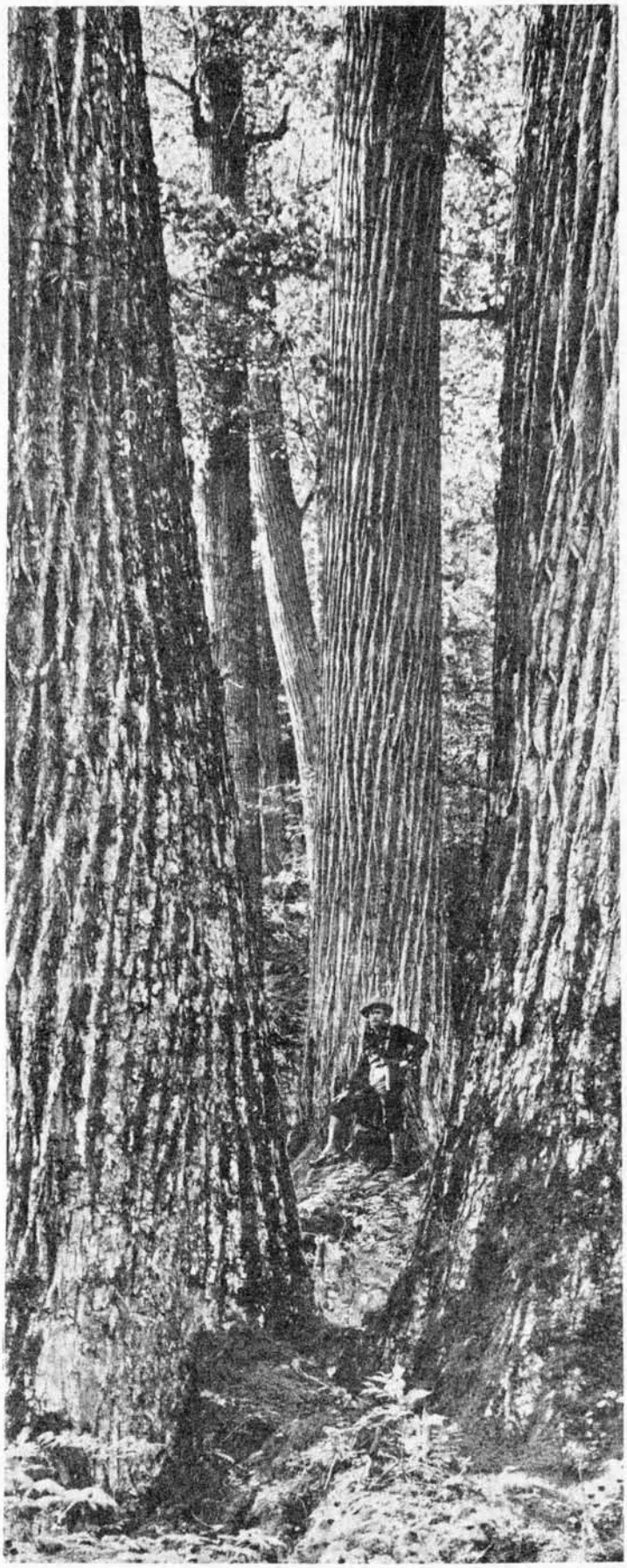
Under 'normal' conditions this moth causes little or no noticeable defoliation. However on certain occasions, for reasons that are probably related to climate, the tussock moth population of a particular area can explode and cause a great deal of defoliation. Twenty five to thirty per cent of the trees can die over a period of three years. Most of them, however, die as an indirect consequence of defoliation, actually succumbing to bark beetles and other invaders. What is particularly important is that tussock moth outbreaks usually only last three years — after which the entire population tends to collapse as a result of an attack by their natural enemies, in particular a polyhedrosis virus.

For the last twenty-five years, the tendency has been to spray the affected forest. There is no evidence however that this has had any effect. A study by the US forest services, for instance, concluded that 'limited comparisons in California of two chemically treated areas with two untreated areas showed no significant differences in total tree mortality'. In both cases, the virus intection seemed to be the main cause of the decline of the moth population. Another report (S G Hermann 1973) showed that 99.9 per cent of the population of tussock moths in the Blue Mountain epidemic in 1972 had died by the end of the following year of natural causes. The polyhedrosis virus being mainly responsible.

The Gypsy Moth

The gypsy moth feeds on oak leaves, and when its population explodes it can cause considerable defoliation. However these population explosions cannot be sustained for long. 'Two years of defoliation are usually followed by a population crash with dispersal, disease and parasitization all contributing to a drastic reduction in gypsy moth numbers'. (Hinckley 1972).

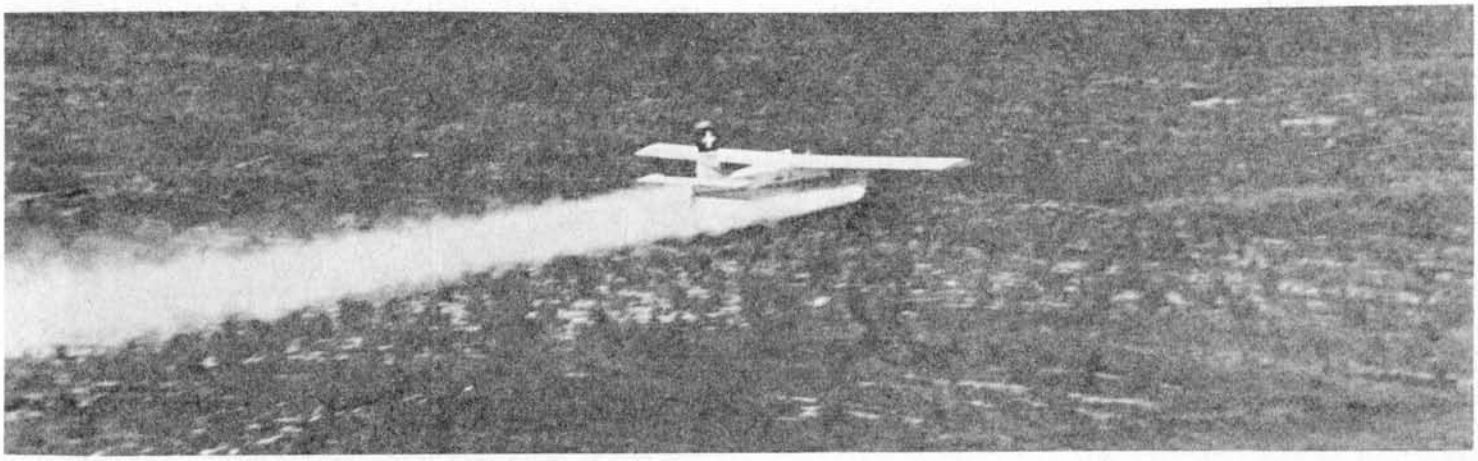
The affected trees tend to be leafless by the end of June but can refoliate during July and August. Some branches of older trees may die. but it is largely the pines which have little capacity for refoliation or deciduous trees in the forest under-storey that tend to succumb. As Hinckley points out 'if this process continues long enough, a different forest emerges, one no less interesting and more in balance with the gypsy moth. Lumber interests would have to put up with a temporary loss in production, but this would be made good if they had the patience to wait for the forest to recover. Unfortunately they do not have and insist on spraying.'



Museum of North Idaho

The American chestnut —
virtually disappeared from the landscape

Until 1961 DDT was used in massive spray programmes in New England and New York. Caterpillars were killed in May and a lot of defoliation was pre-



Forestry Commission

Spraying has proved a costly failure

vented. The eminent ecologist Kenneth Watt showed that these spray programmes had but little effect on the population dynamics of the gypsy moth. He considers that weather conditions are more important than anything else in determining the growth and the fall of gypsy moth populations (Kenneth Watt 1968).

More recently Sevin (Carbaryl) has been introduced to replace DDT which is now banned in the USA. It is non-persistent and breaks down on contact with water. But to be effective it must be applied at a very specific time, just after the majority of caterpillars have begun feeding and before the leaf canopy has built up. Because of micro-climatic difficulties, it is impossible to apply Sevin with this sort of precision over large areas, and as a result the pesticide merely tends to thin out the caterpillar populations, increase survival to pupation — because of the reduced competition for food — and hence prolong the outbreak, (Doane, 1968).

In addition this pesticide will also kill many insects, including parasitic flies and wasps, that are the natural predators on the moth (Kamram 1971). It will also kill bees which must thereby reduce pollination and food production.

The Spruce Budworm

The spruce budworm infests spruce forests in Canada, and the response has been to spray them, (May 1978). In 1952 DDT was sprayed on 200,000 acres of forests in New Brunswick. The main effect was to increase the acreage affected and the need for further spraying operations. In 1963, about twenty-five per cent of the land area of the province was affected — but by 1973, after twenty years spraying, the figure was closer to ninety per cent. In 1976 9.5 million acres of forest had to be sprayed.

Eventually DDT was abandoned and an organophosphate called fenitrothion was used instead, but this has not been any more successful. As Elizabeth May writes "the killing of a large proportion of the budworm population (about eighty-five per cent) was termed successful but left the survivors with an abundant food supply; starvation was no longer a limit to population growth. The lethal effect of both DDT and fenitrothion on the birds, small insects, spiders and wasps which prey on the budworms removed another check. The only remaining check on unlimited population growth was the annual dousing with chemicals from the air — the very thing which allowed the infestation to continue and spread." The perpetual epidemic created in New Brunswick created a breeding ground for infestations in other areas, and forced both Quebec and Maine to start spraying too (Robert Paelhke 1978).

The biological and ecological damage done by all this spraying was of course immense. Among other things it caused an outbreak of a disease called Reye's Syndrome — unknown before the 1950s — which causes liver and brain damage and is frequently fatal, primarily affecting rural children.

Recently, Prince Edward Island decided against spraying and instead set about replanting more varied, more resistant species, to replace the dying spruces. However, as Paelhke points out "in all of the provinces where forestry was big business spraying was either carried out or fought hard for by the big forest companies. Their lack of concern with anything but maximising short term yields is truly disgraceful", (Paelhke 1971).

In Nova Scotia where spraying had not occurred, the infestation came to an end by itself and when Nova Scotia's Forest Industries (NSFI) requested a permit to spray 100,000 acres of Cape Breton forests with fenitrothion, Nova Scotia's Deputy Minister of Lands and Forests turned down the request stating that "bud worms have hit Cape Breton before but they died out on their own . . . We feel that it is far better from a forestry point of view to suffer our losses now, rather than spray and prolong the inevitable, as New Brunswick has done. The forests of New Brunswick after twenty-five years of spraying certainly are not the envy of any one involved in proper forest management."

Other spraying Failures: when will the Experts learn?

There have also been attempts to use insecticides in the fight against Dutch elm disease in the US. Its use, to quote Frank Graham Jnr., provided scientists with "one of the classic environmental horror stories. Enormous amounts of long-lasting insecticides were sprayed on American cities and towns. Robins, feeding on earthworms which earlier had fed on the sprayed leaves, died in untold numbers. Sewers carried DDT residues from city streets into rivers and lakes, where destruction became magnified. Yet, after great financial and environmental cost, the cities lost their elms

anyway, and the disease kept spreading into new areas.''

Attempts to save trees affected by serious tree diseases by injecting them with chemicals have been a total failure. Efforts to inject trees afflicted with chestnut blight or Dutch elm disease have failed. First of all the cost is very much too high which means that the method can only be used for saving a few amenity trees around public buildings, for instance, or in private gardens. In any case resistance soon builds up against the chemical.

According to William B Ennis of the Agricultural Research Centre, efforts to inject palm trees threatened with Lethal Yellowing disease can slow the progress of the disease but that is all, the tree cannot be cured and will eventually die.

Unfortunately the experts never learn — largely of course, because they do not want to. In spite of the almost universal failure of spraying campaigns they remain the main weapon in the armoury used by plant pathologists. In this country the Forestry Commission last year mounted what was in its own words 'its biggest ever aerial spraying operation', (press notice 2.6.78). Twelve thousand acres of lodgepole pine plantations infested with the larvae of the pine beauty moth (*flammea panolis*) were sprayed with fenitrothion, precisely the same pesticide used so unsuccessfully in New Brunswick and elsewhere.*

Health and Stability: the ecological approach

We have seen that the technological approach to tree disease is an abortive one. If the parasite is the only cause of the disease then there is no solution to the problem because once the parasite is established we shall never succeed in eliminating it. Fortunately the parasite is only the 'cause' of the disease in the very narrowest sense of the term. The problem is a very much more complex one, and cannot be understood in terms of the simple cause-and-effect relationships so beloved by our misguided empiricist philosophers.

To understand the real cause of the disease we must look much more closely into the question of disease in general, and this we cannot do until we can first explain what is 'health' — from which 'disease' is nothing more than some sort of deviation. The term is normally applied to biological organisms only. A biological organism, however, is simply an instance of a natural system. If 'health' is a basic term, like such terms as 'control', 'stability', 'order' etc., then we should also be able to talk of the health of other natural systems such as ecosystems, social systems etc. If a system is healthy, this can only mean that it is stable, i.e. that it functions properly. That state can only be established if one knows what is the system's goal. Since we know this to be the achievement of stability or continuity or homeorhesos, to use C.H. Waddington's term (Waddington 1957), then one can regard a system to be functioning properly to the extent that it achieves this goal. In other words health equals stability.

A natural system is hierarchically organised, i.e. made up of sub-systems and sub sub-systems. To maintain its structure, these must all fulfil their appointed functions and thereby cooperate towards the achievement of a common goal. Those that do not and have thereby ceased to be viable tend to be eliminated by natural selection. In this way 'noise' or 'randomness' or 'entropy' is reduced to a minimum, organisation or negative-entropy is maximised and the viability of a system, and hence its adaptiveness, stability or health, is maximised. Disease in a stable society is, in fact, but a means of natural selection which explains why it eliminates mainly the weak and the sickly. If it does not eradicate the healthy, it is because it is not adaptive to do so, still less to wipe out whole populations of healthy organisms. It is the strategy of nature precisely to avoid such things. To achieve stability means precisely that: reducing discontinuities of this sort to a minimum. Hence epidemics do not occur in stable ecosystems any more than do other major discontinuities such as large scale droughts, floods or massacres. Their occurrence is a sign that something has gone wrong, that the system has ceased to be stable, that a serious maladjustment has occurred.

Looking to the Root of the Problem

A serious disease is therefore a more complex phenomenon than is generally thought and cannot simply be attributed to the agency of the parasite or pathogen that appears to have triggered it off.

As Day writes ''it is customary to speak loosely regarding diseases with which parasites are associated, assuming that the parasite is the sole factor with which one need be concerned, whereas other factors may be more necessary to the production of the diseased condition. *One evil result of this is that fundamental causes tend to be overlooked and attention concentrated on the obvious factors in the problem, even though these may be of secondary importance,* '' (W.R. Day 1929).

The fundamental causes are often those that reduce the tree's resistance to parasite invasions. This reduction in their resistance must be regarded as an injury — unfortunately one that is not always normally visible. It

*** Note**

In the July/August 1978 issue of *The New Ecologist* we mentioned that they were using this deadly substance which had been so totally discredited in Canada. Subsequently we received an indignant letter from C G Stewart of the Forestry Commission insisting that fenitrothion is 'not deadly'. His argument is that ''it is registered in the 1978 Approved Products for Farmers and Growers under the Agricultural Chemicals Approvals Scheme for use with a variety of food crops. Before the British operation received the necessary clearance for use in forestry, all aspects were subject to close scrutiny, under the terms of the Pesticides Safety Precautions Scheme, by the Advisory Committee on Pesticides which gave a very high degree of assurance on the safety of its use.'' Needless to say those poisons used in agriculture and forestry that have today been shown to be carcinogenic and mutagenic and may have been partially or totally banned were also in their day approved and monitored by the appropriate official bodies. In the UK, for instance, known carcinogens such as 2, 4, 5-T are still used — and this somewhat reduces the value of Mr Stewart's assurances. In any case he does not mention what reasons he has for supposing that this campaign will be effective. In the long run, on theoretical and empirical grounds it cannot be. The only real benefit will be to the chemical companies, and the experts that they sponsor.

is important that means of discerning them be devised before a combination of other injuries leads to tree losses. Keller has introduced the distinction between 'visible' and 'latent' or hidden injury. As Keller writes "the forester in industrialised countries should not wait until injuries are discernable (chronic or acute injury) and economic losses do occur. He should evaluate the situation well in advance and should recognize (and demonstrate) the existence of a potential danger to the forests as soon as the trees are under stress and long before they exhibit visible symptoms or even collapse," (Keller 1976).

It is exactly the denial of the existence of 'hidden' injury and the use or occurrence of visible injury as sole criterion of a plant's reaction to air pollution which led to such erroneous conclusions as "a concentration of 0.2 ppm SO_2 is tolerated for several weeks even by young conifers", (Zahn 1969). Such a conclusion of course would only be justified if a threshold existed below which pollution caused no biological damage — such a threshold of course does not exist. Keller suggests that the level of photsynthesis might be a useful indicator of hidden injury in the case of trees. Photosynthesis is a primary process of wood production. Respiration too depends on it because it utilizes substances produced by this process. Since photosynthesis reacts sensitively to any change of environmental factors, it is a good indicator of a plant's reaction to air pollutants.

In reality, of course, it is these factors — those that have caused the invisible injuries and have thereby reduced the tree's resistance — that are *the real cause of the disease.* For if they were not operative the parasite would be relatively harmless. Day comes to the same conclusion. "If an indigenous parasite depends for successful parasitism on an already existing morbid condition in the host," he writes, "it should be known what such a condition is and how it is brought about. *For the means by which this condition is produced is the real cause and should be referred to as such*", (Day 1929).

One might add that in the case of the importation of an alien parasite, one can regard the importation as such as only a symptom of the disease it may give rise to. The real disease is clearly the state of mobility and world trade in wood products that must inevitably lead to such a situation. For the biosphere to be stable it must be made up of ecosystems displaying great diversity. To maintain this diversity means maintaining them in relative isolation from each other, each in that area in which it has evolved as an adaptive response to a specific set of conditions. Once conditions no longer favour the existence of this isolation and once mobility is such that the components of these ecosystems are simply shuffled about like a deck of cards, biospheric complexity can only be disrupted and stability drastically reduced.

Experts: the Art of Sitting on the Fence

Unfortunately not all plant pathologists are necessarily interested in working out what is the condition referred by Day. Their tendency is often to regard such an inquiry as sheer speculation unworthy of professional scientists.

Consider the following answer I received from a professional plant pathologist to an inquiry about the underlying causes of a specific tree epidemic in the area in which he lived. "I share with you your concern with regard to the apparent rapid degradation of the vegetation component of ecosystems in many parts of the world", he wrote. "At the philosophical level I think it is reasonable to hypothesize that many of our problems are a consequence of modern society's desire to impose uniformity on ecosystems which survived in the past because of their diversity. However, as I am a public servant engaged in scientific research, I cannot *engage (publically) in philosophical discussion.*"

He is thus telling us that to consider the real factors giving rise to a forest epidemic is outside the brief of public servants and scientists. Their role, it is assumed is to keep their noses firmly glued to their test tubes, come out with learned descriptions of the actual mechanics of the disease, and then propose technological remedies for destroying the parasites that appear to be involved, whether such methods work or not.

What keeps trees healthy?

Indigenous versus exotic Species

In order to determine what are the conditions leading to reduced resistance to disease we must first of all establish what are those that favour the maintenance of health. Since a tree species is a product of evolution which is a directive process tending towards the maximisation of stability, tree populations must display the greatest stability, and hence the highest degree of health, *when growing in the environment to which they have been adapted by their evolution.* Again all the empirical evidence confirms this thesis. Thus Day points out that in general "indigenous species are less affected by disease than exotics", (Day 1949). He points out, too, that in Britain the species most seriously affected by butt rot are exotic conifers such as the Sitka and Norway spruce, the European and Japanese larch, Douglas fir and Thurja plicata. Indigenous trees such as beech, oak and Scots pine may be grown for much longer rotations than can these exotics and remain free from serious butt rot.

Significantly too, Florida's native palm species appear unaffected by Lethal Yellowing disease which exclusively affects exotic species. Pine blister rust in North America also appears to affect pines when they are planted outside their natural range (Bingham 1971). This means that to maximise resistance to disease, we should ideally be planting (whenever possible) our native trees — those that are designed by evolution to survive in the particular environmental conditions present on this island. This would mean planting pendunculate oak on the heavy soils in the south east of England, the sessile oak in the lighter soils of the north and west and in some parts of the Scottish highlands. It would mean planting in all these areas along-

side the oaks, such trees as elms, limes, poplars, ash, beech, hornbeam and birch. The under-storey of these large trees must also not be neglected. In general it should be composed of hazel, holly and thorn trees. In ideal conditions the only conifer we should plant would be the Scots pine which once covered much of the Scottish highlands. Nor should we think simply in terms of species. A species was once looked upon as a group of uniform individuals but we now know that this is not so. There is very considerable diversity within a species.

Provenance: a new Field of Study

Indeed a whole academic field has developed to study this approach, referred to today as provenance research, (Langlet 1962). It has revealed that in a widely distributed species, there are not only considerable differences in the strains to be found in different areas but differences too in the types of diseases to which the strains are subject. Thus among species of trees that are widely distributed such as Scots pine, widely differing "climatic races" occur. As Day points out when a number of these "climatic races" of a single species are planted together in one place, so that some are more and others less suited to their evironment, the different races will differ not only as regards vigour of growth, but also susceptibility to disease (Day 1950). He writes, "The pine needle cast fungi, *lophodermium pinastri*, rarely acts in Britain as an important cause of disease on Scots pine but in some regions on the continent of Europe it frequently does so. In general the Scots pine is affected by a different sort of parasite in the north of Europe than further south. The same in general is true of all tree species." All this is obvious. The evolutionary process has adapted trees of a particular species and of a particular strain within the species to living in a particular environment. As soon as these are moved into a different environment to which they have not been adapted, maladjustments must occur. As Day puts it "any attempt in practice to treat a species as though (i) its environmental range was relatively unlimited, or (ii) it was within itself a constant constitutionally, so that strains native to significantly different environments might be planted without regard to their particular requirements, will lead to a greater or less extent to a breakdown of health", (Day 1950).

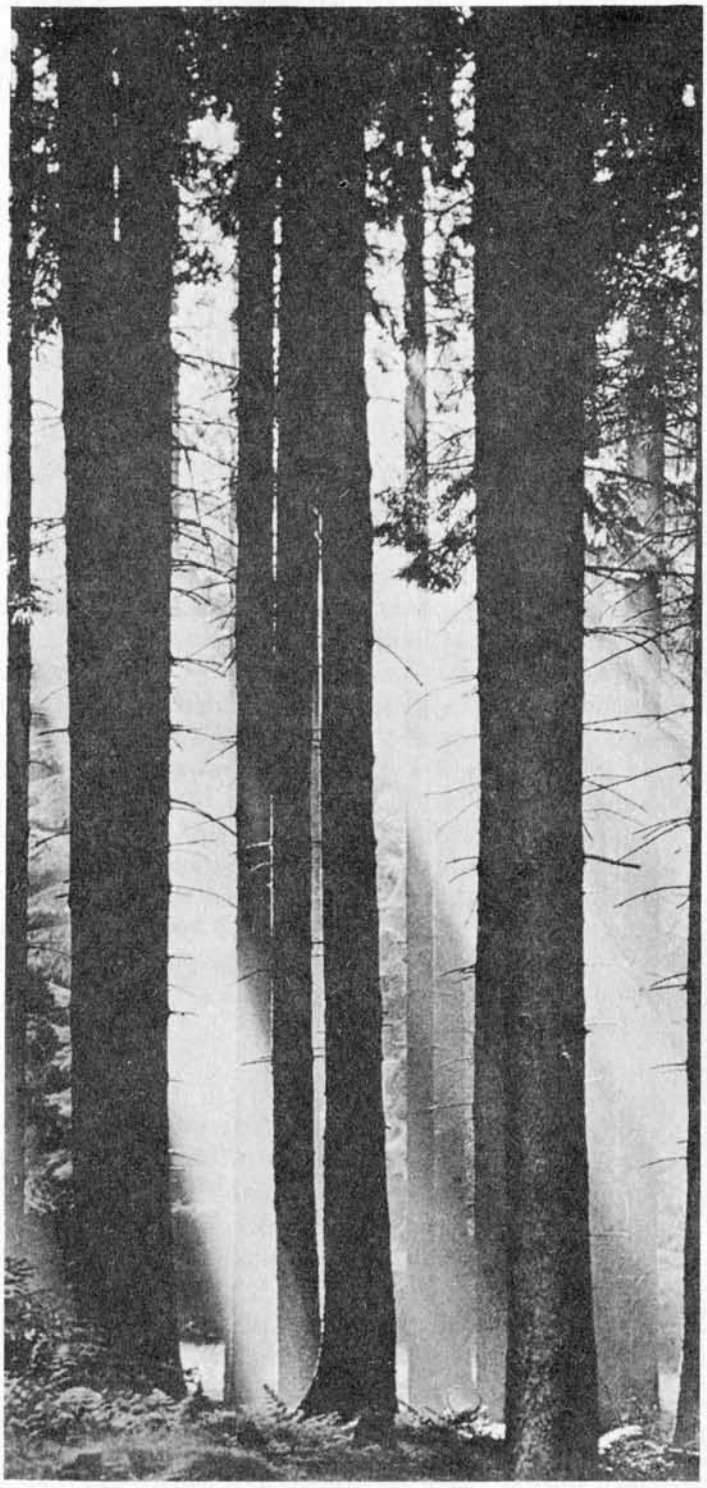
This does not mean that exotics cannot be cultivated, but again as Day points out the successful establishment of exotics in reality, "depends on the movement of the strains of species so that they remain within the limits of their environmental range both for living and non-living factors", (Day 1950).

Hence it is by studying all the main features of their natural range and seeking to reproduce them in the area in which exotics are to be planted that their resistance can be maximised.

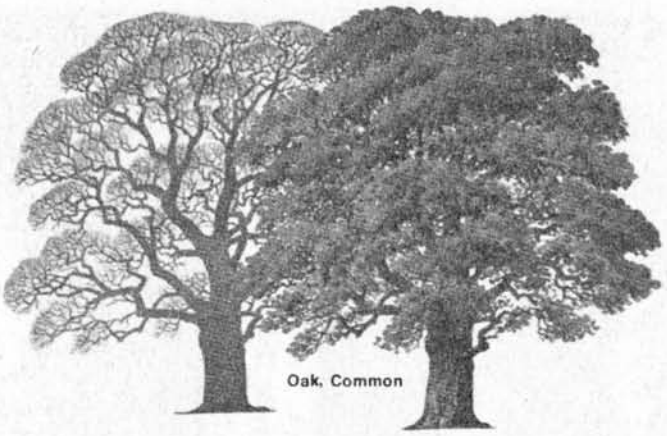
Since forestry in Britain is distinguished from that of most other countries by the extent of our reliance on fast growing exotic species, it is worth examining what are the main 'living and non-living' factors involved.

Climate

The most obvious one is climate, and one of the aspects of climate that most affects the growth and health of trees is the presence or absence of frost. Frost can weaken trees of certain species in such a way as seriously to reduce their resistance to specific diseases. Thus a fungus (*Dasyscypha willcommii*) that causes the dieback and canker of the European larch is normally of little importance, but if the larch are planted outside their normal range, particularly in areas where there is heavy frost, its susceptibility to this parasite increases very siginficantly and the disease associated with it can reach epidemic proportions. The same is true of the Corsican pine which, when planted in areas with heavy frost, is subject to a type of dieback accompanied by canker from which, in normal conditions, it would not suffer, (Day 1950).



Even within a single species, there is considerable diversity — a fact often ignored by foresters.



The Tree Council

Of course cold weather can have the opposite effect and can actually prevent the development of certain diseases. The cold weather of the Northern states of the USA and Canada, for instance, provides an effective barrier against the spread of oak wilt fungus (Carefoot and Sprott 1967). Cloudy weather may be a factor predisposing pines to infection by the fungus *Cronartium ribicola*, in that it provides the conditions necessary for the successful production and distribution of the infecting spores. The rate of evaporation is also relevant. Thus the needle cast fungus (*Meria laricis*) of the European larch was transported with its host from their mountain habitat, where the rate of evaporation is usually high and the opportunity for spore development and infection slight, to Western Europe where the rate of evaporation is often low and opportunity for spore development and infection are very much higher, (Day 1950).

Soil

Another essential factor is soil. Different tree species require very different soil characteristics — different mineral nutrient requirements for instance. The ash, the elm and the sycamore require soil with a high mineral content. Two needled pines and birches on the other hand are less exacting. The oak is intermediate in its demand for minerals (Anderson 1956). To plant trees in soil which does not have the suitable mineral contents is to weaken them and thereby to increase their susceptibility to disease. At the same time this can lead to the degradation of the soil which can still further affect resistance to disease. The growing of conifers on sandy soils and sandy silts over a period of two centuries can acidify (podzolize) soils to the depth of 20 or 30 cms, (Noirfelise). This often leads to a reduction in productivity from the second plantation onwards.

The difference in the mineral content of the leaves and detritus of different species is extremely important. Their cast-off leaves form a little layer which is slowly broken down into humus. The various organisms that decompose the litter are most active when it has a high content of basic mineral salts, also when the litter provides them with an alkaline, neutral or only slightly acid medium. If the medium is too acid, as Anderson (1956) points out, they tend to be absent which causes the litter to accumulate. When this occurs the soil tends to lose its basic mineral elements and becomes increasingly acid. Organic acids develop which move downwards through the soil removing its mineral salts, thus depriving it of many of its micro-organisms, causing it to lose its basic structure and to become podzolized (Anderson 1956). The number of tree species that can grow satisfactorily even in moderately podzolized soil is very limited. The most important is Scots pine. This being so everything should be done to prevent podzolization. Trees should be grown that produce the appropriate litter, which mainly means deciduous trees. Unfortunately these do not satisfy today's requirements for fast growth and high economic yields, but in the long term it is undoubtedly by submitting to these ecological constraints that the health of the forest can be maintained and yields maximised.

Clearly a sound forestry-policy in this country would not only aim at preventing further podzolization but would seek to reverse the process wherever possible. Vast areas of podzolized soil in this country should be systematically improved so that they can be returned to sound forestry. This means planting trees that can grow on podzolized soil and which will produce a litter that is attractive to soil micro-organisms. Among such soil-improving trees are the rowan or mountain ash, the alder and the birch. Unfortunately they do not produce timber of any commercial value which explains why they are not planted on any scale and thereby why few efforts are made to reverse podzolization.

In general, the land available for forestry even when not podzolized is marginal land, mainly in hilly areas — the best land being reserved for agriculture and often too for urbanisation. In itself, marginal land is known to contribute to reduced health and hence resistance to disease. For this reason alone it is important to prevent any further soil deterioration. Among other things, this means avoiding such practices as clear-felling which is still in general use by our own Forestry Commission, and scrub clearance, since both these practices expose the soil unnecessarily to the wind and rain, leading to soil erosion which, particularly on sloping ground, can be very serious.

If trees are to be planted on relatively unfavourable soil, then by way of compensation, all other conditions for tree health should be maximised. As Day writes, "if forestry is, perhaps necessarily, to be confined in the main to the less fertile land, then the composition of woodland should be such that it is able to withstand the relatively great adversities in environment which determine this relatively low fertility. If these are too great, then no amount of care will prevent the forest from being burdened by a great weight of disease in the development of which both non-parasitic as well as parasitic factors may be expected to take part," (Day 1949).

Planting trees on land that has been used for agriculture also favours disease, since its mineral content as well as its micro-fauna demand will have been modified by agriculture. Thus a parasitic fungus, *Fomes annosus*, according to Kujala (1948) is particularly destructive to Murray pine plantations in Finland when these have been established on former cultivated land. "In young stands of natural regeneration in the south the fungus never reached any importance."

Planting trees in land displaying an inappropriate moisture content can also favour the spread of disease.

If the spruce, for instance, is planted on ground that is too dry or too compact to enable it to strike deep roots, it tends to be weakened and in a very dry year, it becomes susceptible to attack by parasites, in particular a ground mushroom that causes rot disease. This also especially affects picea plantations that have been established on previously cultivated soils. According to Noirfelise, planting pine plantations on peaty soil can in certain conditions increase their vulnerability to cryptogram attacks.

It has been noted how changes in the water table, as a result of mining, affect oak mortality in England. Today with increasing water abstraction for both agricultural, domestic use and industry, and falling water levels in many parts of the world, the health of trees is likely to be increasingly affected by this factor.

It is to be noted that the 1976 drought in Britain led to considerable acceleration in the spread of Sooty bark disease of sycamore and also of beech tree disease.

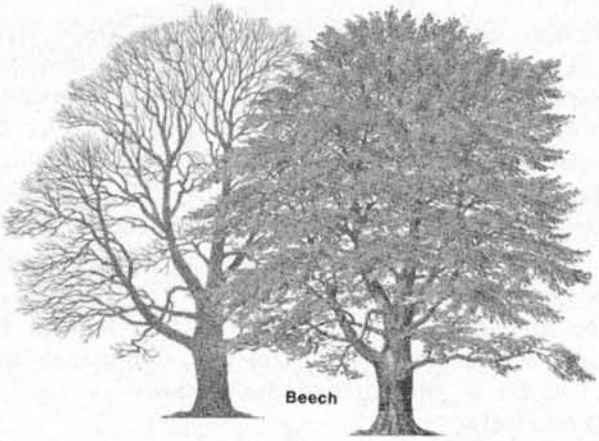
Dry soil also tends to reduce the resistance of various trees to the attacks by the parasite *A. Mellea.* On the other hand, the collar crack disease of cacao only seems to become epidemic when there is high atmospheric humidity and high moisture. According to Day on well drained sites death appears to be only sporadic and losses insignificant, (Day 1929).

Biotic Environment

The third factor is the trees' biotic environment. Foresters are rarely ecologists. They do not seem to realise that, in nature, trees are not arranged at random but in a specific pattern, that which most favours their health and survival as well as that of the forest ecosystem of which they are an integral part. If they are to maintain a stable relationship with their environment, i.e. if they are to be healthy, they must clearly be planted in a biotic environment which resembles as closely as possible that in which they evolved.

There is considerable empirical evidence to show that it is in such conditions that they are most resistant to disease. Keller shows that trees planted in the correct ecological conditions are more resistant to pollution than species "whose demands regarding habitat are only incompletely met, and which in consequence, exhibit diminished vitality." Unfortunately scientific forestry does not always take these things into account. Its main object is to achieve maximum short-term yields. As Anderson points out modern scientific forestry ignores "the fundamental fact that the components of the forest are living organisms with their likes and dislikes and not so many match-sticks, automatically and mechanically increasing in girth, height and volume until they are large enough to meet the fleeting needs of man," (Anderson 1956).

It is ignored that "forests are communities of innumerable living organisms and that they refuse to be bound entirely by rules laid down for them by man." This means first of all that tree monoculture must be avoided. Specific tree species and strains must be planted as much as possible along with the other trees they are accustomed to living with. Ideally the under-storey they have co-evolved should also be reconstituted.



The Tree Council

Nor should trees be unduly overcrowded. Overcrowding is also a factor increasing susceptibility to disease. It is known for instance that canker in larch trees is most destructive in overcrowded woods. In modern dwarf apple orchards in which dwarf trees are planted to a density of one thousand an acre canker can affect as much as thirty per cent of the trees. In the old fashioned orchards with trees planted far apart canker deaths were very much lower. Nor should we plant rows of trees, as is done today, that are all of the same age, for susceptibility to specific diseases varies according to the age of the trees. As Day points out the larch in England is particularly sensitive at the age of fifteen years to a fungus *Armillaria mellea.* Spruce according to Nechleba is most sensitive at the age of twenty-five, (though Frombling finds it most susceptible in the first years after planting). A natural forest, by being made up of trees of different age groups is very much less vulnerable to disease than a plantation of this sort.

There is another reason why trees of the same age and species should not be planted together. It is that their roots will be competing for the same space and hence for the same minerals and moisture. Trees of different species and of different ages, on the other hand, would be making the best use of the soil's fertility (St. Barbe Baker 1979).

Causes of tree disease

Importing Parasites

It remains true that the most serious tree epidemics have been triggered off by changes brought about to the biotic environment of a species or strain of trees by the introduction of one or more alien parasites whose proliferation is not checked, as it would be in their natural environment, by climate, soil or biotic factors.

Thus the canker affecting the Monterey cypress (*Cypressus macrocarpa*) in 1928, was caused by a hitherto undescribed fungus later named *Coryneum cardinale.* After wiping out three quarters of the Monterey cypresses in California, it spread to France in 1940; the Argentine in about 1971; and then to

Australia, England, Georgia, Italy, Northern Ireland and Spain. Wagener, considers that the main cause of its spread was the transport by man of contaminated plants, though the carriage of infected cones by birds was also partly responsible (Wagener 1948).

The gypsy moth (*Porthetria dispar*) the great oak tree defoliator was imported into the US in 1869 from France where, without adequate climatic and biotic controls, it assumed epidemic proportions.

The chestnut blight in the US was caused by a parasite fungus, *Endothia parasitica*, that was imported from China at the turn of the century — and later spread to Italy.

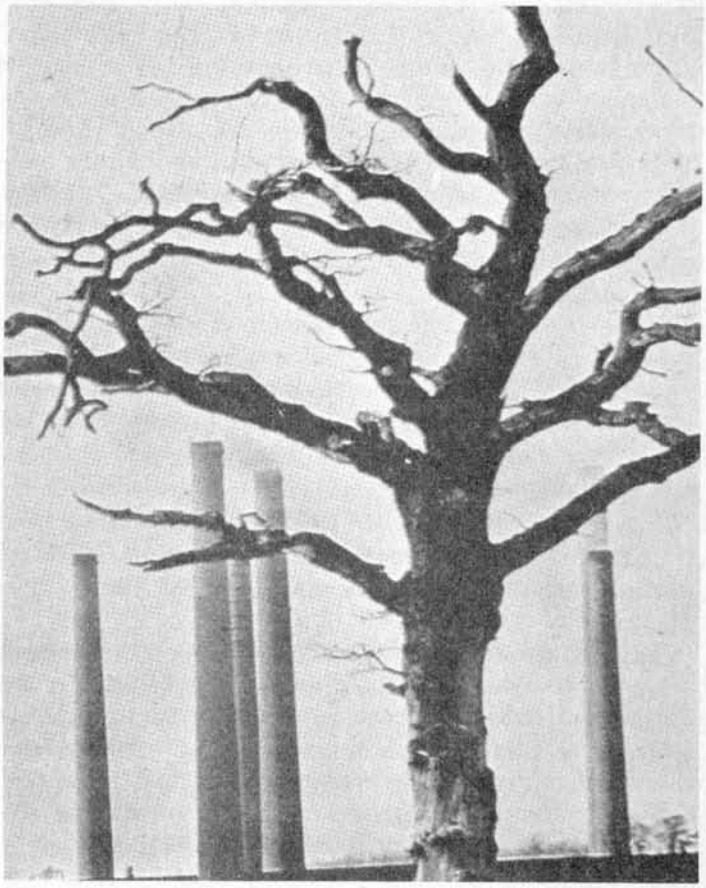
Dutch elm disease in the USA was caused by the Dutch elm fungus, *C. ulmi*, a native of Asia, which had already been introduced to Europe. It was probably brought to the US on a shipment of elm burl logs imported for the manufacture of veneer. Its introduction would probably not have proved fatal were it not that the European elm bark beetle (*Scolytus mulistratus*) was introduced on the same logs and was soon spreading the deadly fungus throughout the USA. Significantly, there is a native American elm bark beetle, but it is comparatively harmless in America, the American elms having achieved a stable relationship with it. It is a new strain of the fungus that appears to have evolved in Canada, and that was taken back across the Atlantic to Britain, that is now annihilating English and Wych elms in the UK, (Gibbs and Frank Graham Jnr.).

Sooty bark disease of sycamore is caused by a saprophyte fungus, *Cryptostroma corticale*, which was introduced into Britain in the 1940s on imported timber from North America where it is a parasite of the sugar maple.

Scleroderris canker which is wiping out red and Scotch pine in New York State appears to be caused by a fungus of a particularly virulent strain which was probably introduced from Europe.

Felling affected Trees: why Governments won't act

How does one deal with this problem. One obvious thing to do is to fell the affected trees and burn them. If this is done early enough the disease can be nipped in the bud. This would probably have been effective in certain cases, in particular in the case of an alien parasite that has still only caused a local infestation. It would have been possible, as Hedger suggests in this issue of *The Ecologist*, in the case of Dutch elm disease. But the elm was partly at least the victim of government priorities. Unfortunately little political capital can be made out of fighting forest diseases. The general public is simply not interested. Thus we find that the Department of the Environment (press release 1977) dismisses the idea of felling all dead elms, stocking them and sawing them up. The economic demand does not justify it. Assuming that a total of 500,000 cubic metres of elms had to be dealt with over a five year period, the felling, transport, handling and storage, together with the payment that would have had to be made to tree owners etc., would cost £15 million. Since, according to their calculations only £10-12½ million would be recoverable, there would be a shortfall of £2½-5 million, and "there is no prospect of the government being willing to underwrite a loss of this kind". The



Pollution drastically weakens a tree's resistence

attitude of government to important issues of this sort is incredibly depressing if one thinks of the massive sums of money wasted every year on projects that do little to foster the long term interests of the people in this country or of their natural environment.

This problem is not peculiar to Britain. The American government has proved to be about as short-sighted. According to Dr Mark McClure of the Connecticut Agricultural Experiment Station in New Haven, the current epidemic affecting red pine in eastern Connecticut is spreading to the native red pine forests of Massachusetts and practically nothing is being done to stop it — among other things, shipments of nursery stock to the yet unaffected areas is still unrestricted. The reason is that money is not available. The government has different priorities and funds are only likely to become available once stands of major economic value are threatened; by then it is likely to be too late (New York Times 10.8.1977).

Keeping out the Parasites

Legislation can, of course, also be passed to prevent the import of timber which might harbour alien parasites. An attempt has been made to do this in this country in particular in order to prevent oak wilt being introduced into Britain. The importation of oak plants from N. America is, in fact, now prohibited and imported wood of oak must have the bark removed to eliminate the bark beetles which could transmit the disease. The wood must also have a moisture content of less than twenty per cent to eliminate the fungus involved in causing this disease. However, it would be naive to suppose that all imports will be meticulously examined to see that they have no bark on them and that the moisture content of the logs is appropriate. As Burdekin himself admits "such measures cannot

guarantee exclusion of oak wilt or other comparable diseases'', (Burdekin 1978).

Pollution

Pollution also reduces the resistance of trees to attacks by parasites. High concentrations are not essential, a combination of different gasses in small quantitites is often sufficient. Damage by smoke favours susceptibility to pests such as bark beetles, weevils and fir lice (Schwerdtfeger 1957). A pest attack by the small spruce leaf aphid was found to be more serious the closer the trees were to the source of the smoke (Wentzel and Ohnesorge 1961).

Smoke also tends to reduce resistance to frost (Wentzel 1956). Frost damage to spruce was higher in smoke polluted areas than elsewhere. The loss of needles to conifers during a frost was very much higher in areas of chronic pollution.

Coal dust has been found to reduce starch in the leaves of trees apparently by impairing the supply of light. Pollution by cement dust according to Ersov (1957) has reduced photosynthesis on lime and elm trees by thirty-four and twenty-one per cent respectively. The reason seems to be that dust from cement, soot or other products blocks the pores and reduces light intensity, thereby interfering with photosynthesis.

Damage from Chemicals

Sulphur — dioxide from blast furnaces, coke plants, fertilizers, soda cellulose and sulphuric acid plants, oil refineries and thermal power stations, is particularly damaging to trees. Again the reason is clear. SO_2 paralyses the regulation of the stomata. Normally to protect themselves against the midday sun the stomata tend to close. When they are paralysed they remain open which means that transpiration proceeds unimpeded and the plant rapidly dries out, the more so since SO_2 also interferes with moisture supplies. As the stomata remain open the leaves absorb more SO_2. Up to a point the plant may try to neutralize the effect of SO_2 by absorbing more mineral salts but extensive damage cannot be prevented. Affected plants exhibit chlorosis of the assimilation organs with necrotic patches, and conifers lose some of their needles. Fruit bearing is interfered with, and if pollution persists seeds, may be deficient or completely absent (Jahnel 1955). Tests with rain acidified with sulphuric acid was also shown to have a considerable effect on increasing susceptibility to pests (Keller).

Pollution by fluorine also has an adverse affect on trees. It occurs largely in the vicinity of aluminium foundries, fertilizer factories and glass smelting plants. Its main effect is to interfere with chlorophyll synthesis. As in the case of SO_2 pollution, it leads to increased respiration, causes the leaves to dry out and gives rise to necrotic patches, (Keller).

Pollutants do not only affect the trees directly but also indirectly by changing the chemical composition of the soil on which they are deposited and the composition of the micro-organism populations. This is particularly true of sulphuric acid which seriously affects the soil in Scandinavian forests leading to reduced tree growth (Jonsson 1975, Katz 1949, 1950).

It goes without saying that all the various forms of damage done to trees by the different pollutants to which they are exposed, directly or indirectly, tend to reduce their viability and hence their health, thereby increasing their susceptibility to attacks by parasites.

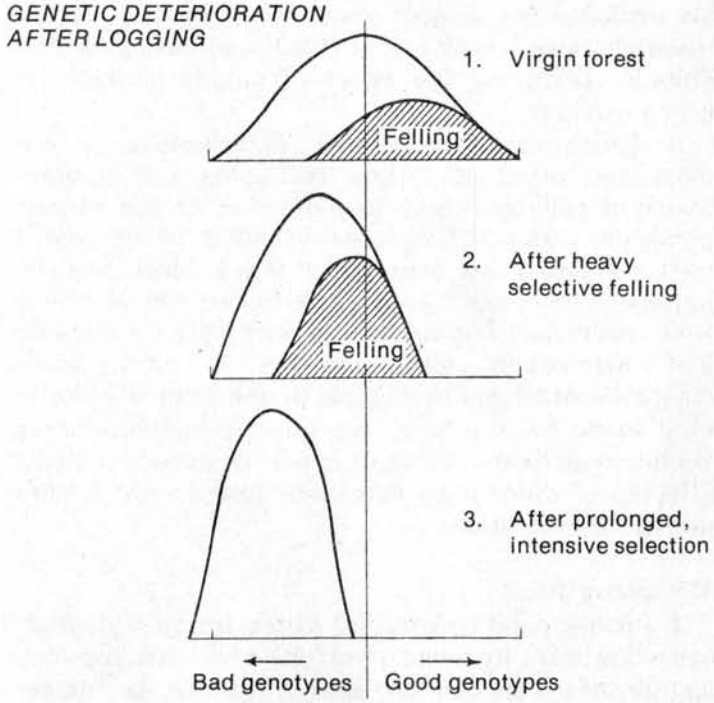
How does one avoid pollution damage? Partly by planting trees away from sources of pollution and partly by refraining from introducing polluting industries into forested areas. But here we must run up against our society's set of basic priorities — a far greater importance is attached to the industrial process than to the maintenance of tree health.

Genetic Deterioration

A further factor in the incidence of tree disease is genetic deterioration. There are many reasons why it is occurring. The first is simply the tendency of loggers over the last centuries to remove the best trees of any particular stand, leaving behind only the second rate and less vigorous ones. This constitutes negative selection and must thereby lead to genetic deterioration. In many cases, the results are clearly discernable. Thus, in Sweden, according to Lindquist, the ''good qualities of oak and the 'noble' qualities of birch have already been reduced to an alarming degree. Definite degeneration of important tree characteristics may be observed on the whole Norrland coast tract from Gäyle to Haparanda.'' In this area, felling for the large sawmilling industry has been going on since the year 1600. Pine woods are now dominated in that area by ''broad-crowned and intermediate types and the timber quality is generally poorer than in the interior parts of the country'' (Lindquist 1948).

According to the same author, the degeneration of pine trees on agricultural land in south and middle Sweden is even more striking.

A second reason for genetic deterioration is to be found in current methods of seed collection for forest cultures — largely without consideration for the genetic characteristics of the parent tree or for the appropriateness of the strain for the area in which it is to be cultivated. According to Lindquist, this involves ''very serious risk of getting seed with bad heriditary properties and of poor timber production in the future.''



Clear-cutting has not only increased soil erosion but has considerably reduced the genetic diversity of forests — further undermining the resistence of trees to disease.

[*photo: US Department of Agriculture*]

A third reason is the effect of pollution on the reproduction of trees. Sulphur-dioxide pollution has a serious effect on plant reproduction. So much so that according to Keller there is a "negative linear correlation between sulphur-dioxide concentration and pollen viability", (Keller 1976). Thus he found that after 141 days of fumigating white fir (*Albies alba*) with sulphur-dioxide in a concentration of no more than 0.1 parts per million (ppm), germination was reduced by almost a third, while if he used a concentration of 0.2 ppm, it was actually reduced by half. Such data showed "a significant detrimental influence on reproduction of an important tree species. It indicates particularly a loss of genes, i.e. an impoverishment of genetical resources with consequences which are presently still unknown," (Keller 1976). Significantly, his evidence fits in with observations made by other researchers such as Wentzel (1963) and Mamajew and Shkarlet (1972) on the effect of sulphur-dioxide on beech and pine.

A fourth cause of genetic deterioration is the *mutagenic* effect of various pollutants and combinations of pollutants and, in particular, of the various pesticides with which forests continue to be sprayed. I have not found any material on this subject, but the mutagenicity of many of these chemicals has now been well established largely with experiments on bacteria and mammalian cells cultivated in vitro. Since chemicals which are mutagenic to one form of life also tend to be so to others, the genetic material being similar in all cases, one must expect trees to be equally affected — which must eventually lead to still further genetic deterioration.

Wounding Trees

A further point to consider is the physical damage caused to trees by people, vehicles and other mechanical devices. This can also lead to disease. Let us see how. A tree is normally capable of resisting invasions by parasites of which it has some phylogenetic experience. It has a number of lines of defence against invaders. Firstly, it forms chemical barriers in the wood behind the wound to prevent infection. These barriers are usually effective and the wound heals. In some cases however micro-organisms may penetrate these barriers. All is still not lost because the tree has another line of defence. The injured cambium produces a zone of special cells that seals off the affected area or 'compartmentalises' it. The compartmentalised zone may decay but the decay is contained and does not spread into the new wood that forms around the affected compartment. If a tree is wounded too often however the tree is gradually weakened, so much so that it may succumb to invasions it would previously have successfully resisted (Shigo, Larsen 1975).

Many serious tree diseases in built-up areas appear to have occurred largely because the trees in the area have been wounded by man's activities and their resistance thereby reduced. This appears to be true of the fungus that causes oak decline (not to be confused with oak wilt) and which mainly affects trees in Texas and on the coast of the Gulf of Mexico. This disease appears mainly to affect trees that have been wounded and hence debilitated by man's activities.

A Combination of Factors

The various factors leading to ecological maladjustments, and hence the reduced resistance of trees to disease, rarely occur independently. Very often trees are affected by various combinations of these factors which have, at best, an additive effect, at worst a synergic one — causing greater damage than any one factor could by itself.

Consider the case of defoliation of oak trees by the oak roller moth. In 1923/4 this led to the death of many oak trees. It was found that the dead trees were covered

with honey fungus which extended right up the trunks. It was also found that most of the dead trees had previously been weakened by other factors. Thus mixed woods from which conifers had been removed during the war suffered excessively, as did those in which the removal of conifer nurses had been too long delayed. It also appeared that alteration of the water table by mining and pumping operations could have had a predisposing effect. It may well be that all these factors were involved.

Consider another example; a disease that broke out in Slavonia in June 1926 and led to the death of pedunculate oaks over a wide area. The trees appeared to have been killed by a fungus *Armillaria mellea*, but according to Robinson (1927) this fungus would not have had such a destructive effect if the trees had not been weakened successively by defoliation by various insects (*Liparis dispar, Liparis chrysorhea* and *Melacosoma neustria*) and if they had not then also been affected by mildew.

The disease affecting beech in England described by Lonsdale in this issue of *The Ecologist* has been attributed by some to the combined efforts of the beech scale insect and a fungus, *Nectria coccnea*. Other plant pathologists have regarded environmental factors as the main cause. The German plant pathologist Zycha considers that drought and frost are the main factors involved. Others, in particular Brown, consider that the scale insect alone causes the disease. Lonsdale considers the thesis that several if not all these factors may be involved. Before a fungus can kill the beech, a lot of conditions may have to be satisfied and this thesis seems to be consistent with the material we have considered in this article.

Treating diseased trees: biological control

This of course, makes tree diseases particularly difficult to treat. A large number of maladjustments must be corrected and the methods used to correct one may actually increase the extent of others. Ideally, one would allow evolution to do the work for us, for the changes brought about by evolution assure the adaptation of systems to their *total* environment, not just to a *single* aspect of it. In this way, precisely those changes would slowly be brought about in the different components of the ecosystem affected that would assure their perfect readjustment to the new conditions.

Needless to say we cannot afford to wait that long; the adaptive process must be speeded up. This as we have seen can be done by planting soil improving trees when poor soil can be incriminated. Planting different species from the most appropriate strains to replace a single monoculture must also increase stability. When it comes to dealing with a maladjustment caused by a very destructive imported parasite more adventurous remedies are clearly required, even though this means taking certain risks. One such strategy is biological control.

Biological Control

If an imported parasite can be particularly damaging, this is because it is no longer subjected to the climatic, topographical and biotic controls that normally keep it in check in its natural habitat. To introduce the appropriate weather or topographical conditions is obviously impossible once the trees have already been planted and affected by the parasite. What can be done however is to introduce one or more of the missing biotic components of the parasite's natural environment i.e. the tree's natural predators. Many successes are supposed to have been achieved in this way. It has even proved effective to introduce (from other areas) predatory insects that are not the pest's natural enemies. A pine forest in Colombia appears to have been saved in this way from destruction by leaf-eating moth larvae. The defoliating moth larvae (*Oxydia trychiata*), previously of little consequence in that country, had suddenly become very destructive to plantations of exotic pines for the pulp and paper industry. Small wasps (*Telenomus alsophilae*) from North America that prey on cankerworms which defoliate such broadleaved trees as oak and maple were released into the plantation in the winter of 1975 (*Science News 1977*) with very satisfactory results.

Biological control is of course fraught with danger. The imported predator may well cause more damage than the target species it is supposed to control. Also it still involves accommodating undesirable trends i.e. the planting of trees in a biotically unsuitable environment — in the case of commercial conifer plantations in an area in which they were previously unknown and in which they encountered parasites of which they had had no phylogenetic experience. Biological control is nevertheless a far sounder strategy than is chemical control since, in the best conditions, it can make a positive contribution towards recreating a less unbalanced forest ecosystem, while chemical control can only have the opposite effect.

Finding and breeding new Strains

If biological control does not provide a means of controlling the population of an imported parasite, the only constructive course of action that can yield fairly rapid results is to find or breed strains of a particular species that are resistant to the disease. It has been found for instance that the Chinese chestnut is resistant to the blight that has affected the American and European chestnuts. The Malayan dwarf coconut palm appears to be resistant to Lethal Yellowing disease as is a newly found variety, the Maypan hybrid. The Chinese elm also appears to be resistant to Dutch elm disease, and is being planted in the USA. A strain of the red oak has been developed that appears to be resistant to oak wilt (press release 1977).

The problem, of course, with breeding resistant strains is that trees can be affected by a lot of potential parasites. The poplar for instance, as Lanier (1974) points out, is susceptible to an astonishingly high number of plant and animal parasites and these are particularly likely to attack certain clones of the cultivated hybrids. If the hybrid, created as an adaptation to an introduced parasite, is too radical a diversion from the native strain, it may simply cease to be adaptive to

all the other constituents of its natural environment; this, in the long run can simply increase the tree's susceptibility to all sorts of other possible diseases. As Bingham et al (1971) write, "If we can only have the forebearance not to rush into stop-gap breeding work that might seriously alter the genetic structure of both host and pathogen, we will be ahead in the long run." Burdekin (1978) also considers it "important that great care and rigour be taken in these breeding programmes to ensure that other factors such as tree shape and vigour, ability to withstand climatic influences and resistance to other diseases are all incorporated in the rigorous testing procedures" — but this may not always be possible.

Another problem is that breedig hybrids is a slow process. Once a resistant tree has been found or bred and planted in large quantities, a long time has elapsed, still longer before it reaches maturity. That is why short cuts must be used. Vegetative techniques, including tissue cutting and rooting, must be resorted to. To reproduce the trees sexually would take too long. Yet it is by doing so that a population displaying the genetic variety necessary for resistance to diseases would be created. When clones are all identical, they display minimal genetic variety and minimal resistance to disease. These techniques in any case are only applicable to commercial forests and amenity trees. When tree populations are annihilated in natural forests they cannot be replaced by such methods. The logistics of the problems involved would be too great as would the cost, especially in view of today's priorities.

Looking towards the future

We have established what are the real causes of tree diseases. They all involve changes that have tended to reduce the stable relationship established by evolution between a tree population and its climatic, topographic and biotic environment, thereby giving rise to various forms of phylogenetic maladjustments (Boyden 1973). These changes tend towards reversing the evolutionary process, since it is precisely the latter's goal to increase the stability of these relationships — correspondingly reducing the incidence and seriousness of such maladjustments.

The ecological approach aims at correcting these maladjustments by restoring the stability of the relationships between tree populations and their environment, thus restoring their real health, and hence that of the ecosystems of which they are part. To implement such a programme in our modern society is difficult for a number of reasons. To begin with, there are no technological means of carrying it out, and in a society that is specifically organised to provide technological solutions to the exclusion of all others, this is very serious. Indeed ecologically orientated policies would not provide research grants for scientists, profits for entrepreneurs, taxes for our government or jobs for job-seekers (at least at the

current rate of pay) to the extent that technological solutions would. Nor would they make the same contribution to our Gross National Product (GNP). Also there are no instant solutions to ecological degradation, no magical cures for it, although unfortunately we have been hoodwinked by many scientists into believing that such things exist and are generally available as the solution to our worsening problems.

In addition, the ecological approach involves accepting a certain level of tree losses. They may decrease as overall forest health improves, but losses there must always be. Parasites will never be entirely exterminated. For this reason alone the ecological approach is unlikely to be accepted by those who have been misguidedly taught that science can actually eliminate pests.

Indeed one might go so far as to say that so long as our society remains on its present course, committed as it is to continued economic growth, it is unlikely that any ecologically orientated policies can be implemented. The reasons are clear.

The planting of fast-growing exotics in climatic, soil and biotic environments to which they have not been adapted by their evolution is necessary to achieve the high rate of tree growth and the short-term profits required to maintain the economic viability of our forestry enterprises.

The planting of very high density monocultures, in which trees are all of the same age, and the adoption of such unsound practices as scrub clearance and clear-felling are usually necessary to render forestry sufficiently economic and, in the short-term, to assure its survival in ever less propitious conditions. Further growth of the forestry sector would probably require the adoption of still more aberrant practices. Indeed Peter Wood of the Commonwealth Forestry Institute stated at a recent conference (Elkington 1978) that we were still at the hunter-gatherer stage in forestry. If we farmed trees as we farm other agricultural crops, we could, according to him, increase yields by up to eight hundred per cent.

Today's Epidemics: only the Beginning?

If misguided people of this sort are allowed to influence developments — and political and economic pressures must tend in that direction — then the destruction we are seeing today may well be but the precursor of even more terrible tree epidemics that yet lie in store.

The abstraction of still greater amounts of water to satisfy the burgeoning industrial, domestic and agricultural demand in a growing economy must lead to further falls of the water-table in remaining forested areas with the associated reduction in tree vitality.

The current loss of forested land to agriculture to make up for the hundred thousand acres or so of agricultural land eaten up every year by urbanisation will continue to increase as more motorways, air ports, factories and housing estates are built to provide the physical super-structure of a growing economy, (Coleman 1977). This must have the effect of pushing forestry to ever more marginal areas — which as we have seen must also further reduce tree health.

The generation of increasing levels of pollution by

Will trees survive in an industrialised world?

smoke, coal, cement dust, sulphur-dioxide, fluorine and the other by-products of the idustrial process will also be inevitable. The cost of systematically reducing these levels in an expanding economy is prohibitive. On the contrary, as economic problems worsen, the amount of money available for pollution control, which is still low down in our government's list of priorities, is likely to decrease rather than increase.

The same is true of pesticides. The total amount put to agricultural and non agricultural use in Britain of even the most poisonous varieties, such as the chlorinated hydrocarbons and organophosphates, has increased rather than decreased and in a growing economy will continue to do so.

As for mobility, which we have seen to be an important cause of tree diseases, its growth is an essential feature of economic progress. Every year more and more people are herded across the oceans for business and pleasure. Trade in wood and wood products is also likely to go on increasing. We in this country import every year 2,000 million pounds worth of wood and the gap between local production and total needs continues to increase. Given the growing ineffectiveness of controls in a chaotic and disintegrating society in which everyone's sense of responsibility is being rapidly eroded, one can only predict the introduction into this country of more rather than less dangerous parasites from abroad.

In the context of a growing industrial economy the future of trees in this country is indeed grim. If we continue in this direction, a treeless Britain, to use the title of Elkington's article in the *New Scientist*, is not only a possibility *but a definite probability.*

This is particularly so if we consider that trees are among the most vulnerable of organisms. They cannot move to get out of the way of their enemies nor migrate to avoid bad weather. They are highly complex and only have a new generation every thirty to three

thousand years as opposed to every two weeks or so in the case of many insects. This means that they are very slow to adapt to changing conditions. Indeed, it may be that an environment capable of supporting healthy populations of such sophisticated forms of life as trees may have to display a degree of complexity and stability that could not be achieved on a much more heavily industrialised planet.

In this country, the situation is particularly acute; because of the density of our population, the already high level of industrialisation and our very low tree diversity, only a few alien parasites, operating in the appropriate conditions, could annihilate the major part of our remaining trees.

Only a reversal of current trends towards increased industrialisation would assure their survival. Fortunately, such a reversal can be predicted with absolute certainty (Goldsmith 1971). Indeed, it is already beginning to happen — not of course, as the result of conscious public policy, but simply because world conditions are becoming ever less favourable to the functioning of the industrial system. It is for this reason, and this reason alone, that I entertain some hope for the future of our trees.

Agricultural Research. The Sturdy Oak. May 1977 vol. 25/11.

Anderson M.L. Some Biological Aspects of Forestry. *Quarterly Journal of Forestry*. No. 50 1956.

Baker R St. Barbe. Personal communication 1979.

Bingham R T, Hoff R J and McDonald G I. Disease Resistance in Forest Trees. *Annual Review of Phytopathology*. Vol. 9 1971.

BioScience vol. 22 No. 10 October 1972. Resistance of Conifers to Invasion by Bark Beetle Fungus associations. Research Report.

Bossavy J. *Proceedings of the First European Congress on the Influence of Air Pollution on Plants and Animals*. Wageningen. 1969.

Boyden S. Evolution and health. *The Ecologist*. August 1973.

Brasier C M and Gibbs J N. Origin of the Dutch Elm Disease Epidemic in Britain. *Nature* vol. 242 April 27 1973.

Burdekin D A. Tree Diseases viewed in Perspective. K190 *Forestry Commission Paper*. 1978.

Burdekin D.A. Dying Beech. *Forestry Commission Paper* 1977.

Callaham R Z. Provenance Research: Investigation of Genetic Diversity associated with Geography. Chapter 4 of *Report of FAO/IUFRO Meeting on Forest Genetics*.

Carefoot GL and Sprott E R. *Famine on the Wind*. Angus and Robertson 1967.

Coleman A. Second Land Utilization Survey. 1978.

Darley E F *The effect* of Photochemical air pollution on Vegetation.

Day W R. Environment and Disease. A discussion on the Parasitism of *Armillaria mellea*. *Forestry* vol. 3, 1929.

Day W R. Forest Pathology in Relation to Land Utilization. *Empire Forestry Review*. Vol. 28 1949.

Day W R. Forest Hygiene. *Empire Forestry Review* vol. 29 1950.

Doane DD. Changes in Egg Mass Density, size and amount of Parasitism after chemical treatment of a heavy population of the Gypsy Moth. *Journal Eon. Entomology*. 61 (5): 1968.

Elkington J. A Treeless Britain? *New Scientist* 13.4.1978.

Ersov (1957) quoted by Keller. *Forestry and Atmospheric Pollution from Industrial Sources*.

Gibbs J N. Origin of the Dutch elm disease epidemic in Britain. *Nature* vol. 242. April 27 1973.

Gibbs J N. Scientific Research with special reference to Dutch elm disease. *Paper for presentation to the Forestry section of the British Association Meeting at Guildford* on 2.9.1975.

Goldsmith E R D. *Can Britain Survive?* Tom Stacy 1971.

Goldsmith E R D. *The Stable Society*. Wadebridge Press 1978.

Goldsmith E R D. Mellanby versus Theory and Fact. *New Ecologist* September/October 1978.

Graham F. Jr. Their elm forest is doomed, but Twin Cities are ready. *Audubon Magazine*.

Haney R L. The Scientists Tell me . . . Killer Fungus Causing Oak decline hits many other tree varieties. *Research Report, The Texas Agricultural Experiment Station*. March 2 1977.

Hermann S G and others. Evergreen State College, Olympia, Washington. Nov 1973.

Hinckley A Dexter. Gypsy Moth. *Environment* vol. 14 no. 2 1972.

Jonsson B. Soil Acidification by Atmospheric Pollution and Forest Growth. *Abstract from First International Symposium on Acid Precipitation and Forest Vegetation*, Columbus, Ohio 1973).

Jouanen M. Les arbres en danger de mort. *L'Express* 26.9.1977.

Kamram M A. Insect Parasites of the Gypsy Moth Porthetria dispar (L) (*Lepidoptera: Liparidae*) on Long Island, New York. *Abstract 20, 43rd Annual Meeting Eastern Branch Entomological Society of America*, Oct. 1971.

Katz M. Sulphur Dioxide in the atmosphere and its relation to plant life. *Industry and Engineering Chemistry*. vol. 41 1949.

Keller T. Forestry and Atmospheric Pollution from Industrial Sources.

Keller T. Some effects of low SO_2 concentrations on physiology of coniferous trees. *Paper presented at XVI IUFRO congress on group* 5.2.09. 1976.

Knabe W. Pollution and Its Threat to Forests in the Ruhr. *Abstracts of 7th International Symposium on Pollution*, Essen. Germany. Sept. 1970.

Kujala V. Murray Pine and destructive Fungi. *Metsa-taloudellinen Aikakauslehti* no. 3 1948 Tr. Helsinki, Finland.

Lanier, L. Les maladies de la foret. *La Recherche* April 1974. No. 44 vol. 5.

Lindquist B. Deterioration of the Genetic quality of Sweden's Forests as a result of earlier forest exploitation. *Genetics in Swedish Forestry Practice*. Stockholm 1948.

Lonsdale D. Beech Bark Disease: One Disorder or Several? *The Ecologist* May/June 1979.

May E. Canada's Moth War. *New Ecologist July/August 1978.*

McClure Dr M. of the Connecticut Agricultural Experiment Station in New Haven quoted in *New York Times* 10.8.1977.

Noirfelise A. Conifers and soil conservation. Council of Europe *Nature and Environment Series No. 1 Aspects of Forest Management.*

Paehlke R. The Moth War still rages. *Environment* vol. 20 no. 7 1978.

Press Release. Forestry Commission Press Notice no. 26/76. October 12 1976. Sooty Bark Disease of sycamore.

Press Release. Forestry Commission Press Notice no. 18. December 1976. Sooty Bark disease.

Press Release. Department of the Environment. Press Notice no. 492. Dutch elm disease — Government response to tree council. 26.9.1977.

Press Release. Department of Information and Agricultural Journalism. Agricultural Extension Service 7.2.1977.

Press Release. US Department of Agriculture. Agricultural Research Service. Red Oak Seedlings resist disease. NC-68-77 May 5,

Press Notice. Forestry Commission Press Notice no. 16/78. 2.6.1978. re Aerial attack on killer caterpillars on Lodgepole Pine.

Robat H., Aluminium plants and conifers in Norway.

Robinson R L. Mortality Among Oak. *Quarterly Journal of Forestry*, vol 21, 1927.

Schwerdtfeger (1957) quoted by T. Keller in Forestry and Atmospheric Pollution from Industrial Sources.

Science News vol. 112 July 20 1977. Exotic forest saved by foreign sting.

Shigo A L and Larson E H. Anatomy of a Wound. *Weed Trees and Turf*. July 1975.

Shigo A L. A New Look at Decay in Trees. *Northern Logger and Timber Processors* October 1971.

Shriner D S. Effects of simulated rain acidified with sulphuric acid on host-parasite interactions. *Abstract from First International Symposium on Acid Precipitation and Forest vegetation*, Columbus, Ohio 1975.

Strouts R.G. Canker of cypresses caused by *Coryneum cardinale Wag.* in Britain. Forestry Commission Research Station. *European Journal of Forest Pathology* 1973.

Waddington C H. *Strategy of the Genes*. Allen and Unwin London 1957.

Wagener (1928) and (1948) Quoted by R G Strouts. Canker of cypresses caused by *Coryneum cardinale*. *European Journal of Forest Pathology 1973.*

Watt K. *Ecology and the Source of Management*. McGraw Hill. New York 1968.

Wentzel Dr K. *Report on 4th International Congress on Injury to trees from Atmospheric pollution*. Vienna, Sept 10-17 1964.

Wentzel Dr K (1956) quoted by T. Keller, Forestry and Atmospheric Pollution from Industrial Sources.

Wentzel and Ohnesorge (1961) quoted by T Keller. Forestry and Atmospheric Pollution from Industrial Sources.

Peter Barry Chowka

The Organised Drugging of America

Legal drugs, sold over the counter for medicinal purposes, have created a host of new diseases. Yet the major drug companies still manage to convince chemists and the public alike that their wares are beneficial. How have they developed this stranglehold over medical care?

Gradually, during the last three generations, medicine has been directed away from its centuries old traditions of healing and into the blind alley of *allopathy* — the myopic method that attacks the symptoms, instead of the causes, of disease. The systematic replacement of natural therapies (non-toxic substances, diet and the innate healing power of the healer and the afflicted) with an evermore dazzling and expensive array of invasive, technological weaponry (including surgery, radiation and foremost, synthetic chemical drugs) is a Faustian bargain that now constitutes a catastrophic threat to public health.

Almost everyone today consumes drugs of one sort or another — licit (over the counter and prescription), illicit (marijuana, LSD, cocaine), or both. It is the licit category that concerns us here, for these substances are sanctioned and sold officially, and all of us have been taught to trust in and consume them from birth.

The licit drug business is a major secure growth industry generating twenty billion dollars in sales and nearly two billion dollars in profits, annually. Yet a major government drug efficacy study recently found that fewer than twenty per cent of the drugs it reviewed were 'effective'. Of the ten most commonly prescribed drugs the report noted 'seven drugs either lacked evidence of efficacy or are the second or third choice for their purpose. Of the other three it is impossible to avoid the conclusion that they are vastly overused'.

Side Effects

Meanwhile synthetic drugs — the central weaponry of modern technological medicine — are associated increasingly with numerous devastating side effects, complications, addictions, iatrogenic illnesses and premature deaths. In 1971 Dr. Kenneth R. Melmon, Professor of Medicine and Pharmacology at the University of California at San Francisco, admitted that 'modern therapeutic agents (drugs) have . . . created a formidable health problem: eighteen to thirty per cent of all hospitalized patients have a drug reaction, and the duration of their hospitalization is about doubled as a consequence . . . One-seventh of all hospital days is devoted to the care of drug toxicity.'

Tragically the use of synthetic chemical drugs has insinuated itself beyond the field of medicine into food and water supplies and, indeed now pervades every activity of modern life. The whole system and imagined necessity of this chemical omnipresence is supported by an ostrich mentality that places profits ahead of health, that trumps up the good news about chemicals and covers up the bad news; and that does everything in its power to suppress viable natural alternatives.

Hospitalizing America

In modern times not only have hospitals proliferated, but the burgeoning drug industry has brought the hospital into every home; today every twenty-four to thirty-six hours, fifty to eighty per cent of all adults in the U.S. swallow at least one medically prescribed drug. It is a fantastic achievement for an industry that is scarcely a century old.

The unprecedented expansion of the drug business — its sales are *one hundred times* what they were in nineteen hundred, with five thousand prescriptions and a hundred thousand over the counter medications available today — is not accounted for by need or service. Contrary to the myth that has been drummed into all of us, the statistics reveal that technological medicine is not at all associated with improved health: in his recent book *Cancer,* Dr. George Berkley notes that a sixty-year-old man today supported by all of the medical advances available can expect to live about one year longer than could a sixty-year-old man in 1789; during a strike of doctors in Los Angeles County, in 1976, mortality rates actually *fell* significantly; drugs have failed to check — and in fact are largely causing — the epidemic increase of chronic degenerative diseases that now ravage Western societies, including heart disease, cancer, hypertension, stroke, mental illness and diabetes.

Drugs and Dogma: the fatal combination

Historically drug usage is intertwined with the excesses of technological society. The oft-employed phrase "magic-bullet", referring to wonder drugs was first used by Paul Ehrlich (1854-1915), who discovered the anti-syphilis drug arsphenamine. Drugs themselves, often bullet-shaped, suggest

a quick, bloodless victory in the "war against disease", they encapsulate not merely chemicals but the modern mystique of science. For a century the metaphors of "fights" and "wars" have been used consistently against a variety of diseases, culminating in the current disastrous ten-billion-dollar "war against cancer" that advances toxic chemotherapy drugs as the ultimate anti-cancer weapons.

As Ivan Illich writes in *Medical Nemesis*, a hundred years ago 'the doctor himself was without dispute the most important therapeutic agent'. Dr. Van den Berg observes, in *Medical Power and Medical Ethics*, 'Compared with doctors today, he could do nothing . . . What then could he do? Of course the old time doctor could do all sorts of things; but his power was completely different from that of his modern colleague . . . He had the power to console, to soothe pain and anguish; the power needed by the patient . . . I think the doctor of the past was better equipped with such power than his present-day colleague'.

Hydrocarbons into Drugs: breakthrough for the industry

Drugs then were few — mostly long-known herbal preparations and, by the mid-nineteenth century, some new opiate-or-alcohol based tonics. All of that changed drastically following the accidental discovery, in 1856, that hydrocarbons — prolific byproducts of petroleum and coal refining — were potentially the basis for a variety of new products including synthetic dyes, chemicals and drugs. As the new petroleum-based industries grew, so did those that produced chemicals and drugs. Today, although some drugs are still biologically based (hormones, alkaloids, vaccines, antibiotics) the majority of pharmaceutical products are derived from petrochemicals or coal tar.

Around the turn of the century the industries that extracted, refined and marketed petroleum and its byproducts were organized into cartels — centralized world-wide shared monopolies. The pre-eminent cartel was that of I.G. Farben, based in Germany and linked with the extensive empire of Rockefeller family holdings in the U.S., which included a sizeable share of the North American pharmaceutical industry.

In the U.S. many of the founders and directors of these petro chemical and drug industries organized not-for-profit, tax-free foundations ostensibly for philanthropic purposes; the real intention may have been far less altruistic — the control and redirection for profit of medicine, food production and the whole way of life of western society.

A multiplicity of hospitals is no test of civilisation, rather it is a symptom of decay.
Mahatma Gandhi

Indoctrinating the Doctor

The current complete domination of health care by drugs is traceable to the publication in 1910 of the Abraham Flexner Report, sponsored by the American Medical Association and the Carnegie Foundation and paid for by the Rockefellers. Prior to 1910 medicine was largely unregulated, and homeopathy herbology, nutrition and other forms of healing flourished. (There is evidence that acupuncture was practised in the U.S. as early as the 1830s.)

Not surprisingly, considering who was paying for it, the *Flexner Report* advocated a symptomatic drug approach to illness, to the exclusion of all traditional healing methods; it required that medical schools, in order to obtain or retain their accreditation, add courses in the new pharmacology, and it favoured research over clinical work.

Following the publication and wide distribution of the *Flexner Report* the major foundations, funded by petrochemical and drug money began to fund medical education. Since 1910 foundations have given billions of dollars to medical institutions; one foundation alone, Eli Lilly (named after and supported by one of the largest U.S. drug firms), has spent more than two hundred and fifty million dollars on medical schools. According to Norman Dodd the research director of a congressional committee that studied the subject in 1953, '. . . the curriculum . . . is designed to indoctrinate the American student from matriculation to the consummation of his education'. Other results in the view of Dr. Halsted Holman, Professor of Medicine at Stanford University School of Medicine, are that medical schools have come to 'emphasize technology and employ increasing numbers of drugs and tests in the name of thoroughness, without adequate control . . .'

Going for Quick Results

Reliance on the criterion of pharmacological action favours compounds that can show some kind of quick, definitive alteration in chemical balance. Dr. Michael Smith, who treats drug addicts in Bronx, New York, using nutrition, herbology and acupuncture, told me recently, 'Pharmacological science always seeks to alter just one thing — a bacteria or a nerve for example; the drug is supposed to have this single effect, although in practice it always has twenty other effects — side effects. This whole process is totally separate from the way life works.'

Dr. Smith told me that 'The drug companies, by controlling education, insured that the doctors will think only of illness and treatment. Presented with an ill person, a doctor conducts different tests to determine how the disease can be labelled. The tests and the treatment go together; essentially the tests are designed by the same people who sell the treatments. Once the treatment is available, the illness is recognized and advertised by the drug companies and a test is designed to identify it; this is the case with adult-onset diabetes, for example. There is a test for sugar in the urine,

but there is not a good test for urea in the urine because the drug companies don't have a treatment for that. The more diagnoses you have, the more treatments you'll get. This sytem is opposed to diet, acupuncture, herbs etc., where treatment is not specific — where you may have the same treatments for a lot of different conditions.'

Case Histories in the Profit Mentality

Drugs today are big business, an integral foundation of the health care delivery system whose costs are accelerating out of control. (In January 1978 an NBC-TV documentary *Medicine in America: Life Death and Dollars* reported that, if present trends continue, by the year 2020 medical costs will exceed the country's entire Gross National Product!) Drugs, too, are part of a context much broader than medicine, which involves food and agriculture. Over ten thousand synthetic chemicals are added to foods — as colourings, preservatives, taste enhancers, fortifiers and residues from fertilizers and pesticides. Chemicals and drugs have become omnipresent in agriculture and livestock production (the cancer-causing hormone DES is fed to most commercially-produced cattle and fowl to speed up the weight-gaining process, along with numerous antibiotics to make livestock more resistant to infection).

In *Medical Nemesis* Ivan Illich writes that drug industry profits (as percentage of sales and net company worth) during the last fifteen years have outranked those of *all other manufacturing industries* listed on the Stock Exchange. Enormous advertising budgets ensure the continuation of this economic insanity. At least twenty per cent of all television advertising is for drugs: over-the-counter headache cures, pain relievers, laxatives, cold remedies, cough suppressants, arthritis palliatives, vitamin tonics, mood elevators, sedatives etc. The Sterling Drug Co. institutionalized the trend toward mass advertising during the early years of this century by investing millions of dollars in newspaper and, later, radio campaigns for Bayer aspirin. Somewhat later, between 1965 and 1975, half a billion dollars was spent by Bayer Aspirin's competitors — Anacin, Bufferin and Excedrin — on television commercials.

How accurate are the claims in this advertising? In the late 1960s Sterling marketed three similar analgesic drugs simultaneously — Bayer Aspirin, Vanquish and Cope — and advertised all three heavily. The individual product commercials, however, claimed that each one was superior. Dr. William Beaver, Professor of Pharmacology at George Washington University commented drily 'The feeling I get from these three ads is that somebody must be lying.'

Target: the Doctor

The bulk of drug advertising is aimed at doctors. Typically a modern pharmaceutical firm budgets from fifteen to thirty five per cent of its annual sales for advertising, roughly ten times the amount a non-drug manufacturing concern proportionately spends. Much of this advertising is placed in the scores of professional medical journals. Since its humble origins in the 1880s, the AMA's *Journal* has grown to have a worldwide circulation of five hundred thousand; it is the leading professional medical publication. In 1973 AMA carried over 5,500 pages of pharmaceutical advertising — more advertising pages than any other U.S. weekly except the *New Yorker*. Drug advertising in the AMA Journal accounts for over fifteen per cent of the AMA's total revenues; drug ads in its thirteen other publications provide an additional ten per cent. In turn the AMA, according to a 1973 United Press International report, has invested another fifty per cent of

its retirement fund in drug company stock.

The medical journals contribute regularly to the closed mind of orthodox medicine. It is difficult for a new therapeutic idea to gain a foothold without prior publication of a favourable article or study in a major journal; but the journals rarely publish articles on any but the accepted — that is, standard — drug-therapies. Profits and patents enter into this sytem, according to Dr. Smith. Nowhere in the journals, he pointed out, can one find mention of the fact that plain garlic was used successfully by British troops during World War I, to prevent infection in wounded soldiers. Garlic and other whole natural compounds offer no incentive to drug companies interested only in profitable patents.

Blacklisting Alternative Treatments

To prevent natural non toxic therapies from being accepted, medical orthodoxy regularly blacklists practitioners and researchers who try to work outside the allopathic system. The American Cancer Society, for example, during the last quarter century has published *Unproven Methods of Cancer Management* — a widely circulated book that lists scores of natural therapies for cancer and biographical data about the researchers responsible for developing them. The book represents an attempt to brand the researchers as quacks and ostracize them from the orthodox scientific community. Many of the blacklisted treatments, however, including a variety of nutritional therapies, hyperthermia (whole body heat treatments) and immunologic toxins, are now being recognised by orthodox institutions as offering great hope for cancer victims.

Selling by Rote; the case of chloramphenicol

Advertising is one, and perhaps the secondary, way that drug companies promote the use of their products; another is the employment of a small army of drug salesmen — 'detail men' — who regularly visit doctors' offices trying to sell drugs. In *200,000,000 Guinea Pigs*, John Fuller quotes a retired Parke Davis detail man who told him, 'When I went to call a doctor, I told him about things I knew nothing about — except by rote. Since he knew nothing about what I was talking about, we were on very equal terms. That made us comfortable. Just how comfortable the patient was as a result of these talks, no one will ever know'. Detail men do more than merely talk, however.

In 1974 the Senate Labor and Welfare Committee, led by Sen. Edward Kennedy, investigated the pharmaceutical industry; the hearings uncovered the fact that in 1972 the drug companies spent an average of three to five thousand dollars on every U.S. physician solely for promotional ploys — everything from ballpoint pens and pocket calculators to upright freezers, televisions and other major appliances were given away (two billion free drug samples also were dispensed). Much of the merchandise represented outright gifts and some constituted bonuses to reward doctors for buying drugs.

In the forefront of drug company promotion and influence peddling is the Pharmaceutical Manufacturers Association, a powerful special interest lobby rivalled only by the American Medical Association. (The AMA is the wealthiest lobby in Washington.) According to Joseph Woodman, a journalist who studied these lobbies recently, 'The PMA and the AMA . . . exert a ruling influence on drug prescribing in general and your local physician in particular'.

One example may clarify the mechanism at work in this modern phenomenon of medicine for profit instead of for health. In the late 1940s, chloramphenicol was developed at Yale University using a grant from Parke Davis which patented the drug; it was a potent antibiotic with potential use in treating serious infections in perhaps as many as ten thousand patients a year. As John Fuller writes, however, 'Consistently, persistently, actively, knowingly, over many years, Parke Davis lured, encouraged and badgered doctors to prescribe the drug, so that prescriptions were pouring into the pharmacies for the treatment of sore throats, colds, acne, even hangnail.' Nearly four million people a year received chloramphenicol. The only problem was that one of its side-effects was a rare blood disease that began proving fatal to scores of victims, including previously healthy children. Nonetheless the drug was good for business; in its peak year of use it accounted for one third of Parke Davis' profits. (If only ten thousand people had received the drug the gross income from its sales would have been two hundred thousand dollars; but four million people using it pushed the company's gross to eighty million dollars.) Parke Davis representatives consistently lied that the drug was harmless, and for a decade resisted the ponderous regulatory machinery that ultimately ended its use. Fuller writes that Parke Davis's manner in 'hoodwinking the customer-doctors is a classic case in venality'.

Bitter Pills: risks and benefits

To some extent nearly all drugs are unsafe, inasmuch as they intrude upon a complex and delicate organism that was never intended to adapt to their imposed presence. Into the exquisitely balanced natural system, an artificial drug intervenes rather like a monkey-wrench, tightening one nut while botching up the whole works. In medical libraries many publications review in detail the dangers of modern drugs, including the countless adverse reactions from their interactions with other drugs and foods: *Side Effects of Drugs* published by Excerptica Medica requires three mammoth volumes of small print just to survey the available literature from 1972 to 1977. These and other studies constitute a gigantic warning against the entire practice of modern drug-oriented therapy, but the problem is so huge and close to us that, like most things in front of our very

noses, it is difficult to recognize it.

Drug use is justified by the dubious concept of 'risk/benefit ratio', the assumption that a drug's advantages outweigh its ever-present risks of toxicity side-effects and premature death. Effectiveness, however, is more difficult to establish than safety, since variable criteria for patients, dosage and benefit may result in differing interpretations of the same data by equally competent clinicians. Transient identifiable benefits are often swamped in the long run by delayed adverse reactions that result in a steady worsening of health. Ultimately, since the symptoms constitute part of a complex defence reaction or warning mechanism, the basic strategy of allopathy — suppressing symptoms — drives the disease into more serious levels and only exacerbates the underlying problem. Traditional methods of healing dealt with that underlying problem — the patient's whole lifestyle — but such methods have been practically outlawed in this century. The symptom-swatting approach, therefore, has become ingrained in modern medical practice, and the drug that can provide a fast fix of temporary symptomatic relief is viewed as indistinguishable from a genuine cure.

Ritual Prescriptions — An Easy Way Out

In 1972, in an article in *Science,* sociologist Dr. Charlotte Muller perceives a ritual function in drug prescribing: a convenient practical means for terminating the doctor-patient consultation. 'The act of prescribing,' Dr. Muller writes, 'conforms to the requirements of successful termination strategies in psychological theory: the prescription is a signal for the approaching end of the encounter, it both summarizes and carries forward the relationship, it is an expression of concern, and it deals with the interests of both parties in a manner perceived as equitable.'

The epidemic of modern iatrogenic disease was first brought to wide attention in a 1964 study entitled 'Hazards of Hospitalization' published in *Annals of Internal Medicine* by Dr. Elihu Schimmel, then Chief Resident of Yale-Newhaven Hospital.

East/West Journal

The report found that one in five of the hospital's patients was made seriously ill by medical treatment, which led to one in ten of all deaths in hospital. Half of these medical misadventures involved drug reactions. Dr. Leighton Cluff, Professor of Medicine at Johns Hopkins, asserted, 'The risk of developing an adverse reaction to drugs is apparently directly related to the number of drugs administered to the patients'. Dr. Cluff suggested 'a critical evaluation of present day drug therapy' including 'reduction in the number of drugs given to patients, eliminating all but essential medications'.

Ineffective 'Cures'

In the case of alleviating the chronic degenerative diseases that are the major killers today, modern drug therapy has failed and is at best a palliative; mounting evidence shows that the avoidance of allopathic therapy offers a better chance for improved health or life-extension.

In treating the circulatory diseases (the primary cause of death) the principal drug agents used are digitalis, anti-coagulants, anti-hypertensives and diuretics. In the *New England Journal of Medicine,* (17th June, 1971), Dr. Melmon observes, 'Of those taking digitalis alone, ten per cent gave evidence of toxicity, and toxicity appears in 17 to 35 per cent of patients taking digitalis and diuretics. Digitalis accounts for 21 per cent of all drug reactions in hospitals and in one study such reactions were lethal in 30 per cent of cases.'

Anti-coagulant therapy produces haemorrhage in five to forty per cent of cases which some authorities feel cancels out its value in preventing blood clots. Several studies show that the mortality rate was the same in an anti-coagulent treated group and an untreated group. A large, controlled study by Dr. Harold Mather and associates at four English hospitals, published in *The British Medical Journal* in 1976, reveals that heart patients who stayed at home fared better, with a lower statistically significant mortality rate, than those treated in hospital coronary care units where larger amounts of medication tend to be employed.

Anti-hypertensive drugs, used to control high blood pressure, are associated with a high proportion of side-effects including impotency rates that approach one hundred per cent in high-dosage male users. Reserpine, a common anti-hypertensive agent, is linked with an increased rate of breast cancer in women. Writing in the *Lancet* in 1974, Dr. John Fry proposed 'selective non-treatment' of hyper-

tension; weight reduction, in fact, is a simple but seldom followed method of lowering high blood pressure without the risks inherent in long-term drug use.

Similarly in the control of diabetes, patients treated by dietary change alone are found to fare as well as those treated by insulin, the major drug of choice. Some studies indicate that several serious complications that have been attributed to the disease, such as diabetic retinopathy, actually may be the side-effects of insulin therapy. Oral anti-hypoglycemic agents, used widely to treat diabetics, are associated with increased mortality from heart disease; these findings, published in 1969, are amongst the results of an eight-year study involving twelve major medical institutions conducted by the University Group Diabetes Program. The conclusion, supported by the AMA, the American Diabetes Association and the Food and Drugs Administration, however, did not deter further prescribing of oral diabetic drugs, which reached a peak of twenty million prescriptions in 1973, four years after the study was published.

The Failure of Cancer Treatments

The attempt to control cancer with the treatments of choice, chemotherapeutic drugs, constitutes the cruellest irony of all. It is literally a gamble whether the patient will survive the treatment long enough to try to withstand the prolonged agony from the side-effects. Cancer therapy has become a war game, with powerful anti-metabolytes and nitrogen mustards, originally developed as chemical warfare during World War 11, used on sick, weakened patients in the hope of destroying an enemy that is part of themselves. In several recent studies of common cancer chemotherapies, conducted at the National Cancer Institute and published in *Cancer Chemotherapy Reports,* as many as twenty-five per cent of the treated patients died directly as a result of drug toxicity. In fact, nearly all of the cancer chemotherapy drugs are highly toxic at applied dosages; immunosuppressive (destructive of the patient's native resistance to a variety of diseases, including cancer); and potentially carcinogenic (causing cancer in rats and mice and possibly according to recent evidence, in humans also).

Numerous drugs prescribed for a variety of conditions have been shown to cause cancer in animals or are associated with heightened cancer risk in humans. R.W. Raven and F.J. Roe, in the medical text *Prevention of Cancer* list many antibiotics as causing cancer of leukemia, including penicillin, sulphanilamides, actinomycin, streptomycin and isoniazid. Several studies identify corticosteroids, commonly used in the treatment of arthritis, as cancer-promoting agents. Much attention has been given to studies linking oestrogen hormones, such as those used in birth control pills, with an increased cancer incidence. Many over-the-counter drug products are also suspect, including mineral oil laxatives and Methapyraline, an anti-histamine commonly used in daytime sedatives. It seems reasonable to assume that drugs, or combinations of drugs with each other or with substances in the environment such as sodium nitrite in meat, may be a major cause of the growing cancer pandemic.

Into the Future

In 1933 Arthur Kallet and F.J. Schlink wrote *100,000,000 Guinea Pigs,* an examination of the hazards of prescription and over-the-counter drugs, food additives, aspirin, meat, hair dyes, germicides, cosmetics and cold remedies. Nearly forty years later John G. Fuller wrote *200,000,000 Guinea Pigs*; his view is that 'today the situation is worse, not better. Every new advance seems to have brought with it a more than equal share of danger. New hazards are more subtle, more sophisticated, more deadly than those of the less regulated days of the 1930s . . .'

The laws and regulations of the FDA form the principal official bulwark against dangers to the public posed by drugs, food and cosmetics. With an annual budget of just over a hundred million dollars, it is charged with regulating food and drug industries that do over three billion dollars worth of business a year. If the FDA were consistently honest in its motivation and vigorous in its actions some substantial effect might be noticed; often though, the agency has been remiss in protecting its own leaders who are preoccupied with playing the 'revolving door' game of moving back and forth between jobs in the FDA and in the industries the agency is supposed to oversee. Even when official intentions are good, action is difficult; when he was FDA Commissioner, Dr. Herbert Ley noted, 'I am under constant pressure from the drug industry'.

Despite the unremitting demand for more of the same, there are steadily growing indications that orthodox, allopathic, drug-oriented medicine is crumbling under the weight of its own failures. More and more medical practitioners are coming to agree with biochemist Ernst Krebs, Jr., who said in 1978, 'In the history of science no chronic or metabolic disease has ever been prevented or cured except by non-toxic factors normal to the diet. The corollary is that no disease has ever been prevented or cured by factors foreign to the diet, foreign to the biological experience. These are axioms that admit to no exception.'

At the start of 1979 Dr. Michael Smith, who uses such non-toxic factors in his treatment of addicts, looked to the future optimistically: 'If you have a successful record of treatment, if you can teach what you're doing fairly easily and if you are open to other people going ahead and using your methods, then by example and by word of mouth you can spread news of what you're doing much better than through the medical journals.' And what of the dominant allopathic paradigm? 'To a large extent,' Dr. Smith continued, 'it will be seen soon for what it is — by and large, destructive.'

Consumerism or Utopia?

by Margaret Laws-Smith

Sir Thomas More must have been the first author to recognise the nature of what today we call the consumerist society, and in his *Utopia*, published in Latin in 1516, he produced a lively plan for an alternative society based on communities of families who worked without the use of money to provide for the material and social needs of their members.

In England the change-over from a feudal to a monetary society had taken place a century earlier after the Black Death. At first the abolition of serfdom resulted in a more equal society, and the 15th century was a time of diffused well-being. Yet well-being brought a rise in population. This, with the natural tendency of land ownership to become more concentrated, as some men took advantage of the misfortunes of others, was creating great social problems by the beginning of the 16th century. Everywhere people were being pushed off the land to find refuge and work in the towns. To eat, they had to earn money. To earn money they had to make, or find others to employ them to make, something to sell to people who had money. But people with money already had their basic needs satisfied, so that expansion of employment could only come about by increasing the production of luxuries and superfluities for the rich.

That state of affairs is the essence of a consumer economy. What has changed between the 16th and the 20th centuries is the class in whose hands the great volume of purchasing power is concentrated. In early Tudor times it lay in the hands of the receivers of land rents, lay and ecclesiastical. In the 17th and 18th centuries these incomes were increasingly augmented by the profits of trade, and in the 19th by the addition of mining and manufacturing profits. The great change in the 20th century has been that the working class, taking white and blue collar workers together, have come to possess the greatest volume of purchasing power.

In 1515 the English monetary society was shaped like a tadpole, with a very large head of rich consumers and a long thin tail of craftsmen and workmen who ate sparingly, and beggars, outcasts and vagrants who could hardly eat at all except by theft.

Thomas More saw this. In the words of his Tudor translator Ralph Robinson, he says:—

"For where money beareth all the swing, there many vain and superfluous occupations must needs be used, to serve only for riotous superfluity and unhonest pleasure. For the same multitude that now is occupied in work, if they were divided into so few occupations as the necessary use of nature requireth, in so great plenty of things as then of necessity would ensue doubtless the prices would be too little for the artificers to maintain their livings."

Rich men in their Castles

There it is. It is money which swings society, pulling the whole pool of labour into the channels in which it will produce the things pre-

ferred by those with money to spend.

Today this leads to the continuous attempts to diversify production to supply something new, but in early Tudor times the extent to which the diversification of goods could be carried was very limited. Technology was still at the stage of water mills and cathedral clocks. Craftsmanship for domestic life was little developed. There was little furniture in the houses even for the rich. There was rough earthenware but no fine china. There were no carriages. If you could afford a horse you rode. If you were rich and infirm you were slung in the litter. Otherwise you walked. Even so there were still the products of the great crafts of the Middle Ages; fine woollen cloths brilliantly dyed, gold and silver vessels and plate, horse trappings and armour.

But the amount of gold and silver and cloth you could parade on your own person and that of your horse was limited. If you had more money than was necessary to clothe and feed yourself, you could only spend it by buying the means of clothing and feeding others. Thus arose the practice by which the rich maintained large households in which many retainers, clothed handsomely and mounted showily, fed at their tables, and where friends and followers were entertained on a lavish scale.

Cardinal Wolsey had in his household five hundred persons according to his checker toll. "At meals a board was kept for his chamberlains and gentlemen ushers", another "mess for the young lords" and "another for his gentlemen". "His gentlemen he clothed in livery coats of crimson velvet of the most purest colour that might be invented, with chains of gold about their necks and his yeomen and lesser officers in "coats of fine scarlet edged with black velvet a hand broad".

Such a society corrupted the rich, who struggled to hold what they had and gain more, as well as the poor and starving who were forced to steal to eat.

Utopia: an imaginery land

Thomas More was a Londoner and lawyer from a family of lawyers. When young he was drawn to monastic life and lived nearly four years with the monks of Charterhouse following their rule, but then married and eventually created an extended family life that became famous.

He wrote *Utopia* to demonstrate the impossibility for most men of living virtuously in the acquisitive society of the time, and to present an alternative based on moral principles. He presented it as a description of a newly discovered land at a time when everyone was eager to hear of the latest voyages of discovery. Utopia he said had been described to him and Peter Gilles, the town clerk of Antwerp, during his visit to that city in 1515 by the traveller Raphael Hythlodaeus, and in spite of the warning contained in the name (Hythlodaeus means dispenser - of - nonsense), there were many who believed it to be a true tale.

Extended families were the basis of the political structure, the cells from which the communities — the real units of social life — were constructed.

Work in Utopia

In Utopia everyone worked. There was no money, and the wants of all were supplied from the common store of goods, the result of their collective labour. Only a very few, men and women, who were exceptionally brilliant were excused manual work to devote themselves to study. Manual workers who showed promise could enter this group, but if their promise was not fulfilled they returned to craftsmanship. All officials were drawn from the learned group, but the majority did not avail themselves of their exemption from manual labour, working instead to set an example and maintain the spirit of equality which was the essence of their society.

More's hunch was that six hours work a day from everyone would be ample to satisfy the wants of all where no one had luxuries. The wants were food, of which they all had plenty; housing, which was as good or better than the rich enjoyed in early Tudor days; and clothing, which was the same for all, only differing for men and women, and for the married and unmarried.

There were fifty-four cities in the Island of Utopia, all built upon the same plan, so far as the lie of the land allowed, and each at the centre of the farm lands from which they drew their food. Those who preferred agriculture could spend their whole lives at it if they wished, but it was a "hard and sharp kind of life" to which no man should be constrained against his will, so that all citizens had to spend two years of their lives on the land to assist the permanent workers. These temporary agriculturalists lived in farmhouses under the management of a farmer and his wife "both very sage, discreet and ancient persons", forty to each house. Twenty went back to the city each year, being replaced by newcomers who learned from those with one year's experience. At harvest time extra help came out from the cities so that the harvest was brought in "almost in one fair day".

The citizens were craftsmen, blacksmiths, masons and carpenters, leather workers, spinners and weavers of wool and linen, but there were no tailors, for each family made their own clothes at home. At work everyone wore leather garments which lasted for seven years, and *over* these when not working they wore a woollen or linen robe.

Political Organisation: the common meal

Utopia was thus an agricultural and handicraft society in which everything the people needed was supplied from the immediate land about the cities by a moderate amount of work shared in by all. The only people who worked harder than the rest were the bondsmen and slaves, bondage being the punishment for all criminals.

The system rested on a social and political organisation, based on communities of thirty families. Extended families were the cells from which the communities, the real units of social life, were constructed. All generations of one family lived together in a separate house under the rule of the oldest father who was not senile. Sons brought their wives into the family home, and daughters married out

of it. The size of each family was regulated so that it did not exceed sixteen or fall below ten adults, the numbers in smaller families being made up by transfers and adoptions from those which had grown too large.

Family houses were built in terraces with large gardens behind for cultivation and recreation, and in the centre of each cluster of houses was a community house in which all ate together. Ever since *Utopia* the common meal has been a feature of new thinking about social life. It has featured in the Kibbutz and in Chinese communes. But its purpose has usually been to free women from domestic ties, either to build up economic productivity or to give both sexes the opportunity to live as citizens on equal terms. In Utopia it was more than this. It was the basis of a lively social life and also the foundation of the democratic structure which controlled their political and economic life. It was the key to everything in their society.

Supper in Utopia was the great time of the day. The meal was always followed by fruit and sometimes by wine, which was an inducement to linger and talk, to discuss and form opinions, to hear music, to sing and tell stories. But beyond all this the meal also provided a natural, ready made, unit for the formation of political opinion and for the democratic control of public affairs, dispensing with the need for a separate political organisation. This makes Utopia very interesting to us today.

The political structure More proposed would be likely to work more easily and democratically in our day than in his. We have to remember that by 1515 democracy was very undeveloped and society was authoritarian, with young people deferring to their elders and women subordinate to men. This was form and etiquette, but we know that in the More family, Thomas' wife and his mother and step mothers all had their say. Thus he saw the leadership of his Utopian communities exercised by the fathers of the constituent families, but since everyone gathered at meal, they all knew everything that was happening, and were able to have their say and make their influence felt according to the strength of their personalities.

Community Politics

Each community chose its own head, the Philarch, annually. He lived in the community house, superintended it, and combined the functions of the president of a college with those of a magistrate responsible for the conduct of the members of his families. In practice a Philarch retained his office so long as he was thoroughly acceptable to his community.

The communities were grouped in tens, each ten heads electing their own chief officer, the Tranibore. There were two hundred such groups of ten in each city province, and their heads formed the provincial council which met at least every third day and chose the provincial governor from four candidates put forward by the four quarters of the city. From each of the 54 provinces three wise men were sent yearly to the capital to form the Parliament of the country, which elected the King or President who held office for life unless he was found guilty of tyranny. But the conduct of central affairs does not seem to interest More so much as that of the provinces, which were the real units of economic and social life, being largely self-supporting.

Supper in Utopia was the great occasion of the day. It provided a natural unit for the democratic control of society

In the provinces the Tranibores reported the more important matters that arose at the council meetings to their ten community heads, who then proceeded to "open the matter to their families". That is all we are told. The head, we assume, would talk at supper, making a short announcement if necessary, and discussing it with his neighbours. Information and comment would fly round the room, and everyone would soon express their feelings and ideas. Decisions would be made as the result of free and ample discussion, and would generally be in the nature of an assent to a proposition of the form "We seem to be agreed that . . ." If there was serious dissent, general disagreement would be reported back to the council, and the discussion renewed there in the light of what had been learned of the feeling in the communities about the issue.

Discussions revolve around daily life

Thus the unit of popular government was not something which existed apart from ordinary life. It was not a case of whether people bothered to go to the parish meeting or community meeting after supper. Supper and meeting were the same thing. Political issues did not arise every night, and when they did each one could play a part in discussion according to their personalities. Some would speak up loud and clear on public business, while others gossiped in lower tones about the quarrel between Joe and Harry in the wood yard, or the premature arrival of Mrs Joe's new baby.

The political issues were largely concerned with everyday life. Each city province was primarily self-supporting, but difficulties leading to deficiencies of supplies in one province would be met out of the surpluses realised in others. The population of each was to be kept stable as far as possible, but when through plague and epidemics the population in one was declining it was made up by migrants from others. If the population of the whole country grew too great, colonies were formed on the nearest unoccupied lands with the consent of the rulers of those lands if possible, without if necessary.

A Hint of double-think

The influence of Utopia on social thinking was probably greatest in the fifty years round 1900 when the modern labour movement was emerging. Delighting in the golden vision of a near perfect society, few people seemed to realise that it was, in spite of its democratic nature, ultimately a centralised society with no provision for opposition or dissent. Socialists who admired it probably thought as More obviously did himself, that in such a pleasant society, opposition would very, very seldom emerge. But there were nevertheless some harsh provisions to meet such a threat should it arise.

More thought the greatest danger to the state would be treason. That is attempts by members of the state council, and presumably provincial councils also, to get the leadership into their own hands and rule tyrannically. Therefore all discussion must be in the open council meetings, and any meeting together by a few members outside to discuss council matters was considered to be treason, and was punishable by immediate death.

So far as ordinary people were concerned behaviour which would disrupt the even working of society was punished first by slavery or bondage, but if a bondsman resisted the conditions of his slavery he was put to death. The chief crimes were preaching new forms of religious belief, though people could believe what they liked in private: laziness, evading the customary six hours of labour; and adultery. Divorce for incompatibility was allowable, but presumably adultery would disrupt the social peace of the communities.

The Utopians had few or no technical aids to labour. They used oxen to help with the work of the fields, reserving horses for military exercises, but the heaviness of work was relieved by the use of bondsmen, who did the rougher jobs and worked long hours. In the community houses the direction of the provision of meals was in the hands of the womenfolk of each family in rotation, but all the dirty work in the kitchens was done by bondsmen.

There is thus a bit of double thinking about crime and bondage. The society was so delightful that crime leading to bondage would hardly ever arise, but without bondsmen its delightfulness would be much less. The majority of Utopians would have a vested interest in maintaining the supply of bondsmen, and there would be thus an unconscious tendency on the part of everyone to demand such punishment for much smaller crimes when there were few great ones.

The Relevance of Utopia: direct Democracy

Even allowing for these difficulties, there may still be something to be gained from a thoughtful consideration of Sir Thomas More's *Utopia*. Since the war there has been a great development of the commune movement by people who, by and large, want to be able to achieve for themselves what More's Utopians achieved. They want to spend their lives working for their own subsistence as independently of technology as possible, rejecting the waste of the consumerist society, and to live a communal life which will prevent the loneliness and alienation present in today's society made up of small nuclear families. But communes tend to be small and the problems of modern societies are those of mass populations running into millions.

Utopia was concerned with a population of millions. There were two hundred groups of ten communities of thirty families, each containing ten to sixteen adults plus children, in each of its fifty-four cities. Thus the population of each city province must have been round about a million. Yet these millions were democratically organised in a honeycombe society of which the community of thirty families was the significant unit. It also suggests a way of blending private life with communal life which might be more conducive to a widespread happiness than either completely private or completely communal life. Today privacy is one of the things most sought after as increasing affluence enables people to pay for it. They move from a flat to a semi-detached house, to a single house, and then to another single house with a bigger garden and more room between themselves and their neighbours. Then often to their surprise they find that privacy instead of bringing happiness brings solitude and the evils of isolation. Isolation is a thing to be feared because it withers one's own sense of being and experience of the richness of life just as much as contemplative solitude at the right time can, for some people, enhance it.

Thus what they really need is a combination of privacy and community, like that the Utopians enjoyed. Young couples today usually enjoy the creative excitement of finding, furnishing and decorating their own home and starting a family. With the first baby the wife usually gives up outside work for a time and, from then on she experiences a sense of isolation which grows greater and greater. Instead of affording opportunities for creative activity her home becomes more and more a prison, and the sense of "home as prison" spreads to her husband as he returns to it night after night. But how different it would be for them both if they could turn outward to take a larger and larger part in the common affairs of the community of families to which they belonged, joining in the common meals, the common fun and mental life, and renewing their growth as social personalities, as they emerged from the intense personal preoccupations of young adulthood. They and their growing children would find friends, interest and gossip among their peer groups which would balance the personal relationships of their family life.

For old people too the community house would offer great advantages. With common meals and social life it would abolish much of the need for special services for the old. The Utopian community houses contained a nursery for the under fives. It would also be possible for such houses to provide common rooms for retired people. Such a way of life is still "Utopian" but not impossible. We know that urban renewal is the biggest social problem ahead of us. We have to recondition our towns and their houses to use less fuel and save water. We know that if it were done by local initiative it would be better than if the job were done by planners. The reorganisation of houses round community houses for meals, play and self-government, would not be costly in terms of real resources. It would demand a great deal of labour, but we have labour for there is likely to be more unemployment not less. It would provide the means of a pleasant and fruitful social life without very much in the way of technical equipment.

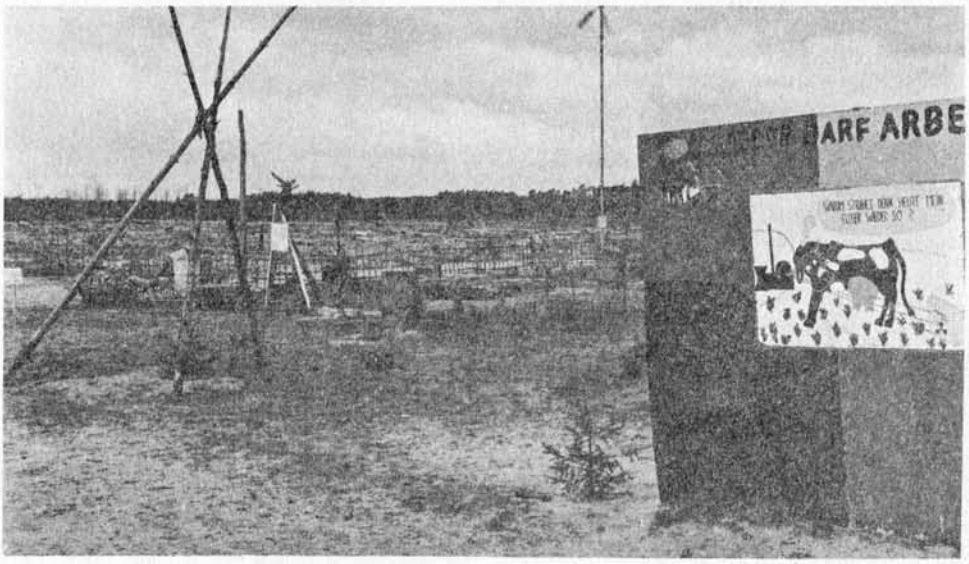
It is worth thinking about.

Sources:

Thomas More *Utopia*, Everyman Paperback. All quotations are from this edition.

For modern translations see that of Edward Surtz, S.J. Yale University Press, 1964, and Paul Turner, Penguin Classics, 1965. The latter contains a very useful introduction, but is insensitive to the freshness of More's insights. By too great a use of the concepts of our own times he tends to take Utopia out of the context of More's own.

Gorleben — the part the Greens played



Peter Wood

Adventure playground created by local ecologists on the proposed Gorleben site.

The decision of the government of Lower Saxony to veto the four billion pound nuclear reprocessing and waste disposal plant near Gorleben — announced by Prime Minister Ernst Albrecht on May 16th — has been received with relief not only by European environmentalists but also by a substantial section of the West German public.

Both before and after the announcement, political manoeuvrings in Bonn and Hanover as much reflected concern over Germany's nuclear programme becoming an issue in next year's national elections as any misgivings over the desirability of nuclear power. Indeed Albrecht made it clear in his public statement that the decision had been based on political considerations rather than on grounds of safety — thus conceding that it was the public's anxiety about Gorleben, rather than his own, that had turned his government against the plans of the German Association for Reprocessing of Nuclear Waste (DKW).

DKW's scheme is now stone-cold and there is little public sympathy in West Germany today for the company which tried to push forward its proposals in blind disregard of public feeling and political sensitivities. The very technical perfectionism with which the DKW pursued its Atom-park plan created an alien public opinion.

Of the various factors which influenced the Gorleben decision and which have combined to force Bonn into a searching review of its nuclear energy policy, two stand out as particularly significant. One is, of course, Harrisburg.

The impact of Harrisburg on West German public opinion has been profound and has been underestimated in Britain. Typical of the new attitude induced by the accident at Three Mile Island is the remarkably open and human reaction of the Interior Minister Gerhart Baum, the man responsible for nuclear reactor safety in the Federal Republic. Baum said: "I have not become an opponent of nuclear power, but I have become a man who after Harrisburg is putting particularly critical questions and whose mind is open for a new verdict". Harrisburg has made it clear that there can no longer be any more easy certainties about nuclear power. In effect Baum and others are now conceding that the fears expressed by ecology parties in West Germany may have some justifications: that Gorleben, in conjunction with a generation of fast-breeder reactors such as that under construction at Kalkar on the Lower Rhine, may well be the first fateful step on the road to a truly terrifying future.

The second, and perhaps the most important factor behind the Gorleben decision is that a large section of the West German public is now seen to have taken up an ecological standpoint. Increasingly, politicians are having to take note of the rising tide of anti-nuclear opinion, not only in the Gorleben area but also in Schleswig-Holstein during the regional elections in the preceding month. Today nuclear power is perhaps the key issue in West German politics.

This breakthrough comes at a time when the influence of Germany's ecology parties appears to be on the decline — if by influence one means the percentage of votes polled in the regional elections. The startling successes in Lower Saxony and Hamburg last summer were followed by poor results in Hessen last autumn, and in Schleswig-Holstein in April of this year *die Grünen* achieved only 2.4 per cent of the poll. The pundits have taken this as a clear indication that the ecology parties will achieve nothing.

The ecologists have, on the contrary, achieved far more than they are now given credit for in a country where the Economics Ministry and an economist-chancellor hold sway. The mushroom growth of the green parties is both the result of increased public concern over environmental issues as well as the reason why environmental issues are now well to the fore in public discussion. The notorious failures of the green groups in recent elections have masked the fact that their concerns have been taken over and their main ideas quietly incorporated in the programmes of the Bonn coalition parties. Without the ecology parties continuing influence in West Germany, the Gorleben decision on May 16th would have been very different.

The Gorleben issue is far from settled. Boring will continue on the site which is, incidentally, in the heart of the Elbe-Drawehn nature park. The tests will determine whether the underlying salt-domes are suitable for the storage of wastes from existing reactors, in the context of a more modest storage plan.

Moreover, it looks as if the critical battle over the extension of West Germany's nuclear energy programme is likely to take a new and possibly nasty turn. Schmidt's government has announced its intention to press ahead with the building of many more atomic power stations — stations that it is agreed cannot operate in the future without extensive waste storage facilities on

the Gorleben scale. The government has adopted this position in the full knowledge that conflict with environmental groups will be heightened, and in spite of the outstanding success of Green List and other ecological candidates in the recent European elections. (In Stuttgart the ecologists collected five per cent of the vote; in Freiberg over ten per cent; while in the rural district of Luchow-Dannenberg, in which Gorleben is situated, they polled 14.4 per cent of the votes).

The apparently autocratic determination of Schmidt (whose attitudes in Cabinet are said to be worrying senior colleagues) to force the nuclear programme through at all costs suggests that the battle is likely to be a bitter one. There is one grain of comfort, however: Schmidt's SPD Party is by no means united on the need for more nuclear power and Baden-Württenberg's Party Chairman, Erhard Eppler, is arguing regionally within the SPD for the more careful use of existing energy, rejecting ever-rising official energy forecasts as ill-founded.

Peter Wood

Nicholas Hildyard adds:

If the Gorleben plans go ahead, the facility (which will store the waste from West Germany's fourteen nuclear plants) will house the largest concentration of nuclear fuel, wastes and reprocessing technology in the world. Spreading over twelve square kilometres, the Gorleben reprocessing plant would cost an estimated six billion dollars. Until now only the Nuclear Research Centre, at Karlsruhe in Southern Germany, has reprocessed radioactive waste — about thirty tonnes of uranium and plutonium a year. Gorleben, however, was expected to reprocess about fourteen hundred tonnes. Inevitably Germany's nuclear industry is extremely piqued by the Gorleben decision. It points out that the storage facilities for spent fuel elements at Germany's nuclear power stations are almost choc-a-block, and the largest site will probably be full by this autumn. Without Gorleben Germany has been forced to sign an extremely costly reprocessing agreement with the French. Under the agreement, Germany will have to pay 641 million pounds for its nuclear waste to be reprocessed at La Hague, France's foremost reprocessing plant. La Hague's reprocessing plant, which must have one of the worst accident records in nuclear history (see *New Ecologist* Nov/Dec 1978) will need to be expanded to take the order. What sort of opposition this will create in France is anybody's guess.

(*Sources: New Scientist*)

NEW ZEALAND

Values Lost

Without doubt, the New Zealand Values Party is one of the most successful ecological parties yet to have been formed anywhere in the world. In the 1975 General Election, Values put up candidates in each of New Zealand's eighty-four parliamentary constituencies, obtaining six per cent of the vote. With such a success behind it, the Party had high hopes of achieving even greater heights in last year's General Election. Those hopes have been dashed, however. Values only gained two per cent of the vote and the Party's morale has taken something of a tumble. During a recent visit to New Zealand, I talked to John Horrocks, one of the Party's leading figures and editor of its newspaper, and asked him; why this set-back?

"To begin with", he explained, "Mr. Muldoon, the Prime Minister had made himself extremely unpopular with a vast section of the population, all of whom were intent on getting him out of power. This led to a great deal of tactical voting, with people who would otherwise have voted for Values opting for Labour, the country's main opposition Party." Interestingly enough, the Labour Party — clearly struck by Values's success at the previous election — had appointed a committee to study the Values manifesto in depth and, on its recommendation, it adopted those policies which were compatible with Labour's own programme. "An example of this," says Horrocks, "was our plan for radically overhauling the present system of electricity pricing. Values has always advocated a graduated tariff — the more a company or individual uses the more he pays. Labour obviously liked the idea and used it in their election campaign, with the media giving them, not us, all the credit. Unfortunately, Labour totally misunderstood the philosophy behind the idea. We intended it as a means of energy conservation which would also favour small industries: Labour saw it as just another means of soaking the rich."

The Values Party's lack of success cannot be explained solely by tactical voting, however, for whilst its political star almost crashed from the sky during the election, that of Social Credit, another minority party, rose dramatically. Indeed, Social Credit polled almost eighteen per cent of the national vote — a success due in large part to the charismatic character of its leader, who had already served one term in Parliament after being elected at a by-election at Rangatiki. Like the Labour Party, Social Credit adopted much of the language and many of the policies of the Values Party. Indeed the cover photograph on Social Credit's manifesto — two children walking on a beach, looking towards the horizon — was almost identical to that used by the Values Party on its 1975 manifesto. Despite this, Social Credit has only the outward trappings of an ecological party, for the substance is lacking. "The main solution for the problems facing our society today is more economic growth to pay for the cost of pollution control," complains Horrocks. "Their basic concern is monetary policy, and they believe that if certain monetary changed are introduced all our problems will be solved over-night. It is an attractive thought simply because it sounds so easy: nobody has to make any effort or sacrifice, all that is needed is a little fiddling around with our currency and everything will be hunky-dorey again." Horrocks regards the Social Credit's manifesto as an example of 'eco pornography', paying lip-service only to ecological ideas while advocating policies which can only lead to further ecological disruption.

In a sense, it is a sign of the Values Party's success that other parties should be trying so hard to appear ecological. "The trouble, of course, is that many people have been lulled into believing that things are beginning to move in the right direction," says Horrocks. "Of course everybody is against pollution, resource depletion, wasting energy and social disruption. So it costs the major parties nothing to state explicitly that they are too. What we really want, however, is some action."

Whereas Values sees such action as its number one priority, the other parties insist that it must be subordinated to other "more pressing" interests, notably stimulating economic growth and free trade. So long as they remain committed to such goals — the root cause of the very ecological and social problems they are trying to solve — any action they take is totally ineffective. Despite its recent setbacks the Values Party remains confident and is concentrating its efforts on winning local elections. Indeed it is at the local level that Values has achieved its major successes to date. For instance, Tony Brunt, the Party's founder, topped the poll in the elections for Wellington County Council back in 1977 and is now well placed to be Mayor of Wellington if this is what he wants: Helen Smith topped the poll in a local election at

Porirua, a working-class, largely polynesian, area: Robin Azirah also topped the poll in the King County Power Board election: and Diedre Kent was elected to the local council at the Tauranga election. Let us hope that as ecological awareness mounts, people will see through the shallowness of the Labour and Social Credit Parties' concern for ecological issues, and realise that only Values can offer a real solution to New Zealand's ills.

Edward Goldsmith

European Elections

If 1979 has proved anything, it is that newscasters *can* pronounce 'Ecologist' without having to affect an embarrassed smile. Having started the year as a minority party, dismissed as well-intentioned cranks by the media, the Ecology Party has won the respect of politicians and political commentators alike. No longer the butt of cheap jokes (I remember one journalist chewing up an Eco pamphlet on television to show 'how natural it was') the Ecologists now constitute Britain's fourth political party; indeed Mrs Shirley Williams, ousted from her seat at the General Election, has conceded that it was largely Eco's success at the polls in May which has prompted the Labour Party to rethink its present environmental policy.

The results of the European Elections have further strengthened the Ecology Party's position, both by proving that the results it gained in May were not flash-in-the-pan successes, and also by demonstrating the extent of popular support for ecological policies *throughout* Europe. Although Britain — alone out of the nine EEC member countries — refused to adopt a system of proportional representation, the Ecology Party candidates almost trebled the percentage of the vote that had been won by their colleagues at the General Election. In the Midlands, Michael Benfield, making full use of the media's interest in the elections (he campaigned in a hot air balloon), gained 3.9 per cent of the vote, with 6,380 votes. In London, Jonathan Porritt, the Party's Deputy Chairman, gained 4.1 per cent with 6,448 votes. And in Cornwall, Edward Goldsmith gained over 5,000 votes (3.0 per cent) standing against a nationalist candidate from Mebyon Kernow. The Ecology Party National Executive must surely be wondering whether an alliance between Eco and Mebyon Kernow, the largest Cornish nationalist party, might not be a thought to bear in mind in future elections; if a joint candidate had stood at the EEC elections, it is likely that he would have captured some fifteen to twenty per cent of the votes.

Perhaps the greatest blow to the Ecologists came in France, where Europe-Ecologie gained 4.4 per cent of the national vote — a mere 0.6 per cent below the five per cent barrier that, once passed, would have allowed them four MPs at Strasbourg. The candidates are now in severe financial difficulties; in order to stand at the election, all parties had to furnish a deposit of three and a half million francs (three hundred thousand pounds) to pay for the printing and posting of electoral addresses on a national scale. Europe-Ecologie has now lost that deposit and at least one candidate has been forced to sell her home to help pay the necessary money; others have taken out second mortgages. Europe-Ecologie points out that the elections were biased from the very start in favour of the major parties; minority 'lists' were only granted four minutes and seventeen seconds on television for their electoral broadcasts; and unlike the major parties, they received no million Francs subsidy to help pay for their campaign. Internal splits also damaged the ecological cause; Friends of the Earth, in particular, refused to throw their weight behind Europe-Ecologie, arguing that, whatever the results, the Ecologists would gain a bad image by standing at the elections (see *The Ecologist* May/June 1979).

Despite the overall failure, however, ecological candidates achieved some good results. In Paris, Europe-Ecologie gained 6 per cent of the vote, with the middle class areas proving most receptive to their message — the richer sixteenth and eighth arrondisements together with St. Denis, a communist suburb, were the only districts to register less than a 5 per cent poll for the ecologists. In the fifth arrondisement (where Brice Lalonde, a major figure in the French ecological movement, has been active for several years), the ecological candidate polled 8.3 per cent; and in the sixth arrondisement 7.5 per cent. In the Provinces, Solange Fernex, founder of Alsace's Ecologie et Survie, gained 10.6 per cent in Haut-Rhin; 12.6 per cent in Colmar; 7.6 per cent in Bas-Rhin; and 9.4 per cent in Strasbourg — all areas of her constituency threatened by France's nuclear programme. In Cherbourg and the district around La Hague (France's reprocessing plant), the ecology candidate polled 8.8 per cent.

The same pattern of high ecology votes in areas where nuclear plants are under construction was seen in Germany; around Gorleben (see previous page), the Greens won 14.4 per cent of the vote. The overall result in Germany, however, was disappointing — 3.2 per cent; again too low to elect a representative at Strasbourg. Nevertheless, Willy Brandt, the former Chancellor, was concerned enough by the results, to lambaste the Greens publically for having taken votes from his Social Democrat Party, thus allowing a clear majority for the Christian Democrat at Strasbourg.

The Ecologists gained similar results in Belgium with 3.4 per cent of the vote. Had their campaign been better orchestrated — it was launched late and with little preparation — the results would certainly have been higher. In many French speaking areas for instance, candidates consistently polled five per cent or more of the votes, and undoubtedly there was much support that was left untapped.

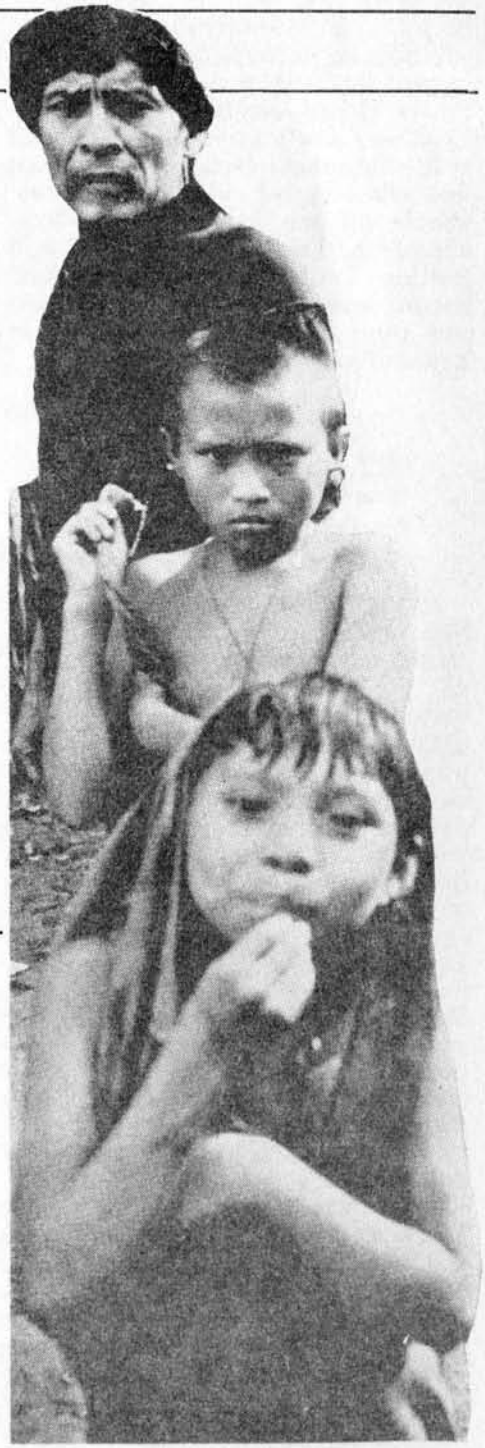
Perhaps it is indicative that the only countries to return Eco-MPs were those in which Green candidates did not stand under the Ecologists banner. In Denmark, three candidates who had signed Ecoropa's *Declaration for a Green Europe* and who are well known for their ecological views were elected; all had stood on an Anti-Common Market ticket. In Holland, four Greens were elected; two had stood as Christian Democrats; one as a Liberal; and one as a Socialist. Significantly the Dutch Radical Party — the closest thing to an Ecology party in Holland — achieved only 1.6 per cent of the vote, failing to return any candidates. In Italy on the other hand, the Radical Party — a fully fledged ecology party (see *The Ecologist* May/June 1979) — gained three seats at Strasbourg; Emma Bonnino and Marco Panella, both staunch supporters of the ecological cause, being elected.

Whilst Ecologists throughout Europe might be disappointed with their overall result, there is no doubt of the impact they made by standing at the elections. Midway through the Dutch campaign, for example, the chairman of the Dutch Union of Policemen, declared that his members would not help the Government suppress demonstrations against the dumping of radioactive waste in salt mines *even if* civil disobedience was involved. "We also have children and fear the danger of this toxic waste," he said. "Our task is to maintain public order and when the government is destroying that order we can no longer obey". It looks as if workers at the company responsible for dumping Holland's radioactive waste in the North Sea will also strike.

Nicholas Hildyard

Ten years of Survival

A profile of Survival International and its founder, Robin Hanbury-Tenison



Last September, Robin Hanbury-Tenison returned to England from the rain forests of Borneo where he had been leading over one hundred scientists in a painstaking survey of the Mulu National Park. The scientists were primarily concerned with the flora, fauna and soil structure of the rain forest and, although a tribe of hunter-gatherers was known to be in the area, it was not part of the expedition's brief either to make contact or to study them.

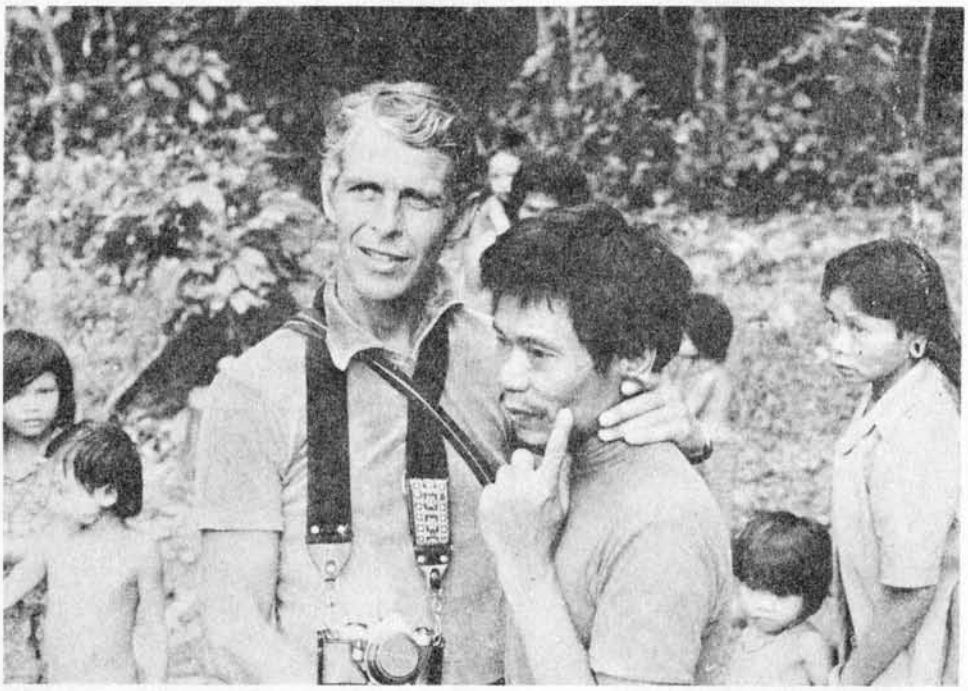
Ironically it was those of the expedition who were themselves under scrutiny for, unbeknown to them, the Penan had been watching their every move from the time of their arrival. Nevertheless, the first the expedition knew about the Penan was several months later when Nyapun, one of the tribe's leaders, summoned up the courage to enter the camp. Immediately he made straight for Robin: it was almost as if he knew intuitively which of the one hundred and forty members of the expedition would be most sympathetic towards him. Nor could he have made a better choice: for not only has Robin vast experience of hunter-gatherer tribes, but he is undoubtedly one of the world's foremost champions of the rights of 'primitive man'.

Robin has recently been awarded the Royal Geographical Society's Patron's Medal for the indispensable part he played in organising the Mulu expedition: acknowledged in the award is the work he has done on behalf of primitive peoples. Ten years ago, it was his determined enthusiasm that led to the creation of the Primitive Peoples' Fund — now renamed Survival International. It was also in the cramped rooms of Survival's Craven Street office that the founding members of *The Ecologist* first met — Teddy Goldsmith, Robert Allen, Peter Bunyard, Jean Liedloff — drawn together by a common concern for the plight of primitive peoples. Indeed the destruction of the primitive way of life in the name of progress seemed a devastating indictment of industrial society's attitude for nature, for the environment and for the phenomenal diversity of human cultures.

Up until 1969 Robin had been on a dozen or so expeditions, including his famous trip across South America with his Oxford friend Richard Mason, who three years later was killed by Kreen-Akarores Indians. He then went on the Royal Geographical Society's hovercraft expedition to the Orinoco in Venezuela. Also on the expedition was Conrad Gorinsky, himself half Amerindian, who at that time was completing his thesis on the medicinal properties of plants used by local Indians. Drawn irresistibly to the Indians, Conrad and Robin left the main expedition behind and set out to make contact with local tribes. On their travels, they came across a Waika village that had been recently visited by missionaries. Made to feel ashamed of their nakedness, the men and women had donned whatever clothing they could lay their hands on, and it had become filthy and tattered. Their faces expressed fear and hostility, and apparently one of their number had caught flu, and, lacking any natural resistance, had died. Clearly the White Man was to blame and Robin and Conrad had to leave hastily.

That episode made a strong impression on Robin and he decided that something had to be done. "Before then," he says, "I was flailing around, doing things because 'they were there' — a depressing activity since I was accomplishing nothing useful."

It had become clear that without anyone to battle on their behalf, the Indians were doomed. To the rest of the hovercraft party, the Indians were of no real consequence and, back home, anthropologists were more interested in kinship diagrams than in the survival of the very people they were studying. Indeed with the academic respectability of an infant science at stake, simple humanitarian values were going by the board for fear that they might cloud 'objectivity'.



Robin Hanbury-Tenison and Nyapun (*right also*) at Mulu

In February 1969 an article appeared in *The Sunday Times* colour supplement, "From fire and sword to arsenic and bullets — civilisation has sent six million Indians to extinction". The impact of that article, with its horrific account of systematic genocide dating from the Conquistadores to Modern Times, was shattering. Nicholas Guppy, who had been concerned for the Indians since travelling in British Guyana ten years previously, contacted a large number of distinguished anthropologists asking them to support a letter to *The Sunday Times* seeking some sort of public action. He finally had the support of Francis Huxley and Audrey Colson, the only two anthropologists prepared to put their reputations on the line. The response to the letter was enormous and as a consequence the Primitive Peoples' Fund came into being.

Robin now feels that Norman Lewis' article contained some outrageous statements. Not that Lewis said anything incorrect, just that in his short article he had compressed events which had taken place over four centuries, and thus distorted the picture. "The appalling thing," says Robin, "is that many of the things which happened were done with good intentions. The Jesuits were trying to save souls and civilise, and unwittingly they spread disease to which the Indians had no resistance. Epidemics rather than cruelty have been the major cause behind the Indians' plight." Indeed Robin points out that similar encounters with missionaries in Africa had none of these devastating effects, mainly because Africans had been in continuous contact with other civilisations — through migrations, the Slave Trade, and conquests — and had thus developed resistance to a far greater range of disease. Before the conquest of South America, the Indians had been too dispersed to sustain an epidemic, nevertheless there were probably as many people in the South American continent as in Africa. "Today," says Robin, "Indians are an embarrassing minority — a wart on the backside of Brazil — and lumped together they would not even fill the Maracana Football Stadium in Rio de Janeiro."

Norman Lewis took much of the material for his article from a report produced by the Brazilian Government on the activities of the Indian Protection Service (IPS). The report revealed that IPS agents were conniving with land speculators in the massacre of Indians: on occasions aircraft being called in to bomb villages with both conventional weapons and smallpox-infected blankets. An official cover-up followed in which the report was conveniently lost, and the office containing all the files was burnt down. Four hundred people had been arraigned for crimes associated with maltreating the Indians, but no-one was ever brought to trial.

Yet, as Robin points out, the IPS did not always have such an evil record. When Colonel Candido Rondon began the Service in 1910, his aim was to protect Indians from confrontation, giving them a chance to choose their own future. Many IPS agents have shown enormous dedication and integrity — witness the Villas Boas brothers whose work in the Xingu has rightly won them international acclaim.

In 1969, FUNAI — the National Foundation for the Indians — took over from the IPS, but already by 1977 charges were being laid that it too had succumbed to corruption. Testifying at a Parliamentary Commission, Padre Antonio Iasi, Secretary of the Indian Missionary Council, accused FUNAI of failing to protect the Indians against roads being driven through their lands. He reports that a high-ranking official in FUNAI told him, "If

I were asked to give evidence, no-one would escape — neither the governors, nor senators, nor deputies, nor the missions themselves, for all of them have committed grave offences against the Indians.''

The Brazilian government has now recognised the rights of Indians to certain lands and, in 1973, FUNAI was given five years to see that those lands were properly demarcated and that the Indians received legal title to them. Today that programme is far from completion, and the Indians are still losing their lands to settlers. ''Some nights I don't sleep, thinking about our problems,'' a Guarany Indian said recently. ''We are tired of waiting. All of us here have had the same experience. Our reserves are devastated, without wood. Who took it? Was it the Indians to make their houses? No, it was the white man. We can no longer keep our arms folded. Perhaps this is the last time we will be able to rise up as tribes, to raise the voices of our tribes . . .''

The latest issue of Survival International's newsletter documents four cases where the Indians *have* taken up arms to assert their rights against the settlers. In each case FUNAI stood back until the Indians themselves took action.

If the Indians are now conscious of their legal rights, credit must in part be given to the work of Survival International. In the ten years since SI was set up, Robin has visited over seventy tribes — thirty-three of them in Brazil. Initially, Robin was accused of wanting to put 'his Indians' in human zoos, playing out some Rousseau-like fantasy. In fact Survival's projects have always encompassed a whole range of approaches — from the wholly protectionist to the intergrationist. Robin now recognises that many tribes embrace the Western way of life enthusiastically. In Papua New Guinea, for example, the traditional Big Man economy is not so markedly different in style from the big business approach of the West; and in the Bougainville area, local tribesmen grasp technology eagerly, happily becoming westernised. One wonders whether such people are not already beyond help, and certainly Robin feels that Survival should not concentrate its efforts in such areas. ''The nomadic people, the hunter-gatherers, they are the ones who particularly need our help and protection,'' he says. ''They cannot cope with the values which we try to impose upon them: they do not embrace the Puritan industrial ethic, and consequently, without help, they are the ones who succumb to despair and disease.''

Ten years ago Robin was pessimistic about the chances of such peoples' survival and, paradoxically, he felt that their only hope was to get onto the white man's ladder. He has now changed his mind. ''They are far better able to resolve their own problems than we have ever given them credit for. They are intelligent, thoughtful, well-organised people. Given one essential — respect — they will have a good stab at solving their problems.''

Nothing, however, can be acccomplished unless tribal land rights are guaranteed, and here Survival International has helped by focussing world opinion and in providing legal aid. Clearly too, where disease is likely to be a problem — as with the Amerindians — proper medical care must be forthcoming, not in the sense of pouring in conventional medical aid, and hooking them onto our system, but of backing up the resources they themselves have. ''It's no good replacing the witch doctor — that leaves no traditional medical structure. We have to go in with humility,'' he says.

Ironically, the outcry at the treatment meted out to primitive people throughout the world has brought a new threat upon them. Having been for so long treated as sub-humans — in Brazil they were 'vermin' — many primitive peoples have now been granted the same status as any other citizen. On the face of it, this may seem a victory but, as Brazil's recent Rule of Emancipation makes clear, it also binds Indians, along with other Brazilians, to paying taxes and serving in the army — indeed they can go to goal for not complying. Clearly such a law serves only to destroy their culture, and anthropologists in Brazil have rightly protested. With the Indians now awakened to their own rights, it remains to be seen how the conflict will be resolved.

Survival International is going from strength to strength. It now has one thousand subscribers and help from the Ford Foundation. Recently it opened an office in New York, and North American Indians are giving their support ''to prevent their brothers from suffering the same fate they suffered one hundred years ago''. After ten years, Robin feels that the greatest accomplishment of Survival is to have itself survived. Survival acts as a focus of interest for all those concerned with the fate of primitive people and, consequently, it has become known as the one place where such people feel that they can turn to for help.

With industrial society floundering, it may not be long before we of the industrial world are forced to take up alternative lifestyles. It is therefore essential that primitive peoples survive — not just as human beings but with their cultures intact — for it is us, not them, in need of guidance.

Peter Bunyard and Nicholas Hildyard

Survival International is a small charity run from a London basement

Survival International is effective in helping tribal peoples to represent their rights at an international level. This is an urgent problem, for many aboriginals face the prospect of irreparable destruction.

Tribal peoples are many things to many people – victims of colonialism, potential converts to missionaries, a minority to 'developers', income to tourist operators and film makers, subject matter to anthropologists . . .

Until they become the subjects of their own destiny rather than the objects of someone else's, the work of SURVIVAL INTERNATIONAL, which is unique amongst the few world organisations working in this "fourth world" area with isolated groups, will continue.

It is sponsored by such people as The Rt. Hon. Viscount Boyd of Merton, P.C., C.H., The Rt. Hon. Malcolm MacDonald, P.C., O.M., Lord Miles of Blackfriars, Spike Milligan, Laurens van der Post, C.B.E., Sir Peter Scott, C.B.E., D.S.C. The Executive consists of experts in all fields covered by S.I.'s interests – with an International Law Adviser (a Barrister-at-Law of Gray's Inn, London), a Medical Adviser (a hospital specialist), distinguished anthropologists such as Francis Huxley, Professor Sir Edmund Leach and Professor Claude Levi-Strauss. The Chairman is the explorer Robin Hanbury-Tenison and the Treasurer is John Hemming, author of "Red Gold – the history of the Brazilian Indians".

SURVIVAL INTERNATIONAL's list of projects effective in the field speaks for itself of the care and concern it vigilantly maintains on behalf of the world's greatest minority; the rich variety of cultures so carelessly being destroyed to the detriment of all mankind.

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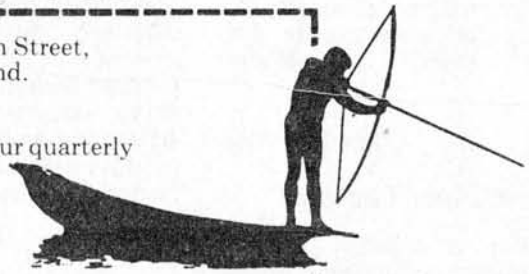

'Sabotage attempt' at A-plant

Agents of the Federal Bureau of Investigation are investigating a claim by a power worker that he and another man tried to sabotage nuclear fuel at a power plant in Surry, Virginia. The man, William Kuykendall, says that he and the other man — not identified — poured sodium hydroxide on new fuel elements at the plant on April 27. He said they did so to try to force the Virginia Electric and Power Company to make changes in safety and security operations at the plant. The company said the fuel rods, valued at about thirty million dollars, had to be cleaned but suffered no permanent damage. The FBI is considering what charges, if any, should be brought. Kuykendall told the *Newport News Daily Press:* "You can hang me up by my thumbs in Richmond Square as long as you put a sign in front of me saying what I did and why I did it."

Daily Telegraph 18.6.79

How Romantic Life has Become . . .

A new blow has been struck for the cause of Romantic Love. Scientists from Houston, Texas report having discovered a remarkably successful cure for male impotence. All the patient has to do is to insert two small cylinders on each side of the penis. A tiny tube connects them to a small reservoir of fluid, a pump and a release valve: by pumping the fluid into the cylinders, the patient achieves an erection. Once copulation has taken place the patient simply hits the release valve, allowing the fluid to return to the cylinder, and his erection collapses. "At first reckoning this may all seem rather complicated, even bizarre", say the scientists, but, we are assured, the entire device is comfortably implanted and easily manipulated externally.

The Observer

. . . And How Tedious

Scott Jablin is allergic to the twentieth century. Modern living has polluted his system so badly that a mere whiff of fresh air can send him into convulsions. Jablin is allergic to everything indoors — from television to telephone, from chairs to carpets. He spends all day and night sitting or sleeping on a wooden bench in the back yard of a house in Oakland, North California. He breathes bottled air through a cotton mask with a charcoal filter, and washes with a sponge and distilled water. Five injections a day of different serums, as well as periodic shots of adrenalin, help to 'keep him alive'.

"I just sit here and hope I can breathe", says Jablin, who had to drop out of his final university year because of his condition — he is allergic to books, pen and ink and fellow students. Jablin warns; "There are going to be more people like me, the more garbage we put into the world, the more people there will be whose bodies break down from it."

Daily Mail 16.6.79

Concrete Jungle; these walls a prison make

An elderly country woman visiting her sister in Utrecht early in April spent three days lost in the town's new shopping centre, which has two hundred stores on several levels. The seventy year old shopper, who became separated from her sister in the Easter crowds, said she was perplexed by the similarity of entrances and exits throughout the building, and could not find her way out. She was too embarrassed to ask anybody to guide her and her sister thought she had returned home. The woman remained undetected by the shopping centre's security staff, who assumed that she was a tramp and so decided to turn a blind eye.

In Austria too it seems people are going unnoticed. An eighteen year old Austrian, Andreas Mihawecz, was arrested in connection with a car accident, in which he had played no part other than sitting next to the driver involved. An official mistook him for the driver and took him to an isolated cell in a small police prison for questioning. Mihawecz remained in the cell for eighteen days, forgotten by the policeman. He survived by eating his leather jacket and drinking his own urine. He was finally discovered when the policeman involved tried to put another prisoner in the cell. So much for community service.

Daily Telegraph 18.4.79
Guardian 20.4.79

Growth will go on!

Professor Yevgeny Fyodorov, Director of the Institute of Applied Geophysics of the USSR Academy of Sciences, is convinced that we have no need to take seriously the predictions of the *Limits to Growth* team. He is convinced that Man will be able to solve whatever problems nature may throw up. "Unreplenishable resources have a tendency to become replenishable", he says, apparently unaware of the Second Law of Thermodynamics. "Each portion of material taken from the bowels of our planet is not lost without trace but can be utilized repeatedly."

He does see a few problems, however, mainly as a result of climatic change caused by pollution and excess carbon dioxide generation. Nevertheless, he is still optimistic, believing that the worst consequences of climatic change can be avoided. "It has been proposed for example, to limit energy expenditure of Earth by transferring to outer space the most energy-intensive enterprises", he argues.

"It may also be possible to control the climate in order to preserve its environmental features, or even to improve them in the event of a change of the planet's thermal balance."

Perhaps it is relevant that Professor Fyodorov also works for the Russian Department for the Environment, euphemistically known as The Ministry for the Rationalisation of Nature.

New Zealand Environment

Japan Squares Watermelons

Japan, home of electronic innovation, has moved into the food market. It is now selling square watermelons. The horticulturalist who developed them says the shape makes them easier to transport and store in refrigerators. But they are not cheap. A Tokyo store sells an 11lb watermelon for about £9.

Daily Telegraph 11.6.79

America's Drug Bill

According to a recent U.S. Government report, drug abuse costs American society more than ten billion dollars a year. This is the cost borne by the police, the U.S. Health and Welfare Services and the legal system. In 1978 more than five hundred million dollars were spent on drug treatment, with State Governments being the largest single source of funding. Although the 'heroin epidemic' of the late 1960s has subsided, there has been a significant increase in the use of cocaine, especially in the 18-25 age group. Almost ten million Americans have tried cocaine, and the percentage of people using it for non-medical purposes has doubled between 1972 and 1977.

The Guardian

Mellanby again

The WHO Expert Committee on the Safe use of Pesticides agreed at a recent meeting that an estimated 500,000 people a year are killed or incapacitated by pesticide poisoning (*New Scientist* 21/28 Dec. 1978). Needless to say, this upset the susceptibilities of 'environmentalist' Kenneth Mellanby, one of the leading proponents of chemical pesticides in this country.

He insists that the number of deaths from insecticide poisoning last year was probably measured "in hundreds and not hundreds of thousands" and that the people poisoned seriously enough to merit the description "incapacitated" was not much larger.

Significantly M.G. Lines, Director of the Trinidad and Tobago Bureau of Standards provided the *New Scientist* (3rd May 1979) with details of deaths from pesticides in his country. According to Trinidad and Tobago's Ministry of Health "there were 198 proven deaths in 1975 from poisoning, of which 145 were due to organophosphorus compounds and 16 to chlorinated hydrocarbons". In 1977, there were 156 deaths, of which 80 were caused by parathion, 20 by paraquat, 13 by other organophosphorous compounds, and 9 by other pesticides — 293 pesticide deaths in two years, in a population of little more than one million. As Lines points out these figures are not only consistent with those suggested by WHO, but also show up Mellanby's figures to be biased nonsense.

Nuclear Plants Cost More

Nuclear Plants built between 1974 and 1977 were 73 per cent more expensive to complete than coal burning plants constructed during the same period, according to a report by Dr. Charles Komanoff. His conclusions are based on a study of 31 nuclear plants and 61 coal plants built during this period. Komanoff claims that new nuclear plants are becoming increasingly expensive to build because of the growth of the nuclear industry and the growing public awareness of the dangers of nuclear power. The result, he says, is the lengthening list of safety and environmental regulations which continually boosts the construction costs of nuclear plants.

Environment March 1979

Pep talk for Nuclear Barons

The man handing out leaflets in front of the downtown Hilton wore coat and tie. A cardboard sign had been set nearby, its message written in large letters with a magic marker, "More nukes, less kooks: protect science from the new dark age."

Picking up the handouts were groups of convention goers who had gathered at the Hilton to discuss "Science, Technology and the Human Prospect", a symposium sponsored by two of America's largest power utilities. The symposium attempted to cover a broad spectrum of science policy issues, but in reality it turned out to be little more than a pep talk to a largely demoralised industry. The timing of the event was strangely inauspicious. Convened on April 1st, the symposium was held while the Three Mile Island power plant near Harrisburg, Pennsylvania, suffered the worst nuclear accident in industry history.

The symposium was opened by Chauncey Starr, Vice Chairman of the Electric Power Research Institute, who gave a speech entitled *The growth of limits*, a play, one supposes, on *Limits to Growth*. "I do not accept the premise", he said, "that constraints on growth are in view, or that our long-range planning horizons should be determined by today's perceptions of existing limits. I believe that a long future of expanding expectations continues to be an available option if we take advantage of the fact that technology is an unlimited resource of the human mind." Who said something about less kooks?

Science 27.4.79

Ban on aerial herbicide spraying

Residents of California's Mendocino County, just north of San Francisco, have voted by a 63 per cent margin to ban the aerial application of phenoxy herbicides in areas of the county not controlled by state or federal agencies. While the Forest Service and other government agencies have been put under considerable pressure to reduce their herbicide applications, this is the first time their use by private timber companies on private land has been affected. "The vote, 8.644 to 4,980, represents a major victory to those fighting against the profligate use of toxic chemicals in our environment", said Steve Krefting of the Sierra Club.

Sierra Club Report 8.6.79

Cooking up lead levels

Vegetables actively absorb lead from the water in which they are cooked, Michael Moore of Glasgow University told a recent Conservation Society meeting in London. Moore revealed that vegetables can concentrate lead from cooking water by a factor of five or more. This result is important because British Government calculations of how much lead people absorb from food take into account only lead in uncooked food — they make no allowance at all for lead absorbed from cooking water.

A 1977 report from the Department of the Environment (*Lead in Drinking Water*) said that, in Britain, the average weekly intake of lead from the diet is less than half the 3 milligrams/week "tolerable intake" stipulated by the World Health Organisation (WHO) and Food and Agriculture Organisation (FAO). But Moore's calculations, taking into account lead absorbed during cooking, show that the average weekly intake of lead from diet could be "greatly in excess" of this limit in areas where there is more lead in water than WHO limits (100 micrograms/litre). The 1977 DoE report admitted that there are 800,000 homes in Britain where the concentration of lead in drinking water exceeds this limit.

New Scientist 24.5.79

Near Melt Down

The most serious 'incident' in the history of the Swedish nuclear programme occurred early in February at an uranium fuel plant in Vasteras, west of Stockholm. The ASEA-ATOM company managed to keep the incident secret from the public for a full month.

The accident occurred when an enriched uranium solution was pumped into the wrong container. Altogether 550 litres of uranium solution were pumped into the container, with the level of radioactivity reaching eight to ten times the permitted level. If the morning shift at the plant had not discovered the mistake, a serious accident could have happened. According to ASEA-ATOM's security section, the uranium that accumulated in the container had reached eighty-three per cent of critical mass. If critical mass had been reached a chain reaction would have begun, which could have led to a melt-down or even a nuclear explosion.

Undercurrents 34

Nuclear Power will not do the job

A new study claims that nuclear power is "technically incapable of providing a timely and significant substitute for oil". A fifty per cent replacement of oil by nuclear power by the year 2000 would require ordering one large power station every 3.5 days. The study, by Amory Lovins of Friends of the Earth, argues that the energy supply problem is "ninety per cent" one of heat and portable liquid fuels. Lovins says that if every oil powered station in the OECD in 1975 had been replaced overnight by nuclear stations the fraction of OECD oil which is imported would have only

been reduced from sixty-five to sixty per cent. And at the same time there would be a greatly increased dependency on imported capital and uranium. The maximum role for nuclear power is in providing electricity which is only ten per cent of all primary energy. Lovins also reviews nineteen studies from eight countries and estimates that conservation measures can hold steady or reduce energy needs while maintaining economic growth. Two British studies indicate that growth can triple while total energy demands could be reduced by only half. The report, *Is Nuclear Power Necessary?* is available from Friends of the Earth, 9 Poland Street, London W1.

Nature 24.5.79

Pesticide Resistance Increases

Resistance to pesticides has been spreading so rapidly among pests that no manufacturer cared to offer a new pesticide to WHO for safety testing in 1978. A report by the United Nations Environment Programme (UNEP) points out that in 1965 there were 182 listed resistant strains of arthropod pests; in 1968, it listed 228 resistant species; and now its latest survey of 1977 lists 364 species.

There are now 223 agricultural pests resistant to 9 of the major groups of pesticides. Many of these, says the UNEP report, "are major pests of major crops, such as the cotton bollworm; the boll weevil, and the leafworm of cotton; the rice stem borer and the brown plant hopper; the Colorado beetle of potatoes; spider mites of fruit and glasshouse crops; and cut-worms and weevils of cereals."

WHO figures, cited in the UNEP report, say that there are 120 resistant strains of insects which directly threaten public health compared to 102 in 1968. In 1969, 15 species of anopheline mosquitoes were resistant to DDT and some 37 to dieldrin. In 1976, some 43 species were known to be resistant to dieldrin, 24 to DDT, 5 to organophosphates like malathion, and 2 to carbamates.

Resistance to insecticides is now found amongst anopheline mosquitoes in 62 countries out of 107 where there is malaria.

Switching over from DDT to other insecticides like malathion has not proved easy. Most of the substitutes of DDT are both much more toxic and much more costly. India's malaria control programme alone consumes nearly 60 per cent of the Indian government's health budget.

Resistance has already appeared to hormone-based pesticides where little resistance has been expected. "New compounds such as growth regulators and microbial pesticides have not been in use long enough or on a wide enough scale to show perceptible resistance, but here again as with chemosterilants, it has been possible in the laboratory to develop resistance by artificial selection."

Nature 24.5.79

The Great Gadget Catalogue

Recently, in the People's Republic of Mongolia, a scientific journal advised its learned readers to use a paper clip to replace the handle of a zip 'if it should be lost or broken', and suggested that the 'yurtwife' scale her fish using a device made by nailing three bottle tops to an oblong piece of wood. Happily, an American publisher has produced a book, *The Great Gadget Catalogue* which now means that the 'yurtwife's' Western counterpart can choose from a cornucopia of manufactured contrivances to overcome her problems; boffins this side of the bamboo curtain (now simulated plastic bamboo) are pleased to offer us the 'Shorty Zipper Pull' to grasp our inadequate trouser zips and the scientifically proven 'Electric Fish Scaler' to do our dirty work.

Thus, the electric toothbrush need no longer be the symbol of superfluous technological paraphernalia in our commodity-crazed society; it has now been surpassed by the devices glorified in *The Great Gadget Catalogue*. For instance, endless non-stop motorways were obviously designed for the use of the 'Auto-John', although women drivers must still look for an alternative; and bread was surely invented for the use of the 'Electric Butter Spreader'.

Some devices actually claim to have environmental merit: the 'Instapure', for example, is a home water-filter that removes chlorine, organic chemicals and other contaminants which may have been flushed into our drinking water, although some will raise their eyebrows when they learn that it is not designed to remove 'beneficial fluorides'. Other gadgets claiming environmental benefit are the 'Solar Cigarette Lighter' and the 'Music Box Pendant' which monitors air pollution and plays an appropriate tune as smoke levels increase. When conditions become desperate, one must surely have an 'Oxygen Belt Pendant', which flashes a light when air pollution becomes intense, releasing at the same time a mask which supplies the wearer with ten crucial minutes of pure oxygen. Even more thoughtful is the 'Ecology Golf Tee' which disintegrates into

an organic fertiliser should it be mislaid by the golfer.

Essential for successful entertaining is the 'Icy Dicy', which dials the correct number of ice cubes for the pernickety guest; the 'Portable Dial-a-Drink Electronic Bar'; the 'Automatic Lemoncutter'; the 'Dripless Wine Pourer'; the 'Push-button Card Shuffler'; and, of course, the 'Flushing Ashtray' (complete with simulated sounds of flushing water).

For those with a less practical bent, or a more cynical nature, the catalogue offers a 'Love Tester' — which might well be best used as a lie-detector when interviewing its manufacturer.

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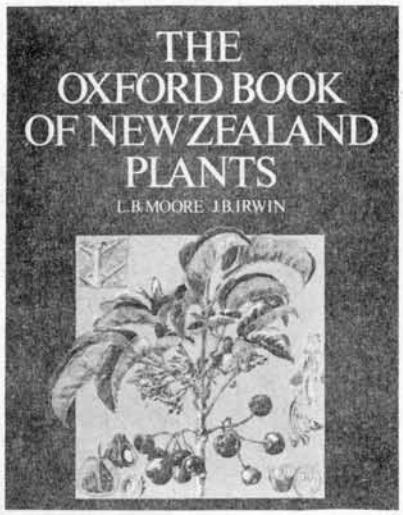

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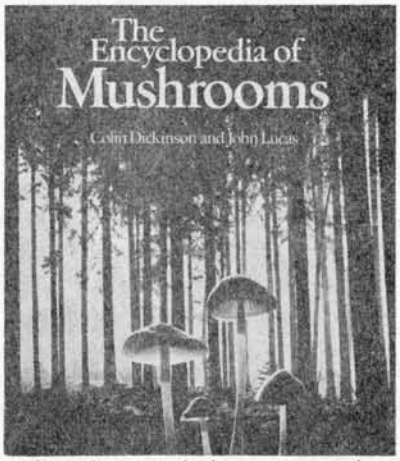

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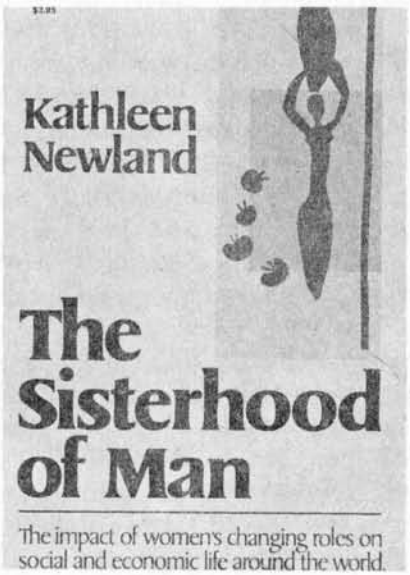

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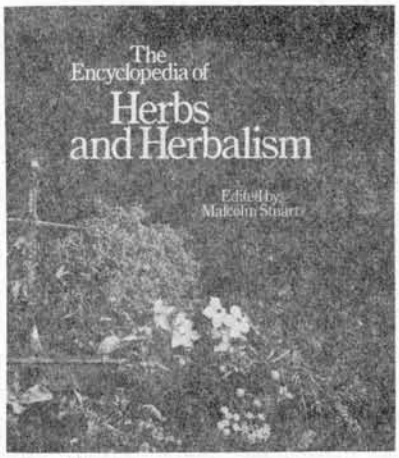

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Books

An anthropocentric view

THE ARROGANCE OF HUMANISM
David Ehrenfeld. Oxford University Press. £4.50.

One of the most significant and unexpected sections of this book deals with the motivation of writers, particularly those who feel compelled to disseminate their beliefs about the evolving human race. The author is a professed anti-humanist (but not misanthrope) who, in rejecting what he believes to be the basic tenets of humanism, asks himself why he has separated himself from the majority of mankind. This leads to a discussion of motivation arising from desire, fear, frustration, wishful thinking about self-vindication, and other egoistic states of mind which contaminate a "truthful, balanced vision of the world." Aware of his own possible contamination, Professor Ehrenfeld nevertheless claims that this does not prejudice the truth of his anti-humanistic belief because, as he rightly points out, it is fallacious to suppose that rational attempts to explain the unconscious motives behind belief necessarily invalidate it. Since impure motives do, however, cloud the truth, even when one is turned squarely towards it, Ehrenfeld's commendable concern with contaminating motivation needs to be pondered, not least by a critical reviewer of his book. Although we both deplore the arrogant humanism of a scientific-technological age submitting to the authority of human reason and objectivity, my interpretation of the nature, scope, and development of humanism deviates sharply from that of Ehrenfeld. Being also aware that egoistic motives may colour the argument that follows, I leave the reader to decide which approach is closer to the truth.

What is first called for, however, are more words of appreciation of the book. The author has succeeded in painting a lucid picture of the evils that have overtaken the world as a result of our excessive anthropocentricity, and he shows that even if we should decide to listen to the "profound, irrational, and ancient voices within us," already much has been lost forever. He also speaks well about the importance of finding the right balance between reason and emotion and wisely stresses the need to restore human greatness and dignity and to salvage such values as justice, equality, tolerance, and freedom. How does he propose to do this? By persuading people "to move beyond humanism," as he believes he himself has done.

I believe we are all humanists on this earth, now and forever, with each playing his own role in the evolution of mankind. David Ehrenfeld has never stepped outside the humanist pale, because it is impossible for any human being on earth to do so. The great question is not whether to accept or reject humanism but to determine what kinds of humanism exist. Elsewhere I have considered three categories: anthropocentric, biocentric, and theocentric. For Ehrenfeld humanism means only the anthropocentric kind, which, despite its "nobler parts", has grown arrogant, ugly, and dangerous. Although he does not quote the views of self-avowed humanists and considers all definitions of humanism idiosyncratic, he hopes those who take issue with his book will not argue about definitions but about its thesis. Yet the thesis of any book on humanism, which has to do with the realization of the human potential, is grounded on the author's understanding and exposition of both humanism and religion. In trying to equate these two terms without making clear what religion means to him, Ehrenfeld, in more than one place, confuses the issue.

The book begins by stating that humanism (i.e., the anthropocentric kind) is the dominant religion of our time; on the next page the author asks whether humanism is a religion at all and considers it a difficult question. He then decides that humanism is a religion but not of the ordinary kind: it is, he tells us later, a religion without God. He also follows Lyn White in blaming religion for the origin and worst features of contemporary humanism and inserts a few remarks, sure to offend some, about the death of God. But anthropocentric humanism, which both Professor Ehrenfeld and I abhor, is *not* a religion. Religion, with or without the Christian, Judaic, or Islamic God, is concerned with the human-divine relation and in its purest theocentric essence is the supreme driving force of man's spiritual evolution. In bringing about the realization of the highest human potentials, religion is continually breaking down the anthropocentric arrogance which is the subject of this book.

The section on the "conservation dilemma" deserves wide reading. The main argument is that since humanists regard as worthless those parts of Nature that cannot be advantageously used by man, conservationists need to find in them some kind of value (preferably economic) in order to convert non-resources to resources. It is commendable that a "non-humanist" should suggest as an alternative to this objectionable attitude that the criterion of value in Nature be simply the fact of existence: species and communities ". . . should be conserved because they exist . . . (as) the present expression of a continuing historical process of immense antiquity and majesty". But the author goes too far in maintaining that everything in the conservation rationale based upon man's appreciation of Nature, even when its beauty stimulates us, is selfish and should be discarded in favour of the more honest "non-humanist" reason for saving Nature. Surely, to see evolution as ancient and majestic is to be stimulated aesthetically — and why not?

Evolving man cannot separate himself from his evolving environment, and his aesthetic appreciation of it often goes hand in hand with his wonder, awe, humility, love and recognition of the inherent rights of others. All such spiritual growth is

non-egoistic and part of the religious face of humanism. Ehrenfeld's own quotation from the ecologist, Charles Elton, emphasizes this fact. Elton maintains that the first reason for conservation — that animals have a right to exist — "is really religious." Of course it is. To protect others on this earth is a question of justice, and justice, like compassion, is part of the divine ethic. Elton is also quoted with approval as saying that we need to conserve natural diversity to promote the "right relation between man and living things." And in its highest form the *right* relation is an essentially religious relation, a manifestation of theocentric humanism, a recognition of the hierarchy of being by which man is spiritually committed to care for lower forms of life.

Professor Ehrenfeld has a very laudable biocentric desire to better the relation between man and Nature. Had he given more thought to the relation between the human and the divine, his thesis would, I believe, have had more intellectual, spiritual, and evolutionary coherence. But since I have deep sympathy with his effort to discredit the arrogance, brutality, and injustice of the anthropocentric face of humanism, I welcome his book as a provocative contribution towards clarifying the great issues confronting us.

Catherine Roberts

Man and Beast

ANIMALS' RIGHTS — a symposium David Paterson & Richard D. Ryder (ed). Centaur Press £6.50.

The subject matter of this collection is of crucial importance and is one that should not be ignored by anyone concerned with future planning and the ecological balance of the natural world. Although it will undoubtedly be a useful work of reference for the different factions already within the animal rights movement, (and should help the open-minded to broaden their understanding of the subtler arguments of those with whom they do not yet whole-heartedly agree), it is to be hoped that it will reach the much wider public who are unaware of the argument and for whom the principle of animal rights is as yet a smouldering rather than a burning issue.

That an increasing number of thinking people now question the right of man to exploit his follow animals is well demonstrated by the high calibre of the speakers — scientists, academics and others — gathered by the RSPCA for their two day symposium (Trinity College, Cambridge — summer '77) whose papers make up this timely book. Until comparatively recently, as the editors point out in their foreword, problems of morality concerning man himself appeared so overwhelming that they excluded consideration of the rights of animals. Furthermore it seems likely that St Francis has always been in a minority — for the most part ordinary mortals have assumed that no species other than their own was capable of feeling pain or of suffering from deprivation, fear or loss of freedom. It is important to make the point, however, that the symposium was not about 'love' of animals but about their moral rights in a man-dominated world; these are ethical and philosophical concepts which have little to do with the sentimental world of Walt Disney or the Tail-Waggers League.

As must be expected in a collection of this kind, the contributions vary widely both in the seriousness of their content and the quality of their writing. The sixteen main papers are reproduced in full together with shorter contributions from the discussion sessions. One sympathises with the editors' proper desire to give all sides a fair hearing, but it cannot be denied that the book would have been better if it had undergone some pruning: ". . . blundering logic" as Tom Regan comments in his paper exploring the idea of animal rights, "will intensify the prevailing disposition not to take what we say and stand for seriously . . ." He was not the only speaker to refer to this problem of identifying 'Animal Rights' in such a way that the public will learn to separate it from exhortations to be kind to our pets.

The book is conveniently divided into sections covering the historical and social background; the theological view and; the ethical and philosophical arguments as well as specific areas of concern such as factory farming and the argument for vegetarianism; medical experiments and the alternatives and the use of animals for the pleasure and sport of man. It would be invidious, in a review of this length, to select individual papers for comment, and in any case different readers will no doubt take particular interest in those articles that deal with their own fields of concern and will find them dealt with in considerable depth. I cannot forbear, however, to commend the contributions from the philosophers, wittily led by Brigid Brophy and ably carried forward by Drs T.L.S. Sprigge and Stephen Clark and by Professor Regan and to suggest that it is the moral and philosophical implications of animal rights that we must get to grips with, and about which we need to be clear, before we can argue from the general to the particular. In the end, after all, it is only the incontrovertible logic of the argument *for* animal rights that will lead to reform. While the dramas of the hunt saboteurs may gain some adherents and excite some admiration their exploits will also divert attention from the more serious arguments, and thus the time when the rights of animals, in our shared world, will be universally recognised.

Ruth Lumley-Smith

Rags and Riches

POVERTY, WEALTH OF MANKIND, Albert Tévoédjrè. Pergamon Press. $10.00. THE CONSERVER SOLUTION by Lawrence Solomon. Doubleday Canada Ltd. Can. $12.50.

Very occasionally, from out of the thousands of books, the tons of papers, the forests of literature, a book emerges that is important. It is important not necessarily because it is startlingly original or because it pretends, usually falsely, to say something new, but because its author speaks with a voice that can be heard above the droning mediocrity of his companions. He fires the imagination, convinces by his arguments, produces a story or a thesis that he makes appear so obvious, so self-evident, that the reader marvels and is changed by

it. I believe I have just read a book by such an author. It comes in a drab cover that promises hours of tedium, and it electrified me.

The title is subtle. *Poverty, Wealth of Mankind* contains no conjunction. Poverty and wealth are not to be contrasted. Mr. Tévoédjrè sets out to show that seen, as he would say, properly they are the same thing.

He begins, then, by defining poverty in such a way as to exclude misery, to separate his word from its frequent neighbour, destitution. He is no Gradgrind patiently explaining to the poor that their misery is as good for them as it is for him. He has been poor, and like everyone who has been poor, he knows that destitution crushes the spirit and destroys hope. It wastes human beings. Poverty, though, can consist in possessing as much as is necessary. More is gluttony, but it is seductive and in the case of former colonial countries it results from a kind of infection with which cultures were innoculated by their European masters and which spreads, sometimes to destroy them. Liberation from the colonial power imposes on newly independent states a perceived need to provide themselves with the trappings of statehood as these were defined by others, for different purposes. The grand palace, the sophisticated, exotic diet, the black limousines, the motor cycle outriders, the elite whose elitism is reflected in the lives of others. The country is drawn, step by hurried step, into an unconscious attempt to mimic its old master. Imposed imitation leads all too easily to voluntary slavery.

There is an alternative, which begins by examining carefully and critically the human resources of which the nation is composed and by recruiting everyone in a collaborative effort whose aim is to banish destitution. If there is to be no great wealth for anyone, at least everyone will share equally in what there is, and it will be enough.

Of course it is idealistic, romantic even, but its idealism is derived from Christianity, from Islam, from socialism, and it can be made to work. There are countries that have achieved it.

Mr Tévoédjrè illuminates his argument with frequent quotations from and citations of Christian and Islamic scripture, classical authors and philosophers, in a way that gives his book an historical and intellectual depth that increases its authority by demonstrating the extent to which its ideas have inspired others in several cultures and over many centuries. He echoes the view of Plato that the lot of most of us might be improved were our leaders to be trained in philosophy.

He is a man of culture, and education plays a central role in his strategy. He points out, correctly, that levels of economic activity and of prosperity are linked closely and directly to levels of educational attainment.

This, after all, is a strategy for development, but for a kind of development that proceeds under the direct control of those it is to benefit, and that can succeed only if its benefits are spread among the entire population.

Mr. Solomon, too, is concerned with development. We may not think of Canada as an underdeveloped country, but in certain important respects that is precisely what it is. Despite its size, its resources, and the high standard of living of its citizens, it is mainly a primary producer, dominated economically and culturally by foreign powers, principally by the United States. Mr. Solomon would make a modest number of changes, of revolutionary implication, whose immediate aim would be the creation of a definable Canadian market that would be supplied most easily by Canadian manufactures. In a word, he would nudge the economy from the primary to the secondary level. He would do so, moreover, while maintaining the quality of life and the integrity of the natural environment.

His is a curious book, naive and yet attractive. It is naive to suggest, as he does, that the recycling of materials could eliminate demand for new materials. It could not because with each recycling there is some inevitable loss, because recycled materials are almost invariably inferior to new materials, and because expanding production requires a constantly increasing supply of raw materials. Even his belief that Canadian minerals should be left in the ground until world shortages increase prices could misfire badly. Such a blatant attempt at manipulation might not increase Canadian popularity and rising prices are more likely to stimulate the introduction of substitutes. That would leave the minerals in the ground for ever, obsolete and worthless. His suggestion that goods be labelled with prices that reflect their durability and maintenance costs should help relieve unemployment, especially among bureaucrats and lawyers.

Yet, as I said, the idea of his "conserver" society is attractive. It requires Canadians to assert their identity, to demand that their economy satisfy their needs, and to work together for their mutual benefit. With that I would agree and so, I am sure, would Mr. Tévoédjrè.

Michael Allaby

Weather Forecast

CAUSES OF CLIMATE, John C. Lockwood. Edward Arnold £12.95, paperback £5.95.

When a geographer who does not appear to be fussy about attention to detail presumes to write about physics and mechanics the result is serious imprecision and misleading errors. This is particularly bad in a book directed at first and second year students.

In this case the definitions of many physical commonplaces are incorrect if only because they are incomplete (e.g. *adiabatic*, p 251 — is wrong for what the author calls an isolated system; and he does not appear to understand *buoyancy* and its relevance and omits *pressure* altogether). Many careless statements have wrong implications — for example 'kinetic energy . . . will soon be converted into other forms *unless* it is continually renewed.' (p.9) Often quite technical terms are used but nowhere explained or defined (e.g. *Seca*, p.44 *thermal Rossby number*, p.129).

Such errors in detail are very annoying in large numbers and are misleading for students of geography and environmental science. The book starts with a banal introduction on the idea of a system, implying that somehow geographers somewhere have mastered the idea of mathematical modelling and great

new revelations are to be expected. But the only model described in any detail (the water budget of the Pennines) is pointless because it assumes the cloud amount to be given. Even if the technique of using a mathematical model is learnt, it would be useless unless the art of designing a good model is understood.

Throughout the book clouds are regarded as a kind of nuisance. They happen to reflect sunshine so well that they are the cause of the largest variations in the earth's albedo (whiteness) which is the biggest factor in determining energy flows. So every time they crop up they are subtracted out by assuming them to be always the same as the climatological average. But clouds vary enormously and are a major factor in determining climate so they must obviously also be a major mechanism in stabilising it. The possibility of negative feedback, which *is* stabilising is mentioned as early as p.19 but no case is actually examined in the rest of the book. Apparently the author considers clouds unimportant, although in fact no-one has yet been able to quantify their effect because of their complexities.

As one might expect man-made factors which have been suggested as possible causes of climate change have been set out in a table. All those listed, except CO_2, are correctly described as 'not understood', but are nevertheless positively described under the heading of *potential* atmospheric effect. What is meant is *suggested possible* effect, which is not the same thing. In respect of one of these the author states that 'numerical models are capable of assessing the order of magnitude of the various effects . . .' without apparently appreciating that wrong models will give an order of magnitude estimate of anything you tell them to give, and may even be right for the wrong reasons, but are more likely to be far worse than the guess of an experienced forecaster whose mind is trained to include the totality of all the variables and mechanisms, while the model may fail to take into account some important ones.

Considering all the talk in recent years about the Milankovitch mechanism of climatic change one is entitled to hope that a new book would at least describe it correctly. it on — but alas he fails. On p.163 one's hopes are dashed again because the author allows himself to be distracted by the positive feedback of amounts of water vapour via the misnamed 'greenhouse' effect, and does not appreciate the fact that this is more than countered by the negative feedback of cloud amount, which is closely tied to it.

The purpose of this critique is to draw the attention of environmentalists to the slavish way in which some geographers, who as a class often know a very great deal about the world of which many mathematicians and physicists are very ignorant indeed, have abandoned their traditional methods for those of second-hand physics and mechanics, riddled with misleading imprecisions and downright errors. The blurb implies that there is something new about the future in this book, but really there isn't and the insertion of nineteen half-tones at fairly relevant points to decorate the book, appears to be an afterthought for there is no reference to them in the text.

R.S. Scorer

Plant Ecology

PLANT STRATEGIES AND VEGETATION PROCESSES by J.P. Grime. John Wiley & Sons. £11.50.

Dr. Grime has compiled a technical book that describes in detail the processes that control the structure and composition of vegetation. His study falls into two parts. In the first he deals with the strategies by which plants compete with one another for light, water and nutrients and by which they adapt to stress. He describes their reaction to disturbance by climatic changes and by human intervention — such as trampling — and he includes the strategies by which plants regenerate. The second part of the book deals with vegetation processes that determine the floristic composition of particular habitats under varying conditions.

The book is of obvious value to students but it should enjoy a rather wider appeal. It contains information relevant to anyone involved in the day to day management of areas of natural habitat, and these include roadside verges and small areas in parks as well as nature reserves. It will be of interest to those responsible for the provision and maintenance of playing fields and other recreational areas, and while it would be pointless to pretend that this is a book for the general reader, it may appeal — at least from a public library — to those whose insatiable curiosity extends to the ways in which plant communities form and survive. It is thorough and as authoritative as one would expect a book to be that is written by the Deputy Director of the Unit of Comparative Plant Ecology of the Natural Environment Research Council (delightfully called the "National" Environment Research Council on the jacket).

Michael Allaby

A Browsing Ground

THE URBAN DWELLER'S COUNTRY ALMANAC by Bernard Schofield. Cassell, £6.95.

"You don't have to live in the country to enjoy the pleasures of rural life", announces the cover of *The Urban Dweller's Country Almanac*. The confirmed countryman might well retort that such pleasures of rural life as can be shared by the urban population are, almost by definition, not the quintessential *rural* pleasures at all. Country life is primarily a matter of acquiring roots, becoming part of an area, understanding it from the inside Bernard Schofield's book will not help you to discover that sort of pleasure (unless you act upon the advice in his final chapter "Moving to the Country"); it is a compendium of mainly outdoor, ecologically acceptable activities for city-dwellers who feel the need for some totally un-urban recreations.

Having said that, I must admit that even from the rural side of the fence this book has its uses. It reminded me of those inspiring compilations of my youth with titles like "1001 Things a Boy Can Do". Like them, it is essentially a collection of suggestions and instructions for activities: and it certainly has the capacity to arouse enthusiasm, and make one want to get up

and fly a kite, or bake some bread, or breed butterflies, or collect pebbles. These four examples are not unrepresentative: other topics covered range from the practical — allotments, preserving food, cycling — through the mildly and appealingly cranky — dowsing, wild foods, hunt sabotage — to such minority hobbies as topiary, steam trains, bottle collecting and toy theatres.

Like Bernard Schofield's previous production, the magazine *Country Bizarre*, this book is visually a delight, packed with a great variety of black-and-while illustrations. And on the practical side it has an excellent Reference Section, with plenty of useful addresses, as well as books, for further information. Most urban dwellers would find it an enjoyable browsing-ground; many will be led by it to the fun of doing things for themselves; a few will no doubt be encouraged to graduate to the more demanding, but rewarding, experience of real country life — perhaps to dream of their city days when they had time to fly kites, raise Red Admirals and gallivant on miniature railways!

Nicholas Gould

A Little Green

THE LITTLE GREEN BOOK by the Editors of *Vole* Magazine, Wildwood House 95p.

Subtitled *An owner's manual to the planet* and produced by *Vole* for the Green Alliance, this midget paperback sets out to answer the questions intelligent ecologically-minded and concerned people are likely to ask about planet Earth,'... the ideas and the issues, the facts and the figures' as they modestly put it themselves, on the back cover. Such an undertaking is manifestly impossible in 128 4″ x 5″ pages of which a good many also contain some sort of illustration and several are entirely devoted to tables or diagrams. Certain questions about the publication must be asked because, if it has been produced to help Green Alliance, it should be taken seriously and presumed to be serious in its intentions. For whom, then, has the book been designed? Is it likely to have an impact on people still unaware of the problems that concern Green Alliance? Will it increase the support and membership of *The Friends of the Green Alliance*? Finally is the information it contains original, startling or useful? The answers are bleak. To the first one can only suggest that the readership is likely to be unserious students of environmental subjects who want to keep up without really trying; to the second, no and to the third no, not original, not startling and, well yes, perhaps fleetingly useful so far as it goes. The choice of what to put in and what (one thousand times as much) to leave out, must have been agonising and looks arbitrary. There is, of course, no room for a contents page or an index, so the reader who wants some specific information must thumb right through in the hope that his special interest happens to be among those selected for inclusion, and that it can be covered in a few hundred words, (fuel and energy are despatched together in fewer than a thousand). Whilst everyone at *The Ecologist*, and no doubt the majority of our readers, wish the Green Alliance well, one cannot feel that this sort of approach is going to do much to enhance its image.

Ruth Lumley-Smith

Other Books Received

Smallternatives Personal Guide to Saving Energy and Money! Published by Second Back Row Press Ltd (Australia) $1.95.

This is a useful little paperback with an enormous spread of practical suggestions on how much we can all reduce the total amount of energy we use in our homes, at work, in transport and in our leisure pursuits. Although primarily written with Australians in mind most of what it says has a universal application, and although some of it is dreadfully trite (in summer wear light loose fitting clothes) one should not be put off. Smallternatives are a dedicated group who came together in Brisbane in 1976 with the single purpose of promoting energy saving, and a lot of original research and hardwork has gone into the compiling of this booklet. Full address from *The Ecologist* office should anyone want to contact them.

Smallternatives Easy Home Programming Steps to Self-Sufficiency Skills, published by Patrick Howden, Clovelly, Mount Hawke, Truro, Cornwall, 40p.

This Cornish venture has absolutely nothing to do with the above except that Pat Howden comes from Australia and, like the Brisbane Group, is primarily concerned with searching out and experimenting with the best ways of saving energy and becoming self-sufficient, and then of communicating these ideas to as many people as he can reach. This extremely brief leaflet, from a long book he hopes soon to see published, is perhaps more of a clarion call for a change of lifestyle than a practical guide; it could be an eye-opener or even a mind-opener for those still asking "What can *I* do about it?".

The Pattern of Animal Communities, Charles S.Elton, Chapman and Hall Science Paperbacks £6.50.

An absorbing and scholarly study by the distinguished author of *The Ecology of Invasion by Animals and Plants*, based on years of research at Wytham Wood in Oxfordshire and originally published in 1966, this paperback edition offers the ordinary reader another chance to enjoy what is primarily intended for researchers and students in ecology, but is full of information to intrigue and delight the amateur naturalist.

The Naturalised Animals of the British Isles, Christopher Lever, Paladin paperback £2.95.

A record of all the naturalised animal species that now live in the wild in our countryside, this comprehensive and excellently documented book is a must for anyone concerned with the survival of our *native* species and such controversial questions as the reintroduction of the beaver. It is a book that no naturalist will want to be without.

The N.E.A. Power Booklet, Natural Energy Association, 2 York St, London W.1. 95p plus 10p postage.

A useful guide to the type and availability of wind-powered generators in the UK, this short book contains a lot of practical advice on choice of type, site and so on and explains what can be sensibly expected from the wide variety of windmills described.

Classified

PERSONAL

ASTROLOGER offers accurate analysis of birth charts, interpretation of future trends and comparison of charts. For details send S.A.E. to Nicholas Campion, 5 Carol Street, London NW1.

RAPPORT is the intelligent person's introduction service. Whatever your age, location or preferences, enrich your quality of life immeasurably with RAPPORT — and rediscover the joy of living. Special introductory rates this month for men over 45. S.a.e. for details to RAPPORT, P.O. Box 94, Oxford.

COURSES

THE SOIL ASSOCIATION
ORGANIC HUSBANDRY COURSE

2nd September — 6th September inclusive
at Wye College — London University,
Nr. Ashford, Kent.

A course designed for the farmer, smallholder and gardener interested in organic methods of growing. Subjects include soil structure and plant nutrition, practical application of organic methods to the production of all food crops including vegetables, livestock, on a farm or smaller scale. The course includes a visit to an organic farm and herb nursery. Course fee of £48 includes tuition, accommodation, all meals and course dinner. Details and booking forms from THE SOIL ASSOCIATION, Walnut Tree Manor, Haughley, Stowmarket, Suffolk IP14 3RS. SAE please.

RURAL RESETTLEMENT GROUP.A residential discussion meeting is to be held at Lower Shaw Farm, Shaw, Swindon, Wilts, over the week-end of 7/8/9 September 1979: The Smallholder — Problems and Opportunities. Course fee £10.00. Write to: RRG, Manor House, Thelnetham, Diss, Norfolk.

BOOKS & PUBLICATIONS:

THE COMING AGE: the magazine of the primordial matriarchal tradition of the one Goddess — a faith that moves to the rhythm of the spheres. 35p. 40 St. John St., Oxford.

DIRECTORY OF ALTERNATIVE COMMUNITIES lists many such groups, £1.50 (cash with order please) from The Teachers (MG3), 18 Garth Road, Bangor, N. Wales.

MISCELLANEOUS

SURVIVAL-KIT for a polluted planet. Fallout-Sweet: Radiark Field — Screens: Anti-nuke, Self-defence. S.A.E. to Dr. Ash, Camstock, North Tamerton, Holsworthy, Devon (Tel. 08403440).

THE WELLBEING CENTRE. The Self-Heal Trust has an opportunity to create an ideal focus for alternative energies in a complex of old school buildings in Illogan (near Redruth, Cornwall) which is being offered for sale. To purchase the school and provide such a centre, we need help urgently. Now! If you can give it in any form — money, skills, advice — or if you would like further information, please write to:— Denise Pyle, Chy-an-Sol, Maynes Row, Tuckingmill, Camborne, Cornwall or Alan Herbert, 12 Beacon View Park, Illogan, Redruth, Cornwall.

NEW AGE GATHERING IN TUNISIA. You are invited to join a gathering on the Mediterranean coast of Tunisia in North Africa this summer from July through to September. You can lean skills like spinning, weaving, brick making, organic gardening, tree planting etc. plus swimming, yoga, meditation, horsemanship . . . All activities and facilities will be free. Vegetarian food provided (less than £1.00 per day). Bring tent and camping gear and children. For details send S.A.E. to: David Mulligan, Green Deserts Projects, Rougham, Nr. Bury St. Edmunds, Suffolk IP30 9LY, England. Tel. Beyton (0359) 70265.

SITUATIONS WANTED

COUPLE IN THEIR 30's looking for job in organic gardening, conservation, bird sanctuary etc. Have some experience, also administration. Maria and Ronald Wood, The Lodge, Lowfields, Burton in Lonsdale, via Carnforth LA6 3LB.

NOTICES

CALL FOR PAPERS for The Fourth Annual Conference on Utopian Studies in Denver, Colorado, October 11-14, 1979. Send paper abstracts or proposals to Michael S. Cummings, Department of Political Science, University of Colorado, Denver, 1100 14th Street, Denver, Colorado 80202.

SPECIAL CALL for papers on 'Technology and Pessimism' for Spring 1980 issue of *Alternative Futures*, which will include four papers delivered at a symposium on this topic at The University of Michigan on October 31 — November 2. Inquiries and submissions should be made to Guest Editors, Dwight Stevenson and Marthalee Barton, Alternative Futures, Department of Humanities, College of Engineering, The University of Michigan, Ann Arbor, MI 48109. Deadline for submission is January 15th, 1980.

CALL FOR PAPERS. The United States Environmental Protection Agency and The University of Texas at Dallas are seeking contributors for their conference on 'Combined Municipal-Industrial Wastewater Treatment' to be held at The University of Texas at Dallas, Richardson, Texas, March 25-27, 1980. Abstracts of not more than 250 words, or requests for further information, should be forwarded to: Professor Aharon Netzer, University of Texas at Dallas, P.O. Box 688 Mail Station BE 22, Richardson, Texas 75080.

ANTI-NUCLEAR CYCLE TOUR OF BRITAIN via Dounreay, Windscale, Dungeness etc. Inquiries to: Howard Clark, 43 Grosvenor Terrace, York. Tel. 0904 39330.

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