The
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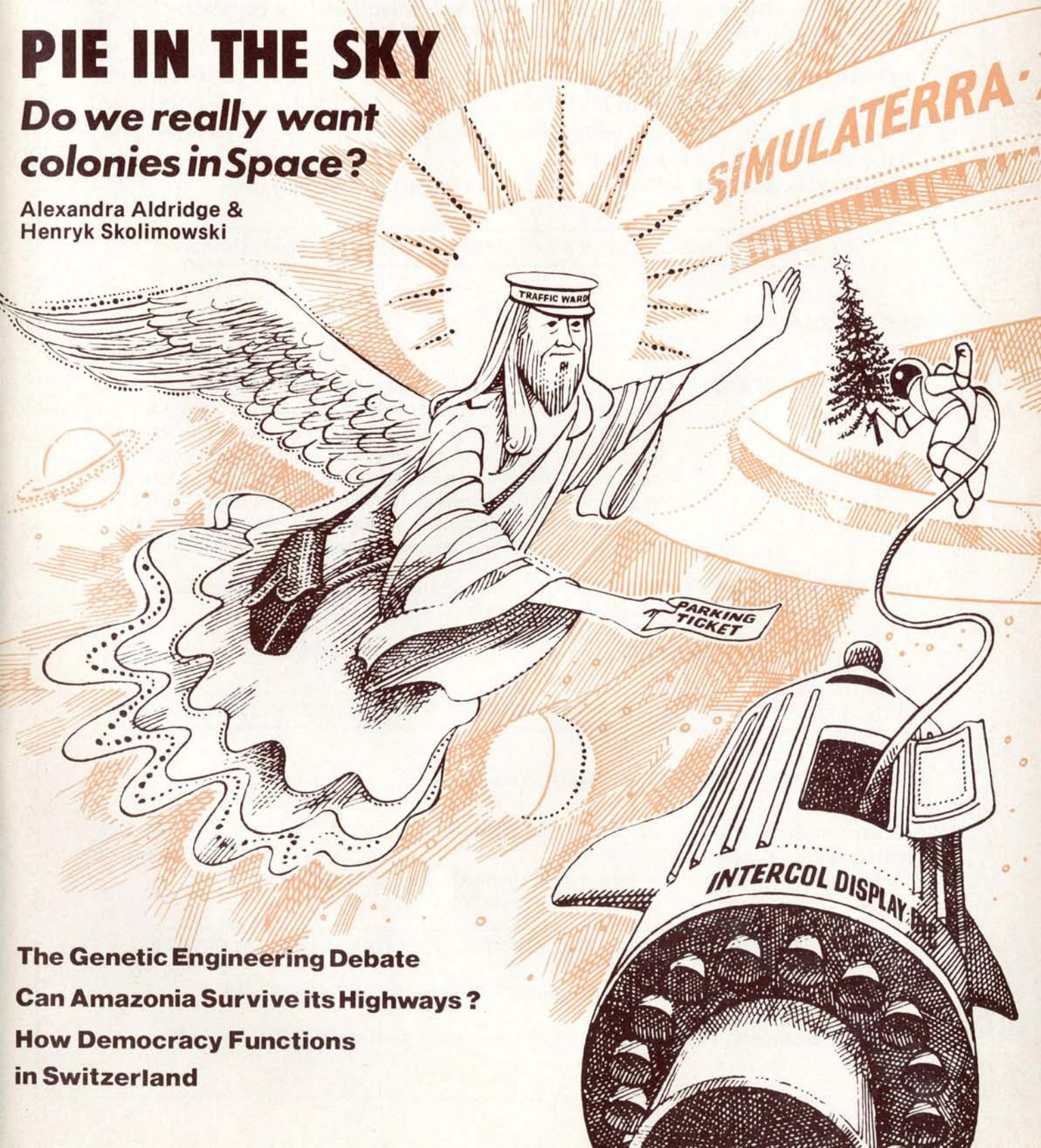
PIE IN THE SKY

Do we really want colonies in Space?

Alexandra Aldridge &
Henryk Skolimowski



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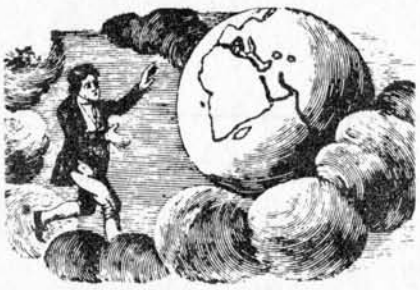


Editorial

All Things Bright and Beautiful

Marxism is a strange political philosophy. It is the only political theory in history to have been damned from the outset by its own credo. That may seem a questionable statement since it reveals that Marx was not, as we have always believed, a great liberator, dedicated to freeing the workers from their bondage, but rather he was the progenitor of an ideology that effectively defeats the ends he sought. For does not Marx say that all ideas are determined by 'the relations of production'? and if this is true then are not Marxist ideas, by the same token, subject to this rule and Marxism itself condemned to perpetuating exploitative economic interests?

It is understandable that Marx should have developed such a theory — without it his whole notion of surplus value would have been a nonsense. Having argued that capitalists were fooling the people, he had to explain why working men — a class not generally noted for their gullibility — were so prepared to accept such an obvious confidence trick. He could have put it down to stupidity, but that would not have done his cause much good, and would have been clearly libellous to boot. How convenient, then, was the notion that ideology was to blame — here was a theory that got everybody off the hook, and added further fuel to his attack. When the worker received his wages he was led to believe that they were the true equivalent of the work he had done. But, not at all, said Marx: the value of the goods he produced was way above what he got in his pay packet. The surplus value simply went into increasing the wealth of the bosses either by reinvestment in the factory or by swelling their own pockets. Wages were the means used for 'mystifying' the relationship between the worker and his employer, and ideology the cloak that shrouded his true interests.

Thus for the Marxist, ideology, that great body of social thought that moulds our world view, has a rather sinister function: its purpose is to delude people. Ideas exist to justify the status quo and dupe the underdog into accepting his lot without question. Religion serves not only to comfort people but to oppress them, for why should they need comfort if they are not oppressed? Even ecology is seen as a weapon of exploitation; ecologists are selfish middle-class intellectuals, spinning a web of spurious scientific dogma to protect their economic interests and drawing up the ladder of rising living standards before the working classes can climb it and claim their just rewards. No ideology is absolute; it cannot express an immutable value, for it is seen as a set of elaborate lies to protect the powers-that-be. It is the servant of class interests; the arch-villain behind the scenes, the force that deceives all, confuses all and exploits all.

Ecologists would be right to qualify these ideas — ideology clearly serves other purposes than simply propping up the economic interests of the powers-that-be — on the other hand few would deny that, in a market economy, a relationship *does* exist. One has only to remember the words of *All Things Bright and Beautiful*, that staple hymn of all good Sunday schools, to realise that Marx stumbled on more than a few grains of truth. 'The rich man in his castle, the poor man at his gate; He made them high or lowly and ordered their estate.' It is a straight and fairly blatant expression of mid-Victorian high Toryism. Psychological power, the currency of the Church, has been mobilised to invest social order with a dubious sanctity. No doubt, too, that ideas only get accepted when the economic climate is ripe. Slavery was not abolished because of the undoubted political expertise of Lord Wilberforce, nor yet because the Clapham Sect swore not to eat sugar until the slaves were freed. It was abolished because the cotton gin, and other new technologies, made wage labour cheaper than keeping slaves. No doubt, either, that the new revolutionary image of Man that emerged from those anti-slavery meetings served the interests of the embryonic industrial economy. It needed the new world view; it needed men to believe that they were free to earn their living as they chose. Without such an ideology the industrial revolution could not have taken off, for it relied upon a mobile labour force.

Understandably Marxists do not accept that their creed has anything to do with exploitation. Their religion, they claim, is different from everybody else's; it was arrived at scientifically, by which one assumes they mean, by Marx poring over books in a little cubicle at the British Museum. It may be that *Das Kapital* was intended to be nothing more than a work of social analysis, but it remains true that Marx was a prisoner of his own relentless logic. And calling himself a scientist by no means excuses him. His ideas arose out of a particular economic system, and must perforce be the tool for perpetuating it. And perpetuate it they do. All the ideas that stir Marxists to red-flag waving, all the ideals they hold so dear, are part and parcel of our economic system, simple rationalisations of economic necessity. Egalitarianism is the child of

market expansion, women's lib the daughter of consumerism and economic growth the lineage that all his ideology perpetuates.

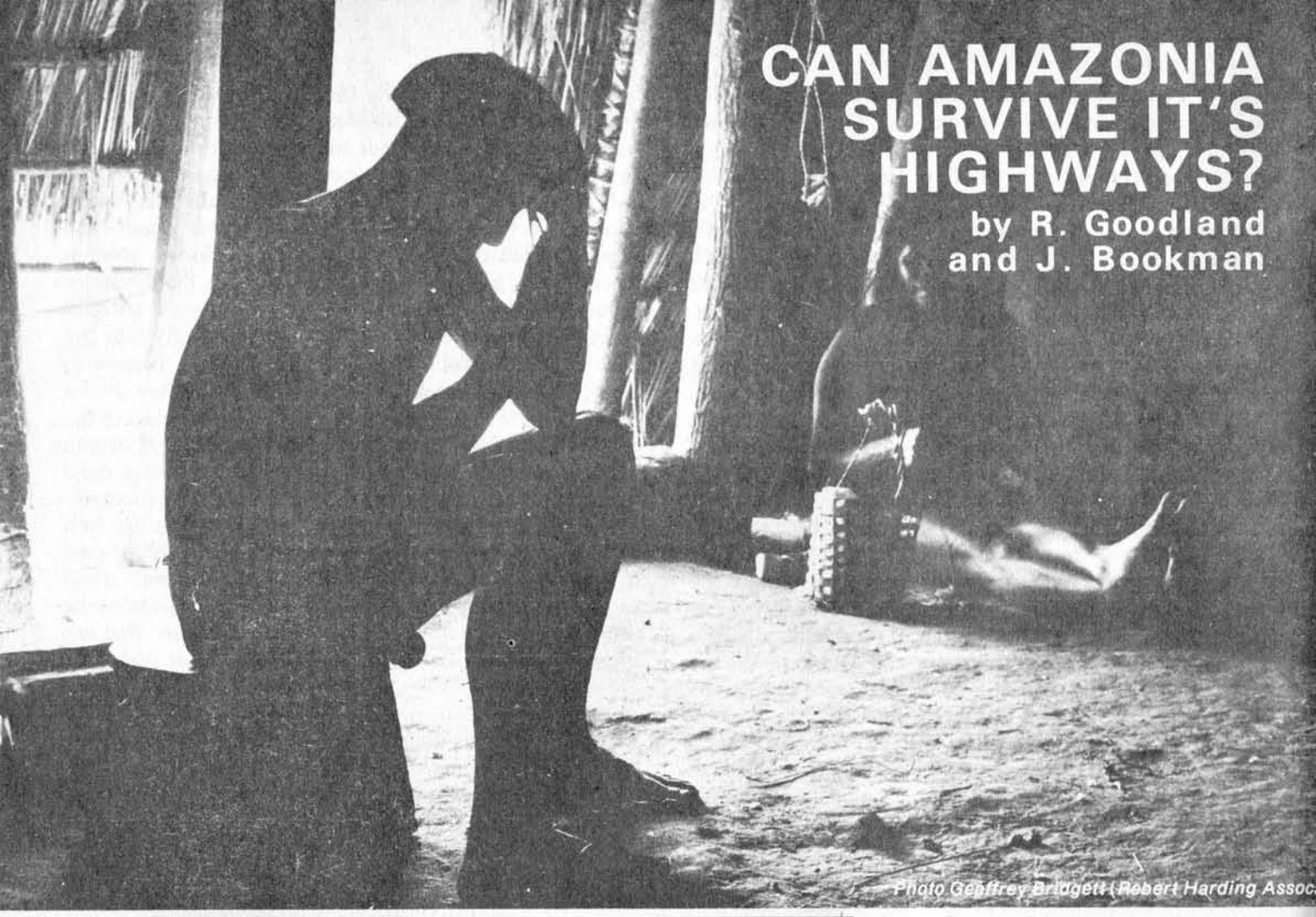
Take egalitarianism: In the film: *Lawrence of Arabia*, a small incident occurs when Omar Sharif kills Lawrence's guide because he is of another tribe and is drinking at Sharif's well. Like all good liberals Lawrence found this tribal squabbling, the proud expression of differences, unacceptable and primitive. So too do the Furies of economic growth. Growth cannot flourish in a country where horizons are bound by ancient taboos, group differences and hierarchies. To maintain growth industry must sell its products; it must trade with all and all must be willing to accept its trade. Fragmented into small groups each hostile to the next, society cannot sustain growth. The market potential may be enormous, but cannot be reached. How convenient then, is an ideology that claims that differences are wrong and each man is equal to the next, both as a human being and, let us not forget, as a consumer of goods. The number of accessible markets mushrooms overnight, growing on the rubble of broken social customs and tribal barriers. The price is the loss of the very structures that traditionally determine a man's status; without them he suffers anonymity and a loss of identity; he has no background against which to measure himself, and without some special talent for self advertisement, melts into obscurity. *That is the exploitation of an egalitarian society.*

As for women's lib, there is no clearer example of the forces of consumerism. People don't need washing machines, but the washing machine manufacturers need people to need them. No child will die if it doesn't have a cuddly toy for Christmas, but the toy manufacturers give its mother the feeling that it will be deprived without one. No woman needs to change her wardrobe each season, but the fashion industry needs her to do so. Necessary or not such goods cost money and sooner or later the men, traditionally the bread winners in the family, find they cannot meet the demand from their own wage packets. So the women themselves go out to earn money. Furthermore industry cannot continue to supply the goods without female labour, so women are drawn inevitably into the cash economy and the single wage family ceases to exist. 'Parents round the world,' reported *Zero Population Growth* recently 'are greatly underestimating the costs of raising a child. Middle income Hawaian parents came up with an average estimate that a child would cost them just 8 per cent of their annual income.' The actual figure was closer to 30 per cent on the first child and 14 per cent on the second. The average cost has risen, between 1969 and 1976, by 63 per cent, while incomes have risen by only 59 per cent. And so the wife must work to satisfy the needs of her children. *But can anyone seriously argue that by swapping her apron for an overall she has become liberated? That by freeing herself from the kitchen sink she is better off manacled to the production line? The only force that has been liberated is consumerism, free to increase its sales once again.* And what is the fall-out from Women's Lib? Children who will spend their earliest years in crêches, deprived not only of their father, but their mother too. More people condemned to working in the noise and monotony and dirt of factories, bringing higher rates of stress and ill health. More people in the cash economy and fewer things being done by people for themselves. Worst of all it results in ever increasing unemployment.

In the USA women now represent 41 per cent of all job holders, double the number recorded in the early 1920s. In the last 24 months the number of women in the US workforce has risen by 2.9 million and if present trends continue it will reach over 47 million in the next ten years. In Britain in 1975 the increase in the working population was shared equally between men and women but in 1976 the increase of 100,000 was entirely due to women seeking work (*The Guardian*, 29.7.77). *That is the exploitation of Women's Lib.*

The failure of Marx to concern himself with secondary issues remains the failure of his followers and the other established creeds, today. It is the main difference between them and the Ecologists. The Marxist claims the 'Right to work'. The Ecologist agrees, but asks 'What work?' Should people have a right to work in concentration camps? Should *anyone* have the right to work in a factory that is polluting the environment? The Marxist asks 'Who should control production?' The Ecologist asks first 'Are these the means of destruction?' and thereafter concerns himself with the politics of control. If ecology is to escape being twisted into a philosophy that supports the industrial system — and already conservationists have been metamorphosed into establishment figures — then there cannot be a single area in our world view that we leave unquestioned. Economic growth is not an inconvenience confined to selected areas, it is a cancer that riddles the whole of our society.

Nicholas Hildyard



CAN AMAZONIA SURVIVE IT'S HIGHWAYS?

by R. Goodland and J. Bookman

Photo Geoffrey Bridgett (Robert Harding Assoc

Tragic and irrevocable disruption followed the construction of a vast network of highways criss-crossing Amazonia. Conceived as a panacea for all the miseries of the poverty-stricken Northeastern area, the results illustrate the folly of undertaking such a project without prior consideration of the impact on the environment.

In 1970, the President of Brazil proposed an epochal solution to the pressing population problem of his country's vast Northeast region, which was suffering the effects of the most disastrous drought in thirty years. Though the rest of Brazil was booming, that area had long been poverty-stricken, and the nation's leader was appalled at the conditions he found during his first visit. Within two weeks of that visit, it was decided to develop the huge green world of the Amazon, opening its vast areas for settlement largely of starving Northeasterners by means of a 14,000 km network of highways. The immediate goal was to relieve the widespread and ever-growing human suffering, in addition to developing what was considered a great natural resource. This essay discusses the actual and potential environmental impact of the Amazonian highways which unfortunately was not evaluated before the onset of construction. Supporting documentation and further details are compiled in Goodland and Irwin (1975a, b) and Irwin (1977). As a direct result of the haste with which the massive project was conceived and executed, the integrity of one of the richest and last truly wild areas of the world, along with its indigenous population, has been shattered for all time.

The network of paved and secondary roads is ostensibly designed to connect the northeastern highway system with Amazonia. It is intended to open up unused forest expanses for cattle raising and agriculture, while at the same time providing access to vast mineral resources. The new road system (Figure 1) includes five major highways, two of which are east-west, and three which are approximately north-south. The two east-west highways are the already completed 4,918 km long Transamazonica (BR 230), running from the Atlantic Coast to Peru, and the uncompleted and indefinitely postponed 2,323 km Perimetral Norte (BR 210), which was to have paralleled the northern boundary of Brazil joining the Atlantic with Colombia.

The three approximately north-south highways are: the paralysed 1,500 km BR 307 linking Venezuela with Acre, which follows the western frontier of Brazil; the completed and partly black-topped Rondonia-Manaus-Roraima, approximately joining Bolivia with Guyana; and the BR 163 Cuiabá to Santarém now largely black-topped. President

Medici first announced plans to construct this network of roads on June 16, 1970 — and less than three months later, construction began.

No environmental appraisal was commissioned before the onset of highway construction, and no official environmental study has been published since. Preliminary planning appears to have been minimal. Roads planned over routes that turned out to be largely under water for six months of the year have not been uncommon (*Science*, April 1977). The immediate overall justification for the huge program was relief for the drought-stricken Northeasterners, although 'National Integration' also was invoked as a major argument for development of the Transamazonica. Integration of the poor and overpopulated Northeast with the poor and almost unpopulated Amazonia becomes feasible only if the severely malnourished immigrants can sustain themselves. It was tacitly assumed that the Northeasterner would be more self-sufficient in Amazonia than in the area of his forebears. But if a peasant cannot sustain himself in the land he knows intimately, he is unlikely to achieve much success in the harsh and contrasting environment of Amazonia, different in almost every way from the environment of the Northeast. It is now becoming increasingly clear that most of Amazonia is wholly unsuitable for peasant agriculture.

As a solution for the excess population of the Northeast, the Transamazonica is futile. The Northeast, already swollen with a population in excess of 25,000,000 is burgeoning at nearly 3 per cent annually, while the nation as a whole is increasing almost that much each year. Yet, except for the plan to develop Amazonia, little is being done to check such increases. There is no official family planning, on the grounds that in view of the country's huge area, Brazil is considered to be 'underpopulated'.

An inseparable aspect of the Amazonian highway system is the mass deforestation and large-scale agriculture that is officially sanctioned 100 kms either side of the highway system. These two destructive practices undoubtedly lead to even more environmental degradation than do the highways themselves (Figure 2). Not only is sedentary agriculture unviable in Amazonia — it is environmentally disastrous. When agriculture fails, the farmer usually adapts by becoming even poorer, hungrier, less philoprogenitive, and more nomadic. But when the environment itself is disrupted and drastically altered, equilibria may never again become established.

The basic premise of Brazil's highway program — that the Amazon jungle can be cleared and turned into productive farmland by hungry colonists from the country's drought-devastated Northeast or, even worse into multi-national agro-industrial cattle pasture — rests on a tragically false premise. To be sure, the lowland tropical wet forest manages to be the most productive ecosystem in the world,

Fig. 1.
Map showing the Main Federal Roads in Amazonia.

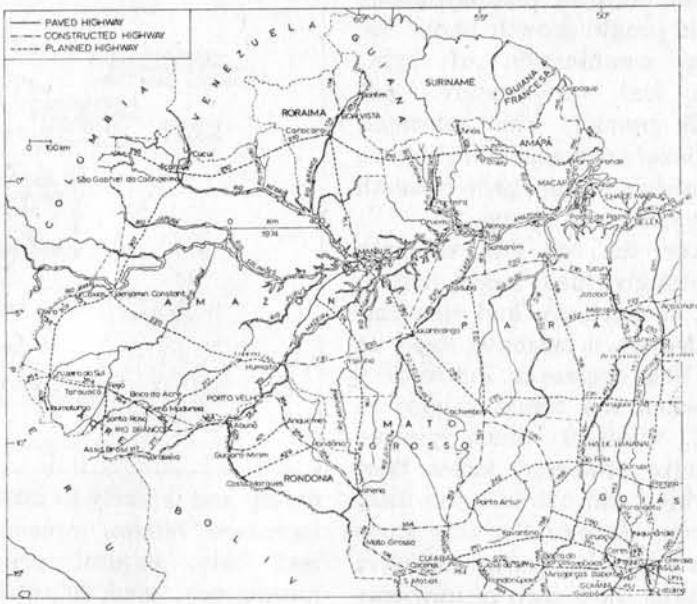
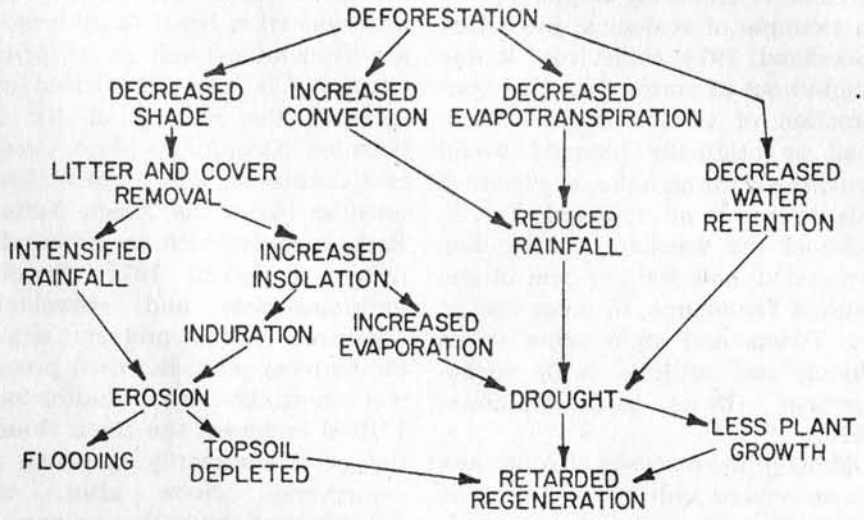


Fig. 2.
Environmental Disruption Caused by Deforestation.

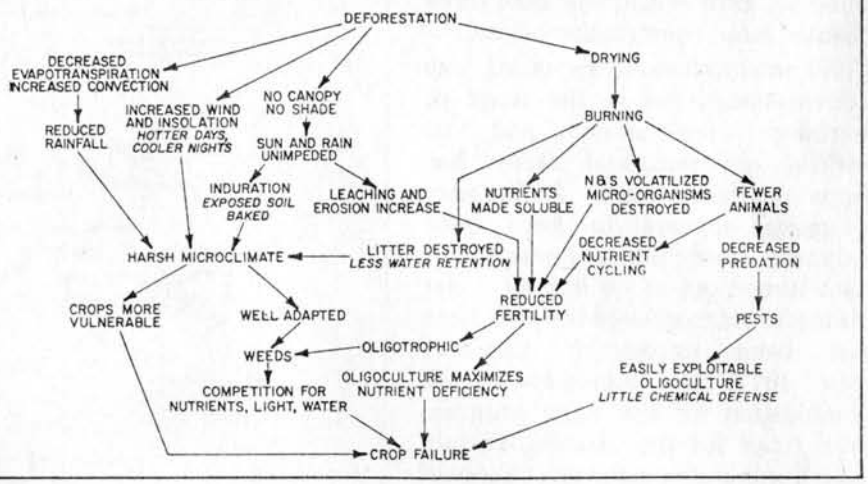


in spite of sterile soils and a superabundance of pathogens and pests. This is so because photosynthesis is rapid in jungle growth under the propitious combination of light, moisture and temperature that commonly prevail, while elevated carbon-dioxide concentration speeds photosynthesis in the shade beneath the heavy canopy of leaves.

However, the soil that supports this seemingly lush vegetation is deficient in nutrients, and once this land is cleared, it promptly loses its fertility. This decline in soil fertility begins when the forest canopy is removed. Sunlight which pierces the hitherto protected forest floor rapidly dries and oxidizes the litter and humus. Eventually, this stops the normal decay processes, which in turn reduces the return of nutrients to the soil. The annual 2-3 m of warm rain leaches nutrients from the unprotected soil, while the common practice of burning the forest vaporizes essential nutrients. Thus, a vicious cycle is perpetuated. Burning and clearing upset the natural controls of pests and predators. Growth of weeds is stimulated, creating still another obstacle for satisfactory agricultural results (Figure 3).

Lack of planning has produced a dangerous paradox. Now that most of the highways already have been built, unplanned settlement of people displaced by cattle and soaring land prices in southern Brazil is occurring spontaneously. Both Federal and State governments are being impelled into large-scale settlement or colonization schemes merely to avoid unplanned squatter communities. Colonies must be located on the road, whether that is the most suitable place for them or not. More significantly, the states are being forced into sponsoring human settlement as a major 'use' of Amazonia regardless of the fact that settlement is one of the least rational uses for the Amazonian ecosystem.

Fig. 3.
The Relationship Between Deforestation and Crop Failure.



Diseases

The environmental disruption caused by the highways is particularly apparent when the effects on public health are examined (Figure 4). Malaria is possibly the most serious disease of Amazonia. It is endemic throughout the entire region and is likely to intensify with increased human presence. Birds and bats, natural predators of mosquitoes, tend to retreat in the presence of man, while the insects and their breeding sites increase dramatically.

It should come as no surprise that schistosomiasis has already spread to Amazonia because the disease afflicts five million people in the northeast of Brazil — origin of most colonizers along the Transamazonian highway. The spread of schistosomiasis has been deterred by naturally inimical water chemistry. However, since increased use of limestone and fertilizer neutralizes the acidity, the disease vector — species of fresh water snail — is increasing the spread of this disease.

Because it could so easily have been avoided with advanced planning, the present epidemic of onchocerciasis is especially tragic. This is an example of ecological prediction (Goodland, 1974) come true. It was pointed out in ample time that construction of the Perimetral Norte road as originally planned would run directly through the only focus of this disease in all of Brazil. Yet, in spite of the warning, construction proceeded: now 100 per cent of one band of Yanomamo, 87.5 per cent of the Tikuna and eight other tribes already are afflicted with onchocerciasis (Davis and Mathews, 1976).

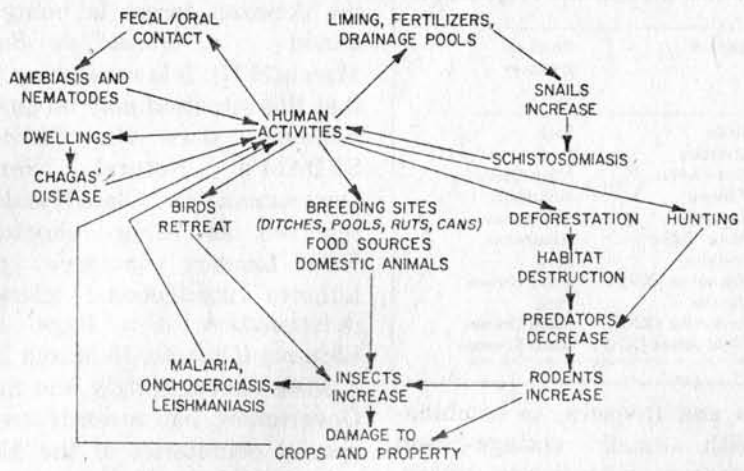
Many of the diseases of Amazonia are associated with low standards of living. Only by raising these standards will such diseases decline. Education in sanitation, hygiene and nutrition will go far in checking disease. Such basic amenities as clean running water and simple sewage and laundry facilities must be part of any development scheme.

Amerindians

Another of the most drastic effects of the highway construction has been on the indigenous population of Amazonia. There is a very real possibility that the Amazonian highways will result in exterminating entire Amerindian tribes. The proposed highways clearly take precedence over the constitutional rights of tribal peoples in the government's view at the present time, and as a result, FUNAI (the government agency charged with protection of the Indians) has allowed itself to degenerate into acting as a buffer between highway crews and the tribes whose lands are violated. As has been the sordid case with 'primitive' peoples the world over, aboriginal rights have been abused and violated in Brazil at all levels of government, as well as by private citizens. The most publicised case involved the routing of BR 080 between Xavantina, Mato Grosso, and Cachimbo, Pará, which threatened to bisect the Xingu National Park, a region rich in Amerindian tribes. Early in 1971, Brazilian anthropologists and ethnologists organized public protests against the highway plan. But their protests were ineffective, and the director of FUNAI endorsed the route through the park, summarily quashing the controversy. Soon after, over 8,000 km² of the park was annexed for highway purposes by presidential decree.

The Indian population of the Brazilian Amazon, estimated to have

Fig. 4.
The Relationship Between Environmental Modification and Disease.



numbered over one million when Europeans first arrived in 1500, has now dwindled to a meagre 50,000. Highways as now planned will bisect 96 of the total 171 tribal areas (Figure 5). Tribes that have already been in permanent contact with outside society are less threatened by the new developments because they have already made their initial adjustments. Tribes that remain isolated or have experienced only intermittent contact are those likely to be the most disrupted by highway construction. Of the 96 tribal territories to be violated by the highways, 45 belong to the groups which have rarely, if ever, been exposed to exogenous contact. As mentioned earlier, specific government policy encourages immigrant settlers to destroy the forest for peasant agriculture 100 km on either side of the new highways. It seems reasonable to conclude that any tribe within 100 km of the highway web will be affected adversely by the construction program. It is calculated that the highways will violate more than 90 percent of the indigenous societies of the area under consideration.

The Brazilian constitution includes assurances to the Indians, which if followed, would provide adequate protection for them. The best program for preservation of the Amerindian population, therefore, would be strict enforcement of the relevant clauses of Brazil's constitution.

Alternatives to Present Trends

Amazonia still has one of the lowest population densities in the world, largely because the region is unsuited to sustain a much greater population. Eventually, techniques may be discovered for rational and sustainable use of the humid forest lands of Amazonia, but at the present time, these techniques do not yet exist. Accordingly, a number of alternatives must be considered.

The first precept must be stringent curtailment of the broad-scale destruction now taking place in Amazonia. Admittedly, this is an extreme viewpoint, but it is justified in view of the irrevocable environmental destruction that is bound to follow in the wake of the present trends of peasant agriculture and the extensive cattle ranching.

Fortunately, much of the pressure for exploiting the Amazon could be diverted to the contiguous cerrado region, which is spread over 1.5 million km² just south of Amazonia (Goodland, 1977). Partly due to distance from population centers, cerrado is still largely undeveloped, though it is now easily accessible by means of the Belém-Brasilia and other highways. Cerrado is endowed with more amenable agricultural conditions, particularly where limestone is available, than is Amazonia in general. Most cerrado is adequately watered for half the year, and is blessed with an invaluable dry season during much of the other half of the year. Conventional agriculture in the cerrado is even at this early stage at least as successful as in Amazonia, with the added advantage that such agriculture produces infinitely less environmental damage. Moreover, technical assistance which employs the results of recently completed research will increase the success of cerrado agriculture. Much less research is needed to guarantee the success of cerrado agriculture than is needed for an Amazonian solution. Cerrado agriculture need not wait for research results; Amazonia should. The road system ensures that Amazonia will be settled and developed — whether planned and sustainable or not — so the question is academic, and one option — preservation — is being foreclosed.

Amazonia consists of at least four distinct ecosystems, each with contrasting agricultural possibilities:

1. Annually-flooded várzea;
2. Forest on patches of rich soil;
3. Islands of savanna or cerrado within the forest;
4. The fragile forest itself.

When exploitation is unavoidable and choices exist, agricultural developments should follow the order of priority outlined in Figure 6.

Várzea, periodically flooded land adjacent to rivers, is fertilized by the annual deposition of rich silt from the Andean slopes, and occupies between one and two percent of the total area of Amazonia. Such tracts could well be manipulated to produce rice, sesame, jute, beans, and maize, and possibly other crops such as ramie, chick peas and urena fiber.

Each new survey of Amazonian soils reveals more islands of fertile soil scattered in the midst of the vast fragile forest. The total area may be about one percent of Amazonia, but even this modest percentage represents an enormous 50,000 km². On these pockets of fertile soil, conventional agriculture would be less harmful and even some cattle browse may be justified.

In the forest itself some types of agriculture can be sustained, but only if four related precautions are respected. First, the closed nutrient cycle must be maintained. Nutrients must not be allowed to leach into the soil. Second, the forest canopy must not be perforated. Third, the extent of nutrients imported into the ecosystem as rain, solutes, dust, fixation by plants, and a little from the substrate, should be used to determine the sustainable size of the crop to be harvested. Fourth, biotic diversity must be maintained above the level at which the activities of pests become a serious factor. Such diversity will reduce nutrient

Fig. 5.

Tribal Groups in Immediate Danger of Extinction Due to the Highways.

Tribal group	Degree of integration	Nearest highway No.	Total population estimate	Region	State or territory
Aparaí	Intermittent	210	50—100	Tiriós	Pará
Arara	Isolated	230	100	Altamira	Pará
Awetí	Intermittent	242	26—41	Pôrto Artur	Mato Grosso
Digüt	?	364	95	Vilhena	Rondônia
Jumá	Extinct?	230	12—100	Humaitá	Amazonas
Karitiâna	Extinct?	364	45	Pôrto Velho	Amazonas
Kuruáya	Isolated	163	100	Itaituba	Pará
Matipuhy	Intermittent	242	50—60	Diauarum (XNP)	Mato Grosso
Mudjetíre	Intermittent	153	50	Marabá	Pará
Trumái	Intermittent	251	25	Xavantina (XNP)	Mato Grosso
Txikão	Isolated	242	51 60	Pôrto Artur (XNP)	Mato Grosso

competition and avoid the depradations of pests.

Economic activities sustainable under Amazonian conditions include the gathering of flowers, nuts, fruits, seeds, loose bark, and the tapping of resins, saps and latex. Also, the forestry practice known as 'refining' as ditinguished from 'clear-cutting', is ecologically preferable. This method of exploitation suggests that there is a place in the Amazon forest for sawmills, pulp mills, sawdust for power, and fluvial transport. Other industries that could be based on the forest resources include production of charcoal, alcohol and methane. Rational development in Amazonia will rely on forestry, tree plantations, tree products (e.g. rubber, oil) and perennial plants, rather than on annual plants and cattle raising, both of which export nutrients out of the system. No product from Amazonia can indefinitely compete with the same product originating in south or central Brazil, near the consuming centers. Subsistence agriculture, particularly in várzeas, for total self-reliance makes sense: exports more economically produced elsewhere do not.

Production of fish may prove to be the most valuable sustainable and commercial possibility of the entire region. Their nutrients originate mainly from Andean erosion with contributions from the forest, from forest leachings, and from the air itself. Their nutrition is therefore relatively independent of the fragile Amazonian forest. Fish culture (including crustaceans, shellfish and other pricey aquatic animals) as an industry barely exists today in the Amazon, but it could become highly developed, including establishment of small mobile ice factories and freezers, in combination with small cottage-based industries to preserve fish by salting, pickling and smoking.

It is significant that before European colonization nearly all aboriginal settlement was closely associated with river, várzea, and riparian forest; the concomitant deracination of the Amerindian tribes provoked their decline. Rivers remain the principal resources of Amazonia, and this fact must be recognized if there is to be any reasonable hope for a sustainable future for Amazonia.

Within the framework of present trends, the ecological balance of Amazonia, covering one-million square kilometers, is being destroyed. The derisory short-term gains that developers are seeking surely will be supplanted by desperate long-term problems, unless remedial action is undertaken soon.

Brazil still has time to stop the blind and irrevocable destruction of a life-filled area, unmatched in all the world. Its multitude of irreplaceable forms of plant and animal life, its exquisite biotic communities, its last survivors of a unique and once-great human culture, can still be saved from extinction.

SUDAM, the federal agency charged with the development of Amazonia, continues to encourage developmental models known to be unsustainable, such as deforestation for pasture. The Superintendent of SUDAM, Hugo de Almeida, recently asserted that '. . . trees must be substituted by grass or even agricultural crops . . .' (*Jornal do Comercio*, Porto Alegre, 8 March 1977). The very next day, the President of Conservation of Fauna and Faunal Resources conference, Dr. José Candido de Melo Carvalho, stated that '. . . it is a huge lie that the Amazon forest is being devastated . . .' (*Jornal do Brasil*, 9 March 1977). It is reassuring to note that this situation may be changing, however, since the Director of SUDAM's Natural Resources Department, Dr. Clara Pandolfo, is reported as being 'shocked' by ERTS/Landsat imagery proving hitherto unsuspected clandestine deforestation of a huge 163,622 hectares (*Opinião*, 18 March 1977).

Most encouragingly, the Brazilian Government has recently created a special Secretariat of the Environment (SEMA) which is most active in environmental management, prevention of pollution and the creation of reserves. National Parks and Biological Reserves constitute only 0.28 per cent of Brazil's surface area, and much of these are not effectively protected. Recently collaborating with the Ministry of Education, SEMA has introduced environmental management and ecological concepts into the curricula of all federal schools, an extremely powerful means of engendering future environmental rationality. Finally, the most hopeful and important contribution towards this rationality is the publication of José Lutzenberger's (1976) seminal 'Brasilian Ecological Manifest'.

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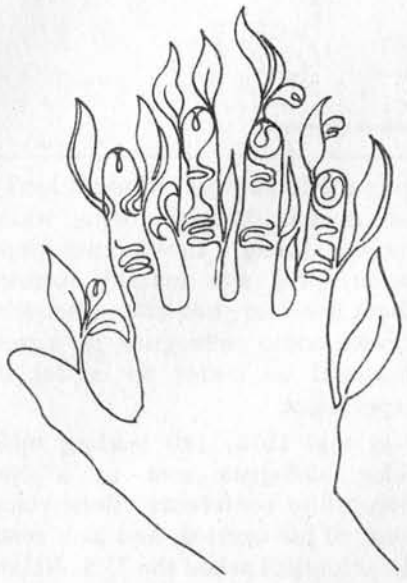
THE GENETIC ENGINEERING DEBATE

by David Straton



Genetic engineering has aroused an unprecdented controversy in the scientific world. It has been described by one Nobel prize-winner as creating the greatest ethical problem that science has ever had to face. (Wald, 1976). Another Nobel prize-winner has been quoted as calling its critics 'shits and incompetents'. (Golden, 1977). This article throws some light on this heated debate by describing some of the techniques involved, tracing the history of the controversy both overseas and in New Zealand, and then summarizing the arguments on each side. It concludes that a wider public debate is needed.

What is Genetic Engineering?

Some people reject this term as being emotive. (Bergquist, Petersen, 1977). But essentially, whether it is called genetic engineering or recombinant DNA research, it amounts to 'Research involving the combinations of DNA molecules from different biological origin using any methods that overcome natural barriers in mating and recombination to yield molecules that can be propagated in some host cell, and the subsequent study of such molecules'. (E.M.B.O., 1976). In simple words, the artificial transfer of genes from one species to another.

The groundwork for this was laid in 1944, when Avery, McLeod and McCarty succeeded in transforming the cell coat of the pneumococcus by adding purified DNA from a different strain of pneumococcus. (Avery and others, 1944). However, the significance of this research was not widely recognized at the time. Throughout the fifties and most of the sixties, attempts to manipulate the genetic structure of organisms used the technique of bombarding them with radiation in order to increase the mutation rate.

A series of important breakthroughs occurred in the late 1960s and early 70s. Paul Berg, and Stanley Cohen, both from Stanford University, and Herbert Boyer from the University of California at San Francisco, discovered between them how to cut strands of DNA, how to stick them together, and how to introduce them, using a specific vehicle, into a micro-organism. (Cohen, 1975). This laid open a much more precise form of genetic manipulation that has become known as recombinant DNA research.

How is Recombinant DNA Research Done?

To help explain this I will define some technical terms.

Restriction enzymes are naturally occurring enzymes produced by bacteria and other organisms as a defence against invading viruses. They work by cutting the virus DNA at a specific place, thereby incapacitating the virus and preventing the invasion. These enzymes have been known for some time, but it is only recently that they have been isolated and even more recently that scientists have known which specific points on a DNA chain they will cut. The first restriction enzymes discovered cut directly across both two strands of DNA, making it necessary to add a short length of single-stranded DNA to make a 'sticky end' before a new piece of foreign DNA could be attached. However, a recent development by Boyer was to find a new type of restruction enzyme which cuts the DNA obliquely, thereby leaving a 'sticky end' automatically. This makes the technique considerably simpler.

Ligases are enzymes that repair breaks or nicks in single strands of DNA. It was discovered in 1967 that these enzymes could be used to join together the ends of two separate pieces of DNA.

A plasmid is an intracellular particle which is a molecule of DNA that exists apart from the main bacterial chromosome. It replicates on its own, often carrying the genes for some supplementary activity such as resistance to antibiotics. These plasmids are the most popular vehicles for the recombinant technique.

A typical experiment will go as follows: (See Fig. 1)

1. The bacterial cell wall will be dissolved using a detergent-like liquid. This releases the DNA from inside the cell, both the long principle chromosome and also the

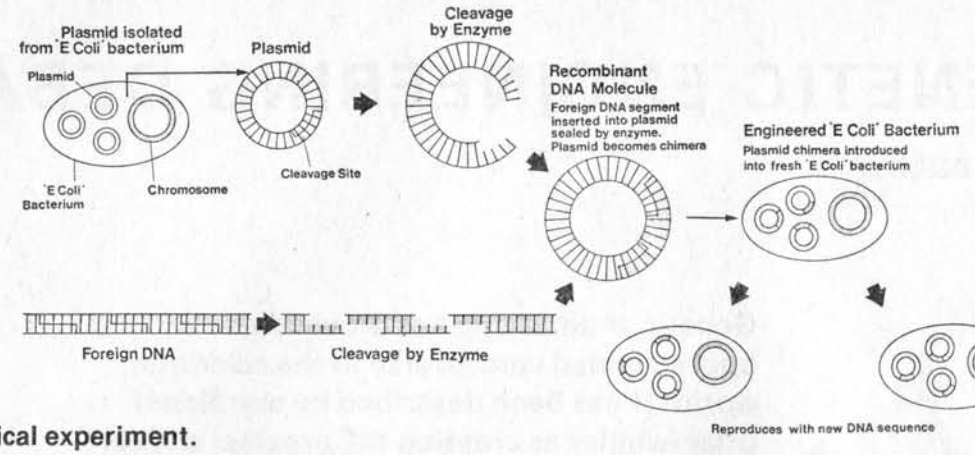


Fig. 1: A typical experiment.

smaller plasmids.

2. The plasmids are then separated out using an ultracentrifuge.

3. Next a restriction enzyme is added to the mixture containing the plasmids, cutting the DNA strands at specific points. This changes them from circles of DNA into linear molecules.

4. Meanwhile some foreign DNA has been prepared and similarly treated from either a virus, a bacterium, a plant, or an animal. The DNA has been cut, using restriction enzymes, and small pieces of DNA molecule obtained.

5. Next the foreign DNA segments are added to the linear plasmid DNA molecules.

6. A ligase enzyme is added to make them join. Once more the plasmid DNA strand becomes a circle, but this time the circle contains the fragment of foreign DNA. At this stage the plasmid is called a 'chimera'.

7. Finally the chimeras are placed in a solution of cold calcium chloride containing normal E.Coli bacteria. When the solution is suddenly heated the membranes of the E.Coli become permeable, allowing the plasmid chimeras to pass through and become part of the E.Coli's new genetic structure.

Not all plasmids are suitable for use as vehicles carrying foreign genes into the cell. One of the most popular ones is the plasmid pSC101 which was developed by Cohen. He produced it by chopping up a larger plasmid and sticking a small strand round into a circle.

Other vehicles have also been devised for carrying genes into bacteria. The bacteriophage 'Lambda' is particularly suitable for genetic modification before it is used to infect E.Coli. For higher types of cell, the polyoma virus of mice can be used, or the SV40 virus of monkeys. This virus was a contaminant of the polio vaccine given to nearly 2 million New Zealanders in the early 1960s. (Hamilton, 1974.)

Whichever vehicle is used to introduce new genetic material into the cell, the effect is much the same. The new genes are reproduced either at the same rate as the cell itself or sometimes independently and faster. The new cells become forms of life that are potentially different from before, with characteristics dictated not only by their own genes, but also by genes from an entirely different species. This process enables the scientist to do two things: firstly, to produce large quantities of identical genetic material as the plasmids are reproduced over and over again (the process is known as cloning); secondly, to examine the change in behaviour of the cell, thereby gaining some insight into the properties of the genes he has introduced.

The History of the Controversy

In 1971, Paul Berg was planning on an experiment. He wanted to introduce DNA of the SV40 virus into E.Coli. SV40 is a small virus with few genes. However, it is oncogenic and causes tumours in newborn hamsters. (Shah, Nathanson, 1976). Berg hoped that by studying the oncogenic gene he might learn how some viruses cause cancer.

A young cancer researcher called Robert Pollack heard of this experiment and phoned Berg to discuss its possible implications. Pollack was worried that if E.Coli were to acquire an oncogenic gene, and such a strain were to escape from the laboratory, it might lead to carcinogenic bacteria being widely spread through the human population. Berg was initially sceptical about this fear, but after discussing it with some colleagues he agreed it would be better to cancel the experiment.

In mid 1973, 140 leading molecular biologists met at a New Hampshire conference. Berg voiced some of his worries, and as a result the scientists asked the U.S. National Academy of Sciences to look into the risks of recombinant DNA esearch. The N.A.S. immediately set up a sub-committee with Berg as its head.

In April 1974 they called for a world-wide moratorium on obviously hazardous sorts of recombinant DNA research.

In February 1975, a conference took place in Asilomar, California. Scientists decided to continue the ban on the obviously dangerous experiments, and also to persuade the National Institutes of Health to establish safety guidelines. (Berg and others, 1975).

In June 1976, the NIH guidelines were released. (Federal Register, 1976). They are voluntary and classify different types of experiment into a number of categories. The most dangerous should not be done at all, and the four categories below that should only be done under appropriate containment conditions. The guidelines describe four levels of physical containment, and three levels of biological containment.

The experiments banned are those where there is some scientific basis for expecting danger, such as the implantation of oncogenic viruses or toxin-producing genes

into bacteria that might infect humans. As for containment, the highest level is called p4. Laboratories classified p4 are similar to those that are currently used for extremely dangerous organisms such as Lassa Fever virus, Marburg virus, and Zaire Haemorragic Fever virus which can cause nearly 100 per cent mortality in infected individuals. A P4 laboratory is specially built with airlocks and filters, biological safety cabinets, clothing changes for personnel, and autoclaves inside the building.

A P3 laboratory is also specially constructed with double doors, negative air pressure, and special air filtration devices.

P2 laboratories are similar to those that have been used for many years for work with bacteria such as Salmonella Typhosa and Clostridium Botulinum. The NIH guidelines require that P2 laboratories be used for research involving recombinant DNA molecules from separate species.

P1 laboratories have the lowest level of containment. These can only be used for experiments involving recombinant DNA from two strains within the same species. Essentially this is where the new bacteria could possibly have occurred naturally.

The American NIH guidelines also specify levels of biological containment. This means the use of specially crippled bacteria, and other organisms, so that in the event of one of them escaping from the laboratory it would not be able to survive long. The three levels of biological containments are: E.K.1. This means using the K12 strain of E.Coli which has been shown to be naturally feeble. E.K.2 would involve using more extensively crippled bacteria that require specific laboratory nutrients in order to reproduce it all. They may also require specific temperatures to survive. Some crippled bacteria of this sort have been produced already, although it is disputed whether they meet the E.K.2 standards. (Goldstein and others, 1976). E.K.3 Biological containment is similar to E.K.2 except that it has been rigorously field tested. This has not been done yet.

A few days after the NIH guidelines were released, an eminent Nobel Prize winner, Professor George Wald, launched his attack on them. (Wald, 1976). I will leave some of his argument until later, but will say at this stage just this:

1. The guidelines discuss the conditions under which the research should be done, but they do not address the question of whether the research should be done at all.

2. They involved no public discussion.

3. They are voluntary, not compulsory.

4. He went into a detailed criticism of both physical and biological containments.

5. The techniques are unpredictable.

6. Their consequences are potentially unprecedented.

7. Because of these factors a much wider debate and more stringent controls on this research was necessary before it went ahead.

Wald persuaded the Cambridge (Mass.) City Council to place a temporary ban on P3 and P4 experiments planned at Harvard University. The Mayor of Cambridge, Mr. Vellucci, who has had a number of battles with the University in the past, became a vocal and powerful opponent of the research. The decision by the Cambridge City Council immediately made the debate more public and also extremely heated.

Meanwhile in Britain the debate was also going on. (Lewin, 1976). In July 1974 when the American National Academy of Sciences urged a world-wide moratorium on hazardous Recombinant DNA experiments, a committee of enquiry was set up in Britain under Lord Ashby, to investigate the potential risks and benefits of genetic manipulation. This working party reported in January 1975 giving general approval of genetic engineering while affirming the need for adequate safeguards.

The British Department of Education and Science then set up a second working party chaired by Professor Williams to suggest ways in which this research could be monitored and regulated. This working party published the Williams Report in August 1976. But there is not just one 'British Report'; in the same month, the British Health and Safety Commission also published a consultative document, which in many important ways was completely different from the Williams Report. The Williams Report recommended the setting up of a Genetic Manipulation Advisory Group, known as G.M.A.G. The membership of G.M.A.G. includes people to take into account the interests of employees and also the general public. The Williams Report also specifies four levels of laboratory containment, but unlike the American NIH guidelines, it does not specify precisely the types of laboratory needed for each category of experiment. Instead, it offers more 'flexibility'. The Williams Report emphasizes physical containment methods, rather more than the physical and biological containment systems in the NIH guidelines.

The Health and Safety Commission Report, on the other hand, is much more stringent. It proposes to control with statutory powers all forms of genetic manipulation. This H.S.C. document has antagonised large numbers of scientists in Britain who are afraid that their research might come under bureaucratic control. A heated debate has been going on in Britain, although whereas the debate in America is between those in favour and those against the research, in Britain it has been between scientists who want flexible voluntary guidelines and government administrators who want statutory powers. The spectre of international competition has been raised in Britain, with scientists claiming that if their research is restricted, other countries will move ahead and Britain may lose out economically. Reports are currently being prepared in France, West Germany, the Netherlands, Sweden, Norway, Belgium, Denmark, Switzerland, Italy, Israel, and the U.S.S.R. (Tooze, 1977).

The New Zealand Situation

Genetic manipulation has been going on in at least two centres in New Zealand; Auckland University and the Plant Physiology Division of the D.S.I.R. in Palmerston North. Over the last ten years, Professor Bergquist in Auckland has been researching the regulatory controls of DNA replication using small plasmids from E.Coli and cloning them in other E.Coli of the K.12

strain. This research does not involve any genetic material crossing a species barrier, and as such, is not as hazardous as research which does. (Bergquist, 1977.)

The work in Palmerston North has been largely concerned with increasing the abilities of plants to take up nitrogen from the air, thereby requiring less nitrogenous fertilizer. One such experiment involved the introduction of nitrogen fixing bacteria into the cytoplasm of a mycorrhizal fungus which normally lives in association with pinetree roots. (Giles, Whitehead, 1975). The idea was that if the fungus could be enabled to fix nitrogen from the air, then when it was reapplied to the pinetree roots, some of this fixed nitrogen might be made available to the pine trees, thereby increasing their rate of growth without the need to apply nitrogenous fertilizer.

The first of these experiments was successful in so far as some strains of fungi were produced and could live on nitrogen deficient medium. They also were able to reduce acetylene which is the specific test for nitrogenaze activities. Later these strains of modified fungus were applied to the roots of some pinetree seedlings. (Giles, Whitehead, 1977). Some of the pinetrees have appeared to acquire some slight nitrogen fixing ability. However, in the case of one strain of the modified fungus, all the pinetree seedlings that came into contact with it died. It was found that this strain of modified fungus was pathogenic. Hyphae had penetrated to all parts of the plant. The scientists destroyed all the trees and the fungus that had affected them.

I have no reason to suppose that the containment systems of the laboratory were breached, but this gives a nice example of the sort of danger that can occur as a result of this type of research. These scientists were trying to produce a fungus that would have assisted our forest industry. However, they inadvertently produced a fungus that might, if it had escaped the laboratory, have caused a disease affecting pinus radiata trees in this country and destroyed large areas of forest.

Another scientist in Palmerston North has been bombarding pollen with radiation, thereby breaking chromosomes into short lengths and sometimes single genes. Using this technique, he has selectively produced hybrids between types of plants that normally hybridize with difficulty. This technique is relatively simple and could be done by plant breeders without the need for any complicated microbiological training. In the paper (Pandey, 1976) describing this work he mentions 'The essential thing is that this exploratory work be done as speedily as possible, if the initiative is not to pass into the hands of more ambitious laboratories overseas. I believe it may be a unique opportunity for the D.S.I.R. and for agricultural technology in New Zealand. Such an opportunity should not be allowed to pass us by'. This illustrates some of the pressures put on scientists by international competition. It may encourage them to be more hasty in developing this research than might otherwise be desirable.

In 1975 the New Zealand Medical Research Council commissioned a sub-committee to look into the need for guidelines for genetic engineering in New Zealand. This subcommittee consisted of Professor Bergquist from Auckland and Professor Petersen from Otago. Their deliberations occurred in private, and it was only in February 1977 when an article was published in *The NZ Listener* (Booth and others, 1977), that the issue of genetic engineering came to the attention of the public in New Zealand. This article proposed that an enquiry should be held to consider whether genetic engineering should continue in New Zealand. It went on to say that if such an enquiry decided that genetic engineering could continue, then a regulatory authority should be established with legal duties and powers to investigate and control all future research. The authority should have at least the following features:

A. Satisfactory funding to set up independent staffing,

B. Entirely public meetings and records,

C. Representation but not domination by those scientists interested in doing genetic engineering,

D. A majority representation from those groups and viewpoints with a clear understanding of the ethical issues, but not involved in the actual research.

On the 5th March, 1977, the Council of the New Zealand Association of Scientists discussed these proposals, and wrote to the Prime Minister asking for an open enquiry to be held immediately to consider the implications of genetic engineering, and also calling for a moratorium on the research pending the enquiry.

In early March, 1977, the subcommittee of the M.R.C. presented its recommendations to the Medical Research Council itself. (Bergquist, Petersen, 1977). The recommendations were accepted. Essentially they are fairly similar to the British Williams Report, and the emphasis is on physical rather than biological containment. Also the regulations stress flexibility rather than a rigid classification of experiments. There are some differences from the Williams Reports. In general the New Zealand recommendations are more stringent, and in particular, although scientists could do P1 and P2 type experiments in appropriate laboratories here, the suggestion is that type 3 and type 4 laboratories would be uneconomic in New Zealand and scientists wishing to do experiments in those categories would have to use laboratories overseas.

Professor Cavalieri warns that "A single unrecognised accident could contaminate the entire earth with an ineradicable and dangerous agent that might not reveal its presence until its deadly work was done"

The M.R.C. guidelines suggest the setting up of a two tier control system. At the top would be a 'Genetic Manipulation Advisory Committee', containing scientists, medical scientists, trade unionists, representatives from industry, from the public, and from the Department of Health. The committee of half scientists and half non-scientists would continually review research and developments involving recombinant DNA.

The second level of control would

be called the 'Recombinant DNA Advisory Committee' consisting of scientists representing the M.R.C., the government scientific departments, and also universities. These experts would vet all research proposals and advise the level of safety precautions necessary for them. In this way each separate piece of research would be evaluated rather than fall into a general category. In addition, the proposals recommend that each institution doing this research should employ a biological safety officer to ensure that all staff working there knew of the research and who would also be responsible for supervising the safety precautions.

Professor Robert Sinsheimer says "Because of human fallibility, these new organisms are almost certain to escape. Once they have escaped there is no way to recapture them, and so we have the great potential for a major calamity"

Professor Bergquist tells me that the recommendations are different in another respect as well. They are compulsory as far as M.R.C. work is concerned, whereas in Britain and America the guidelines are at present voluntary, although in America at least legislation is being prepared. (Wade, 1977). The D.S.I.R. in New Zealand have asked the Minister for Science to apply the M.R.C. guidelines to research done by the government departments, and there is talk about possible legislation being produced for New Zealand in order to control the activities of industry. (Gandar, 1977).

The present position in New Zealand is that with Professors Bergquist and Petersen having accepted the British standards, Professor Bergquist's research has been stopped while his laboratory is being modified. I understand the research in Palmerston North is continuing. The New Zealand Association of Scientists is still awaiting a decision by the Prime Minister as to whether he will institute a public enquiry. It seems unlikely that this will now take place, although the Royal Society is setting up a sub-committee to investigate genetic engineering and it is possible that the public will be able to make submissions to it.

A Summary of the Arguments

The arguments seem to me to fall into three main groups: The first is the issue of containment within the laboratory, and the consequences if it were breached: The second is the issue of control, that is to say, who should decide if the research should go ahead, and if so under what conditions. Should it be the scientists who are doing the research themselves? Should it be experts from that area of science? Should it be the general public? Should the controls be voluntary, or should they be compulsory under law? The third area of controversy concerns the technological and social implications of this research.

Containment

The advocates of genetic engineering like Cohen (1977), who was one of the originators of the recombinant technique, claim that the benefits will be so great that the risks involved are justified. The benefits, he claims, would be of two types: Firstly the advancement of fundamental scientific and medical knowledge especially in the areas of genetics, the mechanism of carcinogenesis, and drug resistance. The second area of possible benefit is in the practical applications which I will mention later.

As far as the risks are concerned, advocates of the research tend to emphasize the unlikelihood of any major catastrophe occurring. They talk about the risks of being one in a million, or one in a billion (Holliday, 1977). They emphasize the importance of strict guidelines and laboratory control. (Curtiss, 1976.) They say that with P4 containment the physical escape of micro-organisms could be completely prevented and that with biological containment systems as well if such an escape did occur, then the micro-organism would not survive long enough to cause an epidemic.

Some advocates in New Zealand believe the risks to be minimal because inter-species genetic exchange may occur naturally. (Sutton, 1977). If 'natural genetic engineering' is widespread anyway, the argument goes, then dangerous new organisms are unlikely to be produced by researchers because if they could survive they would exist already. This 'she'll-be-right' attitude is rarely mentioned by advocates outside this country.

The more sober of the proponents take pains to disclaim that they mean that all experiments should be freely permitted. They say that they want controls, but that they should not be too restrictive. (Cohen, 1977.)

On the other side of the debate, critics of the research claim the risks are so great that no amount of security would be adequate. Professor Cavalieri, Professor of Biochemistry at Cornell University, warns that 'A single unrecognised accident could contaminate the entire earth with an ineradicable and dangerous agent that might not reveal its presence until its deadly work was done'. Professor Robert Sinsheimer, Chairman of the Biology Division at the California Institute of Technology, says that 'Because of human fallibility, these new organisms are almost certain to escape. Once they have escaped there is no way to recapture them, and so we have the great potential for a major calamity'. (Cavalieri, 1976.)

The case of the critics can be reduced to the following principle points:

1) *ABSOLUTE CONTAINMENT IS IMPOSSIBLE.* When you take into account all the human factors and the possibilities of mechanical failure as well, there is no way that complete containment can be guaranteed. That might be permissible if the consequences of an accident were severe but not potentially disastrous. However if the consequences of the accident are potentially intolerable, the risk of a breach of laboratory containment, however minute that risk might be, becomes a strong argument against doing the research.

The critics point to the fact that Fort Detrick biological warfare laboratories, which developed P4 high-level physical containment, had at least 423 accidental infections over 25 years (Cavalieri, 1976). Biological containment relies on the nature of the host organism for its success. That nature is genetically deter-

mined, yet the genetic makeup of the organism is being modified during the course of an experiment. The nature of the host may change in unpredictable ways, reducing the reliability of the biological containment. It has been shown that the cripple cell E.Coli 1776 can survive better after a certain plasmid has been introduced into it. (Goldstein and others, 1976.)

2) *THE CONSEQUENCES ARE UNPREDICTABLE.* Many of the lengths of DNA that are inserted into new cells contain genes whose function is poorly understood. They are certainly not understood in conjunction with the host cells genes.

Sinsheimer theorises that some of these experiments are crossing what he suspects is an absolute biological barrier — the barrier between the lower forms of life, the Prokaryotes, like bacteria and blue-green algae, and the higher forms of life, like animals and plants, which are called Eukaryotes. He suggests some of the possible consequences of breaching this natural barrier. (Sinsheimer, 1976.) One is that Prokaryotic viruses might acquire the capacity to infect Eukaryotes. In other words, viruses that currently only infect bacteria could acquire the ability to infect higher plants, animals and humans.

Another fear is that bacteria might acquire the capacity to act as a reservoir for the common Eukaryotic viruses, which would then be much more difficult to eradicate.

Apart from the danger of new infectious diseases being created and spread the biggest fear is that an oncogenic gene might escape. Veteran DNA researcher Professor Chargaff of Columbia has been quoted as saying 'the spreading of experimental cancer can be confidently predicted'. (Cavalieri, 1976).

3) *AN ACCIDENT COULD BE IRREVERSIBLE.* As Chargaff put it: 'You can stop splitting the atom, and you can stop visiting the moon, you can stop using aerosols, you may even decide not to kill entire populations by the use of a few bombs. But you cannot recall a new form of life. Once you have constructed a viable bacterium carrying a plasmid DNA into which a piece of foreign DNA has been spliced, it will survive you, and your children, and your children's children. An irreversible attack on the biosphere is something so unheard of, so unthinkable to previous generations that I could only wish that mine had not been guilty of it'. (Chargaff, 1976).

Viruses that currently only infect bacteria could acquire the ability to infect higher plants, animals and humans.

4) *THE HOST CELL IS E.COLI.* Much recombinant DNA research currently taking place uses Escherichia Coli (E. Coli) as the host cell. The reason is that E.Coli is the best understood bacterium available. More is known about the composition of its chromosomes and plasmids than about those of any other type of cell. Unfortunately it is also a normal inhabitant of the human bowel. The chances of a modified strain of bacterium escaping the laboratory is therefore increased, because it could be carried out in the gut of a laboratory worker. In addition if a pathogenic E.Coli was created, the chances that the disease would affect humans and possibly cause a human epidemic would be increased. Many critics of genetic engineering say that if the research is to go ahead, it should not be done using organisms that are known ever to infect humans.

E.Coli also is known to transmit its plasmids to at least 40 other organisms. This for example, is what occurs when multiple drug resistance is transmitted from strains of E.Coli to other bacteria. One of Wald's criticisms of biological containment is that if E.Coli, however weak or crippled, still have the ability to transmit genetic material to other strains, then this so-called 'biological containment' might not amount to much. The danger might not be from pathogenic bacteria escaping the laboratory so much as healthy bacteria getting in. Such healthy bacteria might acquire the pathogenic genes and then be in a position to escape and cause an epidemic. (Wald, 1976).

An example of the danger that can arise from using E.Coli occurred in New York two years ago. (Wade, 1977). Researchers were trying to develop a strain of E.Coli that could digest sewage and produce methane gas for fuel. A desirable project. In the course of their experiments, they produced a strain of E.Coli that possessed the enzyme cellulase, which can break down cellulose. After this had been achieved, it occurred to the scientists that such a bug would be very unpleasant to have in one's gut. It would break down roughage producing cellulose breakdown products which would be likely to cause at least wind and probably chronic diarrhoea. They decided to destroy the organism.

It is incidently interesting to note that, because the experiment was done in vivo and because it used plasmids but not restriction enzymes, it would not have been covered by the NIH guidelines.

5) *A LABORATORY LEAK MIGHT BE INDETECTABLE.* As well as being irreversible, the escape of a pathogenic organism from a laboratory may be hard to detect, since many of the organisms being used in this research are already, in an unmodified state, widespread in the environment. If a leak occurred involving some modified E.Coli, it could be extremely hard to trace. This argument is used to criticize the proposed containment systems. The critics say that in order to establish whether the proposed containment systems are adequate, it should be possible to test the safety systems empirically. During normal operation, it is likely that most laboratories would be able to contain pathogenic organisms. However, the fear is not so much about the normal operation of safety systems as those unexpected and unpredictable situations where things go wrong.

A useful analogy is made here with the problem of radiation and its possible escape from a nuclear power station or a nuclear waste disposal site. If radiation were to leak from a nuclear power station, it could be detected with a geiger counter. It could be concluded then that the safety systems had broken down and needed improving.

But with recombinant DNA, a leak could occur, and nobody know about it. If the organism was already

widespread in an unmodified form in the environment, it could be hard to show immunologically, or in any other way, that anything unusual had happened. Of course, if the organism was dangerous in the sense that it had immediate toxic effects, then a new and unknown disease might appear. However, it is well known that some oncogenic viruses have incubation periods of up to twenty years before the cancer becomes detectable. An example is Herpes Simplex Type 2 and carcinoma of the cervix. (Aurelian, 1976).

In effect, if it is possible for a leak from a laboratory to be both highly dangerous and indetectable in the short term, then it is difficult to prove that safety systems are satisfactory.

Control

Who is to control this research? Should it take place at all? Who should make that decision? Who is to control the conditions under which the research is done?

Not all advocates of genetic engineering agree about this. Some feel that the pursuit of scientific knowledge should not be controlled in any way, and that freedom is vital if science is to remain vigorous. There are others who concede that if 'pure' scientific research involves risk to the public, then it is reasonable to have controls over the types of research done, and the conditions under which it is done. Within that group, some believe that restrictions should be voluntary guidelines drawn up by scientists who are doing the research.

Richard Novick, Chief of Plasmid Biology at New York's Public Health Research Institute, disagrees: 'Given that I would like to do certain R-DNA experiments that I believe to be non-dangerous I am unable to distinguish between the following two alternatives as the basis for this belief:

1) I am convinced they are not dangerous, so it is okay to do them.

2) I have convinced myself that they are safe precisely because I want to do them!'

He defies anyone with a self-interest to make that distinction. (Novick, 1977).

Critics of the research tend to emphasize the importance of public involvement in decision-making, both as to whether the research should be done at all, and also the conditions under which it should be done.

The critics tend to emphasize that the public are to be put at risk by these experiments and that it may be an extreme risk. The public should therefore have the right to veto at least some of this research and to scrutinize the controls on any that is done.

Future Implications

This goes beyond the question of laboratory containment, and the activities of a few scientists to consider the possible long term effects of this research on future technological and social developments. Advocates are optimistic about possible practical applications of genetic engineering. A number of possible benefits have been mentioned (Cohen, 1977), including cheap and plentiful supplies of drugs, antibiotics, hormones, insulin, vitamins, vaccines and many other biologically active agents. These could be produced using specially designed and engineered bacteria as miniature pharmaceutical factories. They would be equipped with the genes to create directly the compounds required.

Other attractive prospects include the possibility of designing bacteria to clean up oilspills, bacteria that could produce methane from sewage, techniques that could enable plants to fix nitrogen from the atmosphere instead of requiring nitrogenous fertilizers, and also possible bacteria or algae that could produce hydrogen from water using the power of photosynthesis. This prospect is particularly attractive to people who are aware of the fact that world petroleum production is expected to start declining in ten to fifteen years time, and the need to find alternative energy supplies that can be used for transport.

Another suggested application for this research is the treatment of genetic diseases. The hope is that in diseases caused by an enzyme deficiency, or even a chromosome deficiency, the patient might be able to be given the genetic material that he is lacking. In fact one attempt at this has already been made in two children suffering from hyperargininaemia, a genetic defect of the enzyme arginase. An attempt was made to correct this enzyme defect by injecting Shope Papaloma virus into the children in the hope that the arginase present in this virus might help the children. In one of these patients the arginine level fell, indicating some partial success. (Nevin, 1977).

Some supporters of genetic engineering think that an understanding of the mechanisms of carcinogenesis will lead to a cure for cancer.

Critics of the research, in particular Francine Simring of Friends of the Earth, have emphasized (Simring, 1976) the long term and possibly immense changes that this research might bring. She has pointed out that the proponents of the research have tended to concentrate on laboratory containment as being the key issue, in much the same way as early researchers into nuclear power concentrated upon reactor safety. Now, of course, the nuclear debate encompasses issues such as terrorism, the inevitability of human mistakes, problems of waste disposal and transport, and the economic and military implications of a nuclear programme.

By analogy with this, she says, we must consider right at the beginning of the genetic debate all the possible ramifications. In particular, questions she has raised include:

THE REDUCTION IN THE DIVERSITY OF THE GENE POOL. A key element in the stability of an ecosystem is the size of the gene pool that it contains. That is to say, in a natural ecosystem there is usually a large variety of different organisms living together and interacting with one another. If this complex ecosystem is simplified and replaced by a monoculture, then the system as a whole becomes much less stable in the face of some possible change in its environmental conditions. Examples of the sort of minor ecocatastrophe that has occurred when a simplified monoculture has been affected by a new situation include the invasion of rabbits in Australia, and the invasion of gorse into New Zealand. In such cases, a single organism possessing an advantage over the existing over-simplified ecosystem can sweep through the environment.

INTERFERENCE WITH NATURAL EVOLUTIONARY PROCESSES. This issue has brought theologians and philosophers into the debate. Up to now, the direction of development in plants and animals has been largely a matter of random mutation and natural selection, although modified by artificial breeding. But with genetic manipulation techniques easily available, the design of plants and animals, and even humans, become theoretically possible. This places a whole range of new powers into human hands and will lead to a whole new dimension of ethical problems as a result.

MILITARY EXPLOITATION. In the past, biological warfare research has been relatively crude, usually involving the use of radiation to increase the mutation rate and thus create novel pathogens. Recombinant DNA technology could make this much more precise and therefore more deadly in the hands of a government or terrorist group. In addition P4 laboratories containing dangerous organisms could make attractive targets for terrorists who wished to hold society to ransom.

INDUSTRIAL EXPLOITATION. When recombinant DNA techniques are widely used by industry, the scale of production of modified micro-organisms will increase immensely. The problems of containment, regulation and inspection of these factories will be much greater. The pursuit of profit or national advantage in a competitive situation may lead to corruption or to regulations being ignored. As in the case of nuclear power systems, some possible accidents would be fairly minor. But it is also true that with genetic engineering, a single release of a pathogenic organism may lead to an unprecedented disaster.

When industries wish to deploy their new organisms, some very complex decisions will need to be made. For example, if the proposed oil-eating bacteria can be created, should they be spread on an oil-slick? What would be the consequences for marine ecology, and what if oil in pipelines or petrol-tanks was also to get infected? Likewise with nitrogen fixing plants. It would be very hard to predict the long-term consequences for the world's flora if some plants suddenly acquired a significant advantage. Could nitrogen-fixing pinus radiata trees take over areas of native forest?

Questions such as these are incredibly complex, yet they would need resolving before genetically engineered organisms could be released from containment conditions. One of the principles of a democratic society is that major decisions should be made by public representatives. With decisions in this area being so complex and with such far-reachig consequences, it will be hard for our democratic institutions to cope with them. It will be all too easy for commercially motivated people to press ahead in spite of that.

Conclusion

Fortunately, the responsibility of the scientists involved has brought the dilemma to public attention before it is too late. The research has not yet progressed so far that it could not still be controlled. The scientists' very responsibility, however, should not blind us to the fact that genetic engineering has implications that extend way beyond the field of molecular biology to affect interests outside the scientific world as well. Nor can the dilemma be avoided by claiming that the pure research is one thing, while what is done with it is another. In this case, even the 'pure' research carries public risks and therefore moral responsibilities.

In the face of all the ethical difficulties that genetic engineering creates, many scientists and other concerned individuals are saying we should take a long, hard look at it before it goes any further.

Robert Sinsheimer put it very simply: 'The Atomic Age began with Hiroshima. After that no one needed to be convinced that we had a problem. We are now entering the Genetic Age; I hope we do not need a similar demonstration.'

David Straton

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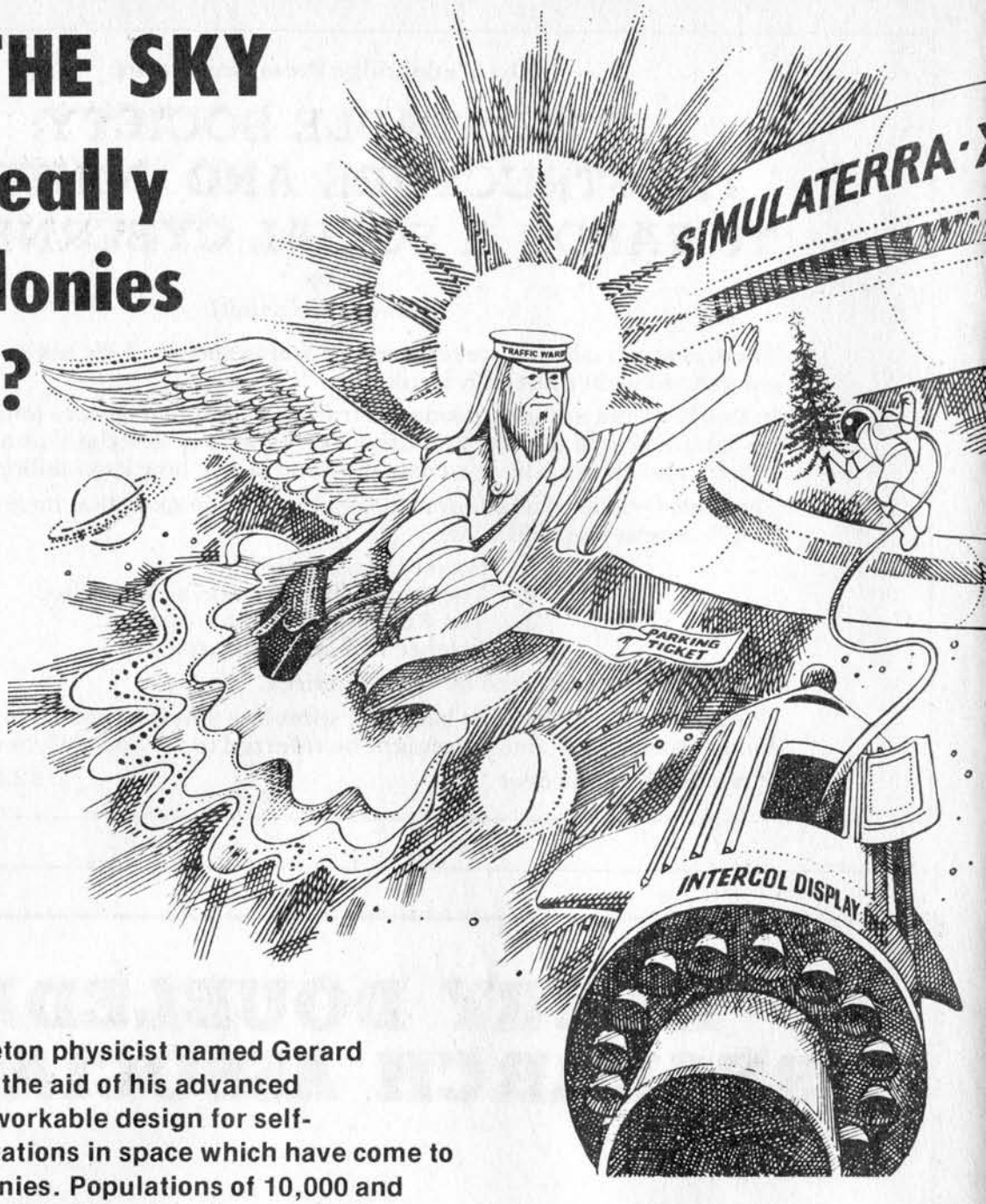
PIE IN THE SKY

Do we really want colonies in space?

by Alexandra Aldridge and Henryk Skolimowski



In 1969, a young Princeton physicist named Gerard K. O'Neill began, with the aid of his advanced students, to execute a workable design for self-sustaining orbital habitations in space which have come to be known as space colonies. Populations of 10,000 and more might live and work in gigantic sphere, cylinder, or ring shaped structures provided with apartments, shops and services, real grass, trees and flowers, and a simulated earth day.

Human beings cannot live on the surfaces of dead planets without oxygen, gravity, and other life resources, but theoretically they could exist inside these enclosed, earth-like environments.

O'Neill proposes to pay back the cost of manufacturing the first colonies by using them to beam solar energy to earth. They are also seen as a means of projecting mankind farther and farther into space, since the inhabitants of each colony would function as the builders of the next.

So far, the project has greatly impressed the House Subcommittee on Space Science and Applications, and NASA, having made preliminary commitments, is poised to carry it out. It has been endorsed by such prominent scientist-writers as Isaac Asimov, Arthur C. Clarke, and Carl Sagan. Wernher von Braun has expressed interest. And space colonies have caught the public imagination. There is even a nationwide organization, the L-5 Society, whose purpose is to cheer the project on and whose more avid members have pledged to join the first mission.

Toward the end of a bleak winter term, a physics professor, known primarily for his work in space technology, came to lecture at The University of Michigan. No one thought his presence would constitute an event. Academic gurus and culture heroes come and go so regularly in Ann Arbor that we are often indifferent to them regardless of the gravity of their message or the degree of their celebrity. We learned later, for example, that a block away, Jorge Luis Borges, a man certainly more renowned for vision and wisdom, was attracting only a small group of devotees when at the same time and to the surprise of many of us, Gerry O'Neill was packing the University's largest performance hall with over 2,000 eager students and faculty. Apparently the physicist, rather than the distinguished novelist, was going to be the bearer of sensational news, the gist of which already had reached greater numbers than we anticipated.

Like all good actors and promoters, O'Neill is conscious that news of whatever kind generates excitement in direct proportion to the personal attractiveness of its disseminator. Not only is he boyish looking at 49, slim, lithe, unprofessorial in a turtleneck sweater and well tailored jacket, but he also has an instinctual stage presence. Consider the drama inherent in his design for an exfoliating system of man-made planets — the flying cities of science fiction. Yet instead of dramatizing, he moved us in the old manner of the radio narrator whose very control — and invisibility — could activate powerful images in the minds of listeners.

In a carefully subdued voice and with a minimum of gesture, he told us that it would be one function of space colonies to replicate themselves. Given infinite lunar and asteroidal construction matter and the sun's energy to power a network of colonies as far as Pluto, within decades we could begin to explore the solar system. While visions of progress and evolution must have danced in some heads (ultimately we might reach the stars!), O'Neill declined to speculate beyond what present-day science and technology could guarantee. The audience was free to imagine unknown worlds, but our speaker knew that we would have distrusted a visionary to bring us to them.

It became clear that O'Neill's popularity and the swelling of his space colonies project into a movement — particularly among the scientifically-minded young — derive from the fact that illusions normally belonging to science fiction are made to seem practicable through his skillful use of scientific rhetoric coupled with the charm and authority necessary to win disciples. Moreover, advanced space technology appears in this case to include redeeming social value. Unlike the Apollo project which held out solely the rewards of experimentation and discovery, *this* undertaking is expected by naive enthusiasts to resolve virtually all the energy-related dilemmas linked to worldwide industrial growth, to insure the survival of the race — even its prospering.

We were told that if intensive designing began now, the first colony could be completed and fulfilling its primary function of supplying the earth with solar energy before 1990. Building in space requires an elaborate procedure, though O'Neill claims that all the necessary technology is known. Reusable rocket-fired shuttles would transport equipment and a workforce of some 2,000 to a point of stable orbit equidistant between the earth and moon. At the same time, a crew of about 200 would be established on the moon in order to mine the lunar surface for its rich store of raw materials. Since it has only one-sixth of the earth's gravity, materials could be moved from the moon to the construction site in space under conditions of weightlessness by means of a kind of gigantic solar or nuclear powered conveyor belt. Once the first colony is built it would be the job of inhabitants in turn to assemble and operate satellite power stations which could transmit an unlimited supply of solar energy to earth by converting sunlight into low density microwaves and beaming them to where they would then be converted into electricity.

The O'Neill plan thereby proposes to vanquish the energy crisis in one bold, if not immeasurably circuitous, stroke. It provides (after an initial expenditure of hundreds of billions of dollars) for a cheap and inexhaustible flow of energy from a source that would largely displace such scarce and expensive materials as coal and oil; and *clean* energy from the sun, O'Neill assures us, would eliminate the pollution now being generated by combustibles. But there is more.

Space colonization is seen by the hopeful as a "humane" means for reducing the earth's population. Were colonies allowed to proliferate according to O'Neill's time table, and assuming vast numbers were willing to go, "By 2150 there could be more people living in space than on earth. The reduction of population pressures on earth, left possibly with only a few billion people, would allow the planet to recover from the ravages of the industrial revolution". He even goes so far as to suggest that earth — pretty well cleared of people altogether — "might serve mainly as a tourist attraction" to colonists who presumably would visit occasionally, strolling and gawking in the same manner as we now tour Greenfield Village or Disneyland.

More immediately, before the end of the century, O'Neill would offer energy from space in order to forestall the global famines that are forecast if world population continues to grow at its present rate: "The provision of low cost energy to the developing nations will probably be the most effective contribution we could make to solving the world's food problem, because the cost of chemicals for high-yield agriculture is almost entirely the cost of energy for their production." (Never mind the greater numbers brought into being as a consequence — they can simply be shipped into space.)

These economic and ecological features of the plan belong, of course, to the dialogue initiated by the Club of Rome's studies on limits to growth wherein cautionary voices have urged the race to control its reproductive and consumptive excesses or face apocalypse. O'Neill is convinced that contrary to the no-growth or slow-growth policies recommended by such studies, industrial expansion need not be reduced, much less halted. Growth at an accelerated pace and of an unprecedented kind could take

place *in space* as colonies multiplied and grew more complex in structure.

Heavy industry, the building of massive products, could go on in non-rotating factories external to living areas. Energy from the sun and materials mined from the moon and asteroids would exist in superabundance and zero gravity would allow the assemblage, without cranes or lifting equipment, of, for example, components for new colonies, huge telescopes, space ships, power plants. Great wealth could accumulate to investors and to some colonists as well. Space colonies would provide an opportunity for humanity to experience, in O'Neill's words "a continuation rather than an arrest of the industrial revolution".

Altogether the project promises to transform the earth, as if by magic, into a technological utopia while the colonies themselves, serving strictly as manufacturing outposts and population blotters, consecrated to efficient production, are likely to become an endlessly replicated series of brave new little worlds.

Still, no one would be so mean as to say that O'Neill's ambitions are without merit. No one could dispute the need for alternative energy sources and immediate solutions to the problems of food production and over-population. Who is to say that creating new worlds and exploring the solar system through a succession of mechanized steppes in the sky is not a romantic prospect? If, in the words of one congressman, "it is something that will happen", who among us would wish to stand in the derrière garde? But before we are swept away in the thrill of so facile a destiny as the one O'Neill invites, let us take a closer look at the necessity for the project, the economic and ecological feasibility of it, and the social and cultural implications both for our own planet and its prospective colonies.

* * * *

We would not want to suggest that current technical and economic realities in a fundamental way preclude space colonies, make them unworkable or impossible. If we exert our wills to the maximum and ardently desire a certain state of affairs then, in spite of its initial low probability, it will happen. But the O'Neill project is neither vital to our survival nor so important to our well-being that we should consider making the sacrifices necessary to realize it. Space colonies will not even solve the energy problems that might partially justify their existence. In fact, they are bound to foster graver problems.

Reflect first on O'Neill's economics. He talks in terms of a 100 billion dollar investment. This sum is high enough in itself. However, the nature of sophisticated technologies is such that the cost at the end is invariably several times the original investment. We must multiply O'Neill's estimate by a factor of 4, 6, or perhaps 10 in order to obtain a realistic figure. Assuming conservatively that the actual cost is bound to be at least five times the estimated cost, we arrive at a dizzying 500 billion dollars. The Apollo project took a modest 39 billion in comparison and we are still debating its value in view of more pressing needs.

An undertaking of this magnitude, once put into motion, would be increasingly difficult to stop. Remember that nothing could halt a much smaller project, the French/British Concorde. Though recognized to be as impractical a luxury as flying boats or zeppelins, Concorde production had to proceed because so much had been invested. The building of space colonies, if begun, would acquire an even greater momentum — one which would come to determine the destinies of scores of individual people as well as a sizeable part of the country's socio-economic structure.

As for the question of funding the O'Neill project, would we as taxpayers smile benignly if federal dollars were spent? Let us be aware that if we start investing in these colonies expecting returns in a foreseeable future, the investment would have to be on a scale of 20 to 30 billion a year.

Space colonies might be financed through private or corporate means. But if funded privately and if in the future they are capable of generating an unlimited supply of energy, as O'Neill claims, then the group that owns them is virtually in control of the world's economy. We will have created a radical monopoly of energy.

Yet there is another question which is the most crucial of all. Must we multiply energy production and consumption. Is it imperative to do so? We should not be persuaded that because certain amounts of energy are required for cooking and heating, for factories and transportation and the maintenance of communities that we have to use more and more and therefore produce more and more.

Perhaps we are approaching the problem in the wrong way when we assume that simply greater quantities of energy must be produced from whatever sources. This, unfortunately, is the assumption of ex-President Ford, of the economic advisors, of official thinking — and of Gerard O'Neill. Coming before the question "how much energy and from what sources?" is the question "how much energy and what for?" We have been conditioned by the old dogma that Progress must go forward, that Progress means high-powered technology and increased production and consumption of energy. We suppose that there is a correlation between the material standard of life and energy use. From this correlation it does not follow, however, that the more energy we consume the more satisfying our lives will be or the more equitable a culture we will have. Indeed, evidence has been accumulating which suggests that increased use of energy ultimately does not enhance the quality of life for the mass of people.

Ivan Illich has argued that "equity and energy can grow concurrently only to a point. Below a threshold of per capita wattage, motors improve the conditions for social progress. Above this threshold, energy grows at the expense of equity. Further energy affluence then means decreased distribution of control over that energy".

Whether or not Illich's observation is right, we can approach the problem in still another way by noting that energy consumption has actually decreased in recent years. This is a significant phenomenon because it undermines all those suppositions that we are destined to consume more and more energy. It might be

overly optimistic to expect that if we continue this trend in the next 20 years we could cut our consumption by half. But those who predict a doubling of energy use every 10 years have been flatly contradicted. Among those contradicted is Gerard O'Neill who maintains that we shall quadruple consumption by the year 2000.

Energy is a dangerous commodity and we have to be cautious while generating and distributing it. Unlimited production of energy would be an invitation to unlimited disaster. Cornell physicist Eric Alden Smith has made the critical point that "extra energy only adds to the positive feedback of the very system which created all the problems O'Neill wants to solve . . . All energy beamed to earth must end up as heat. Only invariant systems of energy production (systems that add no energy to the earth besides naturally received solar energy) can avoid adding excess, and potentially damaging, heat to the biosphere."

The more energy we use the more environmental dangers we encourage as a by-product. If for example, the oceans are warmed to an unnatural degree, icebergs from the Antarctic could start coming to us in the form of floods. All told, multiplying consumption — even if so-called clean solar energy — is not a solution, for it would inevitably bring about more ecological disasters, not to mention more displacement of people, more Calcuttas, more suburbia. Though it may seem tedious to reiterate this homely fact, we must acknowledge that everything is connected to everything else, and everything must go somewhere. Needless expenditures of energy would produce enormous waste problems.

As for an alternative to current sources, admittedly, energy from the sun is to be preferred. But why build futuristic cities in space ostensibly in order to transmit it? Wilson Clark, the author of *Energy for Survival*, suggests that "there is no compelling need to demonstrate solar energy in space. Solar radiation reaching the earth's surface is ample in most areas of human habitation to provide essential energy needs, at far less cost than a space system." Because all ecological problems and many social and economic problems are the result of over-use, the entire energy question should be reviewed not from the perspective of incrementation — *whatever the source* — but in terms of frugal, sensible use.

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It is clear from O'Neill's writings and public statements that in order to win financial backing for his multibillion dollar project, he must justify it largely in energy returns. But it is the romance which enchants him and his supporters: "From the vantage point of several decades in the future, I believe that our children will judge the most important benefits of space colonization to have been not physical or economic, but the opening of new human options, the possibility of a new degree of freedom, not only for the human body, but much more important, for the human spirit and sense of aspiration."

Space colonies offer escape from the attitude of malaise which has become the chief spiritual cliché of the industrialized world. The idea appeals to our unformulated *fin de siècle* longing for something new to happen since we seem to have outlived those 20th century illusions and experiences, desires and pleasures that once more or less sustained us, gave us a sense of possibility, and made us feel real to ourselves. If Norman Mailer is right in saying, as he did recently, that "the nature of existence cannot be felt anymore", then undoubtedly we are primed for some burst of collective energy which might restore us to ourselves. We are particularly vulnerable to anything that would seem to be a great adventure.

In our opinion, however, space colonization is not going to be any more of an adventure than was the Apollo project — certainly not on an individual level. Like the Apollo project, it threatens to be a large scale experiment in group cooperation, staffed in space by only the most rigorously trained and willing automatons. Isaac Asimov makes the neutral observation that "the establishment of a working colony . . . in an artifical structure in space will require a society fundamentally different from our own — a society that can live in an engineered environment . . ." Yet in his articles and speeches O'Neill continually throws out such ill-examined terms as "human freedom" and "cultural diversity", while his speculative descriptions of life in the colonies inadvertently create an impression of non-freedom and stifling homogeneity.

O'Neill's social speculations are to be found mainly in an imagined "letter from a space colonist" written for *The New York Times Magazine* (Jan. 18, 1976). He manages, in this piece, to neutralize completely any potential sense of wonder or contingency that might issue from life in free space. His apparent aim is to create a world so unnaturally normal in its physical environment and in the routine of its inhabitants that an army of skillful morons, requiring only a few reassuring creature-comforts, could successfully perform their labours within.

Strictly on the level of technology, adequate provision has been made for human habitation in the first colonies. That is, after a period of indoctrination, and once claustrophobes and malcontents were weeded out, those who did qualify could expect to follow the same pantomimes of ordinary earth-bound life played out by sailors in submarines or astronauts in skylabs. The major difference is that colonists would gain bits of greenery to remind them of home and larger, more ingeniously devised quarters as well.

O'Neill likens his early models to a super-tanker in mass. They have been described as spherical, cylindrical, or toroidal vessels in space, set on a permanent course, powered by solar energy, and "containing atmospheres with the same oxygen content as at sea level on earth and rotating slowly to provide a gravity as strong as that of the earth".

Their size and scale might seem grand, even colossal when we recall that they are orbital structures to be manufactured, piece by piece, in free space. But the inmates, the 10,000 or so lodged within, would have to content themselves with house-cat dimensions, an entire world of "about 500 meters in diameter whose inside circumference is nearly a mile at its 'equator'," (O'Neill says proudly) a world where there is no open sky but the

"sunshine comes in at an angle of near 45 degrees, rather like mid-morning or mid-afternoon on earth" and where, in effect, the drapes are pulled every "day" at an appointed time to simulate night.

Lunar soil, enriched with nitrates and water made from a combination of earth hydrogen and lunar oxygen, would form the basis for landscapes. Small scale hills, valleys, and streams are to furnish the interior of living areas. (Though in the next century O'Neill believes that colonies made to house millions could duplicate "a portion of the islands of Bermuda or a section of the California coast like Carmel.") Agricultural and industrial activities are to be removed to separate compartments designed solely for those activities. Each area — farming, manufacturing, residential — would be carefully programmed to sustain the temperature, climate, gravity, and atmosphere suitable to its function. From day to day the eye and the imagination would be fed by the same monotonous, artificial environment. Colonists would commute back and forth from the unvarying interior of work to the unvarying interior of residence knowing that not a single bolt was screwed into place, not an angle or slope existed except where some remote engineer back on earth had assigned it.

According to O'Neill, 4,000 of the first colony inhabitants are expected to participate in the building of more colonies and 6,000 would be producing solar satellite power stations. In other words, all 10,000 are to be, effectively, factory workers and managers. What setting, then, could be more fitting for this industrial army than a company or a barracks town? As in any planned community, apartments which go up simultaneously — pre-fab, made from the same mold — look alike. And since the chances of bringing the family antiques from earth are slim, colony-produced furnishings would also duplicate one another — futuristic tables, lamps, chairs, or simpler modular substitutes, everywhere alike.

All camp towns require entertainments — movies, a few eating and drinking establishments nearby. But O'Neill has additional and more elaborate plans for diversion. If free space is not to be the scene of new forms of contemplation and observation, it will at least provide novel distractions for the simple folk. As he imagines it in his "letter from a space colonist":

> There are ballet productions on the big stage out in the low-gravity recreational complex that serves all the colonies. Ballet in one-tenth gravity is beautiful to watch: dreamlike and very graceful. You've seen it on TV, but the reality is even better. Of course right here in Alpha we have our own low-gravity swimming pools, and our clubrooms for human-powered flight.

And best of all, his parenthetical enthusiasm, "(You'd really enjoy riding a 'bicycle' with flapping wings instead of wheels.)" Whoopee.

Individual experience in an engineered environment which has been established specifically as a "manufacturing facility" (O'Neill) cannot help but be superficial, filled as it will be with strict rules, schedules and checks, devoid of choice and spontaneity — a beneficient bondage for the uncomplicated personality. When they are not engaged in their sterile production and maintenance jobs, people will mostly play. As much of the tiny living area as possible will be left green, so play will take place in a small-scale bucolic setting reminiscent of a William Morris utopia.

Everyone, as in utopias generally, will have a function vital to the community. But in the colonies, individuals will be kept in line by their awareness that survival itself depends on the multiple performance of function. They will act obediently because in spite of the gardens and games which are there to distract them they are trying to support life inside a vulnerable machine.

Of course there would be certain virtues in this technological pastorale — the dystopian virtues which Huxley parodied in *Brave New World* and Zamiatin inflated to a ludicrous portrait of man as machine in his novel, *We*. Since everything runs so smoothly in dystopias — people and machines — they are looked upon by many as desirable future worlds.

Yet it is hard to say whether O'Neill's stratagems belong to fictive future worlds or to a seamy historical past. He is literally correct in stating that space colonies will generate a "continuation rather than an arrest of the industrial revolution". They will, moreover, encourage the continuation of an outmoded technological ethos, projected ad nauseum as we push farther out into space. The smokestack and sweatshop ambience of 19th century industry would merely be refined into a clean, computerized and equally alienating space technology.

At the same time, O'Neill's concept of day-to-day life in space could only have been taken from futuristic science fiction, especially from that side of it which one hopes will *not* be a register of any actual future. The societies depicted both in science fiction and in space colonies are automaton. They are projections of infantile fantasies where nothing and no one is disturbed, nothing changes or grows old or decays, or if it does, it is disposed of quietly while people sleep. Individuals are rendered without history or relationship, resembling, instead, parts of a complex machine, working together synchronously, united in the service of a great technology.

Finally, the O'Neill project, like so much science fiction, offers us technology's dream image of a perfectly efficient humanity, removed from its terrestrial roots, conditioned to order and to artifice, the last accomplishment of the Doctrine of Progress, when everyone walks, as it were, with feet slightly off the ground, or more properly, rides a bicycle with flapping wings, light-footed and light-headed — all in one-tenth gravity.

* * * * *

How Democracy Functions in Switzerland

by Hans Tschäni
translated by
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Accounts of Switzerland usually concentrate on one of two aspects: either the country is portrayed as a remarkable economic power, and the talk is of tourism, clocks, cheese and numbered bank accounts; or else attention centres on the Swiss political system, and the key phrases are 'federalism', 'direct democracy' and 'communal autonomy'.

The present article adopts the second course. It is impossible to examine Switzerland's political life without at once encountering the three key phrases. Each of the 25 cantons that compose the Swiss Confederation has an independent democratic existence; every year there are two or three referenda, which lay domestic issues before the whole populace and keep the party machinery in motion; and in around 3050 communes, where clubs and societies provide a rich social life for the local people, the idea of communal autonomy has survived despite all hostile influences. With the advent of modern industrial society, however, and the mobility and concentrations of power which accompany it, all kinds of new problems are being posed for this system of semi-direct participation in the state, so much so that even a total revision of the federal constitution is under consideration.

The Federal Structure

In its basic political structure Switzerland is not significantly different from other Western federal states: at the lowest level there is *Gemeinde*, the commune; next comes the canton; and at the summit stands the central state, called in Switzerland the *Bund*, or *Bundesstaat*, which is responsible for the foreign policy, for the maintenance of the constitution, and for the army, and hence is the ultimate authority in matters of war and peace. It is in the elaboration of this basic structure that the Swiss have taken a path of their own, in accordance with their particular needs. Because of their strong political traditions, it was a matter of necessity for the Swiss to develop their own form of federalism, but they have been able to make a virtue of this necessity. Their success in extending the procedures of local decision-making to the functioning of the *Bund* as a whole has enabled them to keep direct democracy alive side by side with Parliamentary democracy; and further they have managed to preserve many of the benefits of the commune as an autonomous body. In all this, the Swiss were fortunate in that, from the first, the communes and small communities of the Swiss valleys were viable and vigorous entities. In the creation of Switzerland, what had to be 'organised' was only a small number of cantons (by Napoleon) and the *Bund* itself (by the nineteenth-century Liberals). The communes, constituting by far the greater part of the elements of the state, had arisen through a process of natural growth, and finally it required only pressures and influences from outside to bring about the transformation of these small independent communities, after centuries as neighbours, into a united confederation.

Living with Federalism

The Swiss Confederation, the *Eidgenossenschaft*, consists, as the constitution has it, of 'the united peoples of the 22 sovereign cantons' (since three of the cantons — Basel, Appenzell and Unterwalden — are divided into half-cantons, it is more usual to speak of Switzerland's 25 cantons). These cantons are of different sizes, in terms both of population (Innerrhoden 13,700, Zürich 1,118,000) and of land area (Basel Stadt 37.18 sq. km., Graubünden 7109.89). There are also differences of language: French predominates in the west, Italian in Ticino, and German in the northern, central and eastern regions, while in Graubünden Romansch is still spoken. There are three factors which allow this diversity to be accommodated within the *Bundesstaat:*

(1) the political will of the Swiss 'peoples' to be united in the *Bundesstaat*;

(2) the political will of all the subjects of the *Bundesstaat* to respect the distinctive character and lifestyle of political and linguistic minorities; and

(3) the legal structure of the state, which specifies the division of responsibilities between the cantons and the *Bund.*

The whole has come to be known as Helvetic federalism, a system that fosters a particular style of political activity, because it cannot function effectively without a fine balance of power within the structure (neither too much nor too little centralisation) and a great deal of co-operation between the constituent parts.

In recent years it has been almost exclusively the shortcomings of federalism that have occupied public attention in Switzerland: cantonal autonomy means that, when a motorway is to be built, there are difficulties in drawing up a satisfactory timetable for the work; differences between the school systems in the various cantons mean that, when families move to a new area, their children's education may suffer;* and differences in tax laws between cantons are a cause of displeasure to many, but of much satisfaction to the less scrupulous.

Such is the price that must be paid if minorities are to have adequate protection. A federal system, in

* Because the cantons have the right of veto on constitutional amendments (through their representatives in the *Ständerat*, the upper chamber of Parliament) it has not been possible to include educational requirements in the constitution. Such a step would provide the federal government with an instrument of economic control, and although popular approval has been demonstrated in the referendum, the cantonal veto has always carried the day.

accepting the participation of the cantons, must also reckon with their autonomy. Swiss democracy accords equal weight to the wishes of the majority of the citizens and of the country's minorities: this leads to difficulties. The modern state is expected to be not only democratic but also efficient, and the tension between these demands produces the major criticism of federalism: it is seen as an encumbrance. Even if it is granted that a centralised organisation would function more rationally, the essential point remains. The *Bundesstaat*, if it were to be made efficient, would have to be differently organised. If there had existed a will to that effect, then it would indeed have been differently organised, for where there is power there is no difficulty in finding an adequate structure through which it may be exerted. However, the aim of federalism is precisely to oppose such an aggregation of power. When the Swiss were founding the *Bundesstaat*, they were led to federalism by their distrust of state power, and even today's 'centralism' is a scare-word able to sway the outcome of referenda.

Federalism is a system which operates to the benefit of the individual, and hence also of democracy. It divides the state into smaller communities, and so makes an anonymous whole more easily grasped. As already noted, Switzerland's political system is the natural consequence of an historical process. It has its basis in centuries of experience of self-determination and self-government in communes and valley communities, and there can be doubt today that Switzerland must be federal if it is to exist at all. Cultural considerations lead to the same conclusion: a multilingual society can only ensure its continued survival by allowing its diverse cultural strains a real voice in its affairs, and taking care that no grievances arise. In this area, it is a matter above all of preventive action.

Participation in the State, or Semi-direct Democracy

Swiss democracy is the outcome of a natural evolution not only in its federal structure but also in the form of the decision-making procedure. In the Alpine valleys and villages, where the Swiss learnt the communal management of common land and produce, the most important decisions were made by a general assembly of all the free citizens. At the end of the nineteenth century this procedure of decision-making was to be found in practically all the mountain cantons, and it persists to this day in the *landesgemeinden* (free assemblies) of the cantons Obwalden, Nidwalden, Appenzell Ausserrhoden, Appenzell Innerrhoden and Glarus. In addition it is practised in districts of the cantons Schwyz and Graubünden, and of course in most communes. It was inevitable that this long experience would be an important influence in the shaping of the *Bundesstaat*.

However, the first creative impulse of the Liberals had resulted in a powerful and strictly organised state. In the newly organised *Bund*, the Swiss citizen had the right to vote and the right of eligibility for public office, but direct participation was limited to a single channel, the *obligatory referendum* on constitutional reform. Under this provision, any proposal for a revision of the fundamental laws must be laid before the people in a plebiscite. At this stage, a strong, Liberal-dominated Parliament was in firm control, but the Swiss were unlikely to tolerate for long a situation so alien to their experience and ways of thinking.

In its present form, Swiss democracy involves two groups in the decision-making process: the 25 cantons, and the enfranchised population (which today numbers about four million; women were granted the franchise in 1971). The strength of Switzerland's federal traditions was enough to ensure the full participation of the cantons, whose representatives (two per canton, one per half-canton) sit in the upper chamber of the Swiss Parliament, the *Ständerat*. The *Ständerat* must approve any proposals for constitutional reform, and each canton also has the right to initiate such proposals. On the other hand, the right of the people to political participation was not so readily acknowledged. However, they too have an elected chamber of Parliament, the *Nationalrat*, and the obligatory referendum constituted a break with the principle of Parliamentary democracy from the very first. Gradually, under the pressure of tradition, the individual's right of political participation in the *Bundesstaat* was extended.

In the great constitutional reform of 1874, a second type of referendum was introduced. Henceforward, 30,000 voters could demand, by petition, that any important law passed by Parliament be submitted to the people in a referendum. This, the *facultative referendum*, constitutes a genuine right of popular veto. A majority of 60 per cent in the referendum is enough to quash any law passed by Parliament. In 1921, the facultative referendum was extended to cover international treaties, so that the Swiss people now have a right to intervene also in foreign policy.

In 1891, the introduction of the *constitutional initiative* gave a further degree of direct participation in the state. By this measure, any proposals for amendments or additions to the federal constitution which are supported by a petition of 50,000 voters must be submitted to a referendum. Since 1891, there have been very many popular initiatives (above 110 in the first 80 years), but only about 10 per cent have been successful in the referendum.

These two features — the facultative referendum and the constitutional initiative — determine the distinctive style of Swiss politics. They represent an attempt to adapt deep-rooted political traditions — based on an innate distrust of state power and a sense of personal responsibility in community matters — to the conditions of the modern world. However, the effect of these two measures in the past eighty years has not been wholly beneficial. The popular initiative has buried the constitution under an avalanche of particular instances and ruined its systematic form, while the referendum has become a threat to the entire legislative process. Any group that is powerful enough both to initiate a referendum and to carry the vote can force Government and Parliament to pay heed. The stranglehold of the referendum has brought the legislative process in Switzerland to a standstill.

With the recognition of this state of affairs, there has been discussion

of possible reforms. However, there is no question of abolishing these rights for, although the Swiss may not often participate in referenda, they value their right to intervene when the occasion seems to demand it. In this, the Swiss have carried over to the *Bund* what they have learned through the centuries in the cantons and, above all, in the communes.

The Commune, Living Cell of the Body Politic

From what has been said it is clear that the idea of building the state from the bottom upwards is firmly established in Switzerland. The smaller parts of the state were not produced by the division of larger units; on the contrary, as Riccardo Jagmetti says, they were 'the constitutive elements' of the larger units.

Historically, the Swiss commune, the *Gemeinde*, has its origins in the European communal revolutions of the twelfth and thirteenth centuries. The communes of the Alpine valleys, managing to withstand the feudal eagle, preserved the Alemannic practice of self-government. On the communal land, common property was tended and administered, and the decisions affecting the future of the commune were made by an open assembly of the menfolk. This experience ensured that, at the founding of the *Bundesstaat*, the role of the commune as an autonomous unit was retained and affirmed.

The Swiss commune is distinguished by the breadth of its autonomy. This is evident in its organisational structure, where the emphasis is less on the execution of policies determined at the cantonal level than on making decisions of its own. In the medium-sized and smaller Swiss communes, the practice of democracy is direct and unostentatious. Each commune has a president (in some regions known as the *Amman*, the elder), a father figure to whom considerable responsibilities are entrusted. The important decisions are made by a free assembly of all citizens. They determine the taxes and the allocation of communal expenditure, keep an eye on the administration of the commune, approve loans and pass their own laws. The commune administration, in planning building developments or determining the financial outlay for a specific purpose, must always reckon with the possibility that the citizens' assembly will reject its proposals. Often the administration is asked to re-examine a particular project with a view to reducing its cost; direct democracy, as might be expected, tends to restrain over-generous spending by the administration. Of course, it only gradually becomes apparent whether the citizens' judgement in a given case has been wiser than the administration's. In the larger towns, where parliamentary democracy has been introduced, the use of the referendum ensures that the ultimate sanction remains with the citizens.

There are also special communes to undertake specific communal functions — school communes, church communes, which administer church property and elect the local minister, welfare communes,* and so on. Such types of communes are found predominantly in the German-speaking cantons; in the cantons of Thurgau, St. Gallen and Glarus, as many as six different types of commune are to be found. These bodies are true communes, in the sense that, in their particular area of responsibility, they have freedom of decision, subject to cantonal supervision. School communes, for example, exist as independent organisations in six cantons; they are concerned predominantly with primary education, while the canton is responsible for secondary and higher education.† Naturally the school communes are required by law to maintain certain clearly defined standards, and it falls to the education department of the canton to ensure that those standards are met.

Membership of these communes is conditional only upon residence. While particular convictions may lead an individual to become involved in such a commune, they are not a precondition of his involvement and indeed, since the constitutional revision of 1874, there are no special requirements for eligibility at the communal level, except those mentioned below in connection with the *Bürgergemeinde*.

The two most important types of commune in Switzerland are the political commune (which is what is usually meant when the Swiss commune is discussed) and the *Bürgergemeinde*, the citizens' commune.

In Switzerland, citizenship is threefold: the Swiss is a citizen firstly of a commune, then of a canton, and finally of the *Bund*. Federal law prescribes that the citizen may settle anywhere in the country and exercise his right to vote there. However, he retains certain rights and duties in his *Bürgergemeinde*, the commune of which he is a citizen, and of which generations of his family before him have likewise been citizens.* The *Bürgergemeinde* often has considerable property to administer, from which its members are entitled to an annual *Bürgernutzen*, an allowance of wood or of local wine. This right to the fruits of the ancestral property is written into the federal constitution. Article 43, which asserts that the Swiss citizen shall enjoy, at his place of residence, the rights proper to a citizen of that canton and of that commune, specifically excludes the right to a share in the communal property and to a voice in matters that pertain purely to the citizens. In addition to administering the communal property, the *Bürgergemeinde* is responsible for conferring citizenship.†

All matters that do not fall within the province of one of the special communes are dealt with by the political commune, also called the *Einwohnergemeinde*, the residents' commune, which is today the most important form of commune in

* The number of special welfare communes, devoted to poor relief, has steadily decreased since state old-age and sickness insurance came into force thirty years ago.

† The *Bund* has the right to found universities, but to date has only established two technical universities, in Zürich and Lausanne; plans for a genuine federal university have been paralysed by regional anxieties.

* Only about a third of Swiss now live in the commune where they are citizens but, as Jonathan Steinberg has noted, a sense of belonging to the *Bürgergemeinde* persists even among those whose families have lived elsewhere for several generations.[1]

† For a non-Swiss to acquire citizenship is a long process. He may apply first of all for permission to reside, which allows him to work in Switzerland for an extended period. This is purely a matter of sufferance, however, and the permission must be periodically renewed. Permission to settle has a more permanent character, but only after twelve years of residence can he be considered for citizenship; the commune, not the *Bund*, has the final word.

Switzerland. It was first created in the period of the Helvetic Republic (1798-1803), when Switzerland was occupied by Napoleon, and its permanent status was acknowledged two years ago with the inclusion in the constitution of the above-mentioned Article 43. Thereafter, the place of residence of the Swiss citizen was legally of equal standing with the *Bürgergemeinde*, the traditional home of his family.

Traditionally, it was the *Bürgergemeinde* which, in the last resort, would support any of its citizens who fell into destitution, wherever they might be living at the time. In the last few decades, however, because of the increasing mobility of the population, the commune of residence has come to accept more responsibility in this matter. The cantons have already reached an agreement to observe the principle of residence rather than that of citizenship, and the federal Parliament is at present considering a Bill establishing legal norms on welfare, which is based firmly on Article 43 and the principle of residence.

It is clear even from this brief account that the commune is closely integrated into everyday life. The Swiss citizen lives in his commune, marries and dies there, is active in its clubs and societies; above all, it is in and through the commune that he encounters the state. All of the contacts between the individual and the state, as citizen, voter, or taxpayer, occur in the commune. The political climate of the country as a whole takes its tone from the climate in the commune, where everything is small enough to grasp. In the commune, everything is specific, whereas the affairs of the *Bund* are abstract. It is important that what is familiar and at hand can be directly controlled.

This is an idealised picture of the commune. It is necessary also to consider the social changes of more recent times that threaten to undermine the system in practice. Communal autonomy is being eroded, and in some areas local traditions have been completely wiped out. Many communes have been reduced to dormitory towns to which the inhabitants feel no real relation, so that attendance at the communal assemblies is poor. These developments constitute a serious threat, for the multitude of communes at the base of the federal system is an unstable and sensitive structure, responding rapidly to any change. A few decades ago, in the name of efficiency, the larger towns were steadily assimilating the small communities around their peripheries; Zürich, for example, has expanded greatly in this way. It quickly became evident, however, that there are many reasons for preserving the independence of such communes, and peripheral communities faced with assimilation today are apt to put up a spirited resistance in the referendum.

This threat to the federal structure is past, but there remains the problem of emigration from the small mountain communes. Whole villages which no longer have an economic basis for their existence are simply disappearing. In the canton of Graubünden and elsewhere, there are provisions under which such poor communes can be offered financial assistance. In accepting such assistance, however, the commune must submit to a degree of surveillance which significantly impairs their autonomy — by no means a welcome development. Last year, no less than 66 of Graubünden's 219 communes were in this position. Writing of Graubünden, 'the Swiss National Park of communal life', Benjamin Barber observed that industrial society has reduced to nothing the freedom of the Alpine communes.[2]

Throughout the country, the economic boom of the last few decades has overwhelmed the powers of decision of small communities. The wish to profit from economic development and the greed of a few have often led to curtailment or manipulation of local democratic choice. This is true in particular of Alpine tourist resorts and of the urban agglomerations. However, there is no doubt that communal democracy still functions almost without problems in the rural areas — not least because these areas have so far been spared the temptation of extreme economic development.

Switzerland's achievement in securing the survival of communal democracy should not be underestimated. As Alexis de Tocqueville declared: "The strength of a free people rests in the commune. Communal institutions are to freedom what primary schools are to knowledge: they prepare the people for freedom and teach them to take pleasure in its proper exercise."

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Reinhabiting California

Peter Berg and Raymond Dasmann

A change is taking place in California. It cannot be easily quantified or evaluated since many who are involved do not want to be counted or publicized. But the direction is becoming clear. The change involves the spread of communities of people who are trying a new approach to living on and with the land. We call this phenomenon reinhabitation, a process that involves learning to live-in-place.

Living-in-Place

Living-in-place means following the necessities and pleasures of life as they are uniquely presented by a particular site, and evolving ways to ensure long-term occupancy of that site. A society which practises living-in-place keeps a balance with its region of support through links between human lives, other living things, and the processes of the planet — seasons, weather, water cycles — as revealed by the place itself. It is the opposite of a society which "makes a living" through short-term destructive exploitation of land and life. Living-in-place is an age-old way of existence, disrupted in some parts of the world a few millenia ago by the rise of exploitative civilization, and more generally during the past two centuries by the spread of industrial civilization. It is not, however, to be thought of as antagonistic to civilization, in the more humane sense of that word, but may be the only way in which a truly civilized existence can be maintained.

In nearly ever region of North America, including most of California, natural life-support systems have been severely weakened. The original wealth of biotic diversity has been largely spent and altered toward a narrow range of mostly non-native crops and stock. Chronic misuse has ruined huge areas of once-rich farms, forest, and range land. Wastes from absurdly dense industrial concentrations have left some places almost unlivable. But, regardless of the "endless frontier" delusion and invader mentality that came to dominate in North America, removing one species or native people after another to make-a-living for the invaders, we now know that human life depends ultimately on the continuation of other life. Living-in-place provides for such continuation. It has become a necessity if people intend to stay in any region without further changing it in ever more dangerous directions.

Once all California was inhabited by people who used the land lightly and seldom did lasting harm to its life-sustaining capacity. Most of them have gone. But if the life-destructive path of technological society is to be diverted into life-sustaining directions, the land must be reinhabited. *Reinhabitation* means learning to live-in-place in an area that has been disrupted and injured through past exploitation. It involves becoming native to a place through becoming aware of the particular ecological relationships that operate within and around it. It means undertaking activities and evolving social behaviour that will enrich the life of that place, restore its life-supporting systems, and establish an ecologically and socially sustainable pattern of existence within it. Simply stated it involves becoming fully alive in and with a place. It involves applying for membership in a biotic community and ceasing to be its exploiter.

Useful information for reinhabitants can come from a wide range of sources. Studies of local native inhabitants, in particular the experiences of those who have lived there before, both those who tried to make a living, and those who lived-in-place can contribute. Reinhabitants can apply this information toward shaping their own life patterns and establishing relationships with the land and life around them. This will help determine the nature of the bioregion within which they are learning to live-in-place.

Reinhabitation involves developing a bioregional identity, something most North Americans have lost, or have never possessed. We define *bioregion* in a sense different from the biotic province of Dasmann (1973) or the biogeographical province of Udvardy (1975). The term refers both to geographical terrain and a terrain of consciousness — to a place and the ideas that have developed about how to live in that place. Within a bioregion the conditions that influence life are similar and these in turn have influenced human occupancy.

A bioregion can be determined initially by use of climatology, physiography, animal and plant geography, natural history and other descriptive natural sciences. The final boundaries of a bioregion are best described by the people who have long lived within it, through human recognition of the realities of living-in-place. All life on the planet is interconnected in a few obvious ways, and in many more that remain barely explored. But there is a distinct resonance among living things and factors which influence them that occurs specifically within each separate place on the planet. Discovering and describing that resonance is a way to describe a bioregion.

The realities of a bioregion are obvious in a gross sense. Nobody would confuse the Mojave desert with the fertile valley of Central California, nor the Great Basin semi-arid land with the California coast. Between the major bioregions the differences are sufficiently marked that people do not usually attempt to practise the Sonoran desert way of life in the Oregonian coastal area. But there are many intergradations. The chaparral-covered foothills of Southern California are not markedly distinct

from those of the coast ranges of Northern California. But the attitudes of people and the centers to which they relate (San Francisco vs. Los Angeles) are different and these can lead to different approaches to living on the land.

The northern California bioregion is ringed by mountains on the north, east and south and extends some distance into the Pacific Ocean on the west. Since the boundaries depend in part on human attitudes they cannot be clearly mapped. These attitudes, however, have been persistent since prehistoric times. The region is separated from Southern California by the barrier of the Tehachapi Mountains and their extension through the Transverse Ranges to Point Conception on the seaward side. Flora and fauna change to some extent on either side of this boundary, but human attitudes are more important in the separation. Eastward, the region is enclosed by the Sierra Nevada which stops the rain and defines the dry Nevadan bioregion. Northward the volcanic Cascade Range and the geologically ancient Klamath Mountains separate the Oregonian bioregion. Along the coast the boundaries are fuzzy, but one could draw a line at the northern limit of the coastal redwood forests, at Oregon's Chetco River.

Within the bioregion is one major watershed, that of the Sacramento-San Joaquin river system which drains from all of the Sierra-Nevada, Cascade, and interior Coast Ranges and flows through the broad plain of the Central Valley. Coastally, smaller watersheds are significant, those of the Salinas, Russian, Eel, Mad, Klamath and Smith rivers. The Klamath River is anomalous in that it drains from an area that belongs to a different bioregion. So too does the Pit River which joins the Sacramento. Other-wise the drainage systems help to define and tie together the life of the bioregion, and the characteristics of watersheds point out the necessities which those who would live-in-place must recognize.

Biologically the California biotic province, which forms the heart of the bioregion, is not only unique but somewhat incredible — a west coast refuge for obscure species, full of endemic forms of plants and animals. It is a Mediterranean climatic region unlike any other in North America. It is a place of survival for once widespread species as well as a place where other distinct forms evolved. Anthropoligically it is also unique, a refuge for a great variety of non-agricultural peoples on a continent where agriculture had become dominant.

During the century and a half that invader society has occupied northern California, a primary sense of location has been provided by surveyors dividing up the land. We know more about property lines than we do about the life that moves under, over, and through them. People are bombarded with information about the prices of things, but seldom learn their real biospheric costs. They are encouraged to measure the dimensions of things without ever learning their places in the continuity of bioregional life.

Our real "period of discovery" has just begun. The bioregion is only barely recognized in terms of how life systems relate to each other within it. It is still an anxious mystery whether we will be able to continue living here. How many people can the bioregion carry without destroying it further? What kinds of activities should be encouraged? Which ones are too ruinous to continue? How can people find out about bioregional criteria in a way that they will feel these exist for their mutual benefit rather than as an imposed set of regulations?

Natural watersheds could receive prominent recognition as the frameworks within which communities are organized. The network of springs, creeks and rivers flowing together in a specific area exerts a dominant influence on all non-human life there; it is the basic designer of local life. Floods and droughts in northern California remind us that watersheds affect human lives as well, but their full importance is more subtle and pervasive. Native communities were developed expressly around local water supplies and tribal boundaries were often set by the limits of watersheds. Pioneer settlements followed the same pattern, often displacing native groups with the intention of securing their water.

Defining the local watershed, restricting growth and development to fit the limits of water supplies, planning to maintain these and restore the free flowing condition of tributaries that are blocked or the purity of any which have been polluted, and exploring relationships with the larger water systems connecting to it could become primary directions for reinhabitory communities. They could view themselves as centered on and responsible for the watershed.

The Central Valley has become one of the planet's food centers. The current scale of agriculture there is huge; thousands of square miles under constant cultivation to produce multiple annual crops. Fossil-fuel-dependent heavy equipment appears at every stage of farming operations, and there is a steadily rising rate of artificial fertilizer use. Most of the land is owned or leased by absentee agribusiness corporations. It's a naturally productive place. Northern California has a temperate climate, a steady supply of water, and the topsoil is some of the richest in North America. But the current scale of agriculture is untenable in the long-term. Fossil fuel and chemical fertilizer can only become more expensive, and the soil is simultaneously being ruined and blown away.

There needs to be massive redistribution of land to create smaller farms. They would concentrate on growing a wider range of food species (including native food plants), increasing the nutritional value of crops, maintaining the soil, employing alternatives to fossil fuels, and developing small-scale marketing systems. More people would be involved, thereby creating jobs and lightening the population load on the cities.

Forests have to be allowed to rebuild themselves. Clearcutting ruins their capability to provide a long-term renewable resource. Watershed-based reforestation and stream restoration projects are necessary everywhere that logging has been done. Cut trees are currently being processed wastefully; tops, stumps and branches are left behind, and whole logs are shipped away to be processed elsewhere and sold back in the region. Crafts that use every part

of the tree should be employed to make maximum use of the materials while employing a greater number of regional people. Fisheries have to be carefully protected. They provide a long-term life-support of rich protein, if used correctly, or a quickly emptied biological niche, if mishandled. Catching fish and maintaining the fisheries have to be seen as parts of the same concern.

Reinhabitory consciousness can multiply the opportunities for employment within the bioregion. New reinhabitory livelihoods based on exchanging information, cooperative planning, administering exchanges of labor and tools, intra- and inter-regional networking, and watershed media emphasizing bioregional rather than city-consumer information could replace a few centralized positions with many decentralized ones. The goals of restoring and maintaining watersheds, topsoil, and native species invite the creation of many jobs to simply un-do the bioregional damage that invader society has already done.

Politics

Beginning with the Spanish Occupation, the distinctiveness of northern California's ongoing bioregional life has been obscured by a succession of alien super-identities. The place to fit into simply wasn't recognized.

First, it was part of "New Spain" a designation that tells nothing of this specific place and lumps it with a dozen barely related bioregions radiating out from the Caribbean. "California" was a fictional island created by a 16th century Spanish novelist and it became the next rough label pasted over the bioregion when it was adopted for the Pacific side of New Spain. "Alta California" actually approximated the bioregion by accident; its real use was simply to acknowledge further Spanish explorations above the "baja". Mexico held it (along with half the western U.S.) in the early 19th century, but since the middle of last century almost the whole bioregion has been included in the annexed portion of Mexican territory that was sliced out as the State of California along with totally foreign pieces of the Great Basin desert and similarly dry stretches below the Tehachapi Mountains.

The bioregion that exists largely in what is now called northern California has now become visible as a separate whole, and, for purposes of reinhabiting the place, it should have a political identity of its own It is predictable that as long as it belongs to a larger state it will be subject to southern California's demands on its watersheds. Its rivers already run through pipes to Los Angeles. Its control over use of the Central Valley is pre-empted by policies tailored for southern monocultures. From a reinhabitory point of view, both are bioregional death threats. Elections over the last decade have shown a distinct difference in voting sentiments between northern and southern California. It is likely that this difference will continue and increase on vital bioregional issues on which the population weight of southern California will prevail.

The bioregion cannot be treated with regard for its own life-continuities while it is part of and administered by a larger state government. It should be a separate state. As a separate state, the bioregion could redistrict its counties to create watershed governments appropriate to maintaining local life-places. City-country divisions could be resolved on bioregional grounds. Perhaps the greatest advantage of separate statehood would be the opportunity to declare a space for addressing each other as members of a species sharing the planet together and with all the other species.

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The energies of our system will decay, the glory of the sun will be dimmed, and the earth, tideless and inert, will no longer tolerate the race which has for a moment disturbed its solitude. Man will go down into the pit, and all his thoughts will perish.

A.J. Balfour (1848-1930)

An eye for an eye

Leonard Williams is founder and Director of what is probably the most successful breeding colony of Woolly monkies outside the Amazon jungle. The following correspondence illustrates the difficulty some people experience in distinguishing a sanctuary from a mortuary:

From A.A. Best Esq., Director Rowland Ward Ltd., Taxidermists.

Dear Mr. Williams,

From time to time we receive enquiries from our clients who wish to purchase animal skins of all types, usually made up as rugs from our stocks.

I am writing to enquire whether you can offer us skins of such animals as tiger, leopard, polar bear etc., when any of your animals die. If you can arrange to supply us, I shall be glad to hear from you in due course.

to which Leonard Williams replied:

Dear Mr. Best,

In reply to your letter, I regret to say that we have very little to offer you in the way of animal skins. Most of the big game hunters who are shot in our sanctuary are collected by their relatives, who prefer to make their own funeral arrangements.

Recently however a distinguished colonel — famous for his sportsmanship as a great killer of African wild life — was captured by us alive. His skin is in poor condition, but his mane would make an excellent wig for a chimpanzee friend of mine who is going bald. If you can supply me with the wig, I will be pleased to let you have the colonel free of charge.

The quality of Silence is not strained . . .

"Nuisance is an inconvenience materially interfering with the ordinary physical comfort of human existence, not merely according to elegant or dainty modes and habits of living, but according to plain and sober and simple notions obtaining among English people." So says the Noise Abatement Act of 1960. And so say all of us, no doubt, but inspite of this almost Victorian vision of a nation consisting of good simple living Englishmen, the Act, like so many of its kind is virtually without teeth, and today, according to the Noise Advisory Council ". . . about a quarter of a million of the vehicles on our roads at any given time have defective or inefficient silencers . . . at the present level of enforcement the chances of the owner of one of those vehicles being caught and prosecuted is obviously remote."

Family trees

During National Tree Week this month hundreds of thousands of pounds will have been spent on planting trees, but as Nicholas Gould pointed out in his Notebook (*The Ecologist Vol 6. 8.*) ". . . too many people still believe that all you have to do to plant a tree is to stick it in a hole and leave it to grow'. Following the 'Plant a tree in '73' campaign thousands of small dead trees were to be seen in villages and towns around the country. The best, therefore, that one can hope from National Tree week, is that some of the trees will survive and equally important that some of the information and the vastness of the problem will stay in the public mind. Speaking in Hertfordshire recently, the Deputy County Planning Officer, Mr. Geoffrey Steeley said that though the county still retained many of its fine old trees, a healthy landscape needed *nine young trees to every one mature tree* . . . in Hertforshire that nine to one ratio was only one to one which spelled disaster for our countryside. Mr. Steeley compared the situation to that of a village which is said to be dying when it becomes predominantly inhabited by old people, and suggested that the only answer was for counties to undertake massive tree-planting programmes, parish by parish, until the existing ratio was improved to something nearer the ideal of one to nine. Scrubland, wasteland and hedge rows are all important places where young trees can grow, and it is these areas that can and should be used by local authorities to plant our native hardwoods.

Conservation News No 66 1977

Sugaring the pill

Resistance to new foods is strong in the Third World, as it must be in any society still informed with the spirits of its own tradition and culture. Forcing an Indian to eat cow-meat or an Englishman to eat rats causes serious disruption. There is however one ingenious method for overcoming this problem, as Ignacy Sachs discovered when he met the distinguished Ghanaian biologist Dr. Letitia Obenge. "You come from a country of frog-eaters" she told him (Sachs is French) "In Ghana there are plenty of frogs but nobody would eat them. So I tried an experiment. In the evening I put lights round my pond to attract mosquitoes. Then the frogs came and ate the mosquitoes; I used the frogs to prepare meal for my chickens, which they thrived on. That is how I transformed mosquitoes into steaks."

Personal communication from Ignacy Sachs.

Per Ardua ad Astra

NASA (the US National Aeronautics and Space Administration) is seeing stars again. They have commissioned Lockheed-California to study the feasibility of a hypersonic airliner which will burn liquid hydrogen. The plane will fly so high that it seems unlikely it will often bother the citizens of old planet earth.

"An aircraft such as the one we are studying would cruise at altitudes 110,000 ft to 120,000 ft" says Lockheed manager for Hydrogen Studies, Dan Brewer. "From that height the intensity of any sonic boom should be so dissipated by the time it reaches the ground that it would not be objectionable to anyone hearing it." Is this to be the final nail in Concorde's coffin?

New Scientist 10.11.77

Stability

"Nature, left undisturbed, so fashions her territory as to give it almost unchanging permanence of form, outline and proportion, except when shattered by geologic convulsion; and in these comparatively rare cases of derangement, she sets herself at once to repair the superficial damage, and to restore as nearly as practicable, the former aspect of her dominion . . . A condition of equilibrium has been reached which, without the action of man, would remain with little fluctuation, for countless ages."

George Perkins Marsh. Man and Nature

Books

Map Reading

A GUIDE FOR THE PERPLEXED
E.F. Schumacher; Jonathan Cape, £3.95.

Following a North American lecture tour drawing 60,000 people, Fritz Schumacher died last September aged just sixty-seven. His persistent, gently powerful theme was that of evolution towards a society which, though it could never sustain current consumer fantasy, would satisfy the totality of our human needs, and not merely the material ones. Respectful therefore of the ecological tapestry's delicate fabric, as well as of individual dignity and cultural differences, Schumacher's vision was of future societies largely decentralised and abiding by the human scale in their technology, institutions and settlements. In his own phrase, "small is beautiful".

Spiritually aware as well as scientifically well informed in his approach to problems, Schumacher's work was rooted as much in an inner world of feeling as in observable facts and figures. And it was this self-awareness — usually rejected (or avoided?) by the scientist as immaterial and by political and environmental activists as a selfish "cop-out" — that gave him the strong empathising base from which to comprehend the actions and aspirations of his fellow men; thus was he able to convey such profound commonsense for thoughtful and reflective people of all persuasions.

> "It is", he writes, "a grave error to blame a man who pursues self-knowledge for 'turning his back on society'. The opposite would be more nearly true: that a man who fails to pursue self-knowledge is and remains a danger to society, for he will tend to misunderstand everything that other people say or do and remain blissfully unaware of many of the things he does himself."

So largely ignored in this utilitarian age, finding the initial commitment to that "journey into the interior" is a continuous motif of the book.

Schumacher is interested in looking at, and making sense of, the world *as a whole*; and in helping the reader to do the same. To this end he unfolds his own metaphysical map, and with a humour and clarity I have never before encountered in a philosophical text, proceeds to offer us a guidebook to that small corner of the universe which he labels "Man lives in the world". Of his map-making, he says:

> "Its motto, in a sense, is 'Accept everything; reject nothing.' If something is *there*, if it has any kind of existence, if people notice it and are interested in it, it must be indicated on the map, in its proper place."

The unorthodox, in art, nature and all the sciences, are therefore not omitted but recorded *prominently;* because, unproven, they constitute a challenge to the living. Such a map is:

> "simply a beginning — the very beginning that is at present lacking, when people ask: 'What does it all mean?' or 'What am I supposed to do with my life?' "

Though, as he emphasises, his map neither "solves" problems nor "explains" mysteries, it does help identify them, offering landmarks to show how others have approached or transcended them in the past.

The trouble is, of course, that the maps we are given today in our schools, universities and the wider culture leave all the questions that really matter unanswered.

> "More than that, they do not even show a way to a possible answer: they deny the validity of the questions. . . . the ever more rigorous application of the scientific method to all subjects and disciplines has destroyed even the last remnants of ancient wisdom — at least in the Western World."

Schumacher's contemporary relevance is greatly strengthened by his being neither unscientific nor against science; (he was, remember, for twenty years economic advisor to the Coal Board, and then founder-chairman of the Intermediate Technology Development Group.) But his first task here is clearly to put science in its rightful place. Which he does in a sane, temperate and succinct manner, recognising its immense benefits as "science for understanding", or wisdom; and its wantonly unheeded limitations as "science for manipulation".

Though easy enough to follow, I shall not attempt to describe Schumacher's map; the abbreviation necessary would invite its dismissal as being oversimplified or unworkable. It is neither. Instead I urge you to engage this book for yourself.

For though we may strive sincerely towards social and technological change — for hunter-gatherers or agin fast-breeders — inwardly we are most of us dynamic conservatives to the last. In the one realm in which we can each really make progress, our inner selves, we tenaciously resist growth and change.

In what is a moral book, certainly, but not a religious tract, Schumacher is reaffirming the centrality of self-knowledge. Coming in the closing quarter of the twentieth century, from one who fully appreciated the place of science, this book is both timely and important: a tool to help heal dualities and span the abyss to a wholeness beyond reductionism.

Thus, for example, while nuclear power's arch advocates appear increasingly bionic in their public utterances, they are probably, like other technocrats, quite human. Such a book touches hard-liners in their soft spot. And the wide-eyed world-saving eco-freak can, in Schumacher's liberating company, move from polarity towards the Middle Way. The common ground may be our timeless inner humanity, all but lost in the materialist rush. Now mapped in modern terms, more of us may dare make the journey; acknowledging forgotten needs, shedding spurious wants. And that's some programme for social change!

Reading "A Guide" again, I wonder where such a fine spirit might have progressed to next. That is for each of us to discover. Here and now, though, I cannot imagine a more welcome and lastingly worthwhile legacy.

Philip Brachi

Jolly Good Nosh, Old Bean!

BEAN CUISINE A Culinary Guide for the Ecogourmet, Beverly White. Routledge & Kegan Paul. Paperback £2.50.

If you have a pressure cooker and you want an intelligent and imaginative guide to producing vegetarian meals based on beans, you'll love this book. If, like me, you do not have a pressure cooker, and aren't about to spend upwards of £10.00 buying one, you are likely to be frustrated when you read that: 'This book assumes that the bean cook will have purchased a pressure cooker as standard equipment.' And although the author says that instructions for cooking without pressure are also included, I can tell you that these are mighty hard to find. I turned eagerly to the section headed *Oven Beanpots*, only to be disappointed once again; of the seventeen recipes in this chapter *ten* include instructions for pressure cooking ingredients before putting them in the oven, and of the seven others only two contain uncooked beans, both of them based on navy beans which are among the softest, and therefore most easily cooked types. Nowhere in this book can an aspiring cook find out how long the hard beans must be cooked en casserole in a slow oven, (except in the welcome and amusing Campfire Baked Beans American Indian style — 'dig a hole in the ground . . .' which is splendid) Pressure cookers no doubt have their place. My aversion to them stems from the days when they first appeared and pressure cooked stews, so inferior to slow oven cooked ones, were a boring cult. That's about as logical a reason for not having one today as my friend Mr. Bowden had, back in 1942, for not having a milking machine. Six of us milkmaids used to milk upwards of ninety cows morning and night, by hand. Above our heads in the long cowshed, as we crouched on three-legged stools, foreheads pressed to the shining flanks of the shorthorns, we eyed yards of dusty piping. 'Yes', sighed Rosie Bowden, 'Dad had it put in in 1915. It was the first one in the south of England and it didn't work very well, so he stopped using it, and he'll have no more to do with milking machines.'

But back to *Bean Cuisine*. Beverley White has spent years researching her subject and probably knows as much as anyone about beans; given rapidly increasing interest in vegetarian cookery there is obviously a genuine need for her book. More importantly the author is ideologically committed to the idea of substituting beans for traditional meat dishes, as main meals, not only on the grounds of improved health and greater thrift, but in order to minimise the exploitation of farm animals. By promoting the habit of eating more leguminous foods ourselves, instead of after they have been wastefully processed through an animal to provide meat, we can make a direct, logical and effective contribution to reducing the pressures on world food resources.

The book is nicely produced and pleasant to look at, but at £2.50 it compares badly with Rose Eliot's Bean Feast at £1.05, and many other paperback cookery books.

Ruth Lumley-Smith

Natural Aids

PLANTS WITH A PURPOSE Richard Mabey. Collins, £4.50.

Richard Mabey is one of those authors with an enviable gift for picking winners. *Food for Free*, *The Unofficial Countryside*, and now *Plants with a Purpose* are all books which were just waiting to be written. Like many great ideas they seem obvious as soon as someone else has thought of them: but it is lucky that Mabey got there first, for he is a writer talented enough to do full justice to his themes. His style is delightful, his learning is immense, and he has a rare combination of imagination and common sense which is particularly valuable when writing on such topics as are contained in the present book.

Plants with a Purpose is a sequel to *Food for Free:* its theme is the multitude of things one can do with wild plants besides eating them — to name but a few, Brooms and Glue and Insecticide and Soap and Pillows and Ink and Tobacco and Carpets and Recorders and String for Free! It is perilously easy to do this sort of thing badly: whimsical references to "olden days" or "country folk", snippets of ill-digested folklore, wild and totally unsubstantiated claims of curative properties, inadequate instructions for the manufacture of arty-crafty rubbish. Richard Mabey has none of this. He points out that only about 4 per cent of the 300,000 plant species in the world have been thoroughly investigated for useful products — yet think how *many* useful products this tiny sample has in fact yielded. *Plants with a Purpose* obviously does not claim to be a comprehensive survey of the uses even of the comparatively poor British flora. Mabey's primary objective is to re-awaken our awareness of the potential usefulness of wild plants: this he does by concentrating on "a representative selection of plants that illustrate *styles of approach* to plant use".

The variety this limitation still allows him is remarkable. He classifies the products of plants into five broad categories: "their chemicals, for medicines; their colours, for dyes; their scents; their woody parts, for carving; and their fibrous and twiggy parts for weaving". The first category, medicinal plants, he wisely plays down; it is a field where much is claimed but little proven (though the fact that so many modern drugs, from aspirin and penicillin to the Pill, are plant derivatives suggests that medical researchers would be foolish to reject out of hand the claims of the herbalists). *Plants with a Purpose* mentions only some of the milder, pleasanter remedies, like balsams and hop pillows. On dyes, too, Mabey is a restrained advocate: he sees the disadvantages — like the fact that natural dyes tend to need unnatural, and highly toxic, mordants to "fix" their colours.

Many plants, of course, have uses which fall into several categories. Mabey's favourite is that despised 'weed", the elder. This, he says, "has more practical uses discovered for it than any other temperate zone plant". Its bark, leaves, flowers and berries all have medicinal, cosmetic or culinary properties; the hollowed-out stems will make flutes, bellows-pipes or pop-guns; the pith inside is one of the lightest

solids known (with a specific gravity of 0.09 to cork's 0.24), and has a number of obscure industrial uses; the mature wood is hard enough to make cogs in mill machinery, but while still green is first-rate for carving; even the leaves repel flies. And with all these virtues elder grows fast and is amazingly tolerant of poor soil and polluted air. Surely a plant for our time, "not just economic but truly economical, a plant which makes the best and most efficient use of its resources. Mysterious, fecund, marvellously adaptable — nothing about it is dull, and none of it need go to waste". Nothing about Richard Mabey is dull, either. I hope this book will win many more converts to the intimate, *empathetic* way of looking at the natural world which he has made so distinctively his own.

Nicholas Gould

Colour Coding

THE RACE BOMB: Skin Colour, Prejudice and Intelligence by Paul R. Ehrlich and Shirley Feldman. Quadrangle/New York Times Book Co. $9.95.

Scientific racism has a long, ignoble history and a squalid, potentially explosive present. A semi-respectable aspect of it, the theory that blacks are innately — *genetically* — less intelligent than whites, has evolved from IQ test statistics, and is subscribed to, with varying degrees of reluctance, by non-racist as well as racist academics. In *The Race Bomb*, Paul Ehrlich and Shirley Feldman of Stanford University, challenge the theory with the combative subjectivity of Mohamed Ali himself. A mixture of sober scientific analysis and crusading liberal journalism, the book claims a seventh round knockout and certainly achieves a win on points.

The authors argue convincingly that race is a social reality but a biological illusion. From this it follows that the race-intelligence question reduces to one of skin colour and intelligence — and there is no genetic reason why colour of skin should affect intelligence any more than colour of eye or hair. What then of the IQ tests which seem to show that in practice American blacks achieve lower average scores than American whites?

Here again the authors effectively deflate the claim of IQ testers and interpreters. First they demonstrate that intelligence is indefinable and therefore not measurable. Secondly they show that whatever the IQ tests do measure it is not something that is innate and fixed but something which responds significantly to environmental/educational influences. They also show that in America IQ tests are based on literate, white, middle-class attitudes and are in effect rigged against blacks (and indeed all the poorer classes). In experimental IQ tests based on black culture, blacks score higher than whites. Ehrlich and Feldman concede, however, that standard IQ tests are moderately accurate at predicting academic performance and ability to succeed (or fail) in the United States.

Yet even if race is a myth and IQ a partial fraud, it is still relevant to ask whether intelligence — and/or what we measure in IQ tests — is partly inherited. Here the authors' evidence is suggestive rather than conclusive. They show that black children adopted into white middle class homes achieve white middle-class IQs, that black children with mentally retarded mothers achieve IQs up to 33 points higher if removed from their homes and placed in an 'enriched environment', and that there is no difference in average IQ between the children of white US servicemen and black US servicemen where the mothers are of a common third 'race' (in this case) Vietnamese). Environment is clearly a vital influence on IQ, but is it the exclusive influence? It can easily lift IQ a few points, in some cases ten to twenty points, in extreme examples 33 points, but no one claims it can make Huxleys of us all.

The logic of the environmentalist argument must be that heredity has no significant bearing on intelligence, but if education (in its widest sense) alone cannot lift everyone into the Mensa IQ bracket, what is it that holds some of us back? In our present state of knowledge it seems that it must be something inherited. It would appear that we are all

This Month's Authors

Dr Robert J.A. Goodland, a native of England, received his PhD in Ecology at McGill University, Montreal. He has carried out extensive environmental studies in Brazil, with particular reference to the ecology of cerrado in Amazonia. In 1972 he was appointed to the Cary Arboretum of the New York Botanical Garden, and is now Assistant Director and Chairman of its Department of Environmental Assessment. In this capacity he has carried out numerous environmental studies in S. America, Bangladesh and Malaysia. Among his published works the most recent is: *Amazon Jungle: Green Hell to Red Desert* (Elsevier 1975).

Janet S. Bookman, is a former Washington correspondent for the United Press. She has edited books on scientific subjects for Harpers and Columbia University Press. Recently she has edited a number of books and reports for the Cary Arboretum and the New York Botanical Garden.

David Straton was a founder member of the New Zealand Values Party and was until recently the National Secretary, a post he has given up to devote himself more fully to his own researches. He is a Lecturer in the Department of Psychological Medicine, Wellington Clinical School of Medicine.

Alexandra Aldridge is founder and co-editor of *Alternative Futures* a new quarterly of Utopian and Futures Studies sponsored by Rensselaer Polytechnic Institute and the University of Michigan. She writes and lectures in the fields of Utopias and Science Fiction and has taught Humanities at Wayne State University and the University of Michigan.

Henryk Skolimowski is Professor of Philosophy in the Department of Humanities at the University of Michigan. His main interest lies in the development of the post-industrial society. He is an Associate Editor of *The Ecologist*.

Hans Tchäni lives in Switzerland where he is political correspondent on the Zürich daily paper *Tages-Anzeiger*. He is a member of the New Helvetia Society and the author of a number of books on political subjects, among them *Profil der Schweiz; Dikatur des Patriotismus; Demokratie auf dem Holzweg*.

Raymond Dasmann is currently senior ecologist at I.U.C.N. in Morges. He has published hundreds of papers on wildlife and conservation, many books including *Planet in Peril: Ecological Principles for Economic Development, The Conservation Alternative,* and four editions of *Environmental Conservation*.

Peter Berg is an associate of Dr. Dasmann's, a naturalist and ecologist, and author of *Reinhabiting a Separate Country*. Plant/Drum San Francisco 1977.

coded, but emphatically not *colour*-coded, with a certain intelligence potential, and that middle-class whites have a much better chance of fulfilling that potential than, for example, lower class blacks. To put it another way average potential intelligence is probably equal between classes and ethnic groupings but in practice the 'disadvantaged' classes (which at present include a disproportionate percentage of the black minority in both the USA and the UK) are environmentally (and so intellectually) handicapped from birth.

At one point the authors point out that different cultures traditionally respect different attributes and imply that these attributes — which include piety and obesity — are as relevant to intelligence as, say, the ability to reason. This leads them close to the view that blacks are just as intellligent as whites, though not so good at a few unimportant things like comprehension, problem solving, verbal skill, number ability and reasoning power. Stripped of sociological euphemism that seems just another way of saying 'black is dumb'. However the main burden of this thoughtful and provocative tract for our times is that biologically blacks and whites are equally dumb — and equally bright.

Victor Gordon

Just Beyond the Door

THE NATURAL HISTORY OF SELBORNE by Gilbert White, edited by Richard Mabey. Penguin, 95p.
THE NATURAL HISTORY OF THE GARDEN by Michael Chinery. Collins, £4.50.

The Natural History of Selborne is, according to Richard Mabey, "the fourth most published book in the English language". To review it therefore feels rather like reviewing the Authorized Version or Shakespeare. One is hardly likely to find hitherto undiscovered merits in such a book. Probably it is even superfluous to say that *Selborne* should be on the shelves of every English lover of wildlife and the countryside: for with a few exceptions I imagine it already is. Those exceptions can now remedy the defect for less than a pound. Richard Mabey's introduction to this edition is a sensible and perceptive contribution to the perennial puzzle which confronts all lovers of White — what is it about these nature-notes of a middle-aged curate that has captured so many generations of readers? It is not, of course, a question which admits of a simple answer. White has so many virtues — a pleasant and economical style, inexhaustible curiosity, minute observation, an innocent delight in all the curious variety of God's creation. He is a surprisingly *modern* naturalist, as Mabey points out; for he was devoted to the study of the living animal in its natural habitat at a time when most zoologists were obsessed with problems of taxonomy and comparative anatomy.

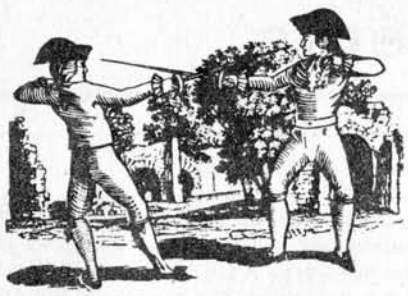
Some notes are essential for the modern reader, if only to indicate what species White is talking about in cases where the name has changed, and to point out the (rare) instances where he is misleading or mistaken. These Richard Mabey provides: he also updates White's information where necessary, for example when the distribution of a species has changed since the 18th century, as with the raven, chough, corncrake and great bustard (all on the debit side, though there have been some gains too). Some minor errors might be corrected in a future edition, such as the statement (p.274) that there are five native British reptiles: Mr. Mabey has evidently forgotten the slow-worm. A much more serious defect, the absence of an index, is presumably the fault of the publishers.

Gilbert White found more than enough to occupy his mind within the bounds of his native parish. Michael Chinery is a worthy successor, for in *The Natural History of the Garden* he reveals what an astonishing diversity of living creatures share what each of us mistakenly regards as our *own* small patch of ground. Reading this book, I get the impression that a naturalist could spend his entire life pleasantly and profitably within a stone's throw of his own house. "Biologists still have much to learn about the behaviour of woodlice", for example (though you'd need to know a lot about them not to learn anything new from Mr. Chinery). Why go rushing off to Serengeti, when creatures less well studied than lions or elephants are leading their secret lives under the nearest half-brick or broken flower-pot?

Sensibly, this book gives less space to those species already well documented on most people's bookshelves — wild flowers, birds and mammals — though Mr. Chinery does give adequate accounts of the ones most likely to occur in gardens. (His section on "weeds" is useful precisely because it omits all but the commoner species.) But he really comes into his own on the invertebrates, with a chapter each for worms, snails and slugs, insects, spiders, and the centipedes, millipedes and woodlice. His personal enthusiasms are engaging — who else could proudly claim "my garden must be one of the few that can boast all four species of British earwigs"?

Mr. Chinery rejects at the outset the old-fashioned "friends and foes" approach to garden wildlife. The great majority of garden creatures, apparently, "are completely neutral to the gardener's interests". All the more reason to avoid the use of blockbuster insecticides, ending a hundred innocent lives rather than let one guilty one continue. Gardeners who read this book may even end up caring more about their wildlife than their cultivated plants — though the author claims that he grows most of his family's vegetables in spite of all his uninvited guests! Certainly I can imagine my own gardening activities being seriously handicapped by a desire to consult Chinery on every chance-met creepy-crawly: and I shall have to remember to wash my hands first, too, for this is a lovely book to look at, with the high-quality illustrations one has come to expect from Collins. I wish I had had it twenty years ago, when I had more time to stand (or more likely *kneel*) and stare. Every budding naturalist should own it, and learn from it the valuable lesson that wild life can be studied without travelling to Kenya or Galapagos, simply by stepping out of one's own back door.

Nicholas Gould



Letters

The Best of Both Worlds

Dear Sir,

I would be most interested to have the reactions of those of your readers who are not dedicated anti-capitalists and who do not believe that the industrial age is coming to an end abruptly in the next five to ten years, to a proposed form of linking between industry and rural areas along the lines proposed below.

Assumption 1

Increasing numbers of workers in urban areas are becoming alienated from their work and living environment, due to a multitude of reasons which are well known and will not be restated here; not the least is inflation which reinforces powerfully the materialistic outlook so carefully stimulated by certain politicians in the past, which destroys work satisfaction and leads workers contually to demand more and give less, in terms of amount and quality of work done. I am stating facts as I see them — not apportioning blame to anyone — except politicians.

Assumption 2

The idea of a peaceful rural existence without commuting, airport noise, leaded fumes, city stress — and growing as much food as possible, inevitably at a lower standard of living, has attracted many, and sometimes communities have been formed, but have not prospered because survival depends on a source of external income from crafts, writing etc. unless a purely peasant existence is accepted. Few will accept this and few have sources of external income or the capacity to earn it — they have only their labour.

I envisage the creation of small factories in rural areas, being branches to larger urban factories, under their control and serviced by them, but associated with groups of rural workers in such a way that no one need work more than half time, though the factory would be fully manned at all times. Thus the workers would have a valuable cash income and time to pursue the activities they enjoy, whether to grow food, make furniture, write books or simply listen to music. I hope I am not being too optimistic in thinking that this sort of life would attract people with a responsible attitude to work, even though the work might be classed as repetitive, dirty enough to require overalls and possibly sweaty in the summer, like threshing used to be before the combine. But good honest work none-the-less. If a group of initially fifteen to twenty like-minded workers could be brought together, housed with reasonably convenient access to a permitted factory site in a rural area, then I doubt if it would take me very long to interest a Board of directors, of which there are many not knowing which way to turn to maintain production at a profitable level. I am closely involved in industry and have access at the highest level to put proposals for consideration.

Yours faithfully,
A.W. Thomas
Dunchurch Rd.,
Rugby.

Another Man's Words

Dear Sir,

In the July issue of The Ecologist you credit a certain H.C. Coombs with the quotation "When to speak is unpopular, it is less pardonable to be silent than to say too much."

I have never before heard of Mr. Coombs, but this characteristic gem of written English appears in the last paragraph of R.H. Tawney's Religion and The Rise of Capitalism, which is based on the Holland Memorial Lectures he gave in 1922.

It is possible that you may feel I am making an undue fuss about a small point of scholarship, but when to speak is unpopular it is less pardonable to be silent than to say too much.

With respects,
John Papworth

Note: Our thanks to John Papworth for pointing out this mistake. Mr. Coombs was no doubt quoting R.H. Tawney, and we are glad to take this opportunity of publishing the true origin of this admirable maxim.

Cultivation on steep slopes.

Himalayan Appeal

Dear Sir,

I do not know whether you have heard abut the tragic incidents of August 14-15th last, in which 44 people and 76 head of cattle were buried alive under a deluge of rocks and mud, following heavy rainfalls. Most of the cultivated topsoil on the steep slopes was washed away. Many houses were cracked and great fissures scored the surrounding earth. Boulders, each weighing more than a hundred tons, had moved down the hillside and could shift again at any time, to take more lives. Such incidents have become a regular feature here in the Himalayas due to the clean shaving of the forests and expansion of cultivation on the steep slopes. We are trying to persuade the Government to resettle people down in the Jerai plain area, although there is a great scarcity of land everywhere.

Another suggestion we have made is to preserve the remaining forests and start a tree-planting programme on a war-footing. We need active support from nature friends all over the world to help us in saving the Himalayan forest. Our demand is to ban green-felling in the catchment areas of Himalayan rivers — this represents a change in the present commercial policy, but it is one we must seek to bring about because the main value of the Himalayan forest lies not in its timber but in its water and natural scenery.

Yours faithfully,
Sunderlal Bahuguna,
Navjeeran Ashram,
Tehri-Gashwal-Himalaya.

A field turned into a heap of debris after a landslide.

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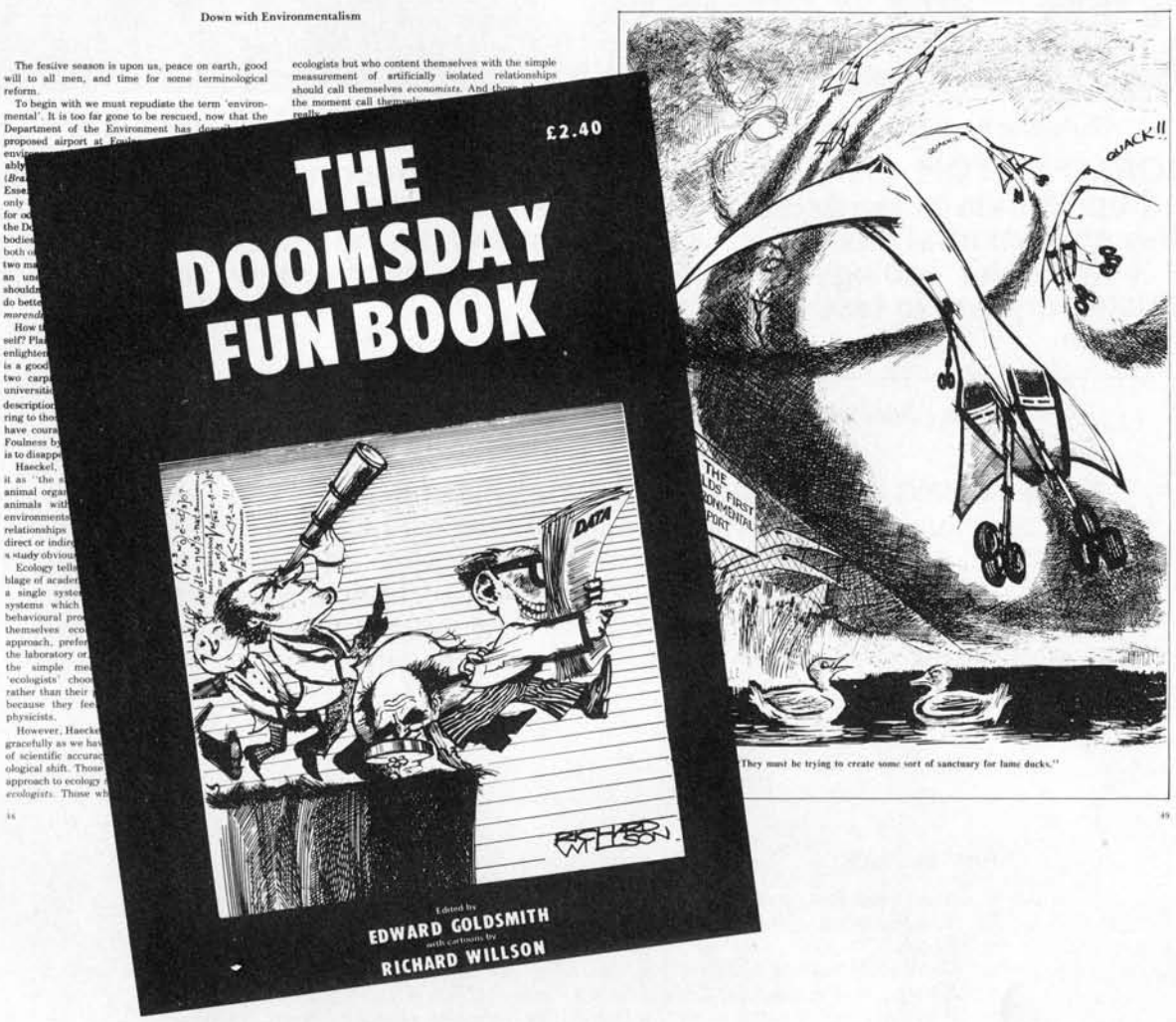

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