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In this issue

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VOL. 7 THE ECOLOGIST 1977

As in the last two years there will be ten issues of *The Ecologist* in 1977. The present combined number replaces the March/April issue, and there will be one number for August/September.

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Editorial

Breakthrough for the European Ecological Movement

It has been clear for some time that the Ecological Movement would soon become a major political force. It was a question of waiting for the breakthrough. But when and where would this occur? The answer appears to be in France and in 1977.

The extraordinary success of the 'Ecologie et Survie' Movement in Alsace has already been reported in the pages of *The Ecologist*. In the cantonal elections in February 1976, it obtained more than 10 per cent of the votes in the ten constituencies where candidates were fielded, and it will be putting up more than 200 candidates for the local elections next spring.

The success of Brice Lalonde, Ecological candidate for the by-election in the fifth arrondissement of Paris in November surprised even more people. Brice Lalonde is Director of Friends of the Earth in France. He was one of that intrepid band that sailed into the French nuclear testing grounds around the Muratao atoll in the Pacific to try to prevent a nuclear test.

He obtained 6.6 per cent of the votes cast and came fourth out of fifteen candidates, beating representatives of well-established parties such as the Parti Socialiste Unifié (PSU) among many others.

The first effect of this success was to break the wall of silence erected by the French press around the activities of the Ecological Party, which had suddenly become news.

Still more shattering to accepted political ideas of today has been the publication of the result of a poll organised by *Le Point* (6.12.76) — one of the most highly regarded French weekly periodicals, on the voting intentions of French youth between the ages of sixteen and twenty-three. Among the questions asked by the pollsters was the following: 'If an Ecology candidate presented himself in your constituency, would you be tempted to vote for him?' The answer — out of every 100 young people who expected to use their vote — was:

very tempted 19%
quite tempted 32%
not very tempted 21%
not at all tempted 14%
don't know 14%

In other words 51 per cent of French young men and women appear tempted to vote for the Ecological Movement. If this poll is accurate, and if ecological consciousness is growing as fast as it seems to be, then it should not be too long now before France has its first Ecological Government.

A few days later, French public opinion was due for another shock. Monique Cazeaux, Shadow Minister of the Environment for the Socialist Party, which by the way has every chance of being returned in the next general election, resigned from her Party to join the Ecological Movement. For three years she had tried in vain to get the Socialists to do more than pay lip service to ecological exigencies, and failed. Their priorities were different and incompatible with those of the Ecological Movement, and she had had enough. She held a press conference to announce her decision on 14th December.

In the meantime, Edouard Kressmann, who resigned as Chairman of Kressmann et Cie, one of the oldest firms of wine merchants in Bordeaux, to devote himself to the Ecological Movement, called a meeting in Paris to set up a European Centre for Ecological Action.

Among those present were Monique Cazeaux herself, Solange Fernex, Leader of the Ecologie et Survie Movement in Alsace, René Dumont, the agronomist who stood as Ecological candidate in the last French Presidential election, Jacques Ellul, Professor at the University of Bordeaux and author of *Technological Man*, Philippe Saint-Marc, administrator and author of *Socialization de la Nature*, Jean-Marie Domenach, Editor of *Esprit*, the French intellectual periodical, Denis de Rougement, the historian and sociologist and Director of the European Cultural Foundation in Geneva, Jean-Marie Pelt, Director of the Institute of Ecology at Metz and Vice-Mayor of Metz, Alain Hervé, Editor of *Le Sauvage*, the French ecological magazine, and Pierre Samuel, Professor of Mathematics at the University of Paris and President of Friends of the Earth in France.

The meeting lasted two days, 11th and 12th December, and the following declaration was issued to the press:

EUROPEAN GROUP FOR ECOLOGICAL ACTION
Declaration

We the undersigned, meeting in Paris on 11 and 12 December, 1976,

CONSIDERING

— that Europe is in a state of emergency, that its resources are being depleted, that one crisis follows another and merges with it: the energy crisis, the environmental crisis, the monetary crisis, the crisis of human liberties — and that all of these are but the symptoms of a single profound and all-pervading *ecological crisis;*

—that industrial societies, founded on obsolete ideologies inherited from the nineteenth century, are organised so as to satisfy their principal goal: that of producing ever larger quantities of material goods which can only be done at the cost of causing:

—the exhaustion of natural resources and the destruction of our cultural and physical heritage,

—the deterioration of human relationships, the increase in material inequality and in the incidence of social aberrations of all sorts,

—the simultaneous growth of unemployment and inflation,

—the progressive militarisation of our economies — of which the most sinister symptoms are the present civil and military nuclear programmes,

—the impoverishment of the Third World and the reduction of its ability to feed itself:

CONCLUDE that all efforts must end in a single direction: towards the subordination of short-term economic and political considerations to vital biological, social, spiritual and psychological ones whose satisfaction would be the goal of a truly ecological policy;

CALL ON all individuals and associations who share this interpretation of our problems to assemble at all social levels — communal, regional and European — so as to set out what must be the necessary conditions for the development of a free society living in balance with nature, in harmony with itself and capable of assuming Europe's responsibilities vis-à-vis the rest of the world;

SUPPORT, in particular, all political or other initiatives to oppose:

—civil and military nuclear programmes in the East as well as in the West,

—the transference of Western agricultural and industrial techniques to the Third World,

—the erosion of fundamental human liberties;

UNDERTAKE to bring to the notice of the people of Europe all initiatives tending towards the achievement of the above goals, and of those, that on the contrary, tend to commit us still further to our present fatal course;

ESTABLISH, for this purpose, an Action Centre, whose main function will be to work out the strategy for achieving these essential goals.

European Group for Ecological Action, 107 Rue de la Course, 33000 BORDEAUX, France.
Signed:

Carl AMERY (Munich)
Jeanne BISSILIAT (Paris)
Alain BOMBARD (Provence)
Henri BRUGMANS (Bruges)
Tom BURKE (London)
Roland CARBIENER (Strasbourg)
Monique CAZEAUX (Paris)
Bernard CHARBONNEAU (Bern)
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Christian HUGLO (Paris)
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Edouard KRESSMANN (Bordeaux)
Daniel LABEY (Paris)
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E. F. SCHMACHER (Surrey)
Manfred SIEBKER (Brussels)
Gerard SIEGWALT (Strasbourg)

Edward Goldsmith

Cosmology as Ecological Analysis . . A View From The Rain Forest

by G. Reichel - Dolmatoff

Until relatively recent times the cultural image of the Indian tribes of tropical America has been that of a group of rather primitive and hostile peoples whose contribution to human thought had been negligible and whose level of social complexity had remained far below that of most aboriginal societies of the Old Wolrd. In fact, only the higher civilisations of America — the ancient Mexicans, Mayas and Peruvians — were occasionally credited with having created fairly elaborate social, political and religious institutions, but even in their case seldom has there been explicit discussion of native philosophical systems, or something approaching an integrated world-view. Sometimes one was almost led to believe that the tropical forest Indians were fossil societies; societies which, in a sense, were incomplete; which had not evolved and had nothing to teach us. They were 'out of the mainstream' some people said, and those of us who made these societies the subject of their studies struggled against the stigma of working somewhat 'out of the mainstream'.

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In the more recent past, however, this image has undergone a notable change. Ethnological research among the surviving tribes of the tropical rain forest has begun to reach a depth and breadth of inquiry that were formerly unthought of, and these newly gained insights are beginning to shed an entirely new light upon the intellectual achievements of the aboriginal peoples of the Amazon Basin, the Orinoco Plains and many other regions of the American Tropics, a vast area covering more than six million square kilometres. It seems that the old stereotypes are disappearing at last; and instead we are presented with a new image: the Indian, not only as a highly pragmatic thinker and an individual with a sound sense of reality, but also the Indian as an abstract philosopher, a builder of intricate cosmic models, and a planner of sweeping moral designs. Also at the same period, in view of current interest in natural resources, many scientists and technologists who have turned their attention to the tropical rain forest areas of the world, have become concerned with the many problems of ecological adaptation which traditional societies have had to solve in these environments. In the case of the Amazon Basin it takes a healthy and energetic society to cope with the rigorous climatic conditions and with the management of easily depleted natural resources, a society that would develop not only a set of highly adaptive behavioural rules for survival — framed within effective institutional bodies — but, more imperative still, a society with a coherent belief system, with a foundation of strongly motivating values which would make endurable the problems of man's existence in an unpredictable world.

In this article it is my purpose to describe and examine some aspects of adaptive behaviour as I have been able to observe it in the course of my contacts with several Indian groups in the Colombian lowlands. I should add here that by 'adaptive' I mean anything that increases the probability of survival of the individual or the group. In the following I shall mainly refer to the Tukano Indians of the North-west Amazon, especially the Desana (Eastern Tukano) and my chief concern will be to trace some connections that exist between the cosmological concepts of these Indians, and the realities of adaptation to a given physical environment. In doing so I shall try to demonstrate that aboriginal cosmologies and myth structures, together with the ritual behaviour derived from them, represent in all respects a set of ecological principles and that these formulate a system of social and economic rules that have a highly adaptive value in the continuous endeavour to maintain a viable equilibrium between the resources of the environment and the demands of society.

Tukano Settlements

The Tukano Indians occupy a large area in the central portion of the northwest Amazon, mainly on the Vaupés River, a major affluent of the Rio Negro. Although most of the country is flat and densely forested, a transitional terrain of hilly uplands lies on the western fringe, while towards the north the forest is sometimes broken by stretches of grassy, tree-strewn savanna country. Although this rain forest area has often been described as a rather homogeneous region, many environmental differences exist which have considerable bearing upon the range and success of human adaptive responses. Game animals, amphibians and reptiles, edible fruits, nuts and insects; and suitable horticultural lands are not evenly distributed and considerable resource fluctuation can be said to exist within and among sub-regions.

The Tukano are bound to their rain forest habitat by a number of circumstances. In the first place, according to myth and tradition, the land inhabited by them at present was originally peopled by their forebears in ancient heroic times, and was handed on to their descendants as a solemn investiture in a perpetual trust. These tribal ancestors whose names and deeds are remembered in myths and genealogical recitals had given proper designations to the rivers and the hills, the rocks and the rapids and to all other notable natural features. This, then, continues to be their country, the homeland of the ancients. It is of interest to observe here that, although the Tukano habitat can, to a large degree, be described as a truly 'natural environment', they themselves perceive it as a man-made environment, transformed and structured in the past not so much by any exploitative activities of their ancestors, but by having been imbued by them with symbolic meaning. There is, then, a time-perspective to their understanding of the environment.

In the second place, Tukano territory is surrounded by lands occupied by other people, be they tribal Indians or be they Colombian or Brazilian settlers, and both these neighbouring groups are quite unwilling to accept immigrants, much less invaders. The Tukano, then, must of necessity exist within the limitations of their given environment and must make the best of it. They have to rely utterly upon their local resources and upon their own traditional skills for exploiting them.

The traditional settlement pattern consists of widely scattered large and well-built communal houses, occupied by extended families whose members derive much of their basic food supply from cultivating manioc gardens. However, seasonal hunting, fishing and gathering play an important part in their economic and social life. Tukano society is divided into more than twenty named exogamic groups; descent is patrilineal and residence is patrilocal, with cross-cousin marriage said to be preferred. Marriage between these different units implies a rigidly structured relationship which is expressed in many forms of reciprocity and exchange. Most of these activities, both social and economic, are closely connected with ceremonies directed by the shaman who also officiates at the rituals of the life cycle and is active as a healer of illnesses. Warfare is not institutionalised.

Here is a brief summary of how the Tukano imagine the origin and structure of the universe and the elementary forces that animate it. The creator was the Sun-Father, an anthropomorphic god who designed a three-layered cosmos consisting of a flat earth, a celestial vault, and a place of bliss situated under the earth. He then peopled the land and created animals and plants, giving to each a set of rules according to which they were to live and mutliply.

However, the Sun-Father created only a limited number of animals and plants, placing both categories under the constant care of specific spirit-beings who were to guard and protect them against eventual abuses. What is more, he assigned to his creation only a restricted, roughly circular, stretch of land, limited on all sides by permanent landmarks. In othe words, the creation of the Tukano universe was not conceived as an all-embracing or expanding system, but was a limited, well-defined proposition with finite and restricted resources. Nor was it accomplished as a single act limited in time: it still continues uninterruptedly because, ever since its initiation, the Sun-Father exercises a fertilising action upon it. It is the energy of the sun, imagined by the Tukano in terms of seminal light and heat, that causes plants to grow and fruit to ripen, that makes mankind and animals reproduce, and that is thought to be creative not only in a germinal, biological sense, but also in the sense of spiritual illumination and the attainment of esoteric wisdom. The essence of this force is imagined as a masculine power that fertilises a feminine element that is this world. In Tukano thought, the biosphere has both male and female aspects, but seen in its totality, it has primarily a feminine character over which the sun exercises his power.

The seminal energy of the sun is thought to constitute a huge circuit in which the entire cosmos participates. This circuit is imagined as having a limited quantity of procreative energy that flows continuously between man and animal, between society and nature. Since the quantity of energy is restricted, man may remove what he needs only under certain conditions and must convert his quantum of 'borrowed' energy into an essence that can be reincorporated into the circuit. For example, when an animal is killed or when a crop is harvested the energy of the local fauna and flora is thought to be diminished; however, as soon as the game or fruit are converted into nourishment, the energy is conserved, now on the level of society, because the consumers of the food have now acquired a reproductive life force that previously belonged to an animal or plant.

Resemblance to modern Systems Analysis

The striking point about these ideas is that this bears a remarkable resemblance to modern systems analysis. In terms of ecological theory, the Tukano thus conceive the world as a system in which the amount of energy output is directly related to the amount of input the system receives. According to the Tukano, the system handles these inputs in two ways: sexual energy, which has been repressed in the individual, returns directly to the capital of total energy in which the biotic components of the system participate; mere health and well-being, resulting from controlled food consumption, represent an input which energises also the abiotic components of the system, for example, the movements of the stars or meteorological phenomena. The individual should never cause a disturbance in this general equilibrium, that is, he should never use energy without restoring it as soon as possible. The entire system is largely derived from the model of sexual physiology. The Tukano concept of solar energy includes a large number of things to which a seminal symbolism is attributed because of their colour, shape, texture or other characteristics; while a number of other things are associated with a female concept of fecundity and gestation. The associations of images and symbols are interpreted by the Tukano on various levels of abstraction and eventually dissociate themselve farther and farther from natural and physiological facts until, at a higher cognitive level, they come to constitute a systems theory of balanced, finite energy flow.

This cosmological model of a system which constantly requires rebalancing in the form of inputs of energy retrieved by individual effort, constitutes a religious proposition which is ultimately connected with the social and economic organisation of the group. In this way, the general balance of energy flow becomes a religious objective in which native ecological concepts play a dominant organisational role. To understand the structure and functioning of the ecosystem becomes therefore a vital task to the Tukano. It follows that the Indian's ethnobiological knowledge of the natural environment is not casual and is not something he assimilates through gradually increasing familiarity and repeated sense experience; it is a structured, disciplined knowledge which is based upon a long tradition of enquiry and which is acquired of necessity as part of his intellectual equipment for biological and cultural survival.

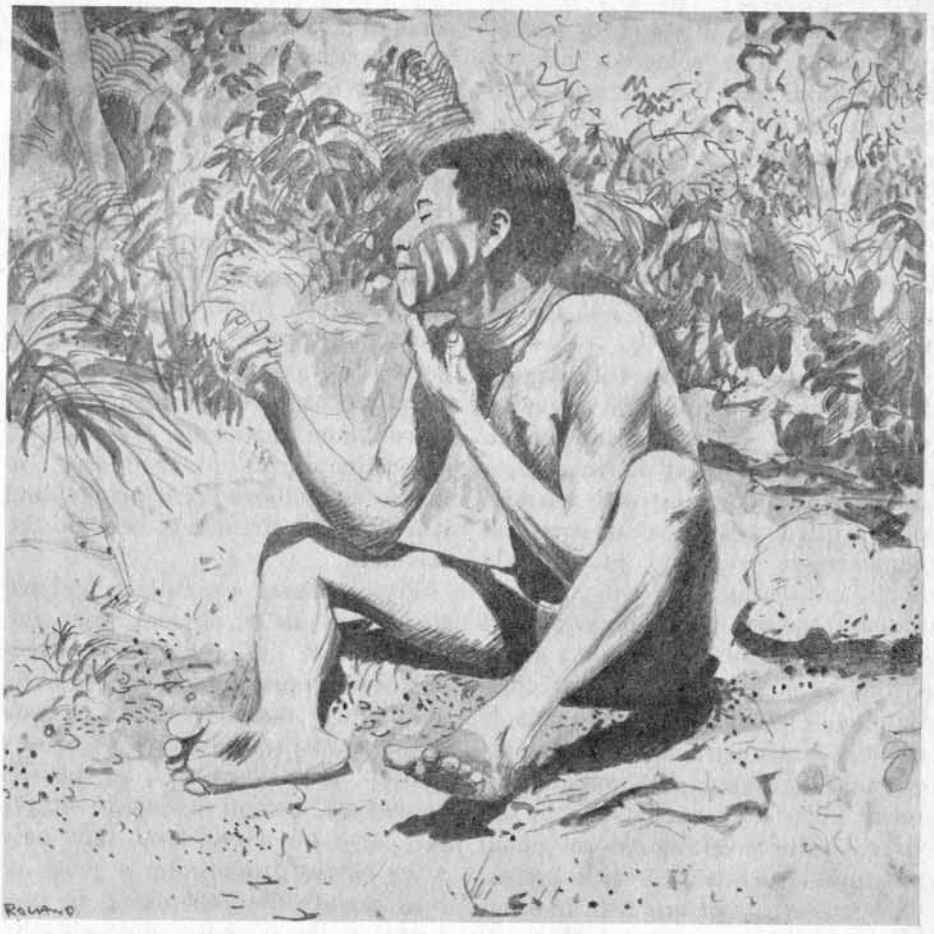
Among the Indians there is usually little interest in new knowledge that might be used for exploiting the environment more effectively and there is little concern for maximising short-term gains or for obtaining more food or raw materials than are actually needed. But there is always a great deal of interest in accumulating more factual knowledge about biological reality and, above all, about knowing what the physical world requires from man. This knowledge, the Indians believe, is essential for survival because man must bring himself into conformity with nature if he wants to exist as part of nature's unity, and must fit his demands to nature's availabilities.

Animal behaviour is of greatest interest to the Indians because it often constitutes a model for what is *possible* in terms of successful adaptation. On the one hand, the Indians have a detailed knowledge of such aspects as seasonal variation and microdistributions of the animal and plant species of their habitat. They have a good understanding of ecological communities, of the behaviour of social insects, of bird flocks, the organisation of fish runs, and other forms of collective behaviour. Such phenomena as parasitism, symbiosis, commensalism and other relationships between co-occurring species have been well observed by them and are pointed out as possible methods of adaptation. On the other hand, myths and tales abound with accounts of visits to the animal world, of people turning into animals in order to learn more about their habits, or of animals teaching men how to make use of certain resources. Shamanistic wisdom often contains detailed descriptions of such contacts and exchanges, and many shamans claim to have acquired part of their specific knowledge from animals which revealed to them some unexpected

food resource, a cure for illness, or a practical procedure in solving some everyday problem. Some of this wisdom may then be considered esoteric and secret, remaining the private property of a shaman, but often enough this specialised knowledge of animal behaviour becomes part of prescribed patterns of human action and interaction because of its obvious adaptive value. Moreover, mythology emphatically tells of animal species which have become extinct or which were punished or degraded for *not* obeying certain prescribed rules of adaptive significance. Thus, gluttony, improvidence, aggressiveness and all forms of overindulgence are punished by the superior forces, to serve as examples not only to the animal community, but also to human society. Animals, then, are metaphors for survival. By analysing animal behaviour the Indians try to discover an order in the physical world, a world-order to which *human* activities can then be adjusted.

In Tukano culture, the individual person is conscious that he forms part of a complex network of interactions which include not only society but the entire universe. Within this context of an essential interrelatedness of all things, a person has to fulfil many functions that go far beyond his or her social roles and that are extra-societal extensions of a set of adaptive norms. These rules or norms, then, guide a person's relationships not only with other people — past or present, kin or ally — but also with animals, plants, as a matter of fact with all biotic and non-biotic components of the environment. The rules the individual has to follow refer, above all, to co-operative behaviour aimed at the conservation of ecological balance as the ultimately desirable quality. Thus the relationship between man and his environment is being formulated not only on a cognitive level, but clarly it also constitutes an effective personal relationship in which individual animals and plants are treated with respect and caution.

The Tukano are quite aware of the fact that, in order to maintain a stable balance of input and output, a number of regulatory mechanisms have to be instituted and, what is more, have to be fully respected by all members of the society. These social controls of necessity possess marked adaptive implications and must be enforced primarily in those aspects of existence which, to a large degree, determine survival. I shall mention here: population growth, the exploitation of the physical environment, and aggression in interpersonal relations. It is quite clear to the Tukano that, in order to ensure individual and collective survival and well-being, adaptive rules have to be established to adjust the birth rate, the harvest rate, and to counterbalance all socially disruptive behaviour.



A Tukano Indian applying bixa on the face with finger.

Population Controls

I shall first turn to the problem of population growth and regulations. Two mechanisms are used by the Indians to control the birth-rate: oral contraceptives and sexual continence. Tukano women use herbal concoctions which, in varying concentrations, cause temporary sterility, and by this means they manage to space their offspring over several years in such a way that when a woman has her second child the first is already sufficiently independent not to be a bother. The number of children is kept low and couples with many children are criticised quite openly as socially irresponsible. It may be added here that the old and infirm, as soon as they cease to collaborate in the food quest of their household group, are eliminated by being abandoned in the forest or on an island in the river.

The second measure is abstention. Sexual abstinence and sexual repression are practised on many occasions and are among the most important prerequisites to many ritual activities. It is important to point out here that, in Tukano thought, food and sex are closely related and are symbolically equivalent. This idea of relationship between caloric and sexual appetite is repressed in many ways; on a metaphorical level sexual intercourse and eating are equated, and in ritual exchange certain foodstuffs come to represent the exchange of women. Since strict exogamic rules constitute the main organising principle in Tukano society, the consumption or avoidance of certain foods are geared to the concept of exogamy in such a way that dietary

restrictions come to stand for sexual restrictions. The selective use of certain foods may thus be said to be subject to the laws of *exophagy*, which determine the permissibility of certain foods under diverse circumstances. There are 'male' and 'female' foods and food preparations, and these rules refer not only to animal-derived foods, but also to vegetable foods.

These aspects are best illustrated by the ideas that guide the activities of the hunter. All game animals are subject to the Master of Animals, a dwarf-like spirit-being with marked phallic attributes. This supernatural gamekeeper jealously guards his flock consisting of deer, tapir, peccary, agouti, paca, monkeys and all other animal species that are a common food resource of the Indians. The Master of Animals is directly their protector and procreator and they all live inside steep rocky hills or in deep pools in the river, both dwelling-places being imagined as large store-houses teeming with game and fish. In order to obtain the supernatural Master's permission to kill a game animal, the prospective hunter must undergo a rigorous preparation which consists of sexual continence, food restrictions, and purification rites including cleansing the body by bathing and emetics. For some days before going on a hunting excursion, the man should refrain from all sexual relations and, what is more, he should not have had any dreams with an erotic content. Moreover, it is necessary that none of the women who live in his household is menstruating. Another mechanism that restricts overhunting is this: according to cosmological myths all game animals are associated with certain constellations, as defined by the Tukano. However, a species can only be hunted *after* its constellation has risen over the horizon, and it is said that the animals cry and weep with fear when they realise that their time is approaching. It may be mentioned here also that the hunt itself is more than a mere food quest in that it is imagined as a courtship in which the prey has to be seduced to submit to the hunter.

Whenever game is scarce, the shaman must visit the Master of Animals in a narcotic trance and try to obtain from him the release of some of his charges. He will not ask for individual animals but rather for herds or for a good hunting season and in return he promises to send to the Master's abode the souls of persons who, at their death, must return to this great store-house to replenish the energy of those animals the supernatural gamekeeper gives to the hunters. The Master of Animals and his numerous personifications are thus conceived as administrators of usufruct rights; since game resources are limited, restrictive rights to their use are instituted by these spirit-beings, and it falls to the shaman to become the mediator.

From these examples I have mentioned it is obvious that the combination of all these prerequisites represents in itself a body of highly adaptive rules which notably restrict the activities of any hunter or fisherman. A person cannot go hunting or fishing simply any time he needs food, but only after having undergone a more or less anxiety-charged period of preparation, the purpose of which is to avoid over-hunting. Illness or misfortune in hunting are almost always attributed to neglect of any of the numerous rules a hunter has to observe.

Food restrictions are not only observed in connection with economic activities, but are a standard practice on most ritual occasions and in many other everyday circumstances. For example, a man whose wife is expecting a child should eat neither tapir, peccary nor monkey meat because this might affect the good health of his yet unborn offspring. A man whose hunting or fishing gear has become polluted from being casually touched by a woman, must observe a liquid diet for several days. When fish run to spawn, those present in one's stretch of the river should not be eaten, nor are birds' eggs ever collected for food, and the flesh of some reptiles is avoided during their breeding season. All these interdictions are verbalised by the Indians in terms of dangers to the consumer's health. Especially strict prohibitions keep people from eating normally while engaged in the acquisition of esoteric knowledge and, similarly, all rituals of the individual life cycle involve temporary dietary restrictions. In summary, during pregnancy, childbirth and menstruation; during mourning periods, or while gathering medicinal herbs; during the couvade or while engaged upon the preparation of poisons, narcotivs or love potions, people carefully control their food intake and, as a general rule, refrain from eating the meat of game animals.

Similar prohibitions restrict the gatherings of wild fruits and nuts, of honey and of edible insects. Even the extraction of raw materials used in technological manufactures is controlled by ritual restrictions. The gathering of thatch for a roof, of clay for pottery making, or of scarce woods or fibres for a number of specific end products, are subject to permits which have to be obtained from the spirit owners of the respective resources.

This complex of dietary and sexual restrictions is closely related to the control of aggressive attitudes. The principal mechanism which checks socially disruptive behaviour is the organisation into exogamic groups which are linked by alliances and stand in a relationship of reciprocal exchange. Besides exchanging women, these complementary units will give and receive foods, raw materials or manufactured goods, and on these periodic occasions which constitute highly formalised rituals, the dances, songs and ceremonial dialogues emphasise over and over again the paired linkages that unite Tukano society.

It appears from the foregoing that the Tukano definition of what constitutes carrying capacity, refers mainly to a certain balance of protein-rich food resources such as game, fish and wild fruits. Environmental degradation is interpreted *not* in terms of soil exhaustion, but in terms of the eventual depletion of game and of increased walking time. Because of the relative scarcity of protein resources restrictive rights to their use have to be established in order to avoid frequent relocation of settlements. Propitious conditions for horticultural activities are perhaps not plentiful, but land for productive garden plots *is* available. However, the nutrient content of practically all vegetable foods of the rain forest is very low

and carrying capacity is therefore determined by the existence of protein resources, and population size and density are functions thereof.

The three aspects I have mentioned — population growth, the exploitation of the physical environment and the control of aggression — can be reduced to one single problem, that is, the maintenance of a balanced ecosystem. The Indians know that their daily existence depends upon the proper functioning of these adaptive interactions. The question arises, how can a people by made to follow these prescriptions and regulations which impose such severe restrictions on their social behaviour and their biological needs?

The Tukano Theory of Illness

The mechanisms which, in the native groups I am concerned with here, enforce the rules, are closely related to the aboriginal theory of disease. To begin with, the specific bodily or mental conditions which, according to the Tukano, constitute illness and which manifest themselves through a large number of signs and symptoms, are always thought to be caused by an agent external to the body. The possible pathogenic agencies fall into three categories: (1) the revenge of game animals; (2) the ill-will of other people, and (3) the malevolence of supernatural beings such as the Master of Animals or other spirit-beings.

This malevolence of people and animals is not an arbitrary force that blindly strikes its unsuspecting victim. On the contrary, illness is always interpreted as a quite natural consequence of a person's breach or neglect of cultural norms. Apart from its being socially and emotionally disturbing, illness is, in the Tukano view, nothing but a reaction to the ecologically inadequate behaviour of the patient to his maladaptive performance. It is the patient who causes the disease, by making himself vulnerable to it. The diagnosis the shaman establishes has, therefore, two different aspects: One refers to the patient's complaints, to the symptoms he has developed; the other aspect refers to the question *why* the person became a victim of the disease. And here we can recognise another important aspect of the shaman's function, an aspect that is closely related to the problem of ecological adaptation.

In shamanistic practice illness is taken to be the consequence of a person's upsetting a certain aspect of the ecological balance. Overhunting is a common cause and so are harvesting activities in which some relatively scarce natural resource has been wasted. The delicate balance existing within the natural environment, between nature and society, and within society itself, is bound to affect the whole. For example, meddling with certain women who should be avoided is the same kind of affront as eating certain fish that should not be eaten; while killing too many animals of a certain species must always be avoided. These are offences the consequence of which is likely to be an illness. In the diagnostic process, which is often accompanied by divinatory practices, the shaman is interested in the patient's illness not so much as a function of biology, but rather as a symptom of a disorder in the energy flow. His main concern is about the relationship between society and the supernatural Masters of game, fish and wild fruits, on whom depend success in harvesting and who command many pathogenic agents. To the shaman it is therefore of the essence to diagnose correctly the causes of the illness, to identify the exact quality of the inadequate relationship (be it adultery, overhunting, or any other over-indulgence or waste), and then to redress the balance by communicating with the spirits and by establishing reconciliatory contacts with the game animals. To mention just one example of how a diagnosis is established: a man who has killed too many animals of a certain species will appear in the shaman's dream of trance states in the shape of that animal and the image will be accompanied by a certain luminosity, a certain degree of light. It is quite remarkable that differences in high or low light intensity are recognised to be very important in the flow of solar energy, as understood by the Tukano, and that shamans will mention in their spells and incantations up to seven shades of 'yellow light' that energise the biosphere.

In summarising this aspect I want to emphasise that the shaman as a healer of illness does not so much interfere on the individual level, but operates on the level of those supra-individual structures that have been disturbed by the person. To be effective, he has to apply his treatment to the disturbed part of the ecosystem. It might be said then that a Tukano shaman does not have individual patients; his task is to cure a social malfunctioning. The diseased organism of the patient is secondary in importance and will be treated eventually, both empirically and ritually, but what really counts is the re-establishment of the rules that will avoid overhunting, the depletion of certain plant resources, and unchecked population increase. The shaman becomes thus a truly powerful force in the control and management of resources.

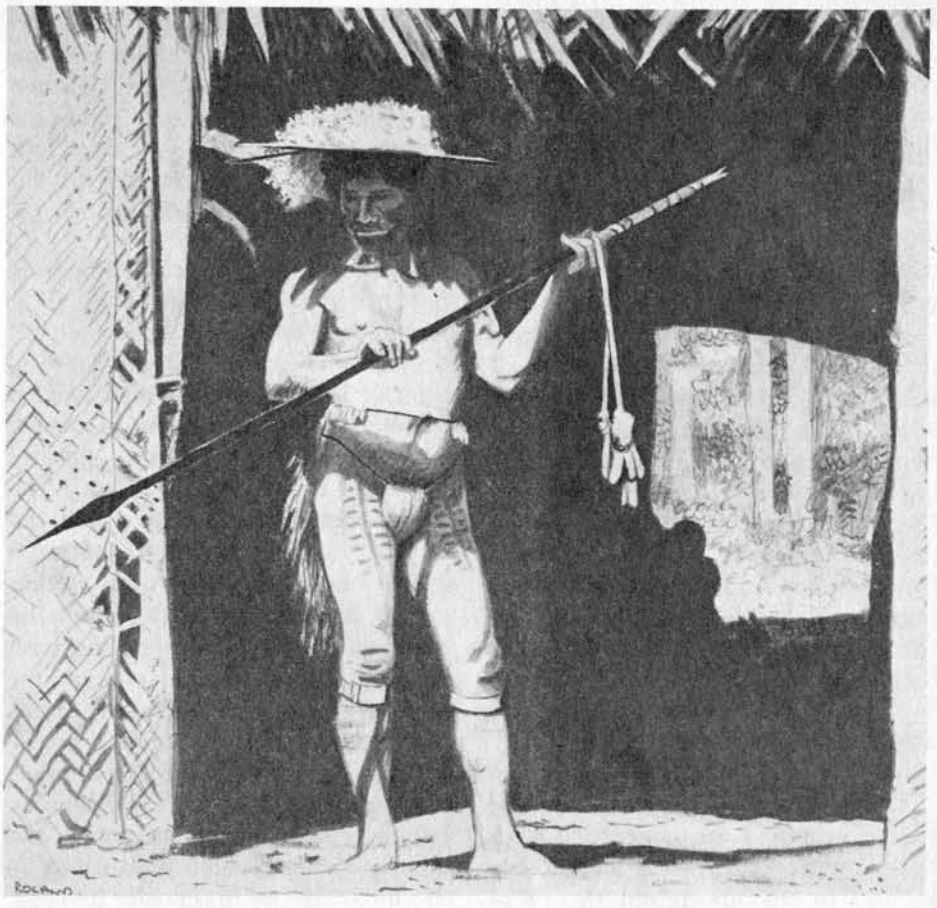
The shaman then interferes quite directly with hunting, fishing, gathering and most other harvesting activities. For example, a shaman will personally control the quantity and concentration of fish poison to be used on a certain stretch of river; he will determine the number of animals to be killed when a herd of peccary is reported, and he will decide on a suitable harvesting strategy for the gathering of wild fruits. He will determine *which* fish have to be thrown back into the water after a haul has been made, and occasionally he might even completely prohibit the killing of certain animals in a restricted area of the forest. He will also control such technological activities as the construction of a communal house, the manufacture of a canoe, or the opening of a trail. All these activities obviously affect the natural environment since trees have to be felled and many plants have to be destroyed or used in the process, and the shaman's role as a protector of game and plant life, explains why animals and plants figure so prominently as his spirit-helpers. All this, I should like to point out here, is not speculation; the Indians are quite explicit in these matters and explain that the spirit-owners of nature must

not be angered and that it is the shaman's task to reconcile them.

The very large denotative vocabulary of a shaman expresses his great concern with establishing the complete inventory of the ecosystem. In order to be able to administer this great store-house, he has to know, name and categorise all its contents. This knowledge eventually provides him with the criteria for ecological planning and this, of course, is problem-solving by anticipation. The fact that many daily activities such as hunting, fishing, gathering, the clearing of a new field or the curing of a disease are subject to divinatory practices in order to locate the most propitious spot or time, or to find the most effective procedure in coping with this or that predicament, gives the shaman ample opportunity to protect wildlife by random scheduling of hunting excursions whenever he thinks that a certain species is endangered, or to channel any other exploitative activity in directions he believes to be best. I know of several cases where shamans initiated limited migratory movements by asking people to abandon their homes in order to avoid an approaching epidemic or the presence of evil spirits, both calamities being revealed in divinatory trance. The true reason, however, seems to have been the advanced depletion of protein resources. In view of the observation of a number of related cases, it seems not unlikely that shamanistic divinatory practices operate with models and that, in this manner, many adaptive changes are being introduced by shamans.

One might ask here: how far is a shaman actually conscious of his role as an ecological broker? Does he always act quite rationally and with an adequate understanding of ecological principles?

There exist, of course, differences. Some shamans, notably the younger and less experienced ones, tend to verbalise their conceptions in quite simplistic terms by saying that overhunting and overharvesting are bound to annoy both the spirits and the game animals, and that illnesses will be the punishment. They will readily point out changes in prey abundance and will attribute the biotic impoverishment of certain restricted areas to the action of vengeful spirits. Others however will not make use of these mystical interpretations but will blame greed and ignorance for the depletion of protein resources. They will attribute some (if not all) diseases to nutritional deficiencies and will state quite plainly that protein resources are scarce and have to be protected.



A Tukano Shaman using a kurbeti stave rattle before a dance

To be sure, the fact that most economic activities are accompanied by rituals does not mean that the shaman simply asks the supernatural forces for abundance, for plenty, for a maximum amount of what the environment can produce, but rather that occasions are being provided for stock-taking, for weighing costs and benefits, and for the eventual re-distribution of resources. At these moments the shaman's book-keeping shows the general system inputs and outputs. In point of fact, most shamanistic activities such as curing rituals, rain-making, the periodic reaffirmation of alliances or food exchange between exogamic groups might be viewed as rituals concerned with resource management and ecological balance. This fact has sometimes been obscured by a tendency to describe native shamans in terms of mere witchdoctors or religious fanatics.

A Deteriorating Universe

The Tukano and many other Colombian tribes believe that the entire universe is steadily deteriorating. Thus it is thought that formerly people were healthier, stronger and more intelligent than they are at present; that animals and fruits were larger and that they were more abundant than now. The Indians will point out stretches of forest, rivers or lagoons saying that in former times animal life was plentiful there. It is true that, at present, this feeling of impending doom is partly justified; in many parts the world of the rain forest Indians *is* on the wane. But the Indian's sense of entropy, of the tendency towards disorder and chaos, does not seem to be a consequence of his present plight, but rather represents an existential anxiety that forms part of native cosmology and philosophy, and that is based upon the close and daily observation of the biological cycles of growth and decline. The important point is that this idea of increasing disorder is always followed by the institutionalised resolution to *recreate* the world and

to re-establish its order and purpose as stated in cosmological tradition. This continuous cycle of ritual creation, destruction and re-creation can be found in many tropical forest societies and is indeed an important mechanism of cultural and biological survival.

In the course of these ceremonial occasions, when the universe and all its components are being renewed, one goal becomes of central importance: the reaffirmation of links with past and future generations, together with the expression of concern about the future well-being of society. The emphasis of ritual is upon unifying the social group, upon continuity, upon the close bonds of identity that unite society with the past and make it the foundation of the future. It seems that this sense of union provides deeply motivating values and strong incentives for ecological responsibility. The lengthy genealogical recitals and the ritual dialogues have a powerful cohesive function, and in many of these rituals animal and plant spirits are thought to participate, expressing by their presence their interrelatedness and interdependency. It must be pointed out here that the ritual re-creation of the universe is generally accompanied by the collective use of narcotics of plant origin. During these drug-induced trance states, or other forms of dissociate phenomena, the participants establish contact with the mythical past, in fact, they see themselves return to the time of divine Creation and thus take part in it. It is clear that, here again, the officiating shaman can adaptively orient the interpretations of the visions people project upon the vivid background of their hallucinations.

During most or all of these rituals which can be said to be essentially concerned with ecological balance, the recital of myths and genealogies is of great importance. These myths explain man's nature and trace man's destiny from birth and infancy through maturity to decline and death; from the sin of incest to chaos and near-destruction, and hence to a new order and the establishment of law. These myths and tales, I should like to emphasise here, are not mere 'literature'; they represent a truly remarkable effort at intellectual interpretation, at providing a cognitive matrix for life. They are a guide for survival because they establish rules of conduct, not only for ritual occasions but for everyday life; a fact which goes unnoticed as long as one has not discovered the metaphorical code in which the myths are transmitted.

The cosmological myths which express the Tukano world-view do not describe Man's Place in Nature in terms of dominion, of mastery over a subordinate environment, nor do they in any way express the notion of what some of us might call a sense of 'harmony with nature'. Nature, in their view, is not a physical entity apart from man and, therefore, he cannot confront it or oppose it or harmonise with it as a separate entity. Occasionally man can unbalance it by his personal malfunctioning as a component, but he never stands apart from it. Man is taken to be a part of a set of supra-individual systems which — be they biological or cultural — transcend our individual lives and within which survival and the maintenance of a certain quality of life are possible only if all other life forms too are allowed to evolve according to their specific needs, as stated in cosmological myths and traditions.

In closing, I should like to note the following. Until quite recently ethnologists and archaeologists have attempted to explain cultural evolution and change in terms of linear cause-and-effect models and this approach is still used by most specialists in these fields. Gregory Bateson was the first ethnographer to sense the need for a systems theory model to account for his ethnographical data, although his now classic monograph on New Guinea was written long before the formal aspects of systems theory had been developed.

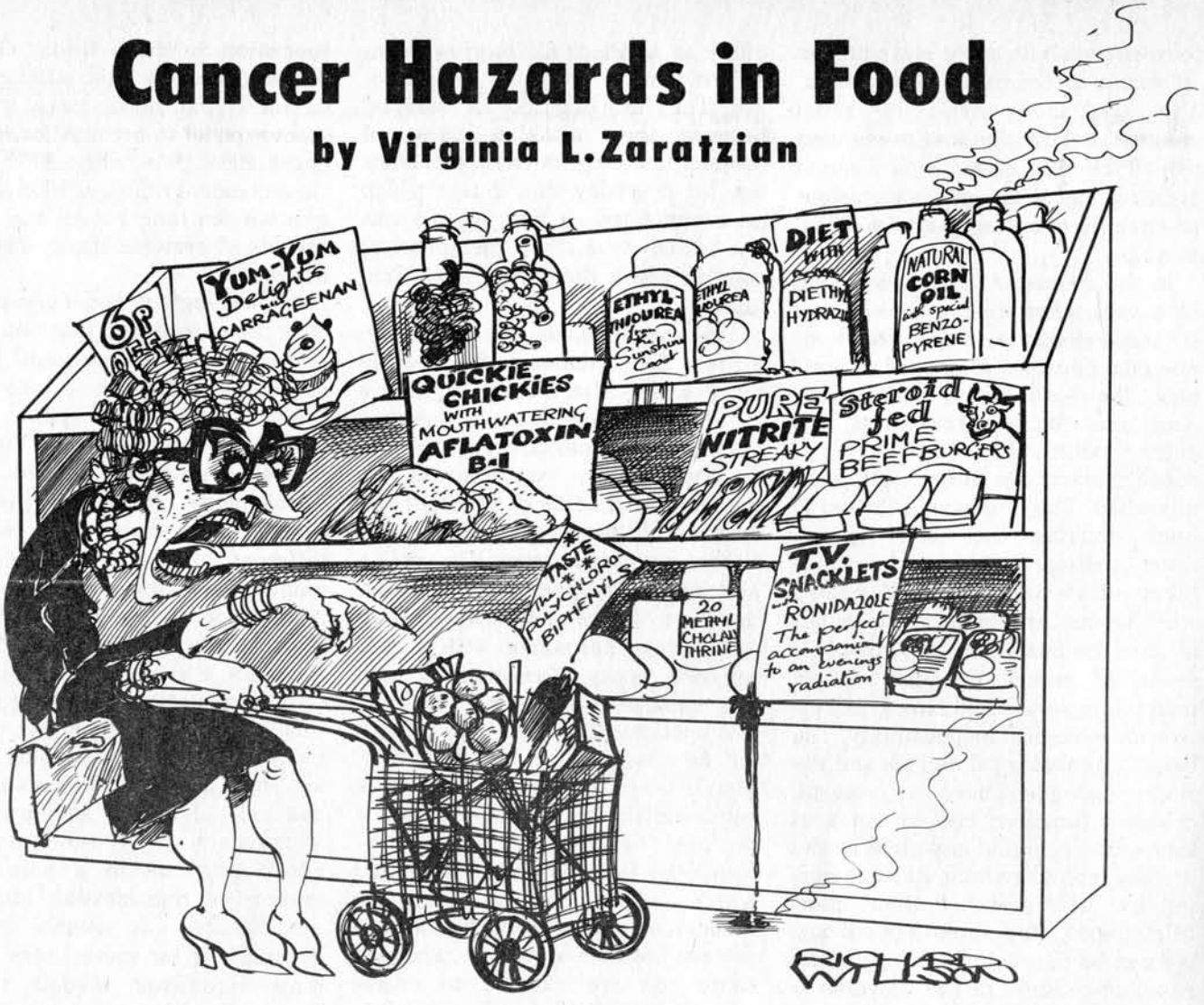
Archaeologists have been particularly prone to dependence on cause-and-effect explanations and models constructed on the principles of linear causality, and these trends have been emphasised in the intellectual movement called 'New Archaeology'. It is only recently that Flannery has noted that two very different kinds of explanatory models are used by the 'New Archaeology'. One of these schools is explicit in its adherence to linear causality. Flannery has applied the term 'law-and-order' archaeology to this school. The other less popular trend has been an application of systems theory to account for cultural change, attributing its dynamics to very slow deviations which originate in a part of the system and then develop into major modifications. It seems that this approach is far more likely to produce significant models than is 'law-and-order' archaeology.

It is striking then that in the last decade ethnographers and archaeologists are coming to accept as the only kind of explanatory model which can be used to handle ecological relationships the kind of overall systems model which was adopted by 'primitive' Indians a very long time ago.

Taken from a Tukano rock engraving in granite on the Piraparana : the River God Ni.

Cancer Hazards in Food

by Virginia L. Zaratzian



"YUHC!! THERE'S MUD ON THESE POTATOES"

In recent times attention has been focused on the need for an adequate, safe food supply for the population of the world. While the population size is increasing, the number of acres available for farming is on the decline and, in order to achieve an adequate food supply, attempts have been made to increase the yield per acre through the use of chemical pesticides and fertilisers. As a consequence, agricultural produce contains residues of pesticides and fertilisers, both from direct applications and as a result of soil and water pollution. At the same time the food-processing industry has conditioned the public, by means of the advertising media, to expect food that has certain qualities — convenience, variety, freshness, savoury flavour, pleasing appearance, nutrition, uniformity of texture, etc. — and achieves these qualities by adding a great variety of chemicals to our food chain. As yet, the risks that this involves have not been fully appreciated.

The term food additive covers all of the many chemicals that gain access to our food supply; it applies to any substance that is not a basic food ingredient. The direct or intentional food additives are substances that have been added for a specific purpose, to change some quality of the food. According to the Federal Code of Regulations, there are 32 terms to "describe the physical or technical functional effects for which direct human food ingredients may be added to foods" [1,2]. The direct additives include nutrients, flavours, flavour enhancers, preservatives, anti-oxidants, emulsifiers, stabilisers, thickeners, colouring agents, bleaching agents and others.

Whereas the direct food additives are put into food for a specific purpose, the indirect or unintentional food additives are substances such as pesticides, solvents, environmental chemicals, moulds, etc. with which the food becomes contaminated during cultivation, processing and storage.

There are thousands of direct food additives presently in use, and proper safety testing is virtually impossible. Even more challenging is the task of investigating unintentional additives, and the effect of all the possible combinations of individual chemicals (as is well known, certain combinations are far more potent than the individual chemicals acting in isolation from one another). In this situation, approval has been given not only to those food additives for which sufficient toxicological data are available to assure safety under the conditions of usage, but also to others that fall in the categories of "generally recognised as safe" and "prior sanction". The endorsement "generally recognised as safe" is based not on scientific testing but on scientific opinion, primarily of representatives from industry.

Where the safety of food add-

itives is concerned, the complexities are enormous, and decisions must be made on the basis of the likely risks and benefits. However, before evaluations of this kind are begun, it should be established that the food additive is essential to the food supply, and the compound should be tested thoroughly for risks on long-term usage, especially as regards cancer. Too many of the chemicals added to food are intended to improve its appearance rather than its nutritional quality.

General Considerations

It is of the greatest importance to determine the cancer risks associated with the chemicals that enter our food supply, for the entire population is exposed on a continuing, long-term basis. Generally speaking, however, substances that induce cancer — carcinogens — are difficult to identify.

The most reliable test for carcinogens is the life-span study conducted on laboratory animals. Factors such as the time of onset of tumour formation and the kinds, sites and numbers of tumours are compared in animals exposed to the test substance and in running controls. Carcinogens increase tumour production, shorten the onset of tumour formation and may produce an unusual and characteristic type of tumour; for example, aromatic amines induce urinary bladder tumours.

It is often difficult to establish a cause-and-effect relationship in investigating carcinogens, because the cancer may not appear until long after exposure; for example, fifteen or twenty years may elapse between exposure to aromatic amines and the appearance of urinary bladder tumours. This interval tends to be shorter in animals than in humans, but some workers in the field of carcinogenesis have warned that, when low doses are used, the onset of tumour formation may be delayed beyond the life span of the animal[3]. One way of minimising this possibility would be to use a very large sample, of 10,000 animals or more, but in practice it is more convenient to use large doses.

Carcinogens usually also have a mutagenic effect, causing genetic damage, and a teratogenic effect, causing abnormalities in the offspring (thalidomide is an example of a teratogenic drug), and may be detected through animal experiments designed to reveal these qualities[4]. (Mutagenic and teratogenic compounds are not always carcinogens, but should clearly be excluded from the food supply on their own account.) Finally, it is possible to identify substances that are carcinogenic in humans through retrospective, long-term studies of cancer incidence in specific populations.

It is well known that sensitivity to carcinogens decreases as maturity proceeds, and that the foetus is particularly susceptible. This means that the child in the womb will be very seriously at risk if carcinogens ingested by the mother are transmitted across the placenta. The process in which cancer is induced in the foetus as a result of substances transmitted from the mother is known as transplacental carcinogenesis.

Transplacental Carcinogenesis

Recently there has been alarming evidence that transplacental carcinogenesis is a real possibility in humans. Examination of the case histories of young women suffering from adenocarcinomas of the vagina, a type of tumour rare in their particular age group, revealed a common factor: in all cases, the patient's mother had been treated with the synthetic hormone diethylstilbestrol during pregnancy, in order to prevent abortion[5]. This phenomenon had been amply demonstrated in experiments upon animals, but had not been recognised as a risk in humans.

Transplacental transmission of chemical agents may also be a factor in the high incidence of leukaemia in the first four years of life[6], while the significantly higher risk of cancer among children born to cigarette-smoking mothers, as compared to children born to non-smokers, is thought to be linked to the transmission through the placenta of carcinogens — such as 3, 4-benzo [a] pyrene[7], ethyl carbamate[8], diethylnitrosamine[9] and diethlhydrazine[10]. The type of tumour produced in the offspring is the same as that produced in the adult animal.

When a carcinogen is administered to a pregnant animal, three possibilities arise: it may be unable to pass through the placenta, in which case the foetus will be unaffected; it may damage the placenta, in which case the foetus will usually die; or it may be transmitted through the placenta, and carcinogenesis will ensue[11]. Whether, to what extent, and how rapidly the substance crosses the placenta will depend upon a number of factors, including the anatomy of the developing embryo; the density and thickness of the placental membrane; and the molecular size, amount, rate of absorption, metabolism and half-life of the particular substance. For any given carcinogen, the mechanism by which a cancer is induced is probably the same in mother and offspring.

Mechanism of Carcinogenesis

The term carcinogen is applied to any substance that causes an increase in tumour incidence, and there seem to be a number of different mechanisms by which these substances act[12]. Generally speaking, carcinogenesis is a multistep process, in which different cell populations evolve from an initial population of healthy cells into malignant tumours. For most carcinogens there is a brief induction period, lasting anywhere between a few minutes and a few days, and a long promotion period, lasting months or years, during which the evolution of the cell populations occurs. The evolution phase may be shortened for experimental purposes by means of a variety of promoting agents, including croton oil, phenol, fatty acids, citrus oils, 'Spans' and 'Tweens'.

More is known about the initiation of cancer than about its development. Although some chemical carcinogens are in reactive form already most are not coverted to reactive form until after they have entered the body[13]. The reactive form then interacts with the DNA, RNA and other cellular components of the target tissue to form addition products, and it is these addition products which are thought to initiate the carcinogenesis[14]. In some cases, a carcinogen may be converted into any one of a number of reactive forms, depending upon local conditions[15]. (If, as is possible, local conditions are such that the carcinogen is not converted to reactive form at all, it may be excreted without causing any damage.)

Although the mechanisms by which chemicals cause cancer have not yet been fully understood, the large body of evidence from screening tests has identified certain chemical classes which tend to have carcinogenic properties. Tables 1-3 list some of the more important carcinogens found in food.

Carcinogens in Food

In the following incomplete survey of proven and potential carcinogens, emphasis has been given to those that have, or have had, widespread use in the population. The carcinogens are grouped according to chemical structure, since similar molecules will be similar to their carcinogenic potential, as in their other properties.

Although, ultimately, each individual chemical must be evaluated separately, it is also useful to identify the types of chemicals that have carcinogenic potential, so that attention can be concentrated on these groups and any others of related structure.

TABLE 1

PROBABLE DIRECT FOOD-ADDITIVE CARCINOGENS

1. Synthetic Chemicals

A. *Colouring agents*

FD&C red No. 2, FD&C yellow No. 5, FD&C yellow No. 6, FD&C red No. 4, FD&C blue No. 4, FD&C green No. 3, FD&C violet No. 1.

B. *Non-nutritive sweeteners*

Cyclamate, saccharin.

2. Natural Products

A. *Emulsifiers, stabilisers, thickeners*

Carrageenan, carboxymethylcellulose.

B. *Preservatives*

Nitrate, nitrite, diethylcarbonate.

TABLE 2

PROBABLE INDIRECT FOOD-ADDITIVE CARCINOGENS

1. Synthetic Chemicals

A. Agricultural chemicals, pesticides
Kepone, zineb, endrin, polychlorobiphenyls (PCBs), DDT, etc.

B. Feed additives
Diethylstilbestrol, ninhydrazone, melangestrol acetate, etc.

C. Chemicals migrating from food packaging materials
Bisphenol, vinylchloride, etc.

D. Chemicals produced by interactions with food additives and other chemicals or food constituents.
Nitrosamines, urethan, etc.

E. Chemicals produced during food processing by heat, ionizing radiation
Benzo[a] pyrene, anthracene derivatives, acridine derivatives, etc.

F. Chemical contamination during food processing
Asbestos, talc, vinylchloride, PCBs.

2. Normal Constituents of Natural Food Products

Cycasin, polyaromatic hydrocarbons, safrole.

3. Natural Contaminants of Natural Food Products

A. Carcinogens from non-microbiological sources
Selenium, arsenic, nitrite, nitrosamines.

B. Carcinogens from microbiological sources
Ergot alkaloids, pyrrolizidine alkaloids, aflatoxins, etc.

Amine and Amide Derivatives

The cyclamates belong to this class. When these food sweeteners were first made available for human consumption, they were used mainly by those who had adopted a low-carbohydrate diet for health reasons. Subsequently, however, low-calorie foods were extensively promoted and came into widespread use throughout the population, although there had been no adequate safety testing and, in particular, no long-term studies of cancer risk. In 1967, 15 million lbs. of cyclamate was produced for human consumption. Two years later, in 1969, the U.S. Food and Drug Administration banned it, because of reports of bladder cancer in laboratory animals.

It is thought that cyclamate has no carcinogenic effects until it has been converted, in the body, into the reactive form cyclohexylamine. In Western countries, the conversion of cyclamate to the reactive form (by bacteria in the lower bowel) occurs in about 25% of the population. The efficiency of the conversion may sometimes be as low as 1% and sometimes as high as 40%, but in general is known to fall as the dose of cyclamate is increased. On this basis it has been argued that conversion of cyclamate to carcinogenic form in the human body is not a very serious risk, and that, since animal data are not directly applicable to man, and in the absence of incriminating evidence from studies of bladder cancer in humans, cyclamate should be reinstated. (The animal evidence is also questioned on the grounds that the test cyclamate was mixed with saccharin, impurities in which may have caused the cancers.)

TABLE 3

PROBABLE INDIRECT NATURAL CARCINOGENS IN FOOD

Food Additive	Food	Source
Ergot alkaloids lysergic acid diethylamide, ergotamine, ergonovine	Rye	*Claviceps purpurea*
Selenium	Various crops	Soil
Sterigmatocystin	Grains	*Aspergillus versicolor*
Cycasin	Cycad nut	Natural constituent
Nitrosamines	Plant and animal food	Bacterial synthesis and nitrite interactions with amines
Polyaromatic hydrocarbons	Plant foods	Natural ingredients
Pyrrolizidine alkaloids	Cereals	*Senecio vulgaris* L., *compositae* and several other strains
Leuteoskyrin	Rice	*Penicillium patulum*
Cychlorotine	Rice	*Aspergillus* strains
Patulin	Apple juice	*Penicillium patulum*
Ochratoxin A	Barley	*Penicillium viridicatum*
Trichothecene T-2	Mouldy maize	*Fusarium equiseti*
Zearalenone	Mouldy maize	*Fusarium graminearum (Fusarium roseum)*
Safrole	Spices	*Sassafras albidum*
Aflatoxins	Ground nuts, cereals cottonseed cake, Ground nutmeal, wheat, mouldy carrots	*Aspergillus flavus*

However, this argument should be dismissed. Cyclamate is converted in the human body to a known carcinogen (cyclohexylamine) and, although the amounts are small, they may be significant enough to induce cancer. It should not be forgotton that the induction time of bladder cancer is at least 18 years, and the effects of cyclamate on low-calorie-food users may be yet to appear[16]. In addition to the link with cancer, there is evidence that food-grade cyclamate is teratogenic[17], and possibly mutagenic[18]. In spite of these reports, attempts to lift the U.S. ban on cyclamates continue, while in Australia the ban was lifted in November 1974[19].*

Another controversial member of the same class is the hallucinogen LSD, which has been subjected to extensive tests for mutagenic, carcinogenic and teratogenic effects in recent years, although without clear results[20]. Finally, the group also includes certain substances found in rye that has been affected by the disease ergot (caused by the fungus *Claviceps purpurea*). These unintentional food additives, the so-called ergot alkaloids, have been proven carcinogenic in experiments on animals[21].

Azo Compounds

The azo compounds are red and yellow dyes which are used to colour foods.

Food colourants are being used to excess: they improve the selling qualities of the food without improving the nutritional qualities.

Almost all processed food and many agricultural commodities are coloured. In the U.S.A., for example, yellow dye is added to bread to give the impression that it is enriched with eggs. The resulting product, called 'egg-bread' although its eff content is low, is more expensive than white bread[1]. Likewise, dog foods and hot dogs are coloured for sales appeal.

Because the public has been led to associate the ripeness of an orange with a certain vivid colouration, even the skins of Florida oranges are dyed; the dyes are ingested when the skins are eaten in marmalade. Dyes in soft drinks simulate fruit juice. How is a cherry drink made? To water is added 50 parts per million (ppm) of FD&C red No. 2 dye, plus a little sugar or other sweetener, and flavourings (usually artificial). An orange drink? 54 ppm of a dye consisting of 96 parts FD&C yellow No.6, and 2 parts of FD&C red No. 2 with 1 part FD&C blue No. 1[22].

FD&C No. 2. (amaranth) is used in almost every food product. In combination with other dyes, it can be used to simulate caramel, apricot, strawberry, raspberry, cherry, currant, blackberry and chocolate. Some of the foods listed by the Food and Drug Administration as containing red No. 2 in 1971 included: "ice cream, processed cheese, luncheon meat, frankfurters, fish fillets (fresh or frozen), shell fish cornflakes, shredded wheat or wheat cereal, rice flakes or puffed rice, rolls (sweet, cinnamon, Bismarcks, etc.), snack items (pretzels, corn chips, crackers, etc.), cookies, pie crust, cake mix, pickles, peaches, citrus juice and fruit juice (canned), canned apricots, cherries, pears, pineapple, fruit cocktail, salad dressings (French, mayonnaise), jelly, pudding-mix, syrup, jam, candy bars, vinegar, and cola drinks"[1]. Each year about 19 million dollars' worth of red No. 2 is produced, and added to about 19-25 billion dollars' worth of food.

In 1970, Russian scientists reported that this dye produced cancer in rats[23], and also caused congenital abnormalities, still-births and sterility[24]. The level which affected the rat foetus was 1.5 mg/kg, exactly the level established by WHO as the 'safe dose', the acceptable daily intake for humans. In a later study with purified amaranth, carcinogenicity was confirmed. Despite this, FD&C No. 2 remains a legally permitted contaminant of U.S. food, because the reliability of

* Recently the ban was sustained in the United States.

the Russian evidence has been questioned.*

As a group, the azo compounds came under suspicion when it was discovered that they inhibit tumour growth, a property often found in substances that are themselves carcinogens[25]. It was established that many azo compounds cause cancers of the liver, but the azo food dyes themselves were assumed to be safe, because they are highly soluble, and hence quickly eliminated from the body. However, even highly soluble substances can have potent carcinogenic effect if appropriate conditions arise[26] and any compound, whether soluble or not, should be thoroughly tested for carcinogenic effects before it is approved for use in food[27,28].

Dihydrofurobenzofuran Derivatives

This group includes toxins produced by moulds (*aspergillus flavus, A. versicolor* and *A. nidulans*) that form in humid conditions on wheat grain, corn, nuts, etc.[29,30]. The most potent are the aflatoxins.

Aflatoxins were discovered when 12,000 turkeys died of an unknown cause. The deaths were traced to feed containing peanut meal contaminated with aflatoxins. Since that time, outbreaks of aflatoxin poisoning have caused deaths among partridges, pheasant, ducklings, calves, pigs and other animals. Affected animals deteriorate rapidly and suffer subcutaneous haemorrhage the liver is particularly affected[29].

Laboratory tests have shown that the aflatoxins can cause cancer in rats and other animals. Indeed, one of them, aflatoxin B-1, is considered the most potent carcinogen ever detected: an intake of 15 parts per billion induced a 100% incidence of liver cancer in rats[31].

In human populations, aflatoxins have been associated with a high incidence of liver cancer in Thailand, the Philippines, South Africa, Uganda and India. When children in India were given a protein supplement containing 300 parts per billion of aflatoxin, 3 out of 18 died of cirrhosis of the liver[1]. In Western India, 106 out of 397 people died after eating maize contaminated with 6-16 parts per million of aflatoxin[32].

We are unduly exposed to biologically active levels of aflatoxins, both because of inadequate monitoring of the food supply and because the tolerance levels are too high. Despite the 100% incidence of liver cancer in rats exposed to 15 parts per billion of aflatoxin, the Food and Drug Administration permits levels of 20 parts per billion in food, because ther analytical methods do not allow accurate measurements at such low levels. It appears that biological systems are more sensitive to aflatoxins than are the physico-chemical tests designed to detect them.

Halogenated Hydrocarbons

Chemicals in this group — including DDT, aldrin, endrin and the PCBs — have been used extensively as pesticides, solvents, etc., but since they are hazardous, and in some cases persistent, their use has now been curtailed.

DDT, aldrin, endrin, heptachlor, heptachlor epoxide and most of the other members of this group are known to cause tumours, but the tumours are not necessarily malignant[33]; opinions on the available evidence differ.

DDT is a celebrated case. It is no longer permitted in animal feed or for food use, but continues to be a food contaminant because of its persistence in the environment. Although the soil is polluted, it is hoped that levels of DDT in food will gradually decline if its use is curtailed. In the U.S.A., Dr. Saffiotti of the National Cancer Institute has reported that DDT is a carcinogenic at low levels in the diet[34]. In one study, DDT was found to be carcinogenic in two strains of mice at a level of 140 parts per million (ppm) in the diet; in a later study, a carcinogenic effect was observed at a level of 250 ppm; and in another, increase in the incidence of tumour formation was found even at the lowest test level of 2 ppm, which is a good deal less than the 7 ppm permitted in and on certain fresh fruits and vegetables, for example. Tolerated levels for food use range from 0.5 ppm in and on certain fresh fruits and certain fresh vegetables to 50 ppm in and on peppermint hay and spearmint hay that is not to be used as animal feed. Residues of DDT and its derivatives in food as a result of soil pollution may amount to levels ranging from 0.5 ppm to 1 ppm.

The polychlorobiphenyls (PCBs) are chemically very stable, and are widely used in industry when heat-resistant and non-flammable liquids are required — for example, as cooling agents in electrical transformers, in paints, oils, adhesives, plasticisers, etc. They are also biologically active, and are used as insecticides. Like DDT, they are persistent (not surprisingly, in view of their chemical stability) and, if ingested in food, they are stored in the body fat. It is almost impossible to avoid exposure to PCBs: together with the DDT derivative, DDE, they are the most widespread of the environmental pollutants[35]. PCBs have been detected in fish, mussels and birds from the Netherlands and the Rhine, in the marine life of Sweden, England and the United States, in human body fat, and in a variety of foods such as margarine and vegetable oils. Research into their biological activity has revealed carcinogenic effects.

Other chemicals that are under suspension are the fumigants ethylene dibromide, methyl bromide and ethylene chlorobromide, which leave residues — sometimes quite considerable — on fruits and vegetables[36]. In the course of further treatment, these residues may be

* Since the above was written the food and drug use of FD&C red No. 2 has at last been banned in the U.S.A., but the sale of existing stocks of contaminated foods is permitted. Among the azo substitutes of FD&C red No. 2, is red No. 40, itself not clear from suspicion. The Food & Drug Administration reports that in laboratory tests animals *"developed premature and malignant lymphomas"*.

converted to ethylene bromohydrin, a known mutagen and suspected carcinogen.

Hydrazine Derivatives

This class includes the indirect food additive maleic hydrazide. Maleic hydrazide is used extensively as a herbicide, fungicide, growth inhibitor and regulator. It is used on tobacco to control weeds, grass and foliage, and on potatoes, onions and other root crops to prevent sprouting during storage. A level of 50 ppm has been approved in or on potatoes, and a level of 15 ppm in or on dry onions.

Hydrazine compounds are known to have tumour-inhibiting properties, and hence are under suspicion as carcinogens and mutagens. It is thought that, in the body, they are transformed into the parent substance, hydrazine, which has been shown to cause tumours in mice; in one case, daily administration of hydrazine for 46 weeks produced 100% incidence of tumours of the lung[37]. Maleic hydrazide itself has been implicated in carcinogenesis in mice[38] and, like x-rays, causes chromosome damage in growing plant tissues[39].

Inorganic Compounds

Among the inorganic compounds suspected as a carcinogen is cobalt sulphate, at one time added as an anti-foaming agent to beer and other alcoholic beverages. It has now been banned, not because of the link with cancer, but because of the serious cardiovascular effects observed among heavy beer drinkers[16].

Talc, used as a coating in packaging and as an anti-caking agent in foods such as peanuts, chewing gum and rice, is chemically related to asbestos, and is often contaminated with asbestos fibres. The link between regular exposure to asbestos and cancer of the oesophagus, stomach, colon and rectum has attracted a great deal of public attention recently. Workers in Japan have traced an abnormally high incidence of stomach cancer in a small population there to the ingestion of rice polished with talc[16]. Polished rice has little to be said for it: the polishing itself yields no nutritional benefits and, when the talc is washed off, valuable vitamins and minerals are lost.

Salenium, regarded as essential to adequate nutrition, causes liver cancer in rats[40]. It is an unintentional food additive, transmitted through the soil.

Arsenic is another element under suspicion. Inorganic compounds of arsenic are used as insecticides and fungicides, and also gain access to our food supply through their persistence in the soil; they are allowed in certain foods at levels between 0.7 and 7 ppm. A number of them have been implicated as carcinogens and, in particular, potassium arsenite has been associated with liver tumours[41]. Because inorganic compounds of arsenic are carcinogens, suspicion must also fall on its organic compounds. Several of these — roxarsone, arsanilic acid, carbarsone and nitarsone — have been approved for use in medicated feed to improve the health, production and efficiency of poultry and swine. Since these compounds are apt to leave residues in the slaughtered animal, it is important to determine whether they are converted to the inorganic compounds. Studies so far conducted have been unable to resolve this question[42], and the long-term safety of all these chemicals remains to be established.

The nitrites have received a great deal of attention recently, in connection with the possibility that carcinogenic substances are produced in the stomach itself, by a reaction between otherwise non-carcinogenic chemicals[43,44]. Nitrites are widely distributed in our food, our water and our environment. Another group of indirect food additives that are increasingly widespread in the environment are the ureas, the thioureas, and the secondary and tertiary amines, which are present in drugs and in agricultural and other environmental chemicals. If, as might easily happen, food containing nitrites is ingested with other food containing one of the amine compounds, they will react together in the acidic conditions in the human stomach and produce nitrosamines, substances which are well documented as carcinogens in laboratory animals. Nitrosamines have caused tumours of the liver, oesophagus, kidney, lung, tongue, stomach, bladder, brain and intestine in rats, mice and hamsters[44,45]. They are transmitted through the placenta in pregnant rats, causing tumours in the offspring[9]. Experiments in which nitrites and amines were administered to animals have confirmed that nitrosamines are produced, with subsequent formation of tumours[46,47].

A series of experiments in which rats and mice were fed nitrites in combination with various amino acids that are present in food proteins, or are produced in the course of the cooking process, failed to demonstrate the formation of tumours[47,49] and a number of animal feeding tests have also yielded negative results. However, little comfort can be derived from such results, because carcinogenic effects are not always easily detected in laboratory tests, especially when the sample size is small.

The hazards due to nitrosamines can only be assessed by long-term testing, and by identifying and evaluating potential sources in our food chain. Certainly, in view of the known carcinogenic properties of most nitrosamines, the ingestion of large amounts of nitrites and of amine compounds by human populations must be a cause of great concern[48].

Steroid Derivatives

The steroid feed additives used to promote the growth of cattle, are a source of compounds that are proven carcinogens. The approved procedure is to remove the additives from the animals' feed some time before slaughter, allowing a withdrawal period sufficient for the chemicals to pass through the digestive process and be excreted. However, this does not always occur in practice, as is shown in the case of melangestrol acetate. This is a synthetic steroid hormone which is given to heifers (daily dose 0.25-0.50 mg per head) to stimulate growth, improve feed utilisation and suppress oestrus. It is known to cause cancer in mice[1]. The withdrawal period prior to slaughter is 48 hours, too short to ensure complete excretion of the steroid.

Stilbene Derivatives

Stilbene derivatives are analogous in structure to the potent carcinogen 3,4-benzo (a) pyrene. As early as

the 1940s, certain substances in this group were linked with cancer[27], and there is now a large body of confirming evidence[50].

The most notorious member of this group is the synthetic hormone diethylstilbestrol, which — as was mentioned in the section on transplacental carcinogenesis — has recently been linked with cancer in human females. Examination of a considerable number of case histories has confirmed that there is an abnormally high incidence of vaginal and cervical cancer among the female children of women treated during pregnancy with this substance[5]. Similar results had been obtained previously in experiments on animals, but the evidence was not regarded as convincing, or sufficiently relevant to humans. It appears that the time of exposure to the drug affects the subsequent incidence of cancer in the child; the early weeks of pregnancy are the most critical, while exposure after the eighteenth week may have no effect.

Diethylstilbestrol is permitted as an additive in animal feed, on condition that no residues remain when the meat reaches the dining room table. The residues are determined 7-10 days prior to slaughter. The tolerance is zero, which is apparently within the accuracy of the available methods. Attempts are in progress to ban this feed additive in the U.S.A. and, at the time of writing, a bill to that effect has been passed by the Senate and awaits House approval.

Sulfate Esters

To this class belong carrageenan and furcellan, which are used as gelling and suspending agents in a number of foods. Carrageenan takes its name from an Irish town, and is derived from the so-called Irish moss (*Chodrus crispus*), as well as a number of other red algae (*Euchema spinosum, Gigartina mammillosa, G stellata,* etc.). Furcellan is an extract from another of the red algae, *Furcellaria fastigiata.*

Although dried, bleached Irish moss has been used for many years in food and medicinal preparation, carrageenan first came into widespread use in World War II, as a replacement for Japanese agar. Its food uses arise because it reacts readily with proteins, especially milk casein, to form a gel[52]. It is not clear what effect this reaction with protein has on the food value of the resulting preparation.

Carrageenan of high molecular weight (100,00 - 500,000) is used as a stabilising, gelling, bodying and suspending agent in milk puddings, chocolate, pie fillings, gelatin desserts, ice cream, salad dressings and dietetic foods; it prevents colour migration in variegated ice cream products; it stabilises and clarifies beer; and it gives body to products such as sauces, soft drinks, fruit drinks, syrups, toppings, cottage cheese, yoghurt, whipping cream, and many others[53]. This extensive use has not been preceded by complete toxicological studies, because carrageenan is approved as a food additive on the basis that it is "generally recognised as safe".

Such limited toxicological studies as have been undertaken have shown that carrageenan is not without hazard. Although it has produced ulcers in several species of animals, it is a permitted ingredient of almost all dairy products, the main food source of those with ulcers[1]. This situation may account for the growing doubts that a milk diet is palliative for ulcer patients, further, carrageenan has anti-coagulant properties, and should never be taken in cases where it might come into contact with the sites of recent haemmorhages[54].On the other hand, degraded carrageenan of molecular weights of 10,000 — 20,000 used in France for peptic ulcers, did not show toxicity in humans[55]. In studies on mammals, it has shown to injure the foetus, and experiments on rats have produced evidence of a link with cancer[56].

The standards for carrageenan laid down by the Federal Code of Regulations of 1975 lack the support of adequate toxicological evidence, and must be of doubtful value[2]. Since it is on the 'Grass' list, the manufacturer can use as much as is necessary to perform the desired function in the food product. The Federal Code of Regulations states "that, to assure safe use of the additive, the label and labelling of the additive shall bear the name of the additive carrageenan." The manufacturer of carrageenan claims that a broad margin of safety for food carrageenan in the diet is assured by low functional use and a minimum molecular weight of 100,000[55].

Thiazol Derivatives

This class includes saccharin, a non-nutritive sweetener which has been widely used, especially since the ban on cyclamates. The safety of saccharin has been questioned, on mutagenic and carcinogenic grounds[57]. There are numerous reports dealing with the mutagenic properties of the sodium salt of saccharin: it is weakly mutagenic at very high doses in salmonella, and at moderate doses in *Drosophila,* while moderate-to-high doses have a mutagenic effect in the mouse. Data on the role of saccharin itself in causing chromosome damage are conflicting and it has been suggested that impurities present in food-grade saccharin may be responsible for the damage.

Laboratory experiments have shown that saccharin causes cancers in animals[58], and that it can itensify the effect of low doses of known carcinogens[59].

Thiocarbamates

To this group belong the fungicides zineb, ziram, maneb, etc. Cancer risks here are associated with ethylene thiourea, which is often present as a contaminant and is also a product of their breakdown. In laboratory animals, ethylene thiourea produced goiters and thyroid cancers[33], whereas administration of fungicides free of ethylene thiourea did not cause thyroid cancer. When these fungicides are applied to crops in the recommended quantities, the residue in food such as spinach is found to obtain between 10 and 30% ethylene thiourea; the presence of water promotes the conversion. While it appears that the ethylene thiourea residues in food are not enough to have physiological significance, the dangers cannot be ignored and related compounds such as thiourea and thiuram are well known as carcinogens[60].

Thiourea itself was at one time used as a preservative for citrus fruits and for dried and frozen fruits. Individual doses are relatively harmless, but experiments on rats have linked long-term exposure

with liver cancer. In consequence of these findings, thiourea is no longer permitted as a food preservative. Another additive, urethan, has also been banned because of its carcinogenic properties[61].

Quinoline Derivatives

The quinoline derivatives are added to animal feed as a protection against parasitic disease[62].

The chemically related compound 8-hydroxyquinoline, which is used widely because of its low toxicity to mammals — as a preservative in cheese, as a bactericidal agent in suppositories, ointments and sanitary powders, as a spermicidal agent in contraceptive creams, as a fungicide for tobacco leaves, and as an antiperspirant — has given evidence of carcinogenicity [63-65], and of chromosome damage in plants and human cells[66].

Polycyclic Aromatic Compounds and Other Hydrocarbons

These compounds, including acridine, benzo [a] pyrene, pyrene, etc. are formed in the incomplete combustion of organic substances. They are found, in particular, in smoked foods, and in trace amounts throughout the environment[67]. An examination of total diets in the U.S.A. revealed that pyrene and fluoranthrene were present in all samples[68]. Benzo [a] pyrene has been detected in the U.S.A. in smoked foods and in refined oils such as soya-bean, cottonseed, corn, olive and peanut, but not in sunflower[69]; it was found to be present in various individual foods in concentrations ranging from 0.5 to 7 pg/kg[70]. There is evidence of potent carcinogenic effect, and also of transplacental carcinogenesis[7]. Mineral oil, a hydrocarbon of another class, that is permitted in food is also carcinogenic[71].

Nitrofuran Derivatives

These compounds have antibacterial properties and are widely used in clinical and veterinary medicine, and as antiseptics in animal feed. Several of them have been proven potent mutagens and carcinogens[72]. The compound 2-(2-furyl)-3-(5-nitro-2-furyl)-acrylamide (AF-2) has been used as a preservative for many foods since 1965, since it inhibits the growth of micro-organisms[72]. It recommends itself in that it is stable in foods, while being readily decomposed and excreted in the animal body, but there is evidence that it is a mutagen in rats[72,73].

The safety of this class of compounds was questioned in 1971, but a final decision was postponed so as to give the manufacturers time to produce new safety data. Having examined these additional data, the Food and Drugs Administration is at present seeking to withdraw approval for the food use of nitrofuran compounds, but the process is likely to be a long one, involving many hearings and challenges.

Triphenylmethane Derivatives

These compounds, which figure among the FD&C dyes, have been linked with the induction of tumours. There are differences of opinion as to their safety, associated with their high solubility and thorough elimination from the body[74], but their use has been restricted.

In general, the test data available for these dyes are inadequate to determine their safety. Among the exceptions is FD&C violet No. 1, which was found to be carcinogenic in animal studies and banned[16]. Long-term experiments on Brilliant FDF, multi-generation study of Patent Blue[75], and tests on indigo carmine revealed no significant adverse effects. Violet 6B is at present under investigation, the results of previous tests having been seriously inconsistent[76,77].

Other Food Additives

The following food additives — direct and indirect — are suspected as carcinogens:

~ the triazole derivatives, including the herbicide aminotriazole[78];

~ safrole, a constituent of sassafras tea and a flavouring agent for root beer, which has been banned for food use (many of its derivatives, also used as flavouring agents, have been found to be carcinogenic and banned from food use, although the substances used to replace them have yet to be adequately tested)[13,79];

~ cycasin, a natural azoxy compound derived from the seeds of the palms *Cycas revoluta* and *Cycas circinalis*[80];

~ the nitroimidazole derivaties, ipronidazole and ronidazole, which are added to poultry feed as anti-parasitic agents and in the same group, metronidazole, used in the treatment of human diseases of amoebal and similar origin[62,81].

~ the organic tin compounds, present in foods both as a residue from their use as a pesticide and also by migration from plastic packaging materials and transparent films to which they have been added as a stabiliser (their uses are numerous: as stabilisers in plastics and polymers, anti-oxidants, anti-corrosives, activators, and catalysts for industrial polymerization reactions, fungicides, bactericides, anti-parasitic agents, rodent repellants, etc.)[35];

~ and lactone derivatives such as patulin, ochratoxing A and zearalenone which are found as indirect food additives.

Evaluation of Cancer Risks

The safety or otherwise of chemicals which are added to foods should be a matter, not for legal interpretation, but for scientific and medical judgement: it must be decided on the basis of adequate data obtained in tests that have been properly designed to detect carcinogenic activity. It is imperative that those who analyse the data be individuals who are knowledgeable and expertly trained in the area of chemical carcinogenesis, so as to ensure that judgements are made with scientific competence and that approval for food use is well-founded[34]. The problem is complicated by the possibility of interactions between individual chemicals, in the environment or in the human body itself: not only do certain combinations of carcinogens have a much more potent effect than the same chemicals acting in isolation from each other, but also there are certain non-carcinogens which will itensify the effect of specific carcinogens if ingested with them. Little information on chemical interactions between carcinogens is available, and the investigation of simultaneous exposure using laboratory animals is a monumental task since, for all practical purposes, the possible combinations of environmental chemicals are inexhaustible.

The Delaney Amendment, the U.S. law which controls carcinogens in food, is concerned primarily with direct food additives, but does require that residues of a carcinogenic pesticide in a derived product shall not exceed the level permitted in the raw agricultural material. Pollution of the environment by pesticides such as DDT, the PCBs, endrin, etc. has now reached a point at which it may be irreversible, and yet neither the pesticides themselves nor the products into which they are transformed in the environment have been adequately tested as carcinogens. A long-term study of aldrin and dieldrin in rats failed to examine their carcinogenic potential[82], although DDT had caused cancers in laboratory rats as early as 1947[71], and subsequently caused them also in mice[83] A survey of over 100 pesticides conducted a few years ago found that only 3 of those that had been adequately tested were not carcinogenic: 13 were found to be carcinogenic; 28 were known to increase tumour incidence but had not been shown conclusively to be carcinogenic; 37 were tested only in one species, with negative results; and none of the remainder had even been tested by appropriate test procedures[84,34].The use of appropriate tests for the detection of carcinogens is imperative, as the entire population of the world is at risk.

Considerable difficulties beset the attempt to determine the safety or otherwise of suspected carcinogens. Some scientists who have worked in this area believe that a safe tolerance for a cancer-producing chemical cannot be established for humans[34]. Certainly there is increasing evidence to link human cancer and chemical exposure: experts in the field are of the opinion that between 50 and 90% of cancer can be prevented by avoiding the offending chemical agents. However, the opponents of the Delaney Amendment show a willingness to accept negative animal data, no matter how it is derived, while responding to animal data by questioning its relevance to humans. They point out that the metabolic pathways by which chemical materials are broken down in the body are different in humans and animals, so that a substance that is converted to a carcinogenic form in the mouse or the rat will not necessarily yield a carcinogenic product in man. However, it can equally well be argued that, because so little is known about these metabolic pathways, it is impossible to determine that a given chemical will *not* be carcinogenic in humans: it may be activated in the course of metabolic transformations. Further, an individual's susceptibility to a given carcinogen will depend upon pharmacological and genetic factors, age, physiological condition, and disease state.

An increasing population demands ever greater supplies of food and certainly, in such a situation, the use of a food additive that will improve the quality and quantity of our food is not questioned so much as the use of substances that are not only potentially a cause of cancer, but are nutritionally of no benefit whatsoever. We are subject to continuing, multiple exposures to food, drug and environmental carcinogens, and a restriction of the use and approval of food additives is urgently necessary, in order to decrease the overall carcinogenic load on the entire human population. Attention should be directed towards all possible means of excluding carcinogens from our food supplies — by substituting less hazardous substances, by appropriate modifications of agricultural and manufacturing practices, and so on. In the case of additives to animal feed, particular caution is necessary, because carcinogens may be biologically active even when present in amounts that are too small to be detected chemically. The withdrawal period should be extended so as to ensure that all biologically active residues are eliminated from the animal prior to slaughter.

Without doubt, the best approach to the cancer problem is prevention, and the best approach to prevention is to control exposure to chemical carcinogens. In the U.S.A. at present, millions of dollars of taxpayers' money are spent on testing chemicals that, while they are not essential to the food supply, are known carcinogens — azo food dyes, triphenylmethane food dyes, saccharin, cyclamate and others — in order to establish a tolerance that may, or may not, be safe for humans. If the use of such substances were prohibited, this money would be released for other more useful purposes, such as monitoring our food for carcinogenic contaminants. To allow the entire population to be exposed to suspected carcinogens, while testing and re-testing continues, is quite irresponsible.

In closing, let me quote Dr. Verett, who has emphasised the hazards of food additives: "All it would take to protect the public from food-additive carcinogens is twenty five cents' worth of ink and pens, so that these chemical carcinogens can be legislated out of our food supply." The solution to the problem is prevention, by identifying carcinogens, and avoiding exposure to them.

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The Disenchantment of the World

by Thomas Merriam

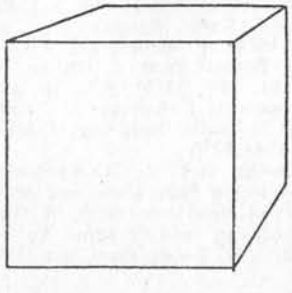
The first pair of figures represent the same cube. That on the left is in parallel perspective while that on the right uses axonometric or planometric projection. The axonometric figure is equilateral; the perspective figure foreshortens the five sides (edges) outside the picture plane. The literal accuracy of axonometric drawing recommends itself to the engineer, one whose profession is a product largely of the Industrial Revolution. Perspective drawing speaks rather the language of the eye, thus suiting the architect, whose profession dates from the Renaissance.

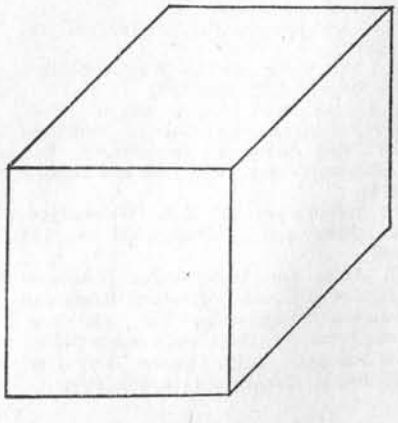
The second pair of figures restate the theme. On the left a cube is shown in non-parallel perspective while on the right it appears isometrically. The isometric figure, like the axonometric, has equal sides, while the perspective figure has none. The isometric representation is formless in comparison with its partner. It favours accuracy of linear measurement and distorts shape for this end. Isometric and axonometric projection reduce three-dimensional plasticity to the stability and fixity of a single linear dimension where numerical measurement is in control.

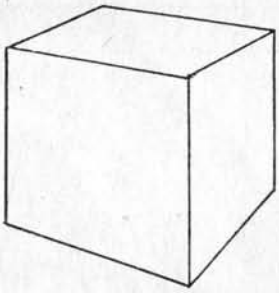
The perspective drawing conforms more to human perception. It is less mechanical and more subjective; it presents a more sympathetic impression. A world conceived in perspective is less impersonal than an isometric one. Such was the world of the Renaissance, which counted the art and science of perspective drawing among its proudest inventions. Pannini's painting *Interior of St. Peter's* and Walter Gropius' drawing of the director's office for the Weimar Bauhaus illustrate the spatial ideals of the Renaissance architect on the one hand, and the twentieth century engineer-architect on the other.

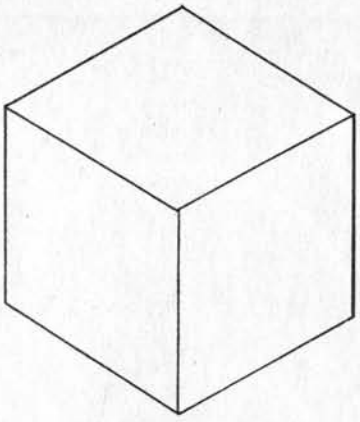
Perspective drawing and technical drawing are forms of perception that reflect evolutionary changes in the way in which the world is perceived. They embody in a visible manner two marked stages of transformation. Perspective is linked with the Renaissance and its extension, the eighteenth century Enlightenment; technical drawing expresses a visualization dominant since the Industrial Revolution. Both mark step-like discontinuities in the progression; they focus ideas and forms distinct from those preceding. Renaissance architecture broke with the Romanesque-Gothic style. Modern industrial architecture in like manner repudiated previous traditions of formal building, medieval and classical. The distinctiveness of these departures is not, however, confined to architecture and the visual arts. It can be traced throughout a broad spectrum of human expression.

What sort of evolution does the change from perspective to isometry indicate? The subjective diminishes: while perspective provides a vehicle for visual emotion, isometry is emotionally neutral, enigmatic. It merely depicts the thing itself, emptied of symbolic or connotative overtones. It suggests nothing beside a literal manifestation, a mere phenomenon. Whereas perspective claims to be an art as well as a science, isometry is a science only. It was appropriately used to represent machines in the early nineteenth century. Human beings and other living creatures are depicted in perspective; isometric projection precludes the rendering of living forms. The distortion is obvious and the effect too unnatural. Isometry









lends itself to certitude rather than conviction, a distinction in danger of being erased.

The progression from perspective to axonometric or isometric drawing (or isometric perspective, as Rudolph Arnheim calls them both) is symptomatic of that 'disenchantment of the world' which Max Weber saw as a prior condition of the Industrial Revolution. The disenchantment of the world is the effective denial of any subjectivity in the world outside man. It entails a restriction of man's subjective growth from the disuse of his ability to participate or communicate with the subjectivity he denies.

This denial has rendered the world opaque and emotionally neutral. Man's perception has changed from one of a living cosmos reflective of his own soul as in Plato's *Timaeus*, to a universe inert and powerless to move itself in a spiritual sense. The change is recorded in the replacement of the old world 'automatous' (self-moving and spontaneous) by the word 'automatic', as the former became inappropriate in describing the clock-work universe of the eighteenth century.[1] Automatic denoted the working of an automaton, moved by powers outside it 'under conditions fixed *for* it, not *by* it.'[2]

From the vantage point of today, the age which predated the sixteenth century to the present was 'one in which men personified a dead universe so that they might talk with the creations of their imaginations.'[3] The underlying assumption is the notion that the real world is a dead one.

> If there is one thing more than another that is essential to provide a 'sense of reality' — our sheer sensation that there is something *real* there before us — it is the deadness, the stolid thickness and deadness of nature. No 'eternal object', or buzzing in our ear, or whiff of perfumed air, can give the sensation of 'the real', so surely as that.[4]

Despite being based on the physics of the nineteenth century, what Wyndham Lewis wrote in the nineteen twenties is no less true today. The secret of life for molecular biologists is a chemical code in the DNA molecule, reducible to mathematical elements. The boundary between life and non-life has all but disappeared. Biology is coterminous with Newtonian physics and shares its determinism. One need only call to mind Descartes' reduction of animals to automata and Pascal's withdrawal from the cold and silent immensity of neutral space to sense the historical origins of this dead cosmos.

The disenchantment of the world brought the identification of the objective, the dead and the real. The personal and subjective came to be residual qualities of uncertain status; where objectivity is conceived in positivist terms they are excluded. But the disenchantment of the world meant, above all, the reduction of the world to a literal surround, an environment lacking in symbolical significance, demythologized and meaning nothing beside itself. Such a world, the familiar world of positivism, objective, dead, 'value-free' impersonal and literal is a world perfectly expressed in visual terms as an isometric environment. It is a world dispirited in more than a single sense. 'For the letter killeth, but the spirit giveth life.'

Life in its plentitude is symbolical:

> That symbolic thought and symbolic behaviour are among the most characteristic features of human life, and that the whole progress of human culture is based on these conditions, is undeniable . . . Without symbolism the life of man would be like that of prisoners in the cave of Plato's famous simile. Man's life would be confined within the limits of his biological needs and practical interests; it could find no access to the 'ideal world' which is opened to him from different sides by religion, art, philosophy, science,[5] yet the validity of symbols depends not on rational operations, but on complex experiences in which thought and feeling merge in the act of spiritual comprehension . . . Goethe, summing up in one line at the end of *Faust II* the mature experience of his life, attributes whatever permanent reality there may be in this transient world to its symbolic significance. What is, is only *real* in so far as it is symbolic. Earlier in his life he defined the 'true symbol' as that 'particular' which represents the 'universal', not, however, 'as a dream or shadow, but as the revelation of the unfathomable in a moment filled with life.'[6]

Not only does the symbol achieve a union of opposites, the universal in the particular, as Blake was also aware; it makes the concrete matter of experience transparent to a reality behind it, thereby preventing its serving as an object of desire in itself, an idol.

The Hebrew word for spirit, 'ruach', means breath; as such it denotes life. It is the principle of participating unity between Persons in the Godhead, and of created beings in that same personal unity, according to the degrees of 'potentiality' appropriate to their nature. The disenchantment of the world deprives it of this participation, this 'extra-sensory link between the percipient and the representations.'[7] The world of Chaucer's pilgrims was enchanted, not only by the artistry of the poet, as with the Romantics, but in its own right:

> Whan that Aprille with his shoures sote
> The droghte of Marche hat perced to the rote,
> And bathed every veyne in switch licour,

Interior of St. Peter's, Giovanni Paolo Pannini, National Gallery, London.

Of which vertu engendered is the flour;
Whan Zephirus eek with his swete breeth
Inspired hat in every holt ane heeth
The tendre croppes, and the yonge sonne
Hath in the Ram his halfe cours y-ronne, . . .

The boundary between life and non-life has virtually disappeared in a direction opposite from that of the molecular biologist. The words *veyne, vertu, inspired* and *yonge* make animate the inanimate; they reinforce by their 'anthropomorphism', as the nineteenth century would have it, the sense of purpose and willed intention at work in Nature. The adjective *his,* referring to April, Zephyr and the sun conveys the note of personal reality which, for us, is 'poetic' or true 'only in a sense.' Such a distinction did not occur in Chaucer's time; indeed, the word *its,* as well as the concept, probably did not exist. The sense of participation is palpable in the lines quoted. The experience of participation in medieval times was taken for granted to such an extent that even its philosophic prose requires its assumption.

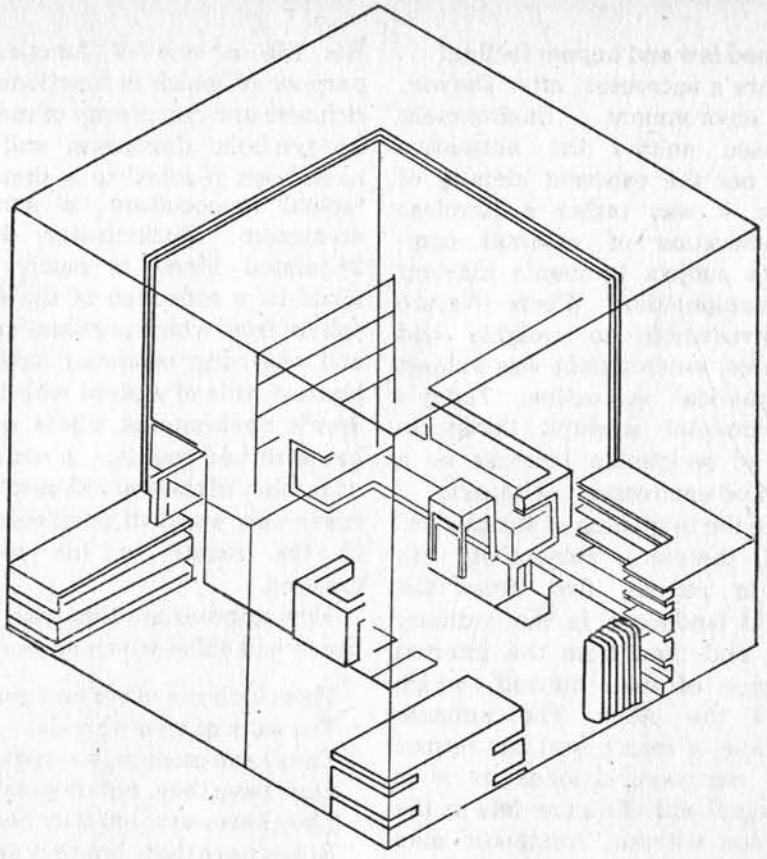
> In the work of Thomas Aquinas, in particular the word *participate* and *participation* occurs almost on every page, and a whole book could be written — indeed one has been written — on the use he makes of it. [8]

Participation is best illustrated by its absence. The climatologist's prose is designed to avoid precisely those elements of participation which would compromise the detachment of its observation.

> Mid-April tends to be unsettled, particularly the period 10-15 April, which produces moderately stormy weather during approximately 38 out of every 50 years, and the peak date for storms is 14 April. Prevailing winds at this time blow generally from between west and north-west, bringing heavy showers, and these affect western districts and high ground facing west coasts in particular. Some of the showers fall as hail . . . The third week of April is generally quite bright and sunny, but also gives showers at times, and some of these are indeed of a thundery character. [9]

April has been demythologized; all is literal fact. The forces at work are 'automatic' rather than 'aut - matous'. Instead of a final cause or conscious purpose at work in Nature, we have the working of probability in the weather machine. Reality, climatic reality at least, is impersonal. The style and texture of the writing are without allusions. The 'matter, could have been written by anyone 'apprised of the facts.'

But, it will be objected, the comparison between fourteenth century poetry of the highest quality and standard technical prose of the twentieth is hardly a comparison of like with like. The poet and climatologist belong, do they not, to separate worlds of imagination and knowledge, subjective emotion and



Isometric Drawing, Director's Office,
Walter Gropius, Bauhaus, Weimar, 1923.

detached observation?

The objection itself is indicative of the fact that we *expect* a dissociation between literature and science and make allowance for it as in the nature of things. The compartmentalisation of literature and science is the accepted price of the material benefits accompanying the triumph of nominalist science. Only by persuading ourselves of the existence of two cultures can we isolate science to its advantage, so that Lord Snow can find the second law of thermodynamics comparable with a work of Shakespeare. The insistence that the medieval poet and the contemporary climatologist impinge on each other within a single culture will be taken, by some, as an attempt to 'turn the clock back' or otherwise deny the achievements of scientific positivism.* For it is sensed, unerringly I believe, that the quarantine of art and religion, in both of which participation can not be denied, from the remainder of reality where it can be denied, is integral to the claims of positivism. The quarantine is maintained chiefly by an underlying disbelief in the reality of participation itself. This is the corrosive thread of unbelief which makes Snow's literary culture a mere embellishment to the positivist banquet. Behind the distrust of instinct manifest in the diffidence of England's representative poet, Philip Larkin, lies the assumption of a difference *in kind* between subjective experience and objective reality. It was not always so.

> . . . when a Roman spoke of events as *auspicious* or *sinister*, or when some natural object was said in the Middle Ages to be *baleful*, or *benign*, or *malign*, a herb to possess such and such a *virtue*, an eye to be *evil*, or the bones of a saint to be *holy*, or even, probably, when Gower wrote:
>
> The day was *merry* and fair *enough*,
>
> it is true that these things were described from the human point of view, but the activity was felt to emanate from the object itself.[10]

The world indwelt by 'ruach' is one where there are resonances between reality and man's inner being. The penetration of the material world by spirit leads naturally to symbolism as a means of knowing. If we compare the nineteenth century notion *environment* with the world of faery that was part of Shakespeare's pastoral poetry, it would appear to the dullest observer that something living had disappeared in the course of change. The older world was full of participatory resonances by means of which the inside and outside of experience corresponded.

The world of faery, last glimpsed in Milton, yielded to the aristocratic notion of landscape with its prone passivity, vitalised with little more than 'conceit' or taste, as a reflection of eighteenth century sensibility. According to contemporary convention, external things could be '*affecting, amusing, boring, charming, diverting, entertaining, enthralling, entrancing, exciting, fascinating, interesting*,'[11] suggesting only a contrived animation or spirit within. Yet despite the progress of disenchantment, the mythopoeic instinct was sufficient to endow Nature in the eighteenth and early nineteenth centuries with a distinctive, if remote identity, that

* 'There is only one (culture), and there can be no substitute. Those who talk of two and of joining them would present us impressively with the sum of two nothings: it is the void the modern world tackles with drugs, sex and alcohol.' F.R. Leavis, *Nor Shall My Sword* (Chatto & Windus, 1972), p. 93.

combined law and human feeling.

Nature's successor, after Darwin, was environment. Environment possessed neither the normative power nor the coherent identity of Nature; it was rather a formless conglomeration of external components subject to man's mastery and manipulation. Where Nature was irreducible to weights and measures, environment was subject to numerical evaluation. Today's environmental scientist thinks in terms of weighable biomass or a quantified environmental impact.

Since the beginning of the modern period, therefore, subjectivity has been in retreat, first from the external landscape in the ordinary sense, and then from the internal landscape of man himself, which mirrors the other. The animate landscape of man's soul has retired within narrowing bounds as it is threatened with the same fate as the landscape without. Automatic man follows automatous man, just as environment succeeds Nature. To some, man himself is a piece of environment; he is another device in the 'technosphere.'

> Man, observes Fuller, is a 'self-balancing, 28-jointed adapter-based biped, an electrochemical reduction plant, integral with the segregated stowages of special energy extracts in storage batteries, for subsequent actuation of thousands of hydraulic and pneumatic pumps, with motors attached; 62,000 miles of capillaries, millions of warning-signal, railroad and conveyor systems; crushers and cranes . . . and a universally distributed telephone system needing no service for 70 years if well managed; the whole, extraordinarily complex mechanism guided with exquisite precision from a turret in which are located telescopic and microscopic self-registering and recording range finders, a spectroscope, et cetera.'*

In such a description, man, like environment, is a collection of components lacking in coherence beyond mere physical coordination. His life is one of function, the purpose of which is functioning. Its richness and complexity of meaning, its symbolic dimension and spirit have been reduced to a literal and factual monoculture, a simplified ecosystem. Buckminster Fuller's 28-jointed biped is easily recognized as a reflection of the technosphere from which personal qualities and vitalising nutrients have been leached. It is of a piece with the isometric environment where quantity has absorbed quality — a *reductio ad absurdam* of the reductionism of the brave new world of positivism, man in the image of his technical creation.

How appropriate that man should become like that which he worships:

> Their idols are silver and gold,
> The work of men's hands.
> They have mouths, but speak not:
> Eyes have they, but they see not:
> They have ears, but they hear not:
> Noses have they, but they smell not:
> They have hands, but they handle not:
> Feet have they, but they walk not:
> Neither speak they through their throat.
> They that make them are like unto them:
> So is every one that trustest in them.[12]

There is no question of a sympathetic correspondence between inner and outer landscapes. For such participation there must be a spirit shared in common. Poetry has always testified to this spirit and the correspondence between the two landscapes.

> Shall I compare thee to a summer's day?
> Thou art more lovely and more temperate;
> Rough winds do shake the darling buds of May,
> And summer's lease hath all too short a date:
> Sometimes too hot the eye of heaven shines,
> And often is his gold complexion dimmed:
> And every fair from fair sometime declines,
> By chance, or nature's changing course, untrimmed:
> But thy eternal summer shall not fade
> Nor lose possession of that fair thou owest;[13]

In an environment made spiritless, the self retreats till its very existence becomes a question or a problem. Norman Mailer kept asking himself whether the astronauts who were to be the first to land on the moon had souls, surrounded as they were by an overwhelming mechanical environment. Neil Armstrong was asked: 'Will you keep a piece of the moon for yourself?'

> It was a beautiful question. If he admitted desire, one could ask if the Armstrong house would sleep on nights of full moon when the piece of rock bayed silently to its distant mistress, and emanations wandered down the stairs. But Armstrong said stiffly, 'At this time, no plans have been made' . . . (Would he ever have the desire to steal a rock?, Aquarius asked silently.) 'No,' Armstrong went on, 'that's not a prerogative we have available to us.' He could of course have said, 'We can't do it' but in trouble he always talked computerese. The use of 'we' was discouraged.[14]

Within a world whose spiritual resonances have been muted by positivism the condition of man is one of spiritual muteness. In order to discover who he is in a way that is ultimately satisfying, man needs a multitude of resonances which reflect, modify, and educate his subjective self. If he is to grow in the depths of his being and its entirety, rather than compartmentally — if he is to become whole, then he must participate with what is outside his ego, in a way which calls on his whole sensibility, makes demands of it, and nourishes it. In short, he must converse and develop the capacity for conversing with what is external to him.

By denying the existence of the participatory dialogue between the inner and outer landscapes, philosophy and science have maimed man's nature. Science, in particular, has done this by denying the reality of the voices speaking to man in the world about him. The isometric environment is quintessentially mute. The angels, those traditional mediators between the divine and the human, sometimes referred to as the gods, are inconceivable in a materialist world. Yet without them, the subjective heart of man com-

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* Quoted by Lewis Mumfrod, *The Pentagon of Power* (Secker and Warburg, 1971), p. 56. 'What is being abolished is autonomous man the inner man . . . His abolition has been long overdue.' B.F. Skinner.

municates with mirages outside and self-induced whispers, private symbols, within. Inevitably they pall. In Mailer's eloquent summary, the use of 'we' is finally discouraged.

In order to be personal, man needs a personal world. Positivist science and rationalist philosophy before it have contrived to render the human world impersonal. The personal, that quality which finds its fulfilment in the loving affirmation of two identities, has retreated from the common realm of experience to a private existence. Being personal now means invading another person's privacy.

The purpose of angles is to make transparent the panoply of creation in order to reflect, in the minutest way, the love of a personal Creator. By means of the angels, man's experience is marked throughout its seeming hum-drum contacts with the character of a personal relationship. He has a relationship with what he has learned to call his environment. No part of creation is opaque or mute. The living spirit inhabits it all.

We recognize the rightness of perception in those who have the *megalopsychia,* great-heartedness, to experience this relationship in defiance of positivism. Here is Dickens:

> Everything in Marseilles, and about Marseilles, had stared at the fervid sky, and had been stared at in return, until a staring habit had become universal there. Strangers were stared out of countenance by staring white houses, staring white walls, staring white streets, staring tracts of arid road, staring hills from which verdure was burnt away. The only things to be seen not fixedly staring and glaring were the vines drooping under their load of grapes. These did occasionally wink a little, as the hot air barely moved their faint leaves.[15]

So pervasive has been the disenchantment of the world, that, in a real though not literal sense, the angels have retired from the Bible in modern translation. In the Authorised Version the spirit of the personal inhabits the 'trees of the field.'

> And all the trees of the field shall know that I the Lord have brought down the high tree, have exalted the low tree, have dried up the green tree, and have made the dry tree to flourish: I the Lord have spoken and have done it.[16]

The trees are animated with a spirit akin to man's; they can know intuitively. Like the spirit of man they can be exalted and humbled. Their flourishing is a symbol of man's prosperity. They are capable of participating to some extent, like man, in the divine life.

In the Jerusalem Bible, on the other hand, the word 'high', with its connotation of 'high and mighty', is changed to 'tall.' 'Tall' denotes physical height alone.

> And every tree of the field will learn that I, the Lord, am the one who stunts tall trees and makes low ones grow, who withers green trees and makes the withered green. I, the Lord, have spoken, and I will do it.

The metaphors are botanical. 'To stunt' is not to humiliate. One senses the incongruity between the contemporary scientific idiom which speaks of growing trees and the uncontemporary statement that every tree will learn. A personal God speaks to an impersonal creation. That is the anomaly of a world conceived without the office of angels.*

* 'If we remember that an angel is a communicating sign, something which has the power to become symbolic of the sacred, we see how in the modern period the citadel of God was first attacked by skirmishes in which the angelic guardians of the ultimate disclosures were eliminated.' Fawcett, *op. cit.*, p. 273.

The disenchantment of the world is but another name for the hushing of the mediating voices between Nature and man. Without these resonances, these partial *words*, Levy-Brühl's mystical participaton between man and Nature is impossible. The tall trees that are stunted and the green trees that are withered are mere hardware with which a relationship is impossible. Trees that flourish, on the other hand, are capable of a relationship with man through their symbolic power and living spirit. Only within the last few years has empirical science accepted the sentience of plant life, which poets have experienced from the beginning. Any reading of the Bible which rejects the spiritual kinship between Nature as God's footstool and man is extraneous to it.

The modern translations of the Bible reflect the incursions of positivism in the air we breathe; in making the Bible understandable to modern man, they assume as axiomatic the absence of participation.

As scientific understanding has grown, so our world has become dehumanized. Man feels himself isolated in the cosmos, because he is no longer involved in nature and has lost emotional 'unconscious identity' with natural phenomena. These have slowly lost their symbolic implications. Thunder is no longer the voice of an angry god, nor is lightning his avenging missile. No river contains a spirit, no tree is a life principle of man, no snake the embodiment of wisdom, no mountain cave the home of a great demon. No voices now speak to man from stones, plants, and animals, nor does he speak to them believing they can hear. His contact with nature has gone, and with it has gone the profound emotional energy that this symbolic connection supplied.[17]

All creation gives glory to a personal God through the praise rendered Him by the angels. The increasing silence of the world from the age of perspective to that of the isometric environment is a measure of man's deafness to this articulation, a deafness broken only by the voice of his dreams. The ensuing silence affects language itself and gives it the dead tone of literalness in the midst of words. Language is ultimately an orchestration whose theme is the exchange of personal identities; language, bereft of its symbolic power, is impersonal to the point of incomprehensibility.

All language, all words, consist finally of variations on a theme of personal love. Their life and vitality depend on reference to their chief role as a communion between persons. Pope John XXIII said to his English teacher on his death bed, 'So we didn't make much headway, did we? But it doesn't matter now. Where I am going, they speak only one language, the language of love.'

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The New Guardhouse in Berlin, Eduard Gärtner, 1833, West Berlin, Ehem. Staatliche Museen, Nationalgalerie. The silence of neutral space is tangible in this painting.
Staatliche Museen, Nationalgalerie, W. Berlin. Photo: Jorg P. Anders.

Notebook

The Passing of the Third World Buck

"If Mexico City has 30 million inhabitants by the end of the century, and, of this 30 million, 15 million are without pure water, without services, without schools, without anything, this is not a Mexican problem, but a problem of the world." That is the view of Enrique Penalosa, who was secretary-general of the U.N.'s Habitat conference. *Why* Mexico should be encouraged to pass the buck on this colossal scale is not clear; but the attitude is typical of a great deal of thinking about the troubles of mankind. I do not want to suggest that Third World countries are entirely the victims of their own folly and incompetence, or to exonerate the richer nations from their sizable share of the blame for world poverty. But for the rulers of any country to allow a monstrously intractable problem to develop over decades, and regard it as their *right* to be saved by "the world" from a catastrophe of their own making, is surely a criminal abrogation of responsibility. (One can imagine the howls of righteous indignation if such countries were accused of being incapable of running their own affairs, let alone taken over by a richer and more powerful nation "for their own good".) Yet, as China has shown, most of the problems of the Third World can be solved without outside help; and there is a good deal of evidence that they *cannot* be solved *with* it. Certainly, millions of words and hundreds of well-meaning resolutions at U.N. conferences have fairly conclusively shown that *the world* is far better at seeing what is wrong than at putting it right.

Will Trees Save the World?

Trees may yet save us all from suffocation, according to Dr. Roger Lewin, reporting in *New Scientist* (23/30 December 1976) on a recent conference in Berlin, where a main topic was the world carbon dioxide balance. The increasing $C0_2$ content of the atmosphere has been known about for years, but is generally regarded as one of the least of our worries. We may have been underestimating the danger. Among other things, it seems likely that "atmospheric carbon dioxide would reach suffocating levels before even a modest fraction of the coal stocks are burned". Do Mr. Benn and Sir Derek Ezra know?

But the big surprise is the suggestion that at present the destruction of forests is contributing as much $C0_2$ to the atmosphere as the use of fossil fuels. Lewin quotes some figures: around 900,000 million tonnes of carbon is locked up in living plants, and as much more in humus. More than 90% of the total is in forests (¾ of that in tropical forests). So the world's forests contain about 1.6 million million tonnes of carbon — about 1/10 of the amount contained in all the fossil fuels. Nobody knows exactly how fast the forests are being destroyed; but a rate of 1% per year seems a fair guess. The use of fossil fuels is estimated to release about 5,000 million tonnes of carbon into the atmosphere each year; so the contribution from destroyed trees is probably somewhat greater. Some speakers at the conference speculated on a possible future need to grow trees as a "carbon dioxide sponge". Since locking up carbon in this way is ineffective if the wood is burnt, these trees would have to be used as timber rather than fuel. All in all, it sounds a rather agreeable way of averting the end of the world!

The Cancer Time-Bomb

"Given today's environment, we are living with a time-bomb that's going to explode 20 or 30 years from now in the form of even more persons being stricken with cancer." The quotation comes from an interview with Dr. Frank Rauscher, director of the American National Cancer Institute, published in *U.S. News and World Report*. He points out that, due to the very long latent period of many cancers, the enormous increase in the incidence of the disease (currently about 3% a year in the U.S.A.) can be attributed largely to environmental factors which prevailed twenty or more years ago. The known or suspected carcinogenic factors in today's environment are far more numerous — so a still greater cancer rate in the year 2000 is already virtually inevitable.

Between 60% and 90% of cancers, Dr. Rauscher says, are associated with external factors — "all the things that we inflict on ourselves." Other than tobacco and alcohol, most of these are "new" chemicals of one kind or another. Nitrites used in curing bacon and ham can be transformed into carcinogens in the gut; people whose work exposes them to certain substances — asbestos, vinyl chloride, motor-car exhaust — run a higher-than-average risk; synthetic oestrogens used to stimulate growth in livestock are probably carcinogenic. Altogether over a thousand chemicals in use today are known to cause cancer in animals: about thirty have been proved to cause it in people. (Proof, understandably, is not easy to come by, and the true extent of the hazards can only be guessed at.)

Dr. Rauscher is cautiously optimistic about progress in the treatment of cancer. Many people will be more sceptical. If medicine today is losing ground in the struggle to cope with the cancers caused by the environment of a generation ago, what reason have we for believing that medicine at the end of the century will be any better able to cope with the victims of the vastly more polluted world of the 1970s?

Britain's Dirty Water

What do our European partners really think of Britain? Does our present Government look as selfish, incompetent and short-sighted from the other side of the Channel as it does from this side? I am prompted to ask, among other reasons, by the spectacle of Britain doing its best to sabotage the E.E.C.'s fairly sensible and far-reaching Environment Action Programme. Take the matter of water pollution. The E.E.C. wants to apply uniform standards to control the discharge of pollutants into rivers and tidal waters. Our Government argues, first that it is not reasonable to impose uniform standards on such different environments as the North Sea and the Mediterranean, secondly that in any case the British system of control is of proven effectiveness, and thirdly that the E.E.C.'s proposed standards are unnecessarily high.

The first of these arguments contains a grain of sense, of course. To insist that some noxious chemical must be diluted with, say, 100 parts of water before discharge, irrespective of whether it is being poured into a land-locked and tideless sea, or into the Atlantic Ocean, may seem an unnecessarily rigid way of limiting pollution. But there are powerful arguments on the other side. Pollution can seldom be confined to its country of origin; and Britain's habit of treating the sea as a rubbish dump looks more and more like the international equivalent of emptying one's dustbin over the garden fence. The neighbours, rightly, are beginning to object. Moreover, there was a time when the Mediterranean seemed as limitless as the Atlantic does now. A smug faith in the ability of *our* seas to absorb all the filth we care to drop into them will not take many years to turn the Atlantic into as foul a cesspit as the Mediterranean.

The Government's second and third arguments hang together. Since the present quality of British waters manifestly falls short of the standards recommended by the E.E.C., the statements that our controls are effective and that the E.E.C.'s standards are too high are clearly interdependent. The true picture, as far as rivers at any rate are concerned, emerges well enough from Britain's official figures. The extent to which the rivers are polluted is indicated by a system of grading. Class 1 waters are "not significantly polluted"; Class 2 "of doubtful quality and needing improvement"; Class 3 "of poor quality, requiring improvement as a matter of some urgency"; and Class 4, "grossly polluted" (which means, incapable of supporting fish life, or completely deoxygenated, or "the source of offensive smells" — not so much a river, more an open sewer). Of the 24,000 odd miles under the control of the various River Authorities, over 5,700 miles fall into Classes 2, 3 and 4, including 1,015 miles of literally poisonous Class 4 water. (1973 statistics.) These are the facts by which we may judge what Denis Howell recently described as "our present and proved method of control." Mr. Howell takes over this year as chairman of the E.E.C. environmental committee. Would it be too much to ask him to do his homework before he brings Britain into even greater contempt with her partners?

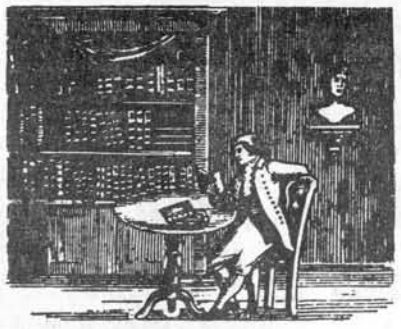
Nicholas Gould

This Month's Authors

Professor G. Reichel-Dolmatoff is a specialist in prehistoric archaeology and the social anthropology of South America. He has published extensively in English, and is Chairman of the Department of Anthropology, University of the Andes, Bogotá, Colombia.

Tom Merriam is a lecturer in environmental studies and English history at Basingstoke Technical College. He was formerly engaged on highway construction and now refuses to own a car.

Dr. Virginia Zaratzian graduated from the University of Michigan and later received a Ph.D. in pharmacology from Wayne State University. She has been Associate Professor of Pharmacology at the University of Cincinatti and held a wide variety of public appointments in the U.S.A. before becoming a Pharmacologist with the National Institute of Mental Health. She recently chaired a conference on *Food Additives: The Silent Violence*, in Virginia, U.S.A.



Books

WILL IT EVER BE POSSIBLE TO ASSESS NUCLEAR HAZARDS?

THE ACCIDENT HAZARDS OF NUCLEAR POWER PLANTS by Richard E. Webb, The University of Massachusetts Press, Amherst, 1976.

Because of the Official Secrets Act we in Britain are kept pretty well in the dark about the operations of our nuclear power plants. We have to guess at the hazards and when there are incidents we are lucky to get dribs and drabs of news. To date the authorities have been relatively fortunate. Despite at least one major incident, such as at the Windscale number one pile in 1957, no one has yet died a dramatic sudden death because of nuclear power in Britain; hence the authorities have found it relatively easy to allay fears about our expanding nuclear power programme. And even if cancers have been caused through exposure to radiation from nuclear power plants how difficult to pick them up against the expected cancer incidence in the general population; for not only are the numbers of such exposed people extremely small for statistical purposes, but the time lag between exposure and the tangible manifestation of disease varies considerably and may take years.

How refreshing therefore to read a book about the potential accident hazards of nuclear power plants in which the author, an experienced nuclear engineer, is not hamstrung by obligations to keep silent because of some government secrets act; but then Dr. Webb is an American writing about American reactors. Before we write the book off on the score that America's problems with its reactors are not our own, we must remember that the British government, endorsed by the UK Atomic Energy Authority, appears to be hastily moving away from its decision to go with the Steam Generating Heavy Water Reactor in favour of the American pressurized vessel Light Water Reactor (LWR).

Dr. Webb's thesis is a simple one. He contends that no mathematical model and no present-day computerisation can give a representative notion of the nuclear interactions and of the neutron flow in the reactor cores of today's nuclear giants. Whereas we might tolerate such ignorance when dealing with most other machines — who for example knows to the nth degree what goes on in his motor car engine? — it is a wholly different matter with nuclear power; for should a big enough explosion occur which breached the concrete containment structure then sufficient irradiated fuel could escape to contaminate huge areas of countryside and bring about an enormous death toll.

Is such an explosion possible? Dr. Webb explains that there is nothing in theory to say that it isn't, it depends primarily on the kind of modelling that is used and the subjective viewpoint of the researcher. Furthermore reactor-operating experience seems to show that the unexpected and improbable occurs with a frequency that would not be expected from probability theory. On that count little could be more bizarre than the fire in the Browns Ferry nuclear plant in Alabama. The Browns Ferry plant consists of two large Boiling Water Reactors which are served by a common control room and cable room. Some workmen were routinely testing for air leaks in the cable room, and for that purpose they had with them a lighted candle. Some plastic sealing material then caught fire and the flames spread rapidly along the bundles of cables, knocking out the majority of safety systems in both reactors and giving rise to all manner of spurious signals. At the time both reactors were operating at full power — giving out more than 2000 megawatts of electricity. As a consequence of the fire the operator lost control of one reactor but managed to regain it after nearly uncovering the reactor core of water. If the core had been completely uncovered the chances are that it would have melted down and could then have given rise to an explosion which might have breached the containment. But that is all very speculative, and it is speculation of that kind that is now part and parcel of the bitter controversy surrounding nuclear reactors.

In his book Dr. Webb describes in detail the kinds of hazards that are likely to occur during reactor operation. There is the well-known Loss of Coolant Accident (LOCA) and its counteraction through the automatic triggering of the Emergency Core Cooling System (ECCS). It was questioning the effectiveness of the ECCS that led to the Washington Hearings of two years ago with the consequent decision of the British government to opt for the British SGHWR system for the next generation of reactors. Dr. Webb does not enter into that particular controversy and instead he discusses the likely consequences of what are termed Power Excursion Accidents (PEAs) and Power-Cooling Mismatch Accidents (PCMAs), both of which he considers more threatening from a safety point of view than LOCAs. He also discusses the effectiveness of Soramming the reactor, whereby the control rods drop into the core and shut off the reaction by mopping up neutrons from the fissioning fuel.

Though written for anyone concerned with nuclear power the book is fairly technical and can only be properly judged by someone well versed in the mechanics and operation of American reactors. But one point seems crucial. *Experimental evidence to justify the faith of nuclear power protagonists in the safety of reactors is almost wholly lacking.* No government has attempted to build full size reactors — of 1000 Megawatts for example — and then methodically set about putting them into accident situations to see whether they can be brought properly under control, and when they cannot, to determine that explosions will be limited to size and will not breach the containment. The cost of course would be prohibitive, but then as Dr. Webb asks, without such testing does a government have the right to build giant reactors and claim them safe? According to Dr. Webb, even the theories have been inadequately followed through owing to financial skimping and to

computer inadequacies. He claims that the most realistic model of a reactor core must be three-dimensional especially if it is to be used to investigate autocatalytic effects, since these are the ones most likely to lead to runaway reactions. But the cost is staggering — roughly a million dollars per calculation compared with four dollars for each accident calculation using one-dimensional theory, and some 2000 dollars using two-dimensional theory. No wonder then reactor researchers stick to two dimensions at best.

Dr. Webb also criticises the accident-probability calculators for other simplifications. They use 'diffusion theory' which assumes that the neutrons fly around equally in all directions when in practice an accident may result from deformations of the core and from void formation. 'Transport theory' would then be required, which, says Dr. Webb, adds two more variables to keep track of neutron directions. Assumptions are also made about neutron speeds, which are described as fast and slow, but they may be intermediate too, especially again when the core is in any way deformed. Another complicating factor is the motion of coolant through the core and movements of the fuel itself. The researcher is dealing therefore with a dynamic interaction of variables in an unseen and potentially unstable core environment. Not surprisingly he finds himself working in the dark.

Nor have the advanced theories on reactor functioning properly stood the test of the little experience that has been gained. Dr. Webb gives as examples the unpredicted reactor explosion in a power excursion test in a small experimental reactor caller SPERT-1, and an even more dramatic and unexpected explosion in BORAX-1, another small experimental reactor. Indeed the explosion there hurled a one-ton piece of equipment 30 feet into the air. Other tests, like the WIGLE test in which neutrons were injected into a reactor core, the LOCA-ECCS simulation experiment, brought about bigger reactions than predicted by theory. *Hence Dr. Webb concludes that the theory is inadequate.*

Various research teams, government sponsored or otherwise, have tried to assess accident probabilities and the consequences of the worst possible accident. The recent Rasmussen Report purports, says Webb, to give an objective appraisal of risk and likely damage, when in fact its findings are based on all the theories that have failed to approximate real reactor conditions. Thus the final Rasmussen Report discusses the probability of a control rod being ejected from the core of a boiling water reactor with a resulting power excursion accident. The report concludes that the chances are two per billion reactor years. Dr. Webb makes his own assessment and comes up with 30 per million reactor years which is a lot higher. He also disagrees with the Report's assessment of radioactive contamination following a containment breach, the figure given being 150 times less than that described in the famous WASH-740 report produced by the Atomic Energy Commission in 1957. The figures should go the other way, Webb argues, to account for the manifold increase in size of modern day reactors compared with their 20-year-old prototypes. Thus, taking into account the six-fold increase in the highly intense short-lived radioactivity and the 15-fold increase in the long-lived radioactivity in present-day reactors, he assesses the maximum conceivable consequences of the worst accident as follows: 1. a lethal cloud of radiation with a range of 75 miles and a width of one mile; 2. evacuation or severe living restrictions for a land area the size of Illinois, Indiana and Ohio combined (120,000 square miles, which is an area considerably bigger than Britain); 3. severe long-term restrictions on agriculture because of strontium-90 fallout over a land area of 500,000 square miles lasting one to several years, with dairying prohibited for a very long time over a 150,000 square mile area.

A light water reactor cannot go up like an atomic bomb, hence the AEC in particular has propagated the myth that it cannot explode. Dr. Webb believes it can, through the generation of steam, produce the equivalent of 1000 pounds of TNT, which is an explosive force that stretches the design capabilities of the concrete containment.

The liquid metal fast breeder reactor is altogether a different story. Its fuel must be enriched with at least five times more fissionable material than a light water reactor to make up for the lack of moderator to slow down fission-sustaining neutrons. Such high fuel enrichment means that should the fuel rods of a breeder reactor compact, either by a meltdown or a core-compressing explosion, then according to the nuclear engineer, the reactivity might not decrease as it would in a water-cooled reactor but could increase. Furthermore he claims that no more than a 2 per cent reduction in the volume of the core, as might occur on a core melting, could trigger a power excursion with all its attendant hazards.

Just what might happen during an uncontrollable power excursion seems to be anyone's guess, and Dr. Webb conjures up one particularly unpleasant scenario. It might start off with what is known as Design-Basis Accident, in which the reactor coolant recirculation pumps stop accidentally while the reactor is at full power. Then a SCRAM, by which the control rods should drop into the core, fails to happen so that the uncooled core continues to work at full power. Any coolant left in the core is then boiled off and after melting the core is shot explosively up to the top of the reactor, with a force estimated at 1,1000 pounds of TNT equivalent by the AEC.

But that is not all. Should the containment hold, and it will be very near its stress limits, then the interaction of coolant vapour at the top of the reactor with molten fuel from the core itself could give rise to a small secondary explosion of around 10 pounds TNT equivalent. This explosion would drive the molten fuel back into the core at high speed, thereby rapidly raising the core reactivity and bringing about what is known euphemistically as 'core disassembly.' The end result of that Hoffnungian episode (recall the builder-on-roof story) would be a proper nuclear explosion of around 20,000 pounds of equivalent of TNT which could blow half the plutonium fuel plus radioactive waste products into the atmosphere. But reactor explosion stories — primarily because they have never happened in a commercial reactor —

are never that simple, or rather they can have different endings. Thus it makes a considerable difference to the end result whether the compacted upward thrusting core falls back in one piece or in many pieces in which instance its downward return is described as 'staggered fuel re-entry.' The scenario-makers have taken to wrangling about the fuel 're-entry' because if it should fall coherently the explosion will be much greater than for a staggered re-entry.

But now we come to a real Catch-22 situation. According to Dr. Webb the only way to ascertain the worst possible accident that can happen to a breeder reactor is to build a full-size reactor and subject it to certain theoretically conceivable operational hazards — PEAs and PCMAs for example. However, to make the experiments like the real thing — they would indeed cost a bomb — it would be necessary, claims Dr. Webb, to use fuel that had already undergone burning as it would in a full-size reactor. To obtain such irradiated fuel would mean operating full-size breeder reactors for a number of years, which would mean that the tests for reactor safety could only follow after considerable reactor operation. Do we take that risk?

Peter Bunyard

Gardening by the Book

THE GOOD FOOD GROWING GUIDE: Gardening and Living Nature's Way. John Bond, David and Charles. £3.95.

"Organic gardening is catching the imagination of everyone concerned about their health and the environment in which they live" states the foreword to this book, and it goes on to explain, in great detail, how the intending organic gardener must set about the production of his chemical-free foods.

Soils, climate, compost, mulching, plant foods and plant health are covered very thoroughly from the angle of natural co-operation with Mother Earth which is the book's mainspring. The material includes much that has been collected over a period of years by the editorial staff of *Mother Earth*, and herein lies perhaps its weakness. A practical gardener, one whose knowledge is rooted in his own experience and observations gleaned from a lifetime of growing all manner of edible foods, cannot but feel that this book has been put together by someone who has spent a great deal of time sifting through printed sources, but not by someone with compost under his finger nails

While a great deal of useful information is contained between the covers, what can one make of such» startling statements as these: "without wind . . . plants would just boil over" (p.22), "Vitamin B_{12} is present in rain water" (p.25), "Wheat sown in October can be harvested in March—April" (p.125), — in this case if the author means in Australia, he should say so, for, if it is obvious to some of us, that in the U.K. wheat cannot be harvested before August, it may not be obvious to the earnest novice from our cities. And do hedgehogs *really* eat docks and sow thistles? Few naturalists would agree that this consumer of insects, frogs, mice and eggs will make much impact on your garden weeds.

The last chapter of the guide — *Growing nutritious food* — is necessarily selective, since it sets out to suggest how a balanced diet may be produced on a very limited amount of ground. Nevertheless here too there are some quite extraordinary claims that would be hard to substantiate. Squashes seldom (if ever) produce anything approaching 20 fruits from each plant, and they need a comparatively large amount of space; peanuts have never been successfully grown on a continuing basis in this country, and emphatically are not for beginners: besides who can guarantee the two weeks of sunshine in October, required to ripen them? The Fiskeby V soya bean has a history of failure which may yet be overcome, but it is unfair to suggest that it is at present a worthwhile crop for the family trying to be self-sufficient on a limited patch of garden. This chapter includes aubergines and sweet-corn, but suggests only one herb, three fruits and a single nut!

At the end of the book there is a useful list of suppliers of organic produce. Strangely only one well known seeds firm is named as a source for organically grown seeds. Chase Seeds, who for years have produced a whole catalogue of 100 per cent organically grown seeds are not even mentioned. Is this accidental? Alas, since the *Good Food Growing Guide* is sponsored by Messrs. Thompson and Morgan one has ones doubts. But who knows? The book is so full of surprises, as for example the suggestion that we should collect old teeth from the dentist to add to our compost heaps. What are we to do with them? Presumably grind them up, since if we put them on the heap as they are they will still be in our gardens for the archaeologists of the thirtieth century to ponder over.

Really this is an impossible book to review fairly. Some of it *is* very good, and will prove useful to new gardeners, but how can one recommend a work containing so many horticultural clangers?

Geoff Molineux

Another Brave New World

ECOTOPIA, by Ernest Callenbach. Banyan Tree Books, Berkeley, California. $2.75.

It is easy to criticize the mass culture of Europe and North America and expand on the countless shortcomings of technological society. It is far more difficult to lay down some blueprints for a new society, and to exercise enough imagination to conceive how life might be lived in such a world. Ernest Callenbach has attempted to answer the question, what would life be like if the counter-culture had its way? What kind of a world would the ecofreaks and hippies, feminists and alternative technologists, put together if given a free hand? His answer is Ecotopia, a fictional nation extending from the Tehachapi Mountains of California north to the Canadian border. Although fictional, Ecotopia becomes much more real in the pages of his book than the United States from which it has seceded. For those who already live in one of the hundreds of alternative communities in northern California or the Pacific Northwest, much of what Callenbach describes is already taking place, so much that a new periodical *Seriatim, the journal of Ecotopia* is being published in

Oregon to describe the events.

Although a form of "devolution" is greatly desired by many in Northern California, it seems improbable that statehood separate from Southern California will be achieved, and even less likely that any real support could be found for secession from the United States. As a fictional device, however, it is useful for examining the prospects for different life styles and new pathways toward a steady-state economy. Since the region described is already the centre of population of those who reject the values of "mainstream culture", one need only look at what is happening today to get some idea of how the future could be shaped.

Ecotopia is a land where motor cars have mostly been phased out in favour of mass transit, where organic farms have supplanted chemical agrobusiness, where sewage and the byproducts of industry are no longer "wastes", and where energy is derived from renewable sources. The beauty of small is recognized, and whatever can be decentralized to advantage, has been. It is viewed through the initially cynical eyes of a "top international affairs reporter" from the United States, the first official visitor from that country allowed inside its borders in twenty years. The gradual conversion and ultimate defection of the narrator is inevitable once he falls into the arms of an Ecotopian lady forester.

The fictional thread of the narrative is strong enough to hold most readers, but the account of the restructuring of society is more compelling. One may boggle at Callenbach's "ritual war games" (inherited from the California Indians), or question the reasoning behind the establishment of autonomous city-states for black people, but the value of the book in stimulating thinking, and perhaps a certain amount of wishful dreaming, is considerable. It is far too easy to tear down old structures, only to replace them with something worse. Callenbach offers his views on how things could be made better. He challenges you to design your own future society, if you can think of a better way to go.

R.F. Dasmann

Skolimowski's Ecological Philosophy

TRACT 19-20: ECOLOGICAL HUMANISM by Henryk Skolimowski. Gryphon Press, 38 Prince Edwards Rd., Lewes, Sussex. £1.

It is Professor Skolimowski's contention that the achievements of the ecological movement will come to nothing if it cannot bring about a fundamental change in values and, as a necessary concomitant, in cosmology.

The largely Newtonian world-view that is dominant in industrial societies (including the USSR) finds expression in instrumentalism, a way of interpreting the physical world in terms of means to an end. As Prof. Skolimowski points out, in a passage apt to cause many a guilty shock of recognition, the ecology movement itself falls into instrumentalism if it regards the environment as a resource, to be cared for simply because our survival depends upon it.

This Newtonian world-view, the common sense of our culture, is ripe for replacement: science has already abandoned it. The cosmology that Prof. Skolimowski proposes is centred neither in man nor in the physical universe but rather in evolution. On this view, evolution is a process of continuous self-transcendence and spiritualisation. Man is its culmination and as such is scared, at least in as far as he acknowledges his responsibility to carry forward the processes that have produced him. This conception of man implies his unity with the Cosmos, for both are participants in the unfolding progress of evolution, and respect for the Cosmos is then an aspect of respect for what is best in hi self and for evolution itself.

"World-views," as Prof. Skolimowski himself remarks, "are peculiar things. Each of them holds certain things hidden and obscure." For this reason, the working philosophy of an ecological society can only arise out of the practical needs and experiences of ecological living, and its final shape is as yet indistinct; what is clear, however, is that any such philosophy which does emerge will benefit in breadth, compassion and human dignity if Prof. Skolimowski's lessons are successfully absorbed.

Bernard Gilbert

Letters

What Does Skolimowski Want?

Dear Sir,

I enjoyed Professor Skolomowski's article 'The Ecology Movement Re-examined' in the October issue of *The Ecologist*, and would like to make some comments. I think my concern with his paper goes not to its basic conclusions but rather to what I perceive to be its incompleteness in certain respects. While he recognises that the environmental movement is in reality many movements, he does not carry that into a full explication of those movements. I think you will find that some, though certainly not all, of them have a fairly complete world view. For example, the people I know who have homesteads preach a gospel of simplicity, of working with the land. While this appraoch is radical in its rejection of technology and its attempt to conquer the separation of humans and nature, it is basically personal. That is, their programme is accomplished only if everyone does the same thing voluntarily. The world view may not be particularly sophisticated, but it is none the less comprehensive. At the opposite end of the spectrum are socialists and others with more or less well-defined leftist views who see environmental contamination as an aspect of ruling class subordination of human values. Whatever you may make of the legitimacy of that view, it is comprehenisve and, in a real sense, ecological. There are at least two other groups I want to mention, and many others which get left out in this analysis. But let us look briefly at environmentalists and conservationists. Environmentalists are the new breed, the people represented by such groups as Friends of the Earth and Environmental Action. They oppose PCB's, new highways and nuclear power, and fight for tighter air and water pollution controls. The conservationists fight against soil erosion and forest fires, and for better fish and game habitat. It is these groups, I think, who Skolimowski is criticizing. The question they cannot answer, and in some ways I cannot answer is what does Skolimowski really want?

The problem of the definition of goals is a problem of liberalism generally. They tend to be incrementalists whose long range goals are defined in the most general terms. And, in a very real sense, the ecology movement is a product of the liberal tendency to fracture knowledge and politics into categories — hence we have a civil rights movement, a women's movement, a gay movement and so on. I suggest that you can make precisely the same kind of critique of each of these movements.

The other related problem in defining the principles of an ecological outlook is the problem of who you define as ecologists. As an environmentalist I've opposed business men on a number of issues. Yet each of them, with only one exception, have told me in personal conversation that he, too considers himself an environmentalist. I think the problem runs a bit deeper than the dichotomy between what people say nd what they do; the problem is that we have ıany outlooks on the environment. I'm not sure ɣou can dismiss the alternate energy freaks out of hand. While they may not be particularly sophisticated philosophers, they stress in their own way the importance of decentralising energy production. Nor do I think that the "Small is Beautiful" theology is petrifying. This past summer I talked with several officials with the U.S. Agency for International Development who spoke of applications of the Schumacher type technologies across the globe. Schumacher makes a demand for continuing innovation in technology (rather than rigid adherence to size, for example), and the alternate energy freaks make a similar demand. Are they environmentalists? A book called *The Little Planet* (M. Hamilton ed.) makes a case for an environmental/Christian theology. The attempt to get to the religious/mystical side of the environmental question dates from Taoism and transcendentalism, and has a variety of current manifestations. Are these people environmentalists? There is still another group of people, bureaucrats, legislators, consultants and academics who would argue that the sole purpose of the environmental movement is to reduce human impact on the environment. They are rather fond of environmental impact statements, technology assessment, and regulation. Are they environmentalists?

If I define the environment movement as a "quality of life" movement are not my goals all embracing? And if we define the environmental outlook in a narrower sense, where do we draw the line?

I see the environmental movement as a broad free-wheeling amalgam of dozens of complete or partial world-views which agree in principle on the basics. You can describe the Christian church (or churches) in much the same way. I find that the radicals, the Christians, the small technology people and the bureaucrats all have ideas from which I can begin to develop an integrated philosophy. I personally think we need a new world order (following Richard Faulk), but I can't get very far on that thinking alone. Quite clearly, the liberal part of the environmental movement needs a consistent and thoughtful outlook. But in a broader and more appropriate sense, perhaps we ought to be planning for the type of world we would like our children to live in.

Yours faithfully,
John Dernbach,
Environmental Law Student,
University of Michigan, U.S.A.

Three Cheers for the Welfare State

Dear Sir,

Henryk Skolimowski's article 'The Ecology Movement Re-examined' is the most valuable article published in your journal since 'A Blueprint for Survival'. It is instructive to subject your editorial 'The Welfare Illusion' in the same issue to the yardstick of Skolimowski's perceptive analysis:

1. It shows a preoccupation with the mechanics of welfare rather than the huge benefits of universal and equal access to health services, education, books, and security against the worst material ravages of unemployment — benefits which, in the scheme at which you hint, would be most inequitably (indeed devisively) distributed.
2. It engages in 'excessive revolutionary rhetoric' and meaningless extrapolation. To give but one example: "At the current rate . . . (welfare expenditure in the US) should increase within the next ten years to something approaching five billion dollars." Professor Donald McKay has defined extrapolation as 'a substitute for thinking'. You have compounded this with inaccuracy.
3. Absence of any comprehensive philosophy. Welfare appears to be just another target for your disjointed polemic. You offer us no programme, no philosophy — only the verbal vandalism of what is, despite its many imperfections, one of our proudest and most equitable institutions — the welfare state.

May I dare to hope that you will now take Skolimowski's lesson to heart, and encourage your contributors to contribute to the theology, ideas and ideals which will sustain and enliven the ecology movement through and beyond its present time of disillusionment.

Yours faithfully,
Colin L. Pritchard,
Society, Religion & Technology Project,
Edinburgh, Scotland.

Unfair to Marx

Dear Sir,

Colin Fry is unfair to Marx ('Marxism Versus Ecology' by Colin Fry, November 1976): he was writing more than a hundred years ago; everyone, however gifted, is bounded to some extent by the world-view of his culture at the time in which he lives; furthermore we must distinguish between the ideas of the founder of an ideology and those of his successors: if Marx were alive today he would not be a member of the 'Communist' Party, any more than Jesus would be a member of the Christian Church. Many years before the Revolution Rosa Luxemburg was attacking Lenin and Trotsky on the subject of bureaucratic centralism in the Party in *Leninism or Marxism*, published by the Anti-Parliamentary Communist Federation, Glasgow. She would have agreed with Colin Fry that it is not necessary to be a 'democratic centralist' in order to believe in human brotherhood and co-operation, and I am sure that Marx would have too.

The 'ruthless centralisation' of political power envisaged by Marx and Engels was to be only a transient stage, the dictatorship of the proletariat, during which the remnant of capitalism would be overcome. Engels wrote in *Anti-Duhring*, "The first act whereby the state really becomes the representative of society as a

whole, namely, the expropriation of the means of production for the benefit of society as a whole, will likewise be its last independent act as a state. The interference of the state authority in social relationships will become superfluous, and will be discontinued in one domain after another. The government over persons will be transformed into the administration of things and the management of the process of production. The state will not be 'abolished', it will 'die out'."

In an article in the *Neue Zeit*, he wrote:

"When we are in possession of the powers of the state, we shall not even dream of forcibly expropriating the poorer peasants, the smallholders (with or without compensation) as we shall have to do in relation to the large landowners. Our task as regards the smallholders will first of all consist in transforming their individual production and individual ownership into co-operative production and co-operative ownership, not forcibly, but by way of example, and by offering social aid for this purpose. We shall then have the means of showing the peasant all the advantages of this change — advantages which even now should be obvious to him."

Far from wanting the capitalist factory farms and domination of the countryside by the towns, Marx and Engels were even at that time envisaging a harmonious integration of agriculture and manufacture which would make it possible for everyone, while remaining close to Mother Earth, to participate in the benefits of civilisation. Marx wrote in *Capital*, Vol. 1:

"In modern agriculture, as in urban industry, the increased productivity and the greater mobility of labour are purchased at the cost of devastating labour power and making it a prey to disease. Moreover, every advance in capitalist agriculture is an advance in the art, not only of robbing the worker, but also of robbing the soil . . . Capitalist production, therefore, is only able to develop the technique and the combination of the social process of production by simultaneously undermining the foundations of all wealth, the land and the workers."

This strikes such a familiar note, I think I must have read something very like it in *The Ecologist*.

Yours faithfully,
Anne Vogel,
London N.11.

A Vulgar View

Dear Sir,

I felt strongly moved to write a rejoinder to Colin Fry's article 'Marxism Versus Ecology' in Vol. 6 No. 9. Fry conflated so many conceptually separate issues that it is difficult to concentrate on any one criticism, apart from a general comment on the vulgarity of his approach. As usual, Marx, Lenin and the USSR are taken to represent 'Marxism', with a complete disregard for both the numerous writers of the twentieth century who would be happy to be called Marxist, and for the various models of development used by different socialist countries, especially in the Third World. Whilst Marx, Lenin and the USSR may be taken as a paradigm example of the late nineteenth centure attitudes towards Marxism, to conflate that example with 'Marxism' today is simply crass sophism.

I must admit that I had always assumed that Dialectical Materialism was above all a method for understanding the human world. I cannot find a reference for Fry's contention that there must be opposing, self-contained historical epochs for the truth of Dialectical Materialism to be demonstrated; in present Marxist writing the notion of 'historical residues' permeating present conditions is well established. And I would have thought that to knock the idea that matter is moving towards a condition of increasing perfection, by using the Second Law of Thermodynamics, is laughable — what, Mr. Fry, do we make of this strange anti-entropic phenomenon called Life? Dialectical Materialism is not a philosophy (Marx explicitly stated that philosophy must be transcended), and Fry's very peculiar understanding of it leads me to conclude that he is rather less familiar with the basic ideas of Marxism.

There are too many other criticisms to include here, but may I refer Mr. Fry to Antonio Gramsci's work, a noted Marxist who strongly promoted the view that relations between the rural South and industrial North of Italy were at least as important as the traditional concern about relations between the proletariat and the bourgeoisie. Articles such as Mr. Fry's are dangerous at this time because they confuse and trammel thinking about political options and models of economic and social development; issues which are crucial for our future — simple dichotomies between town and country actually disallow real discussion about the relationships between industrialism, agribusiness, ecology, the politics of food, oil, nuclear energy and the rest.

Yours faithfully,
Mike George,
West London SERA,
London W14.

Not So Much Right As Wrong

Dear Sir,

Colin Fry's article is based, at least partly, on a confusion and relative ignorance of Marx's philosophy. No doubt Marx hailed the bourgeois Industrial Revolution as a positive step forward in civilization and he was biased in favour of urbanisation; thus Colin Fry's accusations are justified, but only partly.

Fry confuses Marx's philosophy with the sordid 'application' of it in the Soviet Union and elsewhere. The fact that the Russians have adopted capitalist agricultural methods does not in any way prove the validity of the attack on Marxism. In countries such as France, Germany or Italy where studies of Marx are a bit less tinged with shallow and visceral anti-communism than in the English-speaking world, it is now accepted in ever larger circles that the USSR and the so-called 'people's democracies' are grim parodies of Marx's thinking. Fry's article understandably deals with the concrete facts such as Soviet or Chinese agricultural production, but this can't be accepted as an attack on Marx' system.

The only tangible quotation showing Marx's bias contained in the article is the now famous phrase about the idiocy of rural life. The phrase was qualified by Marx and Engels in other passages, and although it is true that they favoured large-scale capital-intensive agriculture, Marx and Engels quite obviously rejected the profit motive that sustained and still sustains the economy of Western countries. This same profit motive is the root cause of the shameful degradation of the quality of all agricultural products. Marx had deep faith in 'science' and so believed that the combination of research, agriculture, and industry would prove beneficial. Of course we now know that this faith may lead to monstrosities mainly because human, non-quantifiable factors are left out of all reckoning (cf Lewis Mumford). Yet ecology itself is a science and the ecological movement is, at least partly, based on scientific consideration (though not exclusively). E.F. Schumacher's Intermediate Technology is nothing less than, in Marx's words, "a combination of agriculture with manufacturing industries". The aims and methods of course are not those of large-scale industry in mass societies and there Schumacher happily differs from Marx but the basic principle remains.

The quotation of the 9th objective of the *Communist Manifesto* contradicts Colin Fry's first assertion: Marx favours a "more equable distribution of the population over the country" and thus is not an urban 'chauvinist'. Marxists here denounce the creation of megalopolies-necropolises.

The aim of this letter is not to defend Marxism; I agree with Colin Fry when he applies the phrase 'Industrial Progressism' to Marx, yet a total rejection of Marxism deprives us of an understanding of the mechanics of capitalist societies. Stating that "Marxist politics is the most acute and virulent form of Capitalism" or that "Left and Right are merely two of the same movement" is no doubt very impressive and sweeping a generalisation but it borders on the ridiculous. Although contrary to the ecological and non-violent movements, Marxists advocate a certain amount of concentration in industry and political power; Marx and a few of his followers also advocated co-operation, decision taking at the local level and communal production and consumption. The caricatures of Russian origin or the dogmatic pronouncements of Western communist parties do not invalidate this philosophical system. In France many ecologically concerned people reject that aspect of Marx that goes against decentralisation and small organic communities, yet they do not equate his thinking with the one actively put into practice by the 'conservatives' of every denomination. (Conservative here means upholder of the present systems.) The fight against nuclear energy here is often carried out by people who accept at least a few Marxist principles. (For those who know about French parties: the PSU, CFDT, MAN, and certain socialists from the PS both fight nuclear energy and read Marx with interest.)

It is clear that there does exist a difference between first Left and Right and also between the 'people's democracies' and Marx's thinking and aspirations. The political works of William Morris show what the happy conjunction of Marxism and ecological concern can achieve. *News from Nowhere* was written by a self-confessed Marxist and it does not differ widely in its implications from *A Blueprint for Survival*. Let us be careful about our rejections and attacks!

Yours faithfully,
Pierre Guerlain,
La Varenne,
France.

Good News from Spain

Dear Sir,

I have just received such good news that I want to share it with you and *The Ecologist*, because it is mainly due to our joint efforts that we have secured a partial victory for Agriculture in Spain. The Government has just published a Decree that agricultural lands which can be proved to be such, *are to be free from Urban taxation*. This was one of the great injustices I pointed out in my article (*The Ecologist*, Vol. 6. No. 6). It is hard to estimate the influence the article in *The Ecologist* had on this decision, but my friends have told me that it was widely read and used by the Agricultural Commission to support their claims.

Another victory, again for the article and *The Ecologist* is likely to be the removal of the deadly 15% tax on savings.

However I am not satisfied that enough has been done. The great need of agriculture in Spain is financial help in the form of long-term cheap loans. In view of this I am proposing an entirely new concept of rural investment. I cannot give a detailed summary of the scheme here, but what it boils down to is this: Investment of capital for three years at 7½% (the usual Bank interest) but free of all tax, and with terms favouring those who reinvest after the initial three year term. Because I have great faith in the potential of Spanish agriculture I believe that this type of investment could be very attractive.

There is still much to do, but meanwhile we have won a small victory, and I hope it will only be the first of many.

Yours faithfully,
David Greenstock,
Colegio de Inglese,
Valladolid, Spain.

A Liberal View of The Ecology Party

Dear Sir,

Much as I admire your journal, its Editor and (most of) its contributors, I strongly resent the constant assertions that are made, that all political parties, other than your own, advocate economic growth. Doubtless this is true of both the Labour and Conservative parties but when have you ever heard a Liberal politician calling for more growth?

It is true that we have not opted for 'nil' growth for, as I think you must agree, there must be some growth in some directions and in some countries; but we reject the goal of indiscriminate growth (as measured by GNP) and, at the Brighton Assembly in '74 a resolution was passed stating quite clearly that we were adopting a policy of: "controlled growth which encourages efficient production without misuse of environment or excessive consumption of non-renewable resources". In view of the fact that our environment and current resources cannot sustain past rates of consumption, it committed Liberals to campaign for zero waste as the goal of our policy of saving, salvaging or recycling. It emphasised the need for a major change in attitude and fully endorsed the report from the environmental panel.

The report was much more specific and called for moves towards achieving an optimum population, for labour-intensive industry rather than high technology and for quality rather than quantity. We have also agreed that in view of the interdependence of all nations at this stage of

world development, more and different forms of aid must be allocated to the poorer countries. Lastly we reject any further stockpiling of nuclear weapons and call for nuclear disarmament and we would wish to see an end to the proliferation of nuclear power stations and reprocessing plants. We consider it to be urgent and essential that more funds should be provided for research into alternate power sources.

I do admit however, that very little of the Liberal party's policies on these matters ever seems to reach the public but the same could be said of The Ecology Party . . . I have yet to meet anyone who has ever heard of it, outside of your readership. I was on the point of joining it myself (in the days when it was called the People Party) but I felt that a greater impact could be made if these views came from a more established party, and that even less would get through to the public if all the 'ecology minded' people left the party to join another. I, personally, would like to see the two parties unite to become a more powerful force capable of making people understand the true nature of the crisis we all face.

Yours faithfully,
Doreen Elton, Political Education Officer,
Storrington, Sussex.

The Liberal party pays lip-service to the goal of preserving what remains of our environment, but is nevertheless firmly committed to policies that must lead to its further deterioration. I cannot agree with the writer in her contention that the Liberals do not support growth. In any case what is required is not just zero growth but negative growth — this was the theme of our Blueprint for Survival.

The Ecology Party, small as it is today, must grow here as it is already doing in other countries. *Editor.*

WHALES — THREATENED GIANTS OF OUR SEAS

This new wall chart produced by Francis Chichester (Maps/Guides/Navigation) in collaboration with the World Wildlife Fund as part of their **International Marine Conservation Programme** features NINE ENDANGERED SPECIES OF GREAT WHALES together with text showing the reasons for their decline, whale products and the conservation of whales.

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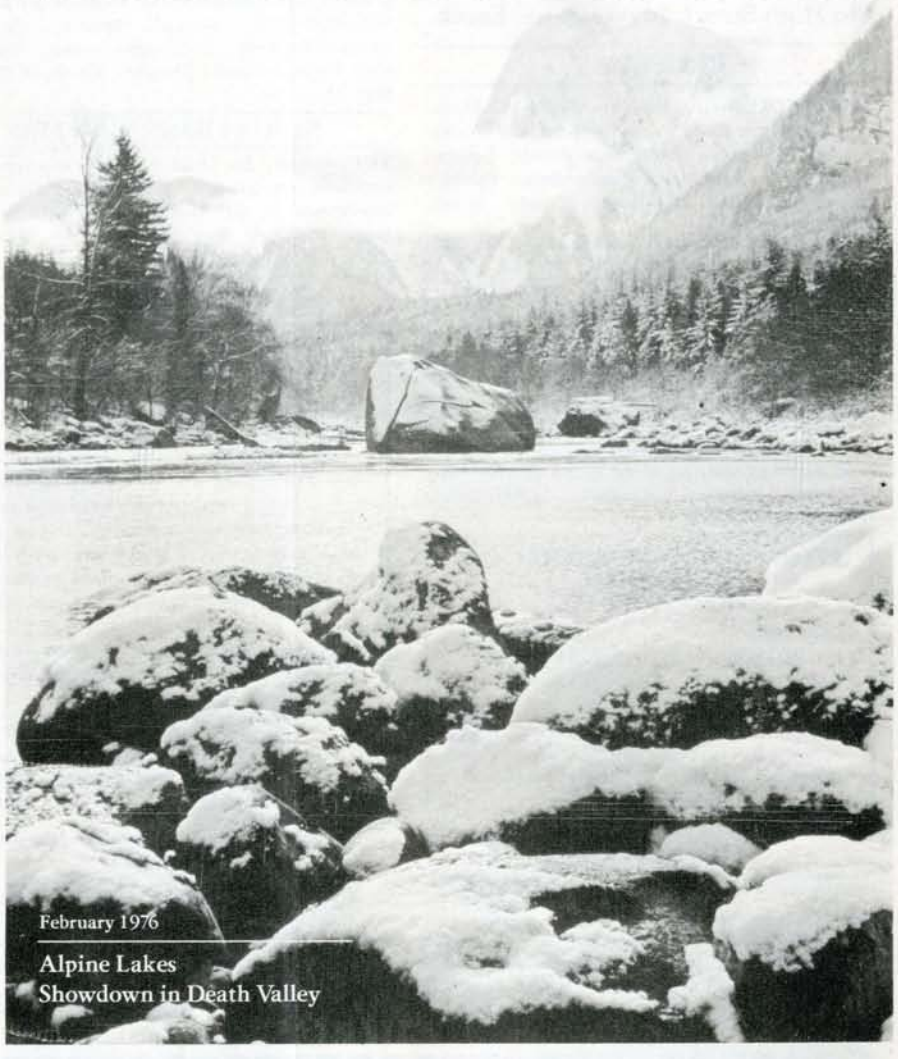

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I enclose my check or money order for $_____

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Address _____

City _____

Country _____

EC/Jan/1977