ECOLOGICAL PROBLEMS IN THEIR GENERAL CONTEXT

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1. Introduction

Ecology has emerged, particularly since the middle of our century, as one of the most advanced steps in scientific thought. For the first time we envisage the possibility of arriving at a unitary, though as yet preliminary, concept of Nature itself. Scientific knowledge, dispersed as it is in the multiple specializations and arbitrary divisions of science, is now on its way to being understood within the framework of a single comprehensive theory which, moreover, is at present at a stage of full development. Ecology has undertaken to reestablish the concepts of the structure and functions of Nature, putting an end once and for all to the anthropocentric concepts to be found throughout the various fields of knowledge. It has also brought to light many interrelationships hitherto obscure and unthought of, even those which have bearing on economic and social processes of the human population, thus opening up new roads to the discovery and definition of yet others.

2. Nature as a system

A principal premise of ecology is to conceive of Nature as a system whose integrating elements are to be found in constant interaction, and wherein each element is capable of exhibiting different states or functions in relation to the states and functions of the remaining elements. In this system, a change in the function or dynamics of one part will provoke, sooner or later, direct or indirect repercussions in the remaining constituent parts.

The greatest of these systems, which we know to exist, is the biosphere or ecosphere which comprises all the living organisms of our planet, vary-

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ing from the great ocean depts of as much as ten thousand metres, withstanding pressures of one thousand atmospheres, to atmospheric heights where the pressure is reduced to but eight hundredmillionth's of a milimetre of Mercury (8×10^{-8}mmHg). The outstanding characteristic of this system—as has been pointed out above—is that all these organisms are to be found interacting among themselves, at the same time that individually, and collectively they act reciprocally to the physical environment which surround them. This great ecosystem may be divided for the purpose of study into divers particular ecosystems which, nevertheless, will continue to interrelate and depend one upon the other. Its inmost behaviour is at present the subject of specialized studies, arduous discussion and careful investigation.

3. Man and Ecology

It is within this context that ecology has unavoidably considered man to form an integral part of the ecosystem. Although it be true that the function of the human species shows characteristics of ecological dominance, owing to its great capacity for understanding and acting upon nature, it also has an undeniable need of nature; it builds, sows and withdraws products from nature; it thinks, conjures up new techniques which become consistently more sophisticated; it changes everything, but invariably uses the resources of the ecosystem and remains within its framework.

It may be said that as a result of the domestication of plants and animals during the Neolithic Period, man arrives at a certain stage in his historic development. From being a nomad, he becomes relatively sedentary and the first permanent dwellings appear, forerunners of the cities of today, for these sources of sustenance offer him more of a safeguard than that obtained through gathering, hunting, and fishing. These processes mark the starting point of transformation and profound change which man has brought about in order to satisfy the needs of his species.

So far, man has acted without foreseeing the alterations and setbacks which have already taken place or may yet take place. Thus, it has been assumed that the great Maya civilizations came to an end around the ninth century of our era, due to inadequate handling of the soil. Generally speaking, man has made use of jungles and forests, arable land, rivers, and seas; he has eliminated depredators and competitors, upset the atmosphere, and accumulated waste, both in quantity and quality, to such a degree that the ecosystem is incapable of processing this at the rate required by the often trivial needs of the species. Moreover, he has not

hesitated to employ groups of his own kind in such a way that the benefits obtained have not even been equitably distributed, for nature has been employed for the benefit of minorities.

The changes which man has introduced into the ecosystem are so profound that we are faced with the perspective of a serious alteration of the biosphere and the problem of the very survival of the human race, or of large segments, in the best of cases. This crisis, in spite of everything, would appear to be a stage congruent with the historic development of man, if we consider that in the past we did not have the formidable accumulation of knowledge and techniques, let alone needs, that we have today. Neither had scientific thought envisaged the possibility of employing them all in order to conceive of nature as ecology does. Today, however, we are in a position to be able to act in this direction.

4. Ecological Problems in the World

Ecological problems which are of worldwide concern—in themselves very varied and of complex interection—take on particular significance when referred to specific areas of the biosphere. They are of worldwide importance for, as has already been mentioned, they not only threaten the survival of the human race, but also the existence of a considerable portion of the ecosystem itself.

In order to study the problems of an ecological nature, it would be necessary to classify them according to the more general functions which bear upon the ecosystem. Such a classification might be as follows:

a) Problems which affect the flow of energy within the ecosystem. Basically, we may refer to the production and distribution of energy necessary for the human population (food) and its relationship to the demographic and agricultural processes and the use of elements obtained from the ocean.

b) Problems related to the biogeochemical cycles in the ecosystem. These refer principally to pollution in its various forms, be it generated by agricultural activity, the consumption of fuels in the city and in industry, or that due to wastes originating in the human population (garbage and excretions). It would be suitable to mention here the problems relating to the availability of mineral and hydrological resources.

c) Problems relating to the environment. These are the ones which have brought about the destruction of natural vegetable and aquatic ecosystems. Prominent among these are agricultural activity and urban development.

d) Problems related to the availability of auxiliary sources of energy.

It must be remembered, however, that any kind of classification becomes arbitrary when we endeavour to analyze these process, for they all interrelate among themselves and form a continuous whole. Thus, for example, some problems of pollution turn out to be the result of man's need to produce more food, due to urban development which, in turn, affects agricultural activity. Then again, the capacity for greater production of food is very closely associated to the availability of economical and technical resources capable of supporting agricultural activity. Despite this, these or other classifications may prove useful when the moment comes to take on the study of given processes.

5. *Problems related to the flow of energy*

In order to understand what occurs in those processes which alter the flow of energy, we may affirm that all activity of living organisms implies changes in energy forms, as, for example, from chemical energy to heat energy. The processes weherby these transformations take place are what are known as respiration.

It may be said, therefore, that the biosphere is traversed by a uni-directional flow of energy, due to the fact that solar energy, which has been stored by green vegetation—the only life form capable of doingthis—reaches other living creatures through the trophic chain. It should be pointed out that the available energy suffers a loss at each trophic level, due to respiration.

The natural ecosystems are normally in a state of equilibrium for although each trophic level takes advantage of the one immediately below it, it does it in such a way that its constituents cannot dwindle away until they disappear, for only the amount of matter produced within a unit of time by that level is taken at any time. To use an illustration from the field of economics, the biomass (mass of organisms which constitute the various trophic levels) represent the "interest-bearing principal". This "interest" is used up by the trophic level immediately above it, which lives off the "earnings" without eating up the "principal".

Hence, production represents the energy really available for consumption by successive ascending trophic levels, and may be represented by a pyramid with green vegetation at the base which is broader than the successive steps to the apex (higher level of carnivora).

Once these basic principles of ecology have been pointed out, we can better understand the problem with which the domestication of plants (agriculture) confronts the ecosystem and the way in which man has been making use of this discovery.

We all know that the nations of the Third World, also known as underdeveloped countries, base their economies principally on agriculture, a major part of which is devoted to the production of food, not only for internal consumption, but also as a source of exchange for the development of said nations. Such is the case that according to data obtained from the 1970 census, in our country alone, 60.7% of the labour force was employed in the production, transportation, processing, and sale of food, which generated 44.2% of the gross national product.

Although these nations have predominantly agrarian economies, where urban and economic development rely fundamentally upon the fruits of the soil, the situation of farm labourers is dramatic, for a high percentage of them live at mere biological subsistence levels, for which the socio-economic structures of these countries are mainly responsible. A considerable proportion of the peasant population continues to employ agricultural practices and techniques the inefficacy of which contribute unquestionably to the rapid depletion and destruction of the soil. As a consequence of this situation, these population groups are not only economically deprived, but are also uninformed of scientific and technological progress (machinery, fertilizers, credit systems, etc.), which up to now have been considered signs of man's achievement.

This circumstance is grave, not only because of the evident social injustice, but because of the effect on the socio-economic welfare and health of a large population nucleus. Moreover, ignorance and the pressure of hunger have brought about an irrational overworking of the vegetable ecosystems, to such a point that if drastic measures are not coordinated soon to manage these ecosystems rationally, we may not only encounter a menace to our own survival but also to that of other species in the very near future.

At present, it is known that the process of domestication is ruled by a mutual relationship, that is to say, a reciprocating action which produces modifications both in man and in the domesticated organism (maize cultures differ from livestock cultures). Furthermore, this special style of mutual behavior produces profound changes in the whole of the ecosystem, because the relationship affects a great many other species and processes (food cycles, energy flow, soil structure, etc.). It is also known that if the feedback pressures of natural selection, which have been suppressed by artificial selection, are not compensated with artificial feedback pressures, domestication, as a deliberate purpose of man, may fail in its long-term objectives. Thus for example, overgrazing by cattle or other domestic animals, will eventually bring about the destruction of the environment, unless it is regulated in terms of the ecosystem as a whole, in such a

way as to assure a mutual beneficial relationship for both, as opposed to a one-sided exploitation.

Up to the present time, owing to a lack an ecological concept and guided by the interests of a minority group belonging to our species, man has never respected the aforementioned principles. Upon substituting one species for another, man has provoked adjustments and alterations in the energetic flow, as well as in the trophic chain. This has resulted in the distruction of the natural ecosystems which through natural selection have taken hundreds of years to adapt in order to better withstand the climatic conditions of the environment. These ecosystems have been replaced with species which are more productive due to their scant variability, but at the same time are much more exposed to disease and pest plagues.

It is, therefore, urgent that man should take advantage of these relatively recent advances and make them available to large groups of farm workers. If this is not done the farmer or livestock breeder will not be the only ones affected.

It is important to emphasize that the vegetable ecosystems are the most important part of the trophic chain. Their function is not limited to supplying man with food, but also to supplying all the remaining biological species on Earth, many of which are also food for our species, or are indispensable for the carrying out of the other functions from which man also benefits. These ecosystems are the main source of oxygen on our planet, and also absorb large quantities of solar light, thus making life for other species possible.

Paradoxically, after becoming acquainted with the picture, we realize that this irrational exploitation which has occurred in the natural vegetable ecosystems has only benefited a few of the countries of the world and the privileged minorities of the underdeveloped countries. The great population masses which constitute approximately two thirds of the total world population are suffering at this moment from cronic malnutrition, with all its complexes and consequences, and many of these people are actually going hungry.

As regards availability of food for the human race in the future, even the most optimistic forecasts hesitate to accept the possibility of the production rising to 9 to 10 times the present levels, even taking into consideration resources which are as yet untapped. Supposing that uniform distribution could be achieved, this production would only suffice to feed 30,000 million people at cronic hunger level. According to estimates based on the present rate of population growth, this figure would be reached around the year 2075. Should man consciously face the problem and adequate controls be applied, world population would become stable at 10,000 millons about the year 2050 which, according to the Committee

on Resources and Man, is "close to the maximum figure which an intensely utilized world may expect to support with a certain degree of comfort and individual liberty". Although we may conclude that we are as yet very far from achieving the maximum possible use of the food resources of the Biosphere, the foregoing estimates are considered ideal, since they do not take into account the contamination of the seas, estuaries, rivers, soil and air, the combined effect of which can drastically reduce the availability of the possible sources of foodstuffs we have mentioned.

As we have just pointed out, man also obtains his food from the exploitation of other ecosystems, such as the ocean. In this respect, it should be pointed out that this exploitation is carried out at the level of herbivorous and carnivorous fish and that the hopes of increasing the catch are not very great, since it has already been estimated that by the year of 2 000 it will be around 150 million tons, whereas at present it does not exceed 60 million tons. One characteristic of this ecosystem is that the exploitation of inferior trophic levels, which are among the most abundant as we have mentioned, is almost nonexistent. The reason lies in the fact that the extraction of these organisms would entail more consumption of energy than that which we could expect to obtain from them. Even supposing that it were feasible to work these marine trophic levels, they would only suffice to feed one third of the present population of the earth.

The possibilities of exploitation in estuaries and coastal zones are better, but these areas represent only a small portion of the sea and are more exposed to pollution than others.

It behooves us, then, to insist that the utilization of the sea and its resources should be done in a scientific and rational manner. Those countries who have important fishing fleets should be ready to accept international agreements with a view to limiting the catch, in order to avoid the extermination of whole species which might provoke repercussions in the entire ecosystem.

For many authors the solution to man's food problems is to be found in the so called "Green Revolution", which consists of a gigantic and accelerated increase in agricultural production through the use of machines, fertilizers, genetically improved seed, etc. However, this revolution has failed—at least from our standpoint—due to the socio-economic structures already referred to, and to the clearly asymetric characteristic of the commercial relations between developed and underdeveloped countries. In spite of the fact that many underdeveloped countries have converted from importers of foodstuffs to exporters of the same —as for example, our country with regard to cereals—, this change has not been sufficient to end the hunger and malnutrition of our people. Although by 1969, we

had arrived at the minimum figures established by FAO for daily protein calorie requirements per person, this progress is somewhat relative, because the figures were obtained by dividing the total food available (considering all losses) by the total number of inhabitants, taking for granted that the distribution was equitable. Later on we shall supply some figures that will show how food is distributed in Mexico.

Finally, we shall mention that man cannot depend on oversimplified ecosystems, such as the domesticated ones, due to the fact that they are very unstable. Hence, if the population continues to grow at the present rate, the fluctuations in production might give rise to serious problems of food shortage when we reach a level close to the maximum tolerance of the planet. This is easily clarified when we compare with human societies. When the economy of a nation depends upon a single crop or industry, the risk of great upsets is greater than when the basis of the economy is more diversified.

6. Problems related to biogeochemical cycles

The chemical elements contained in the earth are to be found in constant process, especially those which are essential to life. These elements are continually passing through the environment to the living organisms, and from these, in turn, to the former. In fact, they make up a cycle in which the same materials are used and used and again. These are basically two types of cycles: the gaseous, in which the deposition of materials is to be found in the atmosphere and the hydrosphere, and those of a sedimentary nature, the depositis of which are to be found in the earth's crust. This is a basic process for the ecosystem as the chemical elements are to be found only in limited quantities on the planet and, so far, there are no known sources of supply from without. Consequently, should this process of matter not take place, there could be no life. To a great extent, these cycles have made it possible for life to develop from as far back as approximately 3,000 million years ago—from the precambric period—and their perfection is such that no depletion has been recorded of any of the elements indispensable to the life process.

There are, however, other elements which, although not necessary to life from a strictly biological standpoint, have been useful to man in his process of adaptation to the environment. Thus, we have materials such as iron ore, copper, bauxite (Al), fossil suels, and many others utilized by man, all of which share the characteristic of being finite, their reserves being, consequently, subject to depletion.

The manner in which the human species employes these materials has given rise to two fundamental problems: firstly, some materials have

accumulated in excessive amounts and at a great rate in certain parts of the ecosystem, in such a way that it is incapable of processing them as soon as would be desireable—a phenomenon usually known as pollution. Secondly, the rapid depletion or scarcity of many materials has come about due to the inadequate exploitation and the irrational use of these resources.

Pollution problems are perhaps those which have drawn the greatest attention. However, they are not per se to be considered as more important or less important than any of the other ecological problems. We will not refer to these because they have already been dealt with in the section of energy flow, but will return to them when the problems of the environment are examined. Therefore, we will concentrate on the depletion of mineral resources.

The universal problem of the availability of mineral resources is in direct proportion to the population increase and to the per capita demand for these resources. Generally speaking, in consumer societies as the per capita income rises there is a corresponding increase in the demand for consumer goods. For example, the USA., which has 6% of the total world population, consumes 35% of the total energy production. In developed countries, it is estimated that the demand for copper—a relatively scarce material—will have trebled by the year 2000. The United States, which prior to the Second World War produced almost all its requirements of bauxite, was by 1960 importing three times as much of this mineral as was then being mined within its territorial limits. Estimates have been made which show that certain key minerals, such as zinc and tin would be exhausted in a matter of fifteen years, if the present rate of consumption is maintained. Fuels, such as uranium 235 and natural gas, might also be used up totally by that time. Other materials, such as lead, gold, silver, and platinum will be exhausted before the end of the century. Copper and tungsten will follow suit shortly after. Undoubtedly the discovery of fresh deposits would relieve the situation, but in any case these deposits, as any other, are finite.

The conclusion arrived at is that, it a quick and sudden exhaustion of resources is to be avoided, a program must be immediately launched to preserve resources and to promote recycling, which would allow many many materials to be at least partly used. A really efficient cycling process, together with an adequate conservation of resources and the diseappearance of the consumer society, would be the only valid methods of extending the availability of mineral resources. It is necessary to point out that, come what may, these elements will eventually be exhausted.

Industrialized nations are not self-sufficient either in mineral resources or in fossil fuels (Europe and Japan rely upon imports for 90 and 99% respectively of supplies). At other times, it turns out to be more profitable

to extract these resources from underdeveloped countries, where they are obtained at low cost and in large amounts, with the aded benefit of leaving local sources undepleted. On these foundations have been built the richest and most opulent societies in history. During the Spanish colonization Mexico lost a great part of her gold and silver reserves, which eventually ended up in several European countries where these riches and those obtained from other sources, went on to accomplish the Industrial Revolution.

The problems of mineral resources reveal, then, two fundamental aspects; in the first place, the need for the industrialized nations of obtaining these resources in order to maintain their present standards of living. This is usually done by using resources of other nations. In the second place, this has brought about a considerable depletion in the reserves of the underdeveloped countries, who obtain scant benefit from this depletion of their natural resources.

Latin America stands out as a significant example of this state of things. There is statistical data to illustrate this. During the period 1929-56, the United States reduced agricultural investment in the area from 23% to 9% of the total volume invested and increased investment in extractive industries from 37% to 43%. In Brazil, this branch of industry showed a 65.2% increase for the year 1960. Of the extractive industries, the oil enterprises are the ones which have had more investment from the United States. In Mexico, during the first three decades of this century, the oil industry was in the hands of foreign concerns, principally American and British. Mexico was one of the most important oil producer of this time. In 1921, Mexico reached the maximum oil production in its history: 193 377 587 barrels, of which approximately 99% was exported. This production was obtained through techniques which assured maximum yield in a minimum of time, and which exhasuted the then known reserves in a very short time. At present these fields hardly produce at all. Had the extraction been more rational, production might have been duplicated although extended over a longer period of time; but the oil companies had other interests, so when production began to dwindle, they looked for other fields in other countries such as Venezuela. Thus, when President Cárdenas decreed the expropriation of this resource, the holding corporations were not too concerned; they were too busy with their new ventures in other parts of the hemisphere. Later on the general outlook of the now nationalized industry was very variable, but in general there was a tendency towards a depletion of reserves. In 1970, these reserves were estimated to last fourteen more years. Moreover, this production did not satisfy internal demands, so it was necessary to supplement this with imports. Future prospects for Mexico would have been tragic

indeed had not recent prospecting brought to light new fields in Tabasco and particularly in Chiapas, fields which have meant self-sufficiency and a small surplus for our country. Although these reserves have not been as yet accurately determined, it is presumed that they are as rich as those which were worked by the foreign consortiums at the beginning of the century. The difference lies in that, by means of adequate techniques —which did exist at that time— annual production may not reach such high annual levels, but will satisfy domestic requirements over an extended period; much longer than had been recently expected.

In three countries in this region, oil production by private American concerns has continued. In 1963 this exploitation represented 36% of the direct investmenst in Latin America. There were at that time countries such as Venezuela where approximately 85% of the drilling and refining was in the hands of three American companies: Standard Oil, Shell, and Gulf Oil, which had higher levels of production there than in the United States. It is due to these reserves that the United States has controlled a great part of the world oil market, while Venezuela has not been able to achieve a higher standard of living. During 1960 Venezuela exported 15% of the world iron ore exports, but the mining of this ore was the hands of two American companies: Iron Mines of Venezuela and Orinoco Mining.

In Mexico, foreign capital in 1961 controlled 98% of copper mining, and 92% of the production of unrefined copper was that of Anaconda Copper, which also extracted gold and silver. This company has crushers, smelters, warehouses, and auxiliary rail systems. Before World War II corporations such as Bethlehem Steel have been working manganese deposits in Latin America. Others —Reynolds Metals in particular— control the extraction and transformation of bauxite.

The extraction of minerals in Latin America has not gone hand in hand with its industrialization because this is done in the United States. A glance at the figures for American investment in extracting and transforming industries shows that in 1938 and 1961, extractive industries in Latin America represented 7 and 10.8% respectively of this activity in this area, but for the transforming industries it only reached 3.4 and 4.1%. In 1961 the first had an increase of 56% with regard to pre-war levels and the second only 14%. That very same year, the production of refined zinc in the United States was 85% over the figure for the extraction of same. In Mexico and Peru, extraction was 4.3 and 5.2 times respectively that of transformation. Moreover, although Latin America produces 14% of the world lead market, it only consumes 4%, and of the 16% of tin which it extracts, in only uses 3%, as is also the case with copper.

This situation, as far as Mexico is concerned, has changed. Towards the end of the sixties, and due to the nationalization policy of the government administrations, foreign investment in extractive industries was very much reduced. In spite of this, its marketing continued to be dominated by foreign interests. This is evident in the non-processed minerals which were exported to the United States in 1973 with regard to the total of Mexican exports of these product: semi-precious stones 64.5%, asbestos 65.5%, graphite 99.8%, fluorite 86.17%, building stone 92.3%, calcium sulphate 83.6%, celestite, phosphorite and magnesite 99.7%, iron ores 96.7%, arsenic monoxide 96.7%, bismuth 61.85%, cadmium 100%, cobalt 100%, copper 64.6%, tin 100%, molibdenum 100%, lead 34.16%, selenium 91.8%, tungsten 48.2% and silver 74.1%.

Other countries such as Japan, Canada, and Great Britain also receive non-processed minerals of Mexican origin.

7. *Problems related to the environment (habitat)*

Habitat is defined as the place where a given species lives. In this case we shall refer to the place inhabited by man, particularly the city.

The process of urban development begins, as we already indicated, with the Neolithic Period as the first permanent dwellings appear, forerunners of the cities of today. These first hamlets had a great advantage over the townships of today for they maintained a state of equilibrium with nature surrounding them.

In the measure that man acquired scientific knowledge and technological advances so did the first industrial societies appear. Towards the end of the eighteenth century this equilibrium began to sag.

The accelerated and uncontrolled growth, together with the lack of city planning and the increasing overworking of the land, were principally to blame for this break in the equilibrium.

At present, cities with their ever increasing needs, industrial development, and the problem of demographic density within them, present the biosphere with serious ecological problems. Many of their repercussions are well known, such as the deterioration of man's health, due to environmental pollution. Others, such as the modification of the physical characteristics and composition of the atmosphere and its possible effect on the energetic balance of the planet, are still difficult to foresee.

Today in every country of the world, the cities —vast population concentrate— absorb the majority of the economical and food resources of the nations. Likewise their inhabitants, seeking to satisfy their needs, have not hesitated to destroy large tracts of cultivated land, forests,

jungles, and other natural vegetable ecosystems, replacing them with residential areas, shops, highways, etc.

Another problem which the cities face is the formation of what in our country we call "cinturones de miseria" (poverty, belts). These underprivileged ghettos present an additional problem because they are formed basically by immigrants from rural areas who, due to the very difficult situation prevailing in their native states are ready to live in even worse conditions than those which they have left behind, if we are to consider that the living space a alloted to a person is much more reduced in these places. These groups are also responsible for the anarchical growth of the city.

With regard to the problem of pollution, its principal causes are to be found in urban agglomerations, although it is there that we encounter their principal victims. The gasses and particles which are continuously being incorporated into the atmosphere are very often transported to other areas which in turn have suffered a high level of pollution. It is possible to state that at present the whole planet is covered by a layer of more or less polluted air and that this process of contamination continues.

We wish to emphasize that the aquatic ecosystems are the ones which receive the greatest quantity and quality of pollutants, as they happen to be the final destination of a considerable quantity of wastes. That is why some authors, specialists in ecology, consider the cities to be parasites of the biosphere, and more particularly of the surrounding countryside, for it is this same countryside which must supply, in one way or another, air, water, and food (all considered as vital factors). The biosphere has the task of degrading huge quantities of waste, which, as has already been indicated, very often exceed the capacity for self-purification of the ecosystems.

Although currently efforts are being made to plan developing cities by limiting the number of inhabitants, setting aside large tracts of land for cultivation, recreational parks, and woodlands, or any other form of natural vegetation, it is necessary to put an end to the unequal distribution between the rural and urban areas. More resources and inducements must be assigned to the former with the end in view of putting a stop to emmigration from the country to the city.

Finally, we may add that it is time that we realized that we are heterotrophically dependent and that our civilization is even more so; which makes it necessary for us to learn to live in mutual harmony with nature, for it might happen, as in the case of the Reah parasite, that we may exploit our host to the point of destroying our own selves.

8. Problems related to the availability of energy allowances.

Earlier we made mention of the flow of energy in the ecosystem and how it passes through the trophic levels, suffering a considerable loss at each one in the form of heat through respiration, which is the cost of self-support of the ecosystem. Other sources of energy may exist which, coming from without the ecosystem, may reinforce its production and reduce its respiration losses. This type of additional energy is known as auxiliary flow, or energy allowance.

Fundamentally, these allowances occur in agricultural activity and through irrigation, fertilizer, genetic selection, and pest control. Another important allowance is the fuel used by farm machinery.

The availability of these resources presents problems at world and local levels and is directly related to technical and economic resources. The problem has been dealt with indirectly earlier when touching on other points. It will, therefore, be only necessary to underline the importance of these sources of energy in order to take better advantage of the earth. For example, in the United States where it has been estimated that a yearly supply of 1HP per hour is employed, there is as a result a production three times the food per second unit of that produced in Africa or Asia, where the allowance is of only 0.1HP, although the cost in the first place is three times that of the second. This cost puts this improvement out of the reach of the poorer nations, which is the reason why the "Green Revolution" has been to a great extent unsuccessful.

Conclusions

A. The problems enunciated by ecology cannot be taken separately, for each one turns out to be relative to the rest. If it is sought to offer solutions, these should be dealt with at the level of systems and sub-systems from the point of view of ecology. Hence, it becomes indispensable to prepare professionals specialized in this field, thus avoiding improvisation which can often be harmful or limited in perspective.

B. The analysis of the ecological problematic reveals a marked inequality between groups of human population at world and local levels. It may be that in the underdeveloped countries and among their exploited classes the problems will appear with more dramatic characteristics and will require more urgent solutions.

C. No information or proposition arising out of the study of ecology will be of use as long as nature and human population groups continue

to be subject to exploitation and while the same individualistic, social, and economic structure prevails. Unquestionably there is need of a change. To achieve this objective, a broad communication of the problems and a popular attitude committed to effecting such indispensable changes are necessary.

D. The exploitation of human groups, the consumer society, individualistic interests, must disappear in degree or by force of necessity, in order to give way to a new human species with equity of resources and opportunities, perhaps not as ostentations and overdeveloped as some in our world today, but rather modest in its way of life, conscious of its position within nature, interested in channelling its efforts in the service of the community, comprising within this not only man but all the organisms and resources which in the course of history have made for the appearance, the development, and the flourishing of the present human race.