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This particular issue of the Journal is exclusively devoted to authoritative papers dealing on the environment, ecology, pollution and pollution abatement. Thus, it will surely provide both very interesting and thought-provoking reading fare to many.

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JOURNAL MANAGEMENT

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PHILIPPINE GEOGRAPHICAL JOURNAL

VOL. XIX APRIL-MAY-JUNE NUMBER 2

ENVIRONMENT: A GEOGRAPHICAL PERSPECTIVE[1]

by

F. K. HARE and C. I. JACKSON[2]

Two events in the summer of 1972 provoke us to enquire into the relations between geography and environment. In June the United Nations Conference on the Human Environment took place in Stockholm. Now the 22nd International Geographical Congress is taking place in Montreal. Only the fact that we are geographers writing in Canada justifies us in bracketing the two events, because no scientific congress, however successful, can match in importance a meeting of the governments of most of the world's nations that is devoted to the search for environmental harmony. The gathering in Stockholm may mark a major step in improving the prospects of all humanity; the meetings in Montreal cannot hope to have an effect on this scale. The conjunction does, however, make it an appropriate moment to ask some questions about the role and responsibility of the geographer in this age of environmental anxiety.

Such questions present themselves very practical terms in Canada itself. Environmental management in this huge country has become a matter of major political and constitutional importance (1). The Government of Canada is committed to the comprehensive management of the natural environment, this term being taken to comprehend air, water, wildlife, forests, land use and fisheries (including marine resources). The ten provincial governments are also vitally concerned with environmental management, since responsibility for natural resources, including land, is constitutionally mainly in provincial hands. Canada is among the world's most urbanized societies, and has the usual environmental problems associated with city growth. Natural resource development — mines, water, forestry, petroleum, fisheries — is at the basis of

[1] Geographical Paper No. 52, Land Directorate, Department of the Environment, Ottawa 1972.

[2] Director General, Research Co-ordination Division, Department of the Environment and Director Planning and Evaluation Division, Ministry of State for Urban Affairs, respectively.

national prosperity. The environmental issues facing Canada have challenged its geographers in the past and will continue to do in the future.

The environmental tradition in geography is, of course, very old. Its history has been well covered elsewhere (2), and we shall not retread this path. Instead we look at the present environmental debate among natural scientists, urbanists and others, and consider what our professional role should be in light of the contemporary needs.

THE ENVIRONMENTAL CRISIS: ITS CHARACTER

> "Congested cities struggling to breathe; rivers fouled by poisonous waste; land ravaged by erosion; garbage dumps growing slowly into burial mounds of our civilization; and the oceans — the cradle of life — turning into global cesspools...."(3)

These were the phrases chosen by Maurice Strong to explain the decision by the United Nations General Assembly in 1968 that a major conference on the human environment should take place in Stockholm this year. They express very well the mood of the moment in the Western world — disgust and apprehension at the side effects of processes our society has not managed to control. The rush to the cities, the endless stream of new technology, the throwaway economy: these have finally shown themselves to be potentially disastrous to the Western life-style, and perhaps to life itself.

The impetus of the environmental movement in advanced industrial countries is apparently very high. In many it has led already to a significant restructuring of governmental apparatus, a rash of new regulations, and even a questioning of the growth ethic so dear to the outlook of industrialized societies, whether capitalist or socialist. Inevitably this enthusiasm has not been matched to anything like the same extent in the developing nations. There, in the words of Strong, the environmental movement "is endowed with no such magic . . . environment is still seen by many as a rich man's problem, a disease that they would be prepared to risk if it is a necessary accompaniment to the economic growth they want and urgently need" (4). Rich men may make poor housekeepers, the argument runs, but this does not justify them arguing against others becoming rich.

For many of us, the writers included, concern for the state of the landscape around us, for the cities and their squalor, and for the fate of endangered species is nothing new; it has been a lifetime attitude. But the development of concern among a wider public is comparatively recent, and, among both scientists and general citizens, it is still highly selective. For many it began with Rachel Carson's *Silent Spring (5)*. At the time the book was published, most of us thought that her warning of the effects of persistent pesticides would fall on deaf ears. We thought that the industrial juggernaut would insist on rolling, and that DDT and its cousins would go on accumulating in the oceans. We were not altogether wrong. But Miss Carson's dramatization succeeded because it came when public opinion was ready for it: few books have been

more timely. In parenthesis, however, it should be noted that not everyone is convinced that the book was beneficial. In an address to the Food and Agricultural Organization in 1971 Nobel prizewinner Norman Borlaug, whose scientific and humanitarian credentials are impeccable, attacked *Silent Spring* as "incomplete, inaccurate and oversimplified", the basis of a "vicious, hysterical propaganda campaign against the use of agricultural chemicals by . . . irresponsible environmentalists." (6). Exaggerated or not, widespread concern was aroused, and the use of environmentally dangerous substances was on the Stockholm agenda.

The ecologists have played a remarkable role in this public awakening. For a great many years they had been accustomed to playing second or third fiddle in the biological band, which in turn played well behind the big brass of the physical sciences. Notwithstanding the immense and lasting prestige of Charles Darwin, environmental biology was not a field that one chose in order to inflate oneself. This may have been one reason why some of the best intellects of our time fortunately chose to become ecologists.

Nowadays, however, ecologists have become anxious, vocal and angry men, as the name of their profession has become a household word. Indignation is a poor substitute for information, and when laymen become angry about the decay of the living world they soon run out of facts. But when ecologists become angry they have no lack of ammunition. Many of them have become social activists of considerable skill, arguing for policies that will protect nature, but which will call for drastic changes in public freedoms (7). Even the conservatives and the cautious among them have tacitly supported the activists; those who are not against them, in fact, are for them.

The protection of the biosphere is their objective and it is one which unites many who were once far apart. The pure conservationists, who were emotionally distressed by the sheer plunder of life and its support system, are almost at one with those who argue that the biosphere is, after all, *our* human support system. The movement has also enrolled those who, from Aldo Leopold (8) to Lynn White (9), have seen the environmental crisis as an ethical or religious failure of the West. Reverence for life is a powerful basis for environmental concern, especially among those who have only a hazy understanding of food chains and ecological balance.

Many others have suddenly declared themselves to be ecologists. The ecosystem, it is argued, is at least as much physical as it is biological. Why then should ecologists be exclusively biologists? What is to prevent soil scientists, climatologists, biometeorologists, hydrologists and even general chemists and physicists from joining this popular new club? And if the ecosystem includes man and his works, as both Fraser Darling (10) and Marston Bates (11) have argued, why exclude the sociologists, geographers, anthropologists, economists and historians?

As the reference earlier to Dr. Borlaug illustrates, the growing involvement of more disciplines, more scientists and more concerns makes it difficult at present to attain an adequate perspective on environment, on environmental science, and on environmental action. Ultimately, however, the dust is going to subside, even if it does not settle, and when it does subside we want to know where to look, scientifically and as working citizens. Our own training as geographers suggests that our environmental perspective will not be found solely within the ecological movement. There have been other sources for the sense of environmental crisis, reflected clearly in the remarks we have quoted from Maurice Strong.

It is an open question whether urban squalor is worse than rural squalor. Many of the world's farmers live in structures that would be condemned in the meanest city, and the world's pandemics sweep villages as well as towns. The English labourer who moved from eighteenth century farming countryside to nineteenth century industrial town may well have gained, rather than lost, in material well-being. What distinguishes urban poverty from rural poverty is that in many parts of the world it is daily being created as the rural poor migrate to become the urban poor, that it brings the added hazards and irritants of congestion, and that it is more obvious.

The revulsion against the city, and against the life of even the prosperous suburbs, is another of the dominant movements of our time; it, too, has been politically powerful. The pattern differs from country to country, but the most important threads are world-wide. In part the revulsion is against the sheer, cumbersome, ugly and hostile character of the physical city — the failure of the built environment, to use the familiar cant. In part it is against the closeness of the human contact involved, which brings to a crisis the internal stresses of mixed societies. The racial hostilities of the great United States cities have their roots in old attitudes that might have remained dormant, if unsolved, in less congested surroundings. A final factor is the failure of political and institutional change to keep pace with the growth of cities, so that the latter must tackle their present problems with devices that might have been competent to deal with the problems of a generation or a century ago.

The crisis of the city has also brought forth its activists, and they too have greatly altered the shape of events. In the United Kingdom, where a largely unitary system of government makes reorganization easier to achieve if central government decides it is necessary, the new Department of the Environment embraces responsibility for most aspects of urban development such as transport, housing and planning, as well as for the natural landscape. There is in Britain also a large school of self-styled environmentalist who concern themselves very largely with built environment — with what has traditionally been planning and architecture, and is now seen as something larger and more positive. Between this school on the one hand, preoccupied with design and

composed mainly of architects, planners, sociologists and geographers, and on the other hand the ecologists, there is much common rhetoric and little shared purpose.

Nor does the spectrum of environmental concern end there. Those in professions such as public health medicine, social work and the law have seen the crisis as even more fully societal than the architects and planners. And the schools of agriculture, forestry, natural resources and engineering in the universities see the environmental question still differently, as one in which the city and its problems loom large or small according to where one is.

There is thus no single source for the sense of crisis, no resounding declaration that one can make about its nature. Ecologists, planners and sociologists sometimes say the same thing, but mean something different. Is there, then, a grand design, a common central purpose, an overriding unity? Or are we faced with a collection of real but disparate problems, a monumental pile of the ad hoc?

The idea of a grand design finds many defenders. Among them are the ecologists who see environmental concern as a search for nothing less than a general recognition of man as a species in the midst of nature rather than as master of all he surveys. The more this vision is made precise, however, the more it seems liable to divide the ecologist from those who are more preoccupied with the welfare of man himself. In saying this, we do not imply that this separation is justifiable, merely that the range of environmental problems is so great that they tend to be beyond the comprehension of most individual human beings. However much we subscribe to the comprehensive view, the number of externalities we consider when contemplating action is inevitably limited. Our design is seldom as grand as we think it is.

For our own part, therefore, we find it safer to proceed inductively. How, in practice, does the scientific community see the environmental crisis? And does the consensus, if one can be discerned, in any way resemble the environmental perspective of the geographer? If there are marked differences, is the geographer misguided or does the consensus lack something?

NATURAL SCIENTISTS AND THE ENVIRONMENT

The leadership in this search for consensus has come from many parts of the scientific world, with Americans well in the lead. The Stockholm Conference has spurred several attempts at synthesis, all by large interdisciplinary teams. Three such documents offer an excellent cross-section of scientific opinion, because each is the report of a short study session by a group of specialists who deliberately set out to achieve consensus and to provide useful advice to the Stockholm delegates. We shall refer to these by their acronyms SCEP, SMIC and GEP, denoting study of critical environmental problems, study of man's impact on climate, and global ecological problems respectively (12).

SCEP and SMIC were organized by a group led by Carroll Wilson, Professor of Management at M.I.T., with the active support and encouragement of M.I.T. itself and many official U.S. agencies. The SCEP report was based on a study conference held in New England in July, 1970, which attempted an overall appraisal of man's impact on the environment. Its success led to a further conference, SMIC, in Stockholm in June 1971. With the same sponsors, but a more international cast, this second conference focussed on climatic stability; thirty scientists from fourteen countries took part.

The third document, GEP, is the report of a study conference of ecologists held in Wisconsin in the summer of 1971. Patterned on SCEP, GEP was organized by Arthur Hasler and the Institute of Ecology. If the bias of SCEP and SMIC was towards climate, that of GEP was towards ecology. Like the others it attracted scientists from many disciplines, but few geographers were invited or present at SCEP, SMIC or GEP.

All three documents were produced and published within a few weeks of the end of their respective conferences, in a remarkable display of coordinated work by writers, editors and publishers. All contain specific recommendations for environmental action.

Certain common themes emerge from the three reports. First and foremost is the unspoken but universal assumption that the 'environment' denotes the natural surrounds of human society, and that the environmental crisis arises from the deliberate or inadvertent impact of man's actions on that external environment. There is no recognition that man's own artefacts constitute part of environment, or that to a large extent man is environed by his fellow men. The natural scientist's attitude, to judge from these documents, is that the study of man's impact on his natural environment is a sufficient enterprise in itself, without fogging the issues by efforts to define what environment really means.

The second theme is the familiar one referred to already: that the chief threats are to the biosphere, and that it is the ecologist who is working at the core of the problem. The meteorologists at SCEP made a good case, later elaborated at SMIC, for fearing man-induced climatic change, although their findings are markedly more conservative than many recent forecasts. SCEP's ecological findings, however, were much more sweeping, and the GEP report elaborates on them. It is easy to get the impression that the stability of ecosystems and its disturbance are the real heart of the matter.

Man in the Living Environment, in fact, strikes us as the most telling document in the entire portfolio. The ecological character of the problem is asserted at the outset:

> Many of the techniques which ecologists have developed for the study of plant and animal populations are applicable to the human population as well. It is true that human society is more complex than any animal society and that social and cultural as-

> pects of human behavior make the study of the human population far more complex than that of animal populations. Nevertheless, man has to live in a viable relationship with the other organisms in his environment or perish. What follows is an analysis of that relationship(13).

This assertion is not argued, on the grounds presumably that it is self-evident. The long and tedious arguments of geographers, sociologists, anthropologists and psychologists about the nature of human behaviour are ignored. Once again the self-confident assurance of the natural scientist shines through.

Of the four themes developed, the first concerns the importance of the natural cycling of chemical elements, and the effects of human interference. The cycles of carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus are among the chief objects of present-day ecological research, and the effect of pollution on them is developed in the report at length. It is estimated that man has increased the global exchange rates, sometimes by a factor of two, with a general rise in biological production. In aquatic environments this often amounts to overgrowth, eutrophication. The authors recommend control and monitoring of the phosphorus and nitrogen cycles, with some attention to sulphur. They find that phosphorus is being removed to inacessible storage in the oceans very rapidly, so that the world faces a critical shortage in about a century.

The second GEP theme is ecosystems for human use. The report develops the idea that natural, stable ecosystems are characterized by low external nutrient requirements, the vegetation maintaining itself essentially by internal recycling. Modern industrial agriculture, whose spread is necessary if the world's people are to be fed, is based on intensive nutrient and energy forcing. This intensive agriculture imposes many threats: it accelerates the nutrient flow and hence aids aquatic eutrophication; it depends on persistent insecticides and herbicides that imperil members of the natural ecosystem; and it hence tends to reduce species diversity, upon which ecosystem stability is held by most to depend and which may well be vital to avoid overdependence on a few strains in a commercial crop.

The third theme, closely related to the second, deals with ecological aspects of land management. All future land use management, it is asserted, should be squarely based on an understanding of the ecological relationships and consequences involved in management decisions. Four major ecosystems are examined in detail — the tropical forests, tropical savannas, arid lands and temperate grasslands. In each natural ecosystem functions and land management problems are analysed in depth. This part of the report is familiar ground to the geographer, and is the only section where the bibliography contains significant material from our literature.

The final theme has to do with aquatic resources and their management. The sea is a major source of high quality protein, and a third of the recent increase in world food production has come from salt-water fisheries: an annual

yield of 100 million tons is conceivable with existing fishing techniques. The coastal zones provide half of the yield, and it is here that the threat of pollution, altered nutrient cycling, and altered fresh-water inflow (due to stream management) must be resisted or regulated. The report urges large-scale investment in aquaculture, rather than expansion of fishing fleets.

These three reports are impressive evidence of the newly-awakened determination of western natural scientists to propel the world forward to better environmental things. All three show evidence of hasty preparation. Scientific caution and reticence have given way before an urgent desire to put evidence into the hands of the Stockholm secretariat early enough to be included in the conference documentation. The sense of crisis is clearly responsible, but we believe that this new concern for world environmental management will persist among the scientists. In effect they have been converted to a viewpoint that some geographers have always held to be the core of their work: namely, that man's stewardship of the earth calls for deep understanding of the nature of the physical and biotic world, and of the links that join mankind to them. This was Dudley Stamp's objective (14), and it is that of the current Soviet school of geographers. It is also ours.

A striking aspect of the SMIC and GEP reports is that the environmental crisis is regarded as inseparable from the themes of resource development and population pressure. Pollution, for example, is no longer seen merely as a threat to the "environmental quality" of western urban societies. It is taken in proper perspective, as something injuriosly affecting the global relationships between man and nature, between the crudity of his technology and the subtleties of natural equilibria.

GEOGRAPHY AND THE PHYSICAL ENVIRONMENT

If, therefore, we agree that natural scientists are now adopting a position close to one long honoured by geographers, we may go on to our second question: how does that position resemble the environmental perspective of the geographer?

At first sight we are inclined to say that a comparison is impossible because geography has lost or abandoned that perspective. The study of man's relation to, and interaction with, his natural environment was a widespread preoccupation of geographers in the early decades of this century, and still persists in many centres in spite of the abuse it has received from internal critics. Broadly speaking it is a theme immediately comprehensible to the external onlooker, but contemptuously dismissed by some of our own methodologists. In Western university geography departments the rise of quantitative analytical methods, and a preoccupation with urban affairs, have thrust it into the far background, and with it has often tended to go the belief that physical geography is an essential basis to the discipline as a whole. On some campuses it is only in undergraduate curricula that man-environment relations are kept

alive as a basic geographical theme. We must except, of course, the strong development of environmental perception courses in some universities, and of popular graduate programs in this area and in environmental management. The thrust of such programs, however, is behavioural rather than environmental: they are concerned mainly with the environment as perceived, and the action that springs from this perception.

The decline of physical geography seems due in part to a recognition that, despite the theory, it did not in fact provide clear evidence of the supposed powerful interaction between man and his physical environment. Physical geography today, if we assess its contents empirically, is a *pot-pourri* of loosely related physical and biological studies owing their association more to historical accident than to logic. The *pot-pourri* (the term is due to Chorley and Kennedy (15)) is made up of climatology, geomorphology, soil science, biogeography and sometimes hydrology. Each of these overlaps with similar studies in other disciplines and relations with these disciplines, such as those between climatology and meteorology, are often closer than those linking them to other parts of physical geography, and always closer than those with geography, and always closer than those with geography as a whole. The binding link, and it is often barely evident, is that the geographers tend to have a bias towards visible, tangible and mappable elements; they place less reliance on laboratory experiments.

By a feat of considerable ingestion it is possible to achieve reasonable comprehension of the objectives, research techniques and substantive results of all the component fields of physical geography. If one does so, two unfortunate conclusions seem inescapable. First, there is no common core, no common measure and no common objective; a unified physical geography gets more distant all the time. Secondly, the total content of physical geography does not add up to an integrated body of knowledge in any way resembling the packages assembled by SMIC, SPEC and GEP. If we accept the latter as reasonable assessments of the natural environment of man, then physical geography is *not* a reasonable assessment of the natural environment of man.

If, moreover, we contend that the study of man-environment relations is still (or perhaps afresh) a central theme of geography, it is clear that *within the discipline* there must be an attempt to comprehend that environment. To the extent that "environment" is made up of the physical and biotic things that surround us, it is hence reasonable to expect that physical geographers should be both the comprehenders and the interpreters of these surrounds. At present they are, in general, not, at least in the western world.

Of course this judgment is not meant to diminish the value of individual climatological, geomorphological and biogeographic research or writing. Watts' recent *Principles of Biogeography* (16), for example, is a thoroughgoing analysis of ecological and biogeographic material that comes close to GEP in its ap-

proach, and that is truly interpretive and environmental in scope. Ward's similar *Principles of Hydrology* (17), in the same far-sighted series, does the same for the water cycle in nature. These works are not specialist, but cross-disciplinary; and both are written on the assumption that the geographer needs such breadth to do his work. Moreover many sound analytical works outside the environmental framework are carried out by specialists working within geography departments.

The SPEC, SMIC and GEP studies were carried out by teams of specialists brought together to produce a consensus, on the assumption that the breadth of the problem rendered the interdisciplinary approach essential. Is it reasonable to expect geography as a discipline to house individuals or groups of individuals capable of comparable syntheses? This is the ancient problem of geography, to achieve holism when the intellectual method runs against it. We suspect that even Leonardo da Vinci would flinch at the task, and that any contemporary Leonardos would be unlikely to become geographers.

It is in the Soviet literature that we find at present the closest approach to what is sought for here. Science in Marxist countries must serve economic purposes, and geographers in the Soviet Union have long seen themselves, and been seen by the state, as agents of the deliberate attempt to alter beneficially the interactions between man and the natural environment. This theme recurs repeatedly in the pronouncements of the Academy and the Geographical Society of the U.S.S.R. (18). Moreover, research proceeds within an established framework of theory in which a unified picture of the natural environment is not so much demonstrated as announced (19). The pioneer works of Grigor'yev (20) and Gerasimov (21) found their catalyst in the energy-balance climatology of Budyko (22), and today Soviet scientists from botanists and agriculturists to hydrologists and economic geographers present their results in much the same language, and with much apparent harmony.

Perhaps this harmony is more apparent than real, but there is no doubt that a large number of Soviet physical geographers have shown themselves able to offer a unified, logical and useful picture of the natural environment to their colleagues. They appear to have achieved on a huge scale the kind of synthesis of specialisms that Isaiah Bowman visualized at Johns Hopkins.

We doubt if Western geographers will quickly follow the Soviet lead. Our traditions are liberal and intellectual, not Marxist and pioneer. Yet we think there are good, non-doctrinaire reasons for moving in the same direction. It has probably become apparent already that we believe that the notion of a "human environment", the subject of the Stockholm Conference, is in danger of being equated with natural phenomena and man's impact on them. We would argue — and it is comforting if unusual to find that we are supported not merely by other geographers but by a decision of the United Nations General Assembly (23) — that the human environment is much more than this. If our en-

vironmental perspective is indeed a broad one, then the physical component of that perspective should also be broad and integrative. If, like Watts and Ward, we seek to advance the holistic study of the environment, we need generalists more than specialists. Rather than climatologists, geomorphologists and, biogeographers, we need physical geographers: interpreters of the natural environment.

SHAPING THE PERSPECTIVE

It would be logical at this point to pursue the argument developed in the preceeding paragraph, and to examine the type of holistic approach towards the human environment that is required from the social sciences, and the implications that this has for the human geographer. To do so would repeat, in a social context, much of the preceding argument. It would also be liable to distract from our main purpose, which is not to establish a theoretical justification for the role of the geographer in environmental problems, but to offer some useful suggestions as to how he should get on with the job. Thirdly, and most important, we believe it is unnecessary. Virtually all geographers would accept that man and his works occupy a central place in their discipline, and the reluctance of the natural scientists to adopt a similar view, demonstrated in the SCEP, SMIC and GEP reports, indicates a need for balance which the geographer can help to meet.

But how? What is required of the geographical perspective in practical terms? At what point in the complex should we seek an entry? To develop reasonable answers, it is useful to suggest some of the ways in which geography is *unlikely* to make a useful contribution.

Firstly, it must be accepted that geography has no unique claim to environmental competence. In the past we might have laid a doubtful claim to the field, in the absence of significant competition, but an absence of competition is not in itself a proof of one's own qualifications. Certainly there is no way in which the uniqueness, or even the primacy of geography as *the* environmental discipline is now likely to be recognized by other scientists or by the public at large.

Secondly, geography must avoid trying to solve those problems which others can do better, or at any rate more efficiently. This may state the obvious, but there are in fact many pressures on the geographer to wander from his main area of competence. One of these is simply intellectual curiosity: the scientific grass may appear greener merely because it grows in an unfamiliar habitat. Another is the pull exerted by those disciplines who believe, sincerely but mistakenly, that theirs is the true avenue to the environment and all must enter through their gate. A third factor is the perennial insecurity of the geographer which makes him vulnerable to such assertions by disciplines that are better able to hide their inferiority complexes.

To declare that these temptations should be resisted is itself capable of misinterpretation. Although we refer frequently to "disciplines" and imply a separation between them, neither of us would argue that such disciplines are anything more than useful subjective divisions of what is essentially a continuum of knowledge. Hence if an individual geographer believes that he make his best contribution to the study of environmental problems by immersing himself in hydrodynamics, cost-benefit analysis, organic chemistry or similar specialisms, then he may well be right. But it does not therefore follow that geography as a discipline need do so.

Thirdly, and perhaps more surprisingly, we believe that what is required for the reduction or solution of many environmental problems is not more research but more concern for the utilization of what is already known. It is an easy temptation to argue that we do not know enough about a problem, environmental or otherwise. Easy for the individual expert, since the research problems are simultaneously familiar and challenging, whereas the process of development and implementation is strange and often frustrating. It may often also be easy for the sponsor, whether government, private industry or some other benefactor. Research is usually cheaper than implementation by several orders of magnitude. To encourage more research may then be a cheap way of avoiding an unpleasant problem, and getting credit for doing so, not least from the intellectual community that receives the research funds.

Once again, it is necessary to avoid being misunderstood. As practitioners of research for many years, we have no wish to deny its importance, still less its necessity. Those who wish to contribute to the solution of environmental problems through research alone are free and, within limits, should be encouraged to do so. To quote Maurice Strong again, he may well be right when he claims that the environment is characterized by "islands of knowledge in a sea of ignorance" (24). But the world cannot wait on the draining of that sea, and the islands where knowledge exists are themselves far larger than the areas where effective environmental management is being practised. Obviously, as an effective management program is prepared, lacunae will be identified where research is needed. Such problem-oriented research directed to specific program needs is one thing; to assume that the prime requirement for environmental improvement is more research is quite another.

There is indeed a real responsibility resting on the scientific community in this connection requiring it to be cautious in its arguments for environmental research. To a large extent scientists speak with an authority on the subject that administrators of funds are reluctant to argue with. If, therefore, they argue, with perfect truth, that there are gaps in our knowledge of a problem, they may get the money they want. But if they provided the whole truth, it might well be that the best way to advance the solution of the problem, which is the ultimate objective, might be to concentrate on applying what we do know, instead of deferring action still further into the future. If this sort of

thing happens, as we suspect it frequently does, it is not because natural scientists use every opportunity to divert funds and programs to their narrow research interests. It can probably often be explained in terms of scientific humility; it is natural, and largely desirable, that scientists should stick to the things in which they are competent, and this is usually scientific research. But environmental problems are usually costly and often urgent. There must be a trade-off between better understanding of the problem and the beginnings of action towards its solution. The geographer might frequently expect to be able to contribute to the evaluation of that trade-off.

It will not do, however, to be content with expectations. In our experience, if an interdisciplinary team of experts is being assembled *ab initio* to work on an environmental problem it is extremely unlikely that geography will be among the disciplines which are held to be necessary, unless of course, the team leader happens to be a geographer himself. There may be many reasons for this, and it is unnecessary to speculate on them, still less to bewail the situation. The same, after all, is true of several other other areas of relevant expertise, including law and political science. The authors' experience, however, is that if a geographer asserts his claim to be included, this is seldom seriously questioned and, if the geographer is competent, he seldom has difficulty in identifying a useful role to play. There seems, however, a real reticence on the part of geographers to make such claims. In the individual this is understandable and, up to a point, praiseworthy; when it becomes a characteristic of the profession as a whole it is neither.

'TRUTH MISCALL'D SIMPLICITY'

The basic reason why a geographical perspective is an important component of most environmental problems is simply because these problems, by definition, have a spatial dimension. Further, the dimensions themselves are generally within the range where the geographer is accustomed to operate. They occur, it is true, across most of that range: they may involve the entire globe or they may be limited to a rural valley or an urban neighbourhood. The fact that the geographer claimed to operate within such a wide spatial frame was, of course, one reason why his scientific credibility used to be doubted by natural and life scientists, who found problems enough in much smaller frameworks. Even his geophysical colleagues, operating also at the macroscale, looked askance at his willingness to add human behaviour to the complex of physical problems. In some respects their doubts were and are justified, but nevertheless in the last decade they too have been anxious to occupy seats in the spaceship Earth, in which the geographer was for long almost the only conscious passenger.

At the simplest level, this concern for the spatial context can be expressed most effectively in the form of a map. This statement will no doubt leave the majority of geographers unimpressed, but, as the Founding Fathers realized,

truths that are self-evident nevertheless require frequent reiteration. Two recent examples that are proving their value in environmental management may be used as examples. About two years ago, a small group of social scientists joined the staff of the Canada Centre for Inland Waters at Burlington, Ontario. The Centre is primarily concerned with problems of the Great Lakes, as seen from the Canadian side, and is staffed mainly by physical and biological scientists, engineers and similar specialists. The first contribution by the geographers in that group was a map (25) on which was assembled, for the first time, all the available data relating to water use — and abuse — in the Great Lakes Basin on both sides of the international border.

The value of the map will be discussed later; its publication led to requests for more similar work elsewhere, and more ambitious maps will appear this year for two other areas where the management of water resources is of critical concern for Canada: the Gulf of St. Lawrence and the marine area off the shores of southwestern British Columbia and in Puget Sound.

Another mapping enterprise is also under way in Environment Canada, and this is specifically designed as a major tool in environmental management. The Department of Indian Affairs and Northern Development recently issued a series of Land Use Regulations (26) designed to protect the landscape and wildlife of the Yukon and Northwest Territories. Besides providing overall guidelines and controls for northern exploration and development, they enable specific stipulations to be made for any individual enterprise. The philosophy behind the regulations is based on the fact that the overwhelming concern of economic interest in the North is ephemeral, at least so far as occupation of an individual site is concerned. Prospectors, surveyors, and other experts pass through an area, but the sites of prolonged settlement or activity are few and scattered. This being the case, there is little point in debating the costs and benefits of such temporary occupation in detail. We need not argue whether one barrel of oil is worth ten ducks; we protect the ducks. For the minority of northern interests that are more clearly attached to a single site for a considerable time, of course, the judgment must be infinitely more difficult, involving a complex analysis of costs and benefits.

Concerning the intent of the Regulations there can be little argument, from either conservationists or developers. The trick is to devise an effective means by which the Regulations can be administered. As essential information for such administration a Land Use Information Series of maps is being prepared (27) covering, a start, the whole of the Mackenzie Valley and the northern Yukon in 44 sheets at a scale of 1:250,000, a total of 200,000 square miles. The maps carry, as an over-print on the normal topographic series and as marginal text, data on critical wildlife habitats and movements, hunting and trapping areas, actual and potential recreation sites, archeological and historic sites, and other information. Being compiled as a separate project, and requiring more time, are maps showing the varying ability of the soil and vegetation in dif-

ferent areas to withstand various types of use by transport and other equipment.

Although again it may be self-evident, it is necessary to emphasize that there are at least four features of importance in the mapping projects just described. First of all they are *integrative*: they seek to assemble, within the framework of a common spatial context, information concerning a wide variety of topics that interact with each other and that together represent a major part of the environmental situation that is the basic subject of study. The individual scientist is reminded of dimensions of the overall problem beyond those in which he is interested or competent, and he is provided with a convenient *aide-mémoire* to their approximate significance. The non-expert, be he administrator or man in the street, similarly is better able both to grasp the complexity of most environmental problems and to resist the arguments of those who might try to oversimplify the issues for their private purposes. Secondly, such maps are a rapid means of *identifying gaps in knowledge*, at least where such gaps have a spatial component. In some cases the gaps are obvious, because they leave an empty space on the map. More frequently, however, the construction of a map indicates that insufficient data have been collected so that, for example, the published map of the Great Lakes suggests that the quantity of heat discharged into Lake Michigan is the same in Green Bay as it is in the upper peninsula; the land use information series may suggest that homogeneous conditions for wildlife in the Mackenzie exist over hundreds of square miles of terrain that differ markedly in altitude, drainage and other physical factors from place to place.

Thirdly, drawing maps is often one of the *quickest* ways to contribute to the solution of environmetal problems. In both the water use and the northern land use maps, the role of the geographer has been mainly to assemble data collected over a long period of time by a variety of other specialists. The word "assemble", of course, covers a multitude of tasks and the last thing we wish to imply is that the geographer is purely a technical assistant to the true scientist. Compiling a map which conveys an accurate and balanced representation of a variety of disparate elements is a thoroughly professional occupation. In the words of Dorothy L. Sayers, "The proportions and relations of things are just as much facts as the things themselves; and if you get those wrong, you falsify the picture really seriously." (28).

It would be foolish to pretend that maps can be drawn immediately on any subject, but it is undoubtedly true that there exists in the world a vast reservoir of available information that might be utilised for environmental action if its significance were demonstrated to a wider audience through a map. In the case of the northern land use series, the task of compilation, analysis and publication of all 44 maps of the series is expected to take less than eighteen months in time from start to finish, representing about 11 man-years of professional and technical staff and a total cost, including printing

1,500 copies of each map, of about $130,000, some of which is recoverable from sales. Compared to the amount which is spent on basic research, or even more on the economic development which the Land Use Regulations seek to control, the cost in labour and money is insignificant.

Lastly, though it is inherent in what has been said already, such maps are *useful*; they are *used*. By integrating a variety of elements and factors, by identifying important gaps in knowledge, by providing a quick source of information, by stimulating professional and general interest in a problem, the geographer as mapmaker can probably do more to contribute to the solution of environmental problems than in any other way.

These four reasons would be enough justification in themselves, but there is yet another which may be still more important. Unless the maps are drawn, unless the importance of the spatial dimension is emphasized, that essential dimension of most environmental problems will frequently be overlooked. For example, both the present authors were recently involved in work sponsored by the Government of Canada that explored the implications for the present constitution, and for possible constitutional changes, of the need to provide for adequate management of the Canadian environment (29). There were several competent experts and administrators who, at the outset, found it difficult to appreciate that environmetal problems must exist in a spatial context, and others who could not see that such spatial aspects were relevant to constitutional questions. To the geographer, by contrast, the Canadian constitution probably appears most vividly as a set of boundaries and units defining Canada, the provinces, the territories and Canadian waters. The position of these and other boundaries in relation to environmental conditions is surely fundamental to any study of the required powers for environmental management and the appropriate division of powers between governments.

There are other ways in which the geographical perspective on environment is necessary to complement or to correct the perspective of other relevant approaches. Some of these have been set out in the form of "Seven principles for geographers" by K.M. Clayton, as a summary of an article in which he argues for "Reality in Conservation" (30). They are reprinted, with permission, at the end of the present monograph. If we had space we would comment on them, and, inevitably, suggest amendments to one or two. Lacking that space we can only underline the importance that Clayton attaches to the frequent misuse of the notion of 'resources' in environmental argument: "the naïve approach to the concept of a resource which is displayed by many ecologists deserves attack" (31).

One issue which is a source of deep, if often unnoticed, division between natural scientists on the one hand and social scientists on the other is that of population growth. It is, of course, easy to demonstrate that, unless the growth in world population is substantially and rapidly checked, attempts to improve the overall quality of human life are doomed to failure. No geographer would

argue with this proposition. Most should however be ready to argue with some of the conclusions which frequently are drawn from it. First, once again demonstrating a lack of concern for the spatial dimension, many natural scientists proceed to the assumption that because world population growth is excessive and dangerous, so must be each of the components of that world integral. Hence ZPG (Zero Population Growth) becomes a desirable formula in India, in the U.S.A. and even in Canada. The painstaking efforts of economists and sociologists to define an optimum population, overpopulation and so on are ignored. The geographer's concern for the importance of the balance between population and resources is similarly brushed aside in favour of a global numbers game. We find it ironic that in Canada one of the few areas that has actually been demonstrated to be overpopulated at present is a region with one of the lowest population densities in the world: the District of Keewatin in the Northwest Territories, where less than 3,000 people fail to make a living in 228,000 square miles (32).

This simplistic approach to population is frequently made worse by the tendency to make simple equations between the growth of population and environmental deterioration. The geographer would not argue that a growth in population — say in a large city or urban region — implies a growth in the potential propensity to pollute. But he should be prepared to dispute very strongly the conclusion that is frequently drawn from this: that a fundamental element in pollution control and environmental quality improvement must be to stop such growth. The propensity to pollute does not mean that increased pollution is inevitable, certainly not in the simple relationships which are frequently propounded by advocates of the numbers game. This is indeed fortunate for the environment. Any demographer, and most geographers, can readily demonstrate that, were environmental deterioration so closely linked to population growth, the outlook would be bleak indeed, since the population of many areas requires considerable time to reach stability, even if family planning and similar campaigns are wholly successful. By implying, even if it does not state, that ZPG is almost a prerequite for improved environmental quality, this simplistic approach does a disservice to the environment.

AN EXAMPLE: WINDSOR-QUEBEC IN PERSPECTIVE

> "It is difficult to exaggerate the importance of expanding urban regions to the future quality of urban life. The largely man-made urban environment is and will be the prevailing Canadian environment. Its quality will largely determine the quality of life for Canadians." (33)

The Windsor-Quebec axis is the demographic and economic heart of Canada. If the improvement of the human environment of Canada is a major national goal, then what happens, now and in the future, along this axis must be of central importance in the strategy to attain that goal. The area therefore provides a convenient focus for some of the ideas which have been developed earlier. To talk of a Windsor-Quebec axis is to employ a simple model that is

useful both to the geographer and to the non-geographer. However, simply because it is primarily a spatial concept of human organization, it appears to present problems to those who are neither primarily spatially-oriented nor primarily concerned with the works of man. They are unlikely to be able to define the essential components of the model; they would also find it difficult to make the maximum use of it in the solution of environmental problems. Indeed, it appears that, lacking precise geographic definition, the model is frequently misapplied, because it is misunderstood. The assumption is readily made that, because this relatively small proportion of the area of Canada contains so much of Canada's population, urbanisation and industrialisation it must therefore be overcrowded and unpleasant, and that it is necessary to slow down or arrest further growth if the quality of the environment is to be improved.

It does not, of course, require a geographical training to see that this is simply not true. Anyone who can drive, for example, from Montreal to Toronto along the freeway between those cities and still conclude that the area is overcrowded must either be a man of singularly fixed ideas or one who gives singularly fixed attention to the road ahead of him. A mere mental summary of the population totals indicated on the exit signs from the freeway clearly indicates how relatively deserted the area between Vaudreuil and Oshawa really is. Between Oshawa and Hamilton, of course, there is something which does more closely resemble the popular image of the congested corridor, but this is but a small fraction of the total distance between Quebec and Windsor. To be precise, it is 70 miles out of 700, but it seems frequently to be the prevailing mental image of the remainder.

We believe, therefore, that it would be difficult to conceive of a single more useful geographical contribution to the solution of Canada's environmental problems than an assessment of the major dimensions, implications, opportunities and constraints that influence the present and future human environment of the Windsor-Quebec axis. We would prefer to say "than a good regional geography of the axis", but the alternative jargon is likely to be more palatable, unfortunately even among geographers. In the limitations of the present text, we can do no more than to articulate some of the principal chapter-heads which we believe might form an integral part of such an assessment.

In the first place, we believe that the spatial dimensions, implications, opportunities and constraints require detailed examination and expression. Since both the present authors were raised in Great Britain, we naturally tend to compare the relation of population to available space in the two areas. Between, let us say, Loch Lomond and the Straits of Dover we have a linear distance rather less than that between Windsor and Montreal. Expressed in areal terms, and related to actual or potential ecumene, we again find the parallel has some relevance. Yet within that area there is contained in Great Britain the overwhelming majority of the British population. Since that population is several times the present population of the whole Windsor-Quebec corridor (and very much larger

than the total population expected on maximum projections in the whole of Canada by the end of the century) we are inclined to conclude that the accommodation of population within the axis for the foreseeable future is neither impossible nor, in itself, the primary problem. We admit that this superficial view may be capable of disproof, but our present purpose is merely to argue that the establishment of the relative physical capacity of the axis to absorb people is itself a fact of environmental importance. To do it adequately will, of course, require more than facile mental superimpositions of the map of Great Britain on the map of Canada.

In the course of this work, it would presumably be necessary to establish the relation of present and potential population centres to the basic requirements of an advanced urban society. In doing this we might again with profit make comparisons with large urban concentrations elsewhere in the world. In the matter of water supply, for instance, it is again tempting to note that within the Thames basin in Britain there exists a total population of about 11 million. The per capita water use of that population is rather less than that at present in Canada but it is nevertheless worth remarking that the water requirements of the population of the Thames Basin have until recently been satisfied from within that basin — and the Thames is not the St. Lawrence.

A major part of the analytical investigation of the present state of the Windsor-Quebec axis might also include a detailed spatial investigation of land use. Detailed, not so much in the scale at which it is mapped or otherwise quantified, but in the size of the matrix of factors relevant to land use which are considered. Land has not been a scarce commodity in the growth of Ontario and Quebec cities, at least by comparison with elsewhere. It is evident that a growing population, a rising standard of living, and a growing concern for environmental quality, will all increase the importance of the land factor in future, and, if the wide variety of land requirements are to be reconciled, we require to know the dimensions, implications, opportunities and constraints of the present situation. There are available to the geographer many tools which would assist in this analysis: theoretical tools concerning the spatial organization of land use, and practical tools such as the massive work of the Canada Land Inventory (34), an immense enterprise created specifically for such problems and demanding to be utilised.

Many other spatial components of the Windsor-Quebec axis require such geographical expression, in the context of a normative approach to the future of the region. The geographer has no monopoly of the truth where the identification of optimum futures is concerned, but his perspective is as important as those of other disciplines, and he has an obligation to provide it. In particular, he should be able to play a useful role in demonstrating the relevance of significant factors which can easily be forgotten in fashioning the future human environment of the region.

For those primarily concerned with the natural environment, for example, a high quality of life in the Windsor-Quebec axis will presumably involve such elements as water and air pollution, congestion, noise and some of the uglier components of the visual landscape, the use of agricultural fertilizers and pesticides, and similar concerns. This may lead to the development of ideas concerning the desirable rate of growth of the overall population of the Windsor-Quebec axis, and also of the individual units of which it is composed. While they may avoid some of the oversimplifications mentioned earlier concerning the relationship between people and pollution, such ideas are not likely to encourage a continuation of the present growth trends.

Similar tentative conclusions may also be arrived at through an evaluation of the economic and social significance of the axis in relation to another of the outstanding metaproblems which face Canada at the present time, that of regional disparities. The St. Lawrence Lowlands have been a magnet for settlement and economic development throughout Canada's first century and seem likely to remain so well into the second. It can at least be tentatively argued that in terms of the overall benefit to Canada as a whole, a desirable future would involve a decrease in the strength of this magnetic attraction, achieved presumably by deliberate action by governments to divert growth to other regions. (The question is deliberately posed in possibilist terms, though there exists an extensive body of opinion, both professional and public, that the proposition is self-evident).

There exists, however, another major factor, the importance of which both of us have repeatedly argued in public and in private in the last few years. This is the significance of the growth of the labour force in Canada over the period from about 1965 to 1980. Due partly to anticipated levels of immigration, but more to natural increase and an expected rise in the female participation rate, the Canadian labour force is expected to grow during this period at a rate which is unmatched by any other major industrialized country, and which is high even by the standards of developing countries characterized by high birth rates and low life expectations. More people are expected to enter the Canadian labour force between 1965 and 1980 than will enter the labour forces of Great Britain, West Germany and Italy combined, despite the fact that the 1965 population of these three countries was 155 million, in Canada only 20 million (35).

As noted elsewhere (36), we regard this fact as one of the most significant features of Canadian economy and society — and geography — during the remainder of this century. It certainly seems likely to be a major factor influencing the future of the Windsor-Quebec axis. Faced with the need for an unprecedented growth of employment of all kinds, will the public permit governments to pursue a vigorous policy of environmental protection if this means the potential loss of jobs in polluting industries? Can these governments afford to

forego opportunities for job creation in the Windsor-Quebec axis in the hope that some of these jobs will thereby be transferred to the have-not areas?

Many, of course, would argue that it is possible to have a high quality of life combined with rapid expansion of the economy, and also that to pursue a vigorous regional policy need not be at the long-term expense of the Windsor-Quebec axis. We tend to agree, perhaps as much through desire as because of the evidence. However, the point we are making is merely that the growth in the labour force is a major element to be accommodated in a normative environmental prospect, but one which is not likely to spring to mind quickly among the majority of biologists or physicists.

If we may carry our concern one step further, it seems to us obvious that a geographical investigation of the ways in which this growth in labour force might shape the built (or for that matter the natural) environment between Windsor and Quebec would be of immense value. During 1972, for instance, it is anticipated that the capital investment represented by building permits issued in metropolitan Toronto will exceed one thousand million dollars. The alternative futures for the axis presumably involve different possibilities in terms of labour/capital ratio. This need not be taken to the extreme suggested last January by a candidate for the leadership of the Liberal Party in Newfoundland, who urged that a tunnel to link the island of Newfoundland with Labrador beneath the Strait of Belle Isle should be undertaken as a means of generating employment, with no use of equipment beyond picks and shovels that was not absolutely vital.

As expressed here, this is primarily an issue for the economist. But surely there is a role for the geographer to suggest the alternative spatial futures of the human environment in Windsor-Quebec which might reconcile environmental quality, lessening of regional disparity, and an adequate rate of job creation. What, for example, would be the implications of building new towns rather than expanding the metropolitan centres? If new towns, should these be built in a quasi-linear fashion, say along the Barrie-North Bay or Ottawa Valley axes, or should they be regarded as satellites of existing centres? We could generate literally hundreds of related questions, but it is unnecessary to do so here. The problems we have posed have no final solutions, and the factors involved change in importance over time. Nevertheless, the problems must be tackled and the geographer has a role to play. This role we have argued is for him fairly straightforward, but it is one which is perceived by others as through a glass, darkly.

CONCLUSION

There can be no disputing that the planned, designed element in the landscape of Canada and of all countries will have to increase if we are to keep a good environmental balance. This implies much more than an extension of physical planning. For geographers it means a renewed concern for the natural

and modified ecosystems of the territory they are working on. It means a transformation, too, in the physical geography they sanction in their classrooms, laboratories and offices. It demands the application to concrete cases, on the regional and national scales, of the theoretical studies in transportation and network analysis, in industrial location and in urban hinterlands that have occupied so much of their time in recent years. And it implies a determination to make their work effective in the political and administrative functions so long dominated by lawyers, economists and engineers.

For the community as a whole, we see the need for recognition that spatial questions are among the major elements in the environmental problem, and among the least considered. It is the distribution of population, the degree of its nucleation, the location of industry, and the layout of communications systems that create the pollution problem. If Canada's population and economic activity were thinly spread across her land surface the problem would not exist, though important questions of resource conservation and wise use would still remain. Although spatial organization is extremely complex, and never repeats itself precisely, it can still be meaningfully analysed. Such analysis is the prerequisite to wise planning and management. We used the Windsor-Quebec axis to illustrate our meaning, but this is a world phenomenon, not a Canadian obsession.

Perhaps, too, the community needs to take stock of its resources in another sense. What should determine the pattern of capital investment? And who should do it? What are the human priorities involved?

Each country at each generation has a different answer. In the post-World War II era, for example, Japan could give only one answer — human skills were her only significant resource. Out of this realization she has worked an economic miracle, at the cost admittedly of environmental pressures beyond those other Western countries have had to tolerate. In those same years Canada's answer has been to look to the opportunities for exploiting her natural resources for export. It is true that the country has also attempted to diversify the manufacturing industries, and services now absorb 59 per cent of the labour force. Nevertheless, resource exploitation, even at heavy environmental cost, remains at the core of the economy, and commands a vast amount of faith and political commitment.

It may well be that Canada's perennial employment problem is intimately related to this conviction. Heavy commitments of public and private capital to resource development that does not create many jobs is becoming increasingly suspect, though it still continues. An unanswered question concerns the role of territorial expansion. Is it conceivable that a deliberate reversal of the growth of metropolitanism might be the answer? Suppose that we set ourselves to create networks of new cities, roads, railways and disseminated industry, would this create new jobs more rapidly? Would it be socially and politically accept-

able? If so, we should be capitalizing the human resource. The unemployed, in this sense, are an untapped source of wealth. Answers to these questions will presumably be sought by economists, who have much empirical evidence to work on; but they should also concern geographers.

Throughout this essay it must have seemed to many that we have been appealing to an older tradition of geography which is now very much out of fashion. To the extent that this is so, we are glad to make that appeal. With rare and outstanding exceptions, however, the older tradition was not activist; it was concerned with description rather than with problem-solving. So, unfortunately, has been much of the new geography that has tended to replace it during the last decade. Our purpose in this essay is wholly activist. We do not advocate mapmaking because it is the way geography should be done, but because there is a need for such maps if environmental management is to be effective. We do not seek a geographical perspective on Windsor-Quebec because the axis is there, but because the quality of life of the millions who live there will be affected by the availability or absence of that perspective. Geographers have taken the environment as their parish for more than a century, but it was ecologists, not geographers, who played a major role in causing the United Nations Conference on the Human Environment to happen. We believe it is time we redeemed our position, not out of concern for the status of our discipline, but because we have a necessary role to play.

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NATIONAL COMMITTEE ON GEOGRAPHICAL SCIENCE
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ECOLOGY IN THE PHILIPPINE SETTING: ISSUES AND CHALLENGES

by

PERCY E. SAJISE[1]

INTRODUCTION

There is a certain ambiguity in the origin of the word ecology but a German biologist, Ernst Haeckel, in 1869 is generally recognized as having first used "ecology" to mean "study of nature's household". It was the science which was practiced by the early plant distribution. It was then a more holistic branch of biology than Systematics, Morphology, Anatomy, Genetics, Physiology, Botany, Zoology, Microbiology, etc. because it drew its vitality from many if not all of these branches of biology. Animal ecologists later put up most of the existing ecological principles that we know today. It is important to note at this point that such principles were obtained mostly from studies of temperature ecosystems. Some of these principles has to be verified under tropical conditions.

It is now apparent that ecology meant to be a holistic science from the very beginnning. However, due to the antiquated and restrictive discipline-oriented methodology, the intent of the science was not immediately realized and plant and animal ecologists went their own ways.

In 1935, Tansley introduced the ecosystems concept. It involved the integrated study of the structure and functioning of ecological system. In 1956, Evans proposed that ecosystems be the basic unit for ecological study.

Ecology as a science has continually evolved to be a holistic science. It has broken through its more classical domain of being a purely biological science. With the advent of the ecosystems approach and use of high speed computers, the scope of the ecosystems approach has ramified to include the social and economic components of the environment.

What brought about this rapid growth and increased popularity of ecology? With the onset of the agricultural and industrial revolution, man has shortened considerably time and distance. He has tremendously increased his number. In his attempt to clothe, feed, shelter and improve the so-called "quality of life" which is often equated with material affluence of his species, he has

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strained the capacity of the environment to produce these needs. This has resulted in population of the air, water and earth, flood, desertification, erosion, overpopulation, and other environmental problems.

Such things happened because of man's fragmentary outlook of his environment, of his desire for short term benefits, and of his lack of understanding and appreciation for the intricate functioning of natural ecosystems. All these and man's technological capacity to interfere on a large scale with natural events has led to the rapid deterioration of our environment.

These are the events which catapulted the youthful science of ecology to the forefront. The science if practiced well can be helpful in two ways; it can identify opportunities for the best long term use of the land; and it can draw attention to the situation where care must be taken if deterioration or other undesirable side effects are to be avoided. Ecology gives the capacity to predict if sufficient facts are available.[2] Ecology, therefore, needs an imbibition of interdisciplinary expertise of the biologist, physical scientist, sociologist, and economist. Only then can the science be truly holistic. It has grown fast, terribly fast that it is now standing on unstable grounds. It does not need to be talked about only but it is in desire need of dedicated research efforts to stabilize and broaden the ecological principles upon which it stands.

THE ISSUES

A. *Land Allocation* — The natural vegetation of the Philippines is a forest. Except for the upper slopes of very high mountains, swamps and other inundated areas, virtually all of the terrestrial surface of our country before is a tropical rainforest. It is the oldest, the most stable and the most diverse of all ecosystems. It is self-perpetuating. Undisturbed, it will protect soil, water, timber, wildlife, scenery, without deterioration or need for any management. It is both the most protective and the least expensive use of land. Non-understanding of the fragile nature of the forest ecosystem, however, has led to a very fast deterioration from forest to grassland and other dry, marginal areas. Many of our forests have been cut and creamed to provide investment for other forms of development. Today even our watershed are denuded and it will require a thorough understanding of the successional process and the necessary economic inputs before a forest cover can be restored in these areas. A cover evolved for several hundred million years was removed in a matter of a few years.

Different forms of socio-economic organizations are capable of exploiting the environment with different degrees of efficiencies. The environment sets the limits to the degree of human exploitation through its feedback mechanisms. In the Philippines today we lack a certain coherence in our land classification efforts. Different national agencies have their own land classification

[2] Poore, D. 1974. Ecological guidelines for development in tropical forest areas of Southeast Asia. Proceedings of Conference on Ecological guidelines for development in tropical forest areas of Southeast Asia, Caracas, Venezuela, February 20-22, 1974.

branches to classify the same set of resources. In any well planned development, the allocation of land for particular objectives or uses is basic. It should attempt to match objectives to the resources available and avoid using capital as a substitute for income. Proper classification will assure the best immediate use and the least possible restriction of future use.

B. *Conservation of natural ecosystems* — Differences in soil, climate, altitude, geological history produces a spectrum of natural ecosystems; forest, grasslands, agricultural or herbaceous and aquatic ecosystems. It is highly important to conserve samples of each of these ecosystems large enough to be self-perpetuating and encompass the range of the larger mammal and migratory species.

With drastic changes in man's environment, he will call more and more on these genetic reserves produced or staged by million of years of evolution to get the genes necessary for food production, insect and pest resistance, tolerance to drought, low soil fertility, etc.

Ecologists have noted that the transformation of the rainforest into grasslands has tremendously degraded the soil. In the face of burgeoning human population and the artificial energy crisis, it will require a large input to put this marginal areas into intensive cultivation. Approximately 30 percent of SE Asia has this rough marginal areas which will have to be put to cultivation in

FIGURE 1. A TYPICAL OPEN COGONAL (*IMPERATA CYLINDRICA* L.) GRASSLAND. APPROXIMATELY 30% OF SOUTHEAST ASIA IS CHARACTERIZED BY THIS LANDSCAPE TYPE. PHOTO TAKEN AT BUREAU OF ANIMAL HUSBANDRY STATION, SAN JOSE, MINDORO OCCIDENTAL.

FIGURE 2. AN OVERGRAZED OPEN GRASSLAND AREA; TYPICAL SYMPTOM OF MISMANAGEMENT OF NATURAL RESOURCES. PHOTO TAKEN AT CARRANGLAN, NUEVA ECIJA.

the future.[3] The tropical rainforest of Borneo and the dry highlands (grassland areas) contain potential economic species adapted to these marginal areas.

C. *Ecosystem stability and shifting agriculture* — Shifting agriculture can be defined as a system of rotation of fields rather than of crops by 1-3 years cropping alternately with fallow periods (10-20 years) and characterized by slash and burn and by exclusive use of human energy. Not all shifting agriculture are destructive. By virtue of size, crop management, and other traditional cultural systems, some systems are in harmonious balance with the environment and are therefore self-perpetuating and stable. Our task is to determine the optimum levels of inputs and systems of management which is self sustaining and stable.

D. *Agroecosystem Management* — A simplified system loses its natural stabilizing factors. To sustain increased levels of productivity, the natural stabilizing factors must be replaced by energy-requiring inputs. Modern agriculture is energy-dependent. Such is the agricultural system that we have imported from the temperate region. It requires one unit of energy input in order to produce one unit of energy. In contrast, the low yielding traditional systems which is human labor intensive requires 1 unit of energy input in order to pro-

[3] P. Ashton. University of Aberdeen, U.K. Personal Communication.

duce 16 units of energy.[4] The challenge is to put back some of these natural stabilizing factors through proper management and to obtain a desirable yield, energy input/output relationships.

E. *Water Management* — Water is a vital input for human survival and economic development. Generally speaking, natural vegetation provides water of higher quality and a more even discharge in areas which have been modified. There are strong reasons for maintaining natural vegetation cover on steep slopes liable to erosion and accelerated runoff.

In considering any change of land use or management within a catchment, proper consideration should be given to the effect of this on the quality of water and the periodicity of discharge.

F. *Management of Fisheries in River Systems* — The water bodies of SE Asia are characterized by great diversity in hydrology and biology, seasonal variation of water level, and locally high potential for producing protein. Altering the numerous interactions between species are not yet well known but a reduction in quantity and specially the extinction of abundant or important elements of the aquatic fauna may have disastrous side effects for the whole system.

The introduction of exotic or alien species into these water systems is dangerous in some instances has proved disastrous such as the introduction of carnivore fauna and some flora e.g., *Eichornia crassipes.* (Mart.) Solms.

The hydrologic cycle represents one of the many cycles in the ecosystems. The tropical rainforest represent only 10 percent of the surface of the earth but it accounts for more than 90 percent of the total biomass on earth. This biomass has a large influence not only on the hydrologic cycle of the biosphere but on other abiotic factors as well. Ecosystems therefore interact and large scale removal of tree biomass elicits changes at the ecosystems and biosphere levels.

CONCLUSIONS

Rationality or irrationality in resource management is expressed by the decision making machinery of any social organization. Economic development oftentimes is equated only with GNP. Exploitation of environmental resources for short term benefits is often enchanced by this kind of set-up. Unless economist and ecologist work more closely together to improve the cost/benefit analysis with sustained yield basis and ecosystems stability as the main parameters of economic development, these environmetal backlashes will always confront us.

In developing countries like the Philippines, the capacity to influence functioning of natural ecosystem on a large scale basis rests on the hands of a

[4] Rapport, R.A. 1971. The flow of energy in an agricultural society. *In;* Energy and Power. A Scientific American Book, W.H. Freeman and Co., San Francisco: 69-80.

few. This will be true at least for a while until the full impact of the rapidly increasing population is felt and until modern imported technology will rest freely in the hands of many.

Man can manage his environment well *only after* he has come to *understand it fully*. He must study it in the most unbiased manner, taking into account the fact that he is an intimate component of the environment.

RECOMMENDATIONS

Environmental *awareness, understanding,* and *management* is a must for every human being concerned with his life and the life of his children's children. These three processes must be incorporated in *our educational system.* Education will mold *human values* for after all what we do or what we contemplate to do will be influenced by our value system. This value system should make the present and future generations of *Homo sapiens* . . .

— More *altruistic*; so that he will be more keenly interested not only in his own survival but in the survival of a bigger group. Such an attitude will become critical as the human population zooms upward and earth's resources become limiting.

— More appreciative of the fact that man as component of the environment must live in harmony with his environment; not as a total master of his environment.

Present national international government set-up must promote closer liaison, cooperation, and integration among agencies involved in the management of natural resources. *Ecology does not recognize* local, national, and international boundaries.

Man loves himself so much that he should be a sincere discipline of ecology. This science is not the domain of any one man or any one discipline. It is a concerted science designed to insure the continued survival and evolution of man. With ecology, man can see himself better in the context of the WHOLE.

PROBLEMS AND STATUS OF ENVIRONMENTAL QUALITY IN THE PHILIPPINES[1]

by

TELESFORO W. LUNA, JR.[2]

The growing concern for environmental quality in the Philippines should produce a challenge to traditional strategies of resources use and management in which the demand must be for a reasonably realistic appraisal of the social and ecological costs, not to mention economic and political, associated with environmental deterioration. Under such an approach the awareness that man is an integral part of nature rather than a separate force would be reflected.

Many of the natural resources in the Philippines which have limited both in quality are in danger of being rapidly depleted. Current systems or resource utilization appear more often than not, to be directed toward the permanent undermining of the environment. There are at present danger signs of extensive and irreversible destruction of forests, accelerated soil erosion, agricultural land impoverishment, river and lake pollution through silting and chemical processes, and the expansion of sub-quality settlements. It is quite apparent that man in the Philippines is no longer living on Nature's dividends but on Nature's capital.

The opportunity to abuse the environment has increased as a result of population growing at an exponential rate. The increase in environmental problems, however, is not directly proportional to the increase in population but is also affected by technology which facilitates the utilizations of less suitable or lower grade resources especially land. Economic decisions particularly those which underscore development at all cost have also contributed their share in undermining the quality of the environment. Under such conditions environmental problems in the form of naturally-occurring or man-induced geophysical and bio-chemical hazards have become widespread.

ECONOMIC DEVELOPMENT AND ENVIRONMENTAL EQUILIBRIUM

The success of development depends decisively upon the ability to combine the demands of the population with the available resources of the region. The regional resources and the limited degree to which they can be utilized and controlled must be recognized.

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[1] Paper prepared for the seminar-workshop on "Societal Response to Environmental Stress", National Research Council of the Philippines with the National Committee on SCOPE, Quezon City, November 27-28, 1974.

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Undesirable side-effects or consequences of development are mainly the result of mistaken notions of the predetermined natural conditions in a region. In order to avoid such unfortunate consequences, insight is needed into the interaction of the different elements or components of the regional environment. A knowledge of the structure and environmental functions of a region is unobtainable in development based exclusively on regional-political and socio-economic processes. In the same manner it is illusory to accept that environmental problems are singularly of a physical-technical matter.

A lack of reference to the developmental limits of a region leads inevitably to a negative sequence. Development plans must include environmental (ecological) criteria as well as socio-economic factors. The effects of the burdens imposed on the environment depend upon the load-bearing capability of the individual environmental components and on the system as a whole.

Development is not determined by a single factor or by a number of isolated factors but by a great number of parameters operating within a system. Within this situation, the single factor varies in its effect according to the condition of the whole system and in relation to various optimum and limiting factors. It must be recognized that development processes are thus extremely complex.

CONSEQUENCES OF DEVELOPMENT AND ENVIRONMENTAL QUALITY

In recent years conservation of resources and environmental pollution have become important social and political issues. There is a growing awareness of problems concerning the continual and accelerated use of nonrenewable resources, concern over loss of land by mismanagement, the creation of man-made deserts, and the degradation of the environmental quality by industrial and urban pollution.

At the Stockholm Conference on Human Environment in 1972 there was a considerable divergence of views. At one extreme, there were those who maintained that growth means pollution, and that what must be done is to stop growth and to stop using energy. On the other hand, the underdeveloped countries rationalized that environmental improvement has no meaning to a starving population, and that the attainment of levels of material well-being achieved by the developed nations must be a primary goal even if it does result in reduced environmental quality.

Justifications for one or another resource policy are commonly stated with little regard for their logical derivation. Planning or the development of natural resources, however, should not be carried out solely for economic gains; there should also be an emphasis on what is socially, culturally and physically desirable. The value of a mining operation or an industrial development should not be assessed as a separate entity from the physical landscape. An overview of the planned land use and its sequential changes must be taken into consideration.

AGRICULTURAL DEVELOPMENT

In the Philippines, increases in agricultural output have traditionally been achieved through an expansion of the cultivated area. It was only during the past decade or so that modern farming technologies have been adopted to increase the productivity of lands under cultivation. Thus the agricultural systems range from traditional subsistence farming to modern agriculture dependent upon auxiliary energy and chemical nutrient sources.

With the rapid growth of population in the Philippines and the land area remaining constant, populations pressure on land for agricultural production inevitably increases especially as competition of different economic activities for land intensifies. Population will therefore, become more and more the basic determinant in the allocation of land for different uses. For land allocated to agriculture, population growth will maintain pressure to increase crop cultivation.

According to a United Nations Development Program report in 1970 on "Land Use Economics in the Philippines", the country has already exhausted its supply of rich and untapped farmlands. In the same vein, the report stated that there is no justification for turning forests into farmlands. If water and proper cultivation are supplied, land now under cultivation can be made to raise three crops a year due to favorable climate. Thus intensification of cultivation with the use of improved high yielding varieties (HYV), fertilizers, pesticides, and herbicides will be decisive factors. The need to develop and expand the irrigation facilities in the country was also underscored.

The need to increase food production because of high population growth rates, therefore, necessitates the shift to modern agricultural technologies, a move that will take Filipino farmers farther away from natural ecosystems. Modern agricultural systems are artificial ecosystems that function only as a result of extensive human manipulation. The magnitude of the indirect costs (in the form of polluted water bodies and health hazards) associated with the technologies designed to maintain and increase the productivity of agricultural system has become a subject of considerable controversy.

It is, nevertheless, a well known fact that modern agricultural developments are associated with tremendous amounts of accumulated organic waste, fertilizers, and pesticides. As yet man has not evolved a technique whereby the disposal of such substances can match their production and accumulation in the environment. Their disposal is still primarily dependent upon natural processes, i.e., on the capacity of the environment to absorb, degrade and recycle waste materials free of charge. Thus when the environment cannot dispose all of the accumulated waste materials, pollution occurs. A comprehensive understanding is, therefore, necessary as to whether the strategies employed in modern agricultural systems to achieve high productivity are consistent with other equally critical considerations as the need to ensure the long-term stability of agricultural systems and the need to prevent the long-term degradation of the productive capacity of

the biosphere. It is, therefore, ironic that the delayed environmental expression of the dangers of instability or imbalance due to the increasing practice of monoculture, pesticides and fertilizers' accumulation, the growing scarcity and high prices of fossil fuels appear at this time when a yield breakthrough using modern farming techniques and principles is imminent.

FOREST EXPLOITATION AND THE ENVIRONMENT

Modifications of the environment by the removal of forest stands in sloping lands where there are no provisions for adequate reforestation include changes in surface discharge. These changes are reflected mainly in the intensity of slope (gravitational) and fluvial processes. A rapid surface discharge during torrential rains is the cause of landslides, mudflows, and accelerated soil erosion. Landslides also develop as a result of undermined slopes. Extreme cases of accelerated soil erosion leads to intensely dissected relief, to the exposure of bare rock, loosening of soil particles and their removal, and to floods.

Unregulated cutting of trees to forested watersheds affect evapo-transpiration, interception. storage, stemflow and drip, surface storage, infiltration, overland flow, soil moisture storage, through-flow, groundwater table, groundwater storage, and baseflow.

Forest watersheds produce overland flow only after heavy rains, and the amounts of flow and peak rates are low compared with those from open land watersheds. In addition, suspended sediment content is low for forest watersheds. Detailed studies, however, reveal that the above generalizations are quite complex and the relationships between watershed alteration and streamflow may not readily lend themselves to simple observations. More studies are, therefore, necessary for a better understanding of these relationships.

The above points are raised to make people aware of other equally important functions of forests other than the conventional acceptance that they are just the sources of commercially useful wood. Sound forest management should involve the integration of lumbering operations with other uses of the land. Soil protection and the maintenance of desirable soil-water relationships should be given greater emphasis in the face of the government's program to make the country self-sufficient in its food requirements. Multiple use, the principle that forests should serve a variety of purposes and that their proper management contribute to environmental equilibrium must be given due consideration.

The rate at which the forested lands of the Philippines are being denuded is truly alarming. The estimated rate in 1972 of about 170,000 hectares a year is a very high figure indeed if one takes into account the fact that only 12.5 million hectares of the total land area is forested. It is hoped that the presidential decree fixing the land area for permanent forests as well as that portion that could be used for other purposes would minimize that further deterioration of the forested lands. The presidential decree was based on suggestions made by the Bureau of

Forest Development making use of the 18% slope as the guide in delineating types of lands that could be used for specific purposes especially for agriculture and forests. Although the Bureau has not come up with detailed studies to support the choice of the 18% slope as an arbitrary line of demarcation, the spatial requirements of a growing population in a country with a limited land area that is fragmented and compartmentalized were given due consideration.

WATER RESOURCES AND THEIR UTILIZATION

Perhaps the most obvious impact of man upon water resources and their utilization is in connection with dam and reservoir construction, irrigation diversions, and as dumping areas for waste materials incidental to urbanization and industrialization, and mining operations. The last will be discussed further under separate topics.

Dams and reservoirs in the Philippines are still few but there is bound to be a gradual increase as the government accelerates its economic development program, in particular, the construction of more irrigation projects to support a more intensive national agricultural productive capability. However, when a dam is built across a stream, the impoundment of water creates a complex net of impacts through the whole breadth of the immediate vicinity and the irrigation service area.

Initially, the transformation of the reservoir site from terrestrial and riverine to aquatic and lacustrine conditions is rather abrupt. Though a man-made lake may resemble a natural lake, the two are not the same. The man-made lake is subject to human manipulations of outflow and water levels. Even when the reservoir is stabilized, the definable new ecosystem, at best, have limited similarities to a natural lake. It will continue to be a hybrid of exhibiting the characteristics of a riverine ecosystem and that of a natural lake ecosystem.

Although artificial reservoirs are necessary for water storage in connection with irrigation, hydro-electric power generation and flood control, a number of problems and their consequent effects on the environment must be recognized. Water reservoirs hold back a considerable part of the matter transported by streams. Thus, sediment-free water flowing out of the dam has a higher erosional capacity to deepen and widen rivers and the destruction of coasts. This effect though can be minimized by the construction of dams in the upper reaches of river systems.

Reservoirs also increase the amount of evaporation from a river and thus increase the salinity of the water downstream which may further affect the aquatic ecosystem. Temperature characteristics of the water in the reservoir is likewise affected. On the basis of the dam design, if water is released from the surface, the reservoir is a "nutrient trap and heat exporter", whereas if the water is released from the bottom, as is generally the case for dams which generate hydroelectric power, the reservoir is a "heat trap and a nutrient exporter". In addi-

tion, for dams with deep water penstocks, evaporative loss is increased as a result of storing warm incoming water and release of cold water. Low dissolved oxygen in the discharged water also reduces the capacity of the stream to receive organic pollutants, and the discharge of hydrogen sulfide and other reduced substances lower downstream water quality and in extreme cases results in the killing of fishes.

The socio-cultural impact of the reservoir comes about in the displacement of the inhabitants of the area flooded as in the case of the Pantabangan Dam of the Upper Pampanga River Project. This situation is to be repeated when the dam for the Magat River project is constructed. In the Pantabangan project, most of the relocatees elected to settle in an area near the dam and, therefore, certain risks must be recognized. The crowding in the new settlement area has increased population density which likewise increased the probability of environmental deterioration as a result of the development of a new land use system in which orchard and vegetable farming, and grazing are emphasized. That this may happen is further evidenced by the lack of a suitable land use plan in which agro-ecological factors are considered. There is also a need for a reservoir management plan outlining the pattern of land use within the reservoir site.

The greater impact on the environment will, however, occur in the irrigation service area of the dam in Nueva Ecija. The area affected is approximately 77,000 hectares where there will be a shift from seasonal farming dependent primarily on rainfall to year-round farming operations utilizing the impounded water for irrigation. As a result it is expected that hydrologic changes will take place, i.e., the water table will rise due to continuous percolation and seepage. The effects of fertilizers, pesticides, and herbicides upon water quality further downstream will also become more pronounced. Silt and sedimentation in the irrigation service area, however, will be insignificant as most of the sediments will be trapped in the reservoir but when the erosional capability of the sediment-free water from the dam is higher. The likelihood of the appearance of certain diseases like schistomiasis is quite high. Schistosomiasis, a snail-borne disease, may find the waterlogged lands a very suitable habitat.

ENVIRONMENTAL DISTURBANCE BY MINING OPERATIONS

Extensive disturbance and pollution of the natural environment can result from mining operations. If, for instance, a mineral deposit is found in an area that is forested, before mining can begin the forest has to be cleared and later on as mining progresses tons of rocks have to be removed together with the mineral. These rocks will then be dumped somewhere further laying waste to additional hectares of land especially if forested land is used or if dumped into rivers, water pollution will result. Even if the rocks are not dumped on valuable forested lands or rivers, they will nevertheless, accumulate into huge unconsolidated piles and given high rainfall and high seismicity in many parts of the Philippines where mining operations are taking place, such rock piles are potentially unstable so that

threats of landslides cannot be discounted. The contribution of such rock waste and tailings to the sedimentation of rivers may likewise result on flash floods and destruction of aquatic life.

The rock wastes are mainly of course materials but the tailings comprise finer materials and when discharged directly into a river system, relying on the stream-flow to carry the materials away, sedimentation is guaranteed. If the natural flow of the river is inadequate to cope with the large sediment output, a marked change in the river channel and considerable overbank deposition, and flooding will certainly occur. The overbank deposition and spread of tailings downstream not only will threaten settlement areas but likewise deprive people of both agricultural land and forested areas, and access to fish in the rivers may be lost.

The Agno and Bued Rivers in north Luzon are being polluted as a result of mining operations upstreams which utilize the rivers to flush their rock waste and tailings. The problems of stream pollution from the Benguet mining operations are two-fold: chemical pollution and silt pollution.

Chemical pollution is due to the discharge of acidic water into the river systems. At the point of discharge of highly acidic water into the river, plankton and bottom organisms, if present, may be killed making the section of the river unfit for aquatic life.

All metal cations and other dilute solutions of single metal salts can be toxic to fish. Silver, mercury, lead, copper, zinc, iron, and gold are heavy metals and highly toxic to fish. A combination of cupric, mercuric and silver salts, being synergistic, are extremely toxic.

Mill tailings cause silting of the river bed and the farm lands using the highly turbid water. The deposition of silt as a blanket on the riverbed smother all algae and destroy all fish eggs. Suspended particles may minimize the penetration of sunlight thus reducing photosynthesis essential to plant life. This in turn affect fish life and the whole riverine biological process. Furthermore, water pollution by chemical or siltation process reduces the availability of stream water for domestic and irrigation purposes.

A number of proposals have been made by the mining companies and the National Pollution Control Commission (NPCC) to minimize the pollution of the Agno and Bued Rivers. These are: (1) construction of silting basins, (2) construction of common sewers or pipelines leading out to sea, and (3) flushing out of the rock waste and tailings to the rivers at flood peaks.

As to what strategy will be finally adopted for the disposal of rock waste and tailings, there appears to be no clear agreement between the NPCC and the mining companies. It was recommended by the companies that they be allowed to flush out their tailings from catchment areas during the rainy season at a time when the rainfall intensity is 4.2mm/hour (0.1653 inches/hour) or a total daily rainfall of approximately four inches. This method will lengthen the life of the

tailings catchment basins of the mining companies at the same time little river sedimentation will occur. Irrigated farms will not needlessly suffer since the irrigation inlet gates will be closed for rain water is then available. It is, therefore, ironic that when water is urgently needed during the dry season for irrigation, pollution levels and river sediment leads are high.

The NPCC, however, insisted that the construction of a common pipeline may be the only permanent solution to the pollution problem. The tailings will be flushed through the pipeline directly to the sea.

One of the largest copper mines in the Philippines, Atlas Consolidated in Cebu suffered from a silting up of a deep water port in Toledo as a consequence of the disposal of tailings into the river that empties into the area. As a result the company had to be persuaded by the NPCC to discharge its tailings by pipelines into the deeper part of Tañon Strait. The volume of tailings disposed a day is about 70,000 tons and the distance to the sea is 13.4 kilometers which is considerably shorter compared with the distance from the Benguet mining operations to the China Sea.

Mining operations without adequate safeguards can result in serious deterioration of the environment. Even with the cessation of mining operations, environmental deterioration does not end. The tunnels, open pits and the rock waste dump will remain as potential sources of pollution due to erosion and leaching of soluble products of oxidation. This is particularly evident in the Philippines in view of the intensity and high rainfall amounts seasonally or annually. The discovery of oil, though most welcomed, will surely bring with it another pollution problem.

SETTLEMENTS AND RELATED DEVELOPMENT

An increasing proportion of the total land area of the Philippines is being taken out of agricultural production and other uses for settlement sites and the construction of auxiliary facilities as roads, airports, harbors, and the like. This is true even as the tendency is towards the consolidation of settlements because as population grows, spatial expansion of settlements also take place.

The great increase in population together with the even more rapid rise in the proportion inhabiting urban places, generates immense problems of environmental degradation never before encountered. Natural cycles of geochemistry and biology which provide raw materials and dispersed wastes so long as men lived in small, scattered settlements no longer function without massive human intervention. The natural cycles with their buffering effects available for the disposal of wastes have been disrupted by man and the more fragile components of the ecosystems eliminated. Worse is the destruction of even the toughest environments by urban inhabitants who have willingly demonstrated such tendencies with the use of modern technologies. In the Philippines such actions are matched only by the lack of consistent efforts to assure the fitness of new urban environments for human habitation.

From the manner urban places or cities are being developed, there appears to be no obstacle which cannot be overcome, or to which satisfactory adjustments cannot be made, given economic motivication. But both the economic costs and the risks to people and to natural systems increase over time with the disappearance of choice urban land. These come about as marginal land like swamps, floodplains, an steep hillside, are developed for these physical settings are highly liable to geophysical hazards like floods, erosion, sedimentation, and landslides.

In turn high density settlements or urbanization has effected radical climatic changes. The city's compact mass of buildings and pavements, and its high energy consuming transport system profoundly alter the natural landscape, resulting in an almost infinite number of microclimates and related phenomena. Among these is the urban heat island which affect urban ecology in a number of ways such as the alteration of the physiological comfort of man; convection cells created by turbulent heat influx and associated air pollution, circulation and diffusion; increased precipitation, and others.

On the effects of urbanization upon hydrology, there is a dearth of available data. However, as experienced in parts of Greater Manila, the paving of streets and accelerated roadway construction, and an ever-increasing density of buildings have greatly reduced the infiltration of precipitation thus increasing the peak runoff and shortening of the time lag between precipitation and peak runoff. The above conditions coupled with an inadequate drainage network particularly storm drains make floods a constant threat during the rainy season.

Disruption of aquatic ecosystems and the general modification of water quality are inevitable consequences of expanding settlements, in particular cities where manufacturing activity is significant owing to municipal sewage and industrial pollution. The alteration of water quality caused by industrial and domestic pollution in the Pasig River and Laguna de Bay has been the focus lately of a number of research activities. However, the study of pollution due to natural rates of sedimentation has received little attention in the Philippines. This form of polluton is important especially in areas undergoing urbanization and probably more significantly, suburbanization.

Many of the problems of urban areas, Greater Manila in particular, are due to the failure in recognizing energy, matter, space, time and diversity as both resources and constraints. The high rate of energy use in urban areas is due to increased dependence on fossil fuels which are stock or fund resources. Fossil fuels have accelerated the carrying capacity of such areas although the depletion of these resources can also abruptly reverse the current trend.

Pollution is one of the many deleterious side effects of the tremendous rate of energy use in cities. It is due to the running of matter through the urban ecosystem faster than the waste produced can be decomposed or dispersed. Consequently, there is a tremendous accumulation of materials which cannot be readily assimilated for recycling through the system.

Cities are physical systems as well as social and economic systems. Thus, it is not surprising to find that cities have an effect on the natural environment and that this effect is modified by the ways cities are developed. Compared to most biological systems which have self-regulatory or homeostatic capabilities, the city is in most cases a system temporarily out of control. If a city grows beyond its resource base, then land speculation at the urban fringe allows the city to grow further. The requirements of the city are obtained by expending fossil fuels to haul in food and other supplies from increasingly distant locations. The availability of fossil fuels, therefore, allows the city to develop as nonhomeostatic or artificial ecosystem since the controls that operate in the case of a natural ecosystem are removed.

CONCLUSIONS

Since much of the deterioration of the environment is related to the exploitation of natural resources, the rational utilization of such resources, preferably preceded by their inventory and survey, should be the basis of the country's economic program. Although much is already known about the existence of such resources and the means for their utilization, more remain to be learned about them. A major task in the Philippines is still in determining just what natural resources are available and what are the most efficient methods of using them in a rational way. Resources must not be sacrificed for immediate short-term benefits.

In general, population growth and technology work hand in hand in intensifying man's use of natural resources and hence his total influence in the environment. The per capita consumption of many resources — space, minerals, energy, water, air — is increasing in developed countries alike, thus further multiplying the impact of the ever--increasing number of people. Economics is another major factor of environmental deterioration. Most economic systems not only allow detrimental impacts but also provide incentives for them. Minimization of costs is a basic goal of these economics but the cost accounting of new technologies of exploiting natural resources does not generally take into account environmental costs. Contributory to this is that political systems usually allow these new technologies to operate before ultimate hazards are known for reasons that are economic; a certain rate of gross national product growth must be attained annually for this apparently is the "only acceptable measurement of positive development".

HOW MAN POLLUTES HIS WORLD[1]

For centuries we have treated land, sea and sky as though they were limitless. They aren't.

We have pumped millions of tons of particulate matter and noxious gases into the atmosphere . . . polluted most of our rivers and lakes . . . produced so much trash that we were running out of places to put it . . . allowed pesticides to travel all through the food chain . . . accumulated mercury, lead, DDT, and strontium 90 in our bodies.

We have disrupted nature's systems — the self-renewing cycles that have automatically rejuvenated our land, water, and air. When we tamper with these systems, we threaten the basis of life itself.

The spaceship Earth seems huge — a giant sphere 8,000 miles in diameter. But we use only a thin layer at its surface. Except for high drifting spores and bacteria, life exists only from about five miles above sea level down to the seven-mile chasm of the deepest ocean trench. That 12-mile zone is called the biosphere. On a two-inch-diameter model of our planet, the biosphere would be thinner than the paper these words are printed on. Actually a far thinner belt-less than two miles thick — contains 95 percent of all life on earth.

Much of the biosphere is low in productivity; 90 percent of our oceans and 30 percent of our land area are so nearly devoid of life as to be considered biological deserts. The rest must support earth's current population of 3.6 billion — which, if its present rate of growth continues, will have passed 6 billion by the end of this century. Every second, four babies are brought into the world. Every nine seconds, one is born in the United States, and that baby's prospective use of earth's resources is extraordinarily high — at a conservative *estimate, thirty times that of a baby in India.*

More than 56,000,000 gallons of water, for personal use as well as for agriculture and industry, will be needed to supply that new American's lifetime wants. And of other resources — at the present rate of consumption — reserve the following for our new infant: 37,000 gallons of gasoline . . . 5 1/2 tons of meat . . . 9 tons of milk and cream . . . 5 1/2 tons of wheat.

What kind of world will this infant inherit? The answer depends largely on actions taken now — by governments and individuals all over the world — on these three kinds of pollution:

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[1] Printed with permission from National Geographic Society, Washington, D.C., National Geographic Magazine 1970.

AIR POLLUTION

These are chiefly man-made causes namely: *motor vehicles, industrial processing, power-generating plants, heating fires, refuse and agricultural burning.* In this country maximum emission standards are being set for each source by federal and state governments, and legislators predict that such laws will be tightened year by year.

LAND POLLUTION

We all contribute to the mountains of garbage and trash that must be disposed of daily. Much of our trash is plastic, aluminum, and glass; these are non degradable — nature can not recycle them through corrosion or decay.

The individual can help of buying beverages in returnable bottles whenever possible; by using the trash-desposable cans increasingly provided in public places; by leaving each campsite at least as clean as he finds it and making sure that fires are out. Forest fires are among the worst desecraters of our land, laying vast acreages open to ruinous erosion.

WATER POLLUTION

Chief causes are inadequately treated sewage and manufacturing wastes, oil from ships and drilling lakes, pesticide residues, fertilizer runoff, and acid drainage from mines.

Each of us can help by holding use of fertilizers and pesticides to a minimum by avoiding long-lasting insecticides such as DDT, by using minimum amounts of detergent, by no longer regarding our lakes and streams as natural receptacles for wastes and trash.

Environmental deterioration has continued and accelerated until it has reached the point of crisis. We must understand the problems we face if we are to solve them. It isn't too late to learn. The more we know about our world, the more effectively we can work to save it. It is the only one we have.

Motor Vehicles — generate almost half of the nations (USA) air pollution; well over 100 million cars, trucks, and buses use America's road. Improved engines, as well as better mass transit facilities, are needed to clear the air.

We can help by making sure that our cars are equipped with exhaust — emission — control devices and that these are working properly; but avoiding unnecessary big-city driving; by obeying laws against backyard burning; by burning off unneeded electric lights and appliances to reduce the growing demands on power plants.

Mercury waste has been flushed into many lakes and rivers by industry. Bacteria in the water convert some of it into highly toxic methyl mercury, which passes along the food chain into fish that we may eat. Other mercury compounds used in agriculture, have personal game birds in many parts of the world.

Chemical fertilizers — have greatly increased crop yields. But wind and rain carry some of these nutrients into our rivers, ponds and lakes, where they contribute to catastrophic overgrowth of algae.

Long-lasting Pesticides — carried into streams, lakes and oceans find their way up the food chain through fish, affecting the reproduction of eagles, ospreys, and other fish-eating birds. Some, such as mercury, are also harmful to mammals including man, and the ultimate effect of others has yet to be determined.

Stripping of Vegetation — for lumber, new highways, and housing developments speeds soil erosion and reduces the planet's supply of oxygen-producing greenery. Strip mining scars mountainsides and lets mine acids wash down to kill more vegetation.

Trash Disposal is a growing problem. Open dumps are giving way to modern incinerators with smoke-trapping devices, but much trash is unburnable. Cities face long, expensive hauls to outlying landfill sites. Accumulated trash also creates visual pollution, as disturbing in its way as other forms of damage to our environment.

Dumping at Sea increases as landfill sites become harder to find. The United States alone, in one recent year, dumped at least ten million tons of waste at sea, plus forty million tons of dredging spoils. Not only sewage sludge and trash, but also such hazardous substances as obsolete nerve gas and radioactive wastes have been sunk in the ocean.

Nuclear Power Plants — produce less air pollution than their oil — and coal-fired counterparts but they create more thermal pollution in the water used or cooling. The heated water holds less oxygen and can disrupt aquatic life cycles.

Oil Spills foul beaches, release toxic chemicals that kill fish and birds, and smother bottom life. Millions of tons of petroleum a year are flushed from ships, spilled at fueling ports, and poured into the sea from leaking or runaway offshore wells and wrecked tankers.

Ruined Rivers result from the onslaught of sewage, sediment, and industrial wastes. Almost every major river in the Nation is polluted, and some pollutants are endangering our estuaries, wetlands, and coastal waters — nurseries for most of our commercially important fish and shellfish.

Urbanization, the mass movement from rural to metropolitan areas, puts an increasing strain on city facilities, from transportation to trash disposal. Factories and myriad car exhaust pipes pollute the air above.

Jet Aircraft causes less than 1 percent of air pollution, but their engines produce water vapor by combining hydrogen in their fuel with oxygen from the atmosphere, at times adding to cloud cover. Supersonic transports will operate in the stratosphere, where pollutants tend to remain in suspension longer, raising as-yet-unanswered questions as to possible long-range effect upon earth's climate.

CONCEPT OF POLLUTION ABATEMENT IN THE PHILIPPINES

by

REYNALDO M. LESACA[1]

1. INTRODUCTION

Pollution, despite its late appearance in the country, is not really a new phenomenon. The world has known pollution for the past several hundred years. In fact, literature tells us that the first case of an attempt to control pollution was reported in England way back around the year 1273, when the burning of "sea coal" was prohibited because it caused severe air pollution especially during the winter months.

A certain degree of pollution is present even in less developed countries. Whenever raw human wastes or refuse is dumped or discharged into bodies of water, pollution also results.

The general causes or sources of pollution may be classified under four general headings, namely (1) that cause by nature itself, over which man has very little or no control; (2) that coming from the general population in the form of sewage and refuse and in the form of gaseous exhausts from motor vehicles and from heating systems; (3) that coming from industrial establishments which discharge solid wastes and liquid effluents into bodies of water or gaseous emissions into the atmosphere; and (4) that coming from agricultural wastes.

When water is polluted it produces several effects. First, it cannot be used as a source of domestic and industrial water supplies without appropriate treatment. Second, it results in low yield of crops when polluted water enters irrigation systems. It also adversely affects the yield in fishponds and catches in communal fishing areas. In this way, it affects the country's economy since 30 to 35 percent of our gross income come from agriculture. Thirdly, water pollution poses a threat to public health; and lastly, water pollution degrades certain waters used for recreational purposes such as swimming, skiing, and sport fishing. To a certain degree, at least aesthetics is affected when a body of water is polluted.

The most important effect of air pollution is on public health. Air pollution is tagged as to cause to some extent chronic diseases like bronchitis, asthma, emphysema and other lung or respiratory diseases. Researchers have also estab-

[1] Commissioner, National Pollution Control Commission.

lished that air pollution is linked to higher mortality rates. For specific acute effects of the major air pollutants, carbon monoxide displaces the oxygen in the blood and exposure to 100 parts per million for eight hours will cause dull job performance. Sulfur dioxide injures the respiratory system. Photochemical oxidants cause eye irritation while particulates may find their way into the air sacs of the lung causing predisposition to respiratory diseases. Air pollution also tends to intensify arteriosclerotic heart disease and other heart conditions.

Air pollution also destroys property. The soot from particulates soils curtains and paintings of buildings, thus increasing cost of maintenance. Particulates also contribute to poor visibility and poses a traffic hazard to motorists. Dusts and fumes from industry affect plants and vegetation and hundreds of thousands of pesos are lost annually in agricultural crops due to air pollution.

2. TRENDS IN ENVIRONMENTAL POLLUTION

2.1 *Metropolitan Manila Area:* —

Studies conducted from 1971 to 1973 in six locations in the MMA regarding air pollution caused by vehicular emissions show that the levels of air pollutants are increasing each year.[2] The studies show, for example, that the level of suspended particulates in the Plaza Miranda area increased from an hourly average of 100 ug/m^3 in January 1971 to more than 300 ug/m^3 in December 1973. The increase is attributed to the increasing number of motor vehicles from 278,000 in 1971 to 309,000 in 1973. The study shows similar increases in other pollutants although the rate of increase may not be as significant as that of suspended particulates.

No study is yet conducted in the trend of air pollution caused by industry but based on a two-year survey of 244 industrial plants the NPCC estimates that the 800 potential polluters in the MMA, the quantity of suspended particulates, sulfur dioxide and other major pollutants reach more than 1,000 tons daily. It is safe to assume however that although industries are being established, the industrial emissions are not significantly increasing because of the preventive measures being undertaken requiring all new industries to put up built-in control devices or facilities. It may be interesting to note that 42 out of 100 industrial firms in the MMA have installed air pollution control equipment as of 1974.

In spite of the above information, the over-all level of air pollution in the MMA is still within acceptable limits.

As far as water pollution is concerned, practically all rivers in the MMA are seriously polluted. The worst of these rivers are the Tinajeros-Tullahan River traversing from Novaliches, Quezon City, to Malabon and Navotas, Rizal and all the esteros. These are followed by the Parañaque River, Zapote River, and San Juan River. The Pasig River and Marikina River are similarly but less serious-

[2] NPCC Bulletin News "Air Quality in Manila".

ly polluted. Except the esteros the pollution of which come practically from domestic wastes of the general population, all these rivers show that 60 percent of their pollution load come from domestic wastes and about 40 percent come from industrial wastes.

After five years of intensive campaign by the NPCC, the main Pasig River has recovered somewhat as shown by the monitoring results. This improvement in the quality may be attributed principally to the removal of thousands of squatter's shanties along its banks and the pollution control program being undertaken by the manufacturing firms within its drainage basin.

2.2 *Pollution in Other Areas:* —

In other parts of the country, the status of pollution is not extensive but rather intensive. It varies from moderate to serious in areas or regions where clusters of industries are situated like Iligan City, the Negros Provinces, the Baguio and Benguet Areas, Iloilo and Cebu. In these areas, the main source of water and air pollutions come from industrial sources.

The Iligan Bay area, for example, is polluted with traces of mercury coming from the effluent of a PVC and caustic soda factory. The atmosphere is likewise polluted heavily by two cement plants and one calcium carbide factory.

In the two Negros provinces, the major problem is water pollution brought about by some 15 sugar centrals and distilleries. Four rivers are now badly polluted and adversely affecting fishing areas. Not one of the sugar centrals and distilleries in the area has a satisfactory industrial waste treatment facility.

The Baguio and Benguet area, the site of eight mining operations, is another region where moderately serious water pollution exists. Records of the Commission show that 29,000 tons of mine tailings are dumped daily to three rivers — the Agno and Bued Rivers flowing down to Pangasinan and the Abra River in Abra province.

3. CONTROL METHODS

3.1 *Philosophy of Approach:* —

The principal strategy adopted by the government towards controlling pollution, particularly industrial pollution, is directed toward prevention of new pollution by industrial dispersal, by developing growth centers other than Manila by giving incentives, by persuasive rather than coercive action, and cooperative arrangements with local executives and other agencies.

(a) *Prevention of New Pollution:* — This is a preventive measure which has accounted for arresting the rising trend of water pollution in the country. This is carried out by entering into a cooperative arrangement with the Board of Investments and requiring that all new industries that are to be registered with BOI are to provide, right at the start, built-in pollution control facilities.

The BOI requires the firm to secure a clearance from the NPCC and the latter issues a clearance only if the necessary anti-pollution equipment or facilities are incorporated in the building plans and are actually installed.

There is also a similar arrangement with banking institutions like the Development Bank of the Philippines and the Philippine National Bank on this requirement.

(b) *Industrial Dispersal:* — In accordance with a Presidential Directive, the establishment of new industries that are highly pollutive or hazardous within a radius of 50 kilometers from Manila is to be prohibited. Existing industries belonging to these categories will be required to provide the necessary anti-pollution facilities within two or three years; otherwise they would be asked to pull out. To encourage the siting of industries in other areas, the government will provide the necessary infrastructure facilities like roads, ports, electric power supply and distribution systems and communication facilities.

Aside from the environmental aspect of this approach, this program of dispersal will at the same time generate employment opportunities for people in the rural areas and indirectly will provide a counter measure to the in-migration of rural population to the Greater Manila Area or other urban centers.

(c) *Providing Growth Centers other than Manila:* — This approach is not only directed to minimizing migration to the GMA but to spread out the development growth of the country which at the present time is limited to only a few centers or cities and consequently is responsible to the high and uneven population growths and the accompanying pollution problems in these few centers. The utilization of resources of outlying areas which now have been neglected as a result of the over-concentration of planning and development activities in the GMA will now be possible.

As far as environmental protection is concerned, the establishment of these growth centers will in effect provide focal points to industries and because of the advantage of preplanning — physical and socio-economic — the problem of environmental degradation or pollution will be considered and prevented.

(d) *Incentives:* — Under PD 274, industries located in the Greater Manila Area, particularly those located within the drainage basin of the Pasig River and its tributaries, are entitled to reimbursement of all duties paid on installed, imported anti-pollution equipment. Under this decree, all expenses in the construction of these pollution control facilities, including the cost of research and studies, are considered deductible items in the firm's income tax returns.

A proposed decree is now being drafted giving all industries, regardless of their location, not only the reimbursement of duties paid but also exemption from all taxes, including real property tax, for pollution control structures or facilities constructed and used.

(e) *Maximum Persuasion for Existing Industries Without Pollution Control Facilities:* — Considering the fact that most of our existing industries belong to

the medium- and small-scale types, the Commission is promoting the soft or persuasive approach by convincing owners of pollutive industries of their responsibility to protect the environment and the health of the residents around the factory. This responsibility involves the putting up of the necessary anti-pollution structures and facilities. Reasonable length of time is given them to study their problem and to design and construct the appropriate pollution control works. It is rarely and only under extreme indifference and insincerity on the part of the owners of industry that the NPCC takes the hard line by taking the case to court or lately by referring the case to the Department of National Defense.

(f) *Cooperation of Local Governments and other agencies:* — For recalcitrant and non-complying firms, the Commission seeks the aid of municipal or city executives and the OCR and the Special Anti-Pollution Team created by the Secretary of National Defense. The mayors are requested to revoke or not to renew mayor's permits to these firms. In many cases the Commission finds the mayors very cooperative. However if nothing is done by the mayor, the NPCC refers the case to the DND's Anti-Pollution Unit for appropriate action. Since the start of cooperation with the DND last year, the NPCC has attained better results in the matter of compliance by these recalcitrant firms.

3.2 *Best Practicable and Available Technology:*

In pursuing its requirements for industry to put up appropriate pollution control facilities, the Commission bases industry's compliance on the best practicable and available technology (BPAT) principle. This policy is predicated on the fact that we are a developing economy and that we cannot immediately get and avail by ourselves the latest control technology as developed by highly industrialized countries. These may be too expensive. Also, there are cases of equipment that will work satisfactorily in temperate climate but may not work efficiently in our kind of climate. On the other hand there may be simpler and workable control methods or equipment developed abroad which are not available locally. Thus, the Commission feels that the best practicable technology that is available locally shall prevail in determining compliance to pollution control laws and regulations. The other reason for this BPAT policy is to encourage Filipino designers and technologists to develop control methods and equipment by utilizing local materials, know-how, and ingenuity.

4.1

3.3 *Industry's Responsibilities:*

The role that industry takes in the economic development of the country must include the responsibility that in producing products and services it has to see to it that is unwanted by-products do not cause a deterioration of the environment. In other words, while industry is free to make profits, it is not free to impose on other people's comfort, health and state of well-being. Thus, it must install the necessary anti-pollution equipment or facilities to reasonably reduce its emissions or effluents in order not to alter or impair the quality of the environment. It has to study very carefully the best location of the plant in addition to consider-

ing present available technology in pollution control. If, for example, its emissions or discharges are of such nature and quantity that available and practicable technology cannot satisfactorily reduce these emissions/discharges to safe or allowable levels, it has to be located where these emissions/discharges will affect the environment the least, or where the local conditions can adequately absorb or neutralize the pollutants.

Another responsibility that industry has to consider is the cost of clean-up in consonance with accepted "the polluter must pay" principle. This means that if the government has to initiate action to clean up any environmental mess resulting from industrial pollution, then industry has to pitch-in heavily in the expenses, ideally on a proportionate basis, i.e., the higher the load, the greater industry has to pay for the clean-up.

3.4 *Enforcement of RA 3931 (Pollution Control Law):*

Since 1968 the NPCC (formerly called NWAPCC or National Water and Air Pollution Control Commission) has continued to make surveys and inspections of factories to determine their potential or actual contribution to water or air pollution. The Commission has also been receiving numerous complaints on pollution from the public. This phase of the work takes priority over the others.

If a violation on pollution is established after an investigation or survey, a public hearing is usually held and the respondent firm, the complainant, and other interested parties (including those of the local government) are invited. Unless it can refute the government's findings, the firm is required to install appropriate devices or facilities that would correct or reduce pollution to levels acceptable to the Commission. A reasonable time limit is given to these firms to complete such installations and if the required devices or improvements are not completed within the stipulated time limit, the Commission issues an order requiring the firm to stop discharging any emission or untreated wastes into the atmosphere or any body of water.

To help the Commission enforce its orders or requirements, the assistance of local executives, like municipal and city mayors, is sought. This assistance may be in the form of revocation of, or the non-issuance of, a mayor's permit to operate as required of these establishments. The Department of National Defense has also assisted the NPCC in the matter of forcing stubborn firms to comply with our requirements.

4. GOVERNMENT POLICIES

4.1 *Standards:*

Under RA 3931, the NPCC is mandated to promulgate rules and regulations for the maintenance of a reasonable standard of purity of the waters and atmospheric air of the country. The philosophy behind the rules and regulations adopted in 1967 is a direct regulation of pollution by the state. As such, these standards are included in the rules and regulations standards for water and air quality. These standards reflect the minimum quality that the atmospheric air should have

and for different bodies of water, depending on their classification based on best beneficial usage. These standards are not static and have to be revised from time to time in order to be realistic. The revisions however should be based on current developments in technology, current researches on allowable threshold limits and, most important, on local conditions.

4.2 *Industrial Estate:*

In consonance with the government's policy on industrial dispersal, the government planners have now in blue print, the establishment of industrial estates in the country. The first of these estates is the Bataan Export Processing Zone. This will be followed by another complex in northern Mindanao and another one in Batangas. The private sector is also involved and there are now two estates in the planning stage — one in Limay, Bataan, and another one in Canlubang, Laguna.

The single most important advantage of establishing these estates as far as pollution abatement is concerned is the possibility of grouping industries that produce effluents or discharges that may neutralize one another; thus lending to the development of common or centralized treatment systems that are economical and cheaper to operate. The other advantage is that the matter of pollution control facilities can be considered right at the start and hand in hand with other engineering and marketing studies.

4.3 *Environmental Impact Assessments:*

As part of project development planning, the government is now looking into the need for a pre-assessment on the effect on the environment of the project. In developed countries, this environmental impact assessment is now a standard procedure. This activity is equally done by environmental experts who study all impacts to the environment of every proposal and its alternatives. Impacts on land and aquatic eco-systems, including the possible disturbance of certain rare animal species, not only after the project is completed but during construction stages are given thorough studies by the environmental experts. Only with such studies that projects like the oil refinery plant on the east side of Laguna Lake and the daily barging of feed stock and lube oil across it which daily are posing a threat to destruction of fish and aquatic life in the lake, could be prevented.

4.4 *Zoning:*

Specific policies on zoning should be also strengthened. Many cities and municipalities have their own zoning regulations and plans but these are generally not well studied and had been, shall we say, ill-prepared. Zoning as is done now is individualistic in the sense that there is no integration by contiguous municipalities or communities. Thus, under present procedures an industrial zone of one municipality may be located next and side by side to a residential zone of the next municipality.

Zoning regulations in order to be beneficial, have to be implemented strictly in order to prevent community complaints and environmental problems.

4.5 Sewerage Systems:

One deficiency of the government's approach to environmental control is the absence of a strong policy requiring municipalities and cities to put their own satisfactory sewerage systems, including municipal sewage treatment plants. This should be considered soon if this country is to lick its water pollution problem. In a study of the pollution of the Pasig River System, it was found out that only 40 percent of its pollution load is due to industrial sources. However, 60 percent of its load comes from untreated municipal sewage. This finding is an eye-opener for government planners.

5. EDUCATION, TRAINING, INFORMATION, RESEARCH

In one of the papers submitted at the International Forum on "Industrialization and Environment," held in Tokyo in 1973, it is said that the "protection of the environment cannot be introduced by law. Much of the damage to our natural resources can be attributed to ignorance. To combat these, proper educational facilities and proper information should be made available at all levels." The RP-US Workshop on "Education and Training Needs for Philippine Environmental Problems" in May 1974 also underscored the importance of education and training in solving environmental problems when it noted that, "concern for the environment must be an integral part of the educational process from an early age and must be directed toward the public in general as well as those in schools."

In line with these principles, the NPCC has recommended to the Department of Education the inclusion of environmental subjects like resources conservation, wastes utilization and recycling, ecology, etc. to be incorporated in the general curricula in elementary and high school. And in the college or university level, particularly in engineering courses, the Commission has likewise recommended the inclusion of pollution control technology. The UP has now MSc. course in Environmental Engineering and PhD course in Environmental Science and Technology.

A public information campaign has been initiated several years back by utilizing the tri-media and through forums, symposia, seminars, and workshops. Civic organizations and the schools had lately been very active in organizing symposia and seminars and the Commission has almost always, despite its limited resources, supported and actively participated these meetings by serving as resource persons in these seminars. The public information program of the Commission is directed to develop public awareness on the nature and hazards of environmental pollution.

In addition to the above, the Commission is doing limited research studies on tolerance limits for various industrial wastes and pesticides, detergents, and certain gaseous pollutants on fish and aquatic life and on vegetation and plants. Results of these studies will be used in up-dating our existing standard on water and ambient air quality so that they can be more realistic.

Other research projects now on-going are the monitoring of bodies of water like the Laguna Lake, Manila Bay, Pasig River and its tributaries, Iligan Bay, etc. to determine trends in the concentration of certain pollutants.

BOOK REVIEW

GEOGRAPHY AND NATURAL RESOURCES OF THE PHILIPPINES BY DOMINGO C. SALITA. COLLEGE OF ARTS AND SCIENCES, UNIVERSITY OF THE PHILIPPINES SYSTEM, 1974. 338 pp., maps, illustrations, diagrams, tables, appendices, bibliography, index, Clothbound ₱23.50 & ₱19.50 paperbound at U.P. Book Center.

The book comes at a time when additional knowledge in resource utilization and environmental pressures are needed for improved planning. The dominant theme of this volume is on the need for an understanding of the workings of geography as a way of appreciating the nature of existing natural resources and the manner by which they may be effectively utilized. Because the forms and functions of natural resources affect the pattern of regional development, decision makers must know not only of the approximate quality and quantity but also the geographic distribution of available resources.

The utilization of natural resources must likewise include programs for their renewal or conservation and proper management in order to enhance the natural endowment. This requires a multi-disciplinary approach in which geographic methods may contribute toward better utilization. A geographic perspective with emphasis on the interdependence of natural resource systems and on the impact of man's interference in the operations is needed.

A major contribution of the present work is the updating of our knowledge of resources available and the current laws and regulations pertaining to their exploitation and development. Each chapter offers information that stimulates the reader to an understanding of the man-resources complex of the Philippines.

Dean Salita's framework is regional as well as topical, the two broad approaches available for a well-rounded presentation of materials of a geographic nature. There is a general consistency and careful use of data and as a result a continuity from topic to topic. This approach goes far in destroying the myth that geography is a mere compilation of figures as well as the obvious. In the Philippines, no less than in other countries, especially in Europe, academic geographers are concerned with the need to diffuse new viewpoints and methods more effectively among students and readers. This volume successfully demonstrates some of the recent trends in geography suggesting that the discipline can be used as an effective tool in planning the use of natural resources.

I am happy that there is finally a book on Philippine geography and natural resources written by a Filipino who has convincingly presented the

viability of geography as an academic and research discipline. This event should allow other practicing geographers opportunities to further develop broad as well as detailed themes on resources and their development.

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(Sgd.) JOSE R. VELASCO
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