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Pyroclasts

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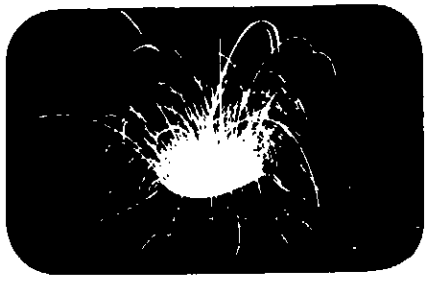

Pyroclasts

Introduction

I began this article before I received the June issue of *Geoscience Canada* with Graham Williams's contribution to Pyroclasts. I had started with remarks concerning the impossibility of following Ward Neale in wit and ready comment on the geoscience scene in Canada, and now I find that Graham has said it better than I could. Furthermore, I would add that the equally impossible task of keeping up with Graham's lively and good-humoured style has strengthened my resolve to play a Cassandra role and to examine some aspects of geoscience or geopolitics in a more serious vein, although doubtless no less controversially than either Ward or Graham.

During the last fifteen or twenty years, I have become increasingly involved in international problems, first scientific and then, little by little, social or political in the broadest sense. International scientific bureaucracy, as everyone knows as an article of faith, is yet more horrific than the domestic variety. Can it conceivably do any good? Over the years, through my association with the Commission on Stratigraphy of IUGS and the IUGS/UNESCO International Geological Correlation Programme (IGCP), and latterly as an adviser on science and technology to the Director-General of UNESCO, I have formed the conclusion that yes, it has done some good, and might do a great deal more.

It is important to realize what some of these international programs are about, including the government sponsored programs of UNESCO and other UN agencies, as well as the programs of non-governmental organizations (NGO), such as the Lithosphere Program and other activities of the Scientific Unions. Many people misconstrue the value of such programs because of the relatively tiny amounts of money available to them. This money, however, is largely devoted to organizational ends which encourage and allow individual scientists to communicate, travel and meet. It is hard to overemphasize the importance of this, although those of you who are familiar with IGCP, for instance, will recognize that a great deal of effective research has been carried out under this program that would not have been done without it, even though its budget is one hundredth of the budget of, for instance, the Geological Survey of Canada. The money for all this research, of course, comes from other agencies once it has been sponsored and approved by the IGCP Board, including GSC. We recently computed that every dollar spent on organization by IGCP generated somewhere between $500 and $1,000 of research activity. My association with such organizations has given me an opportunity of observing the world scene removed from my immediate environment, including its beliefs and ideologies. Increasingly, I have been driven to consider humanity's situation globally, and to wonder what the role of a geologist might be in relation to life on the planet. These feelings have been strengthened during the last three years by my acting as a member of a Visiting Panel on Science, Technology and Society convened by the Director-General of UNESCO. Its meetings reinforced my belief in the emerging concept of the unity of problems facing humankind today. I also found that the distinguished scientists who constituted the Panel appeared to be more concerned with the importance of defining particular research interests than in examining problems facing humanity as a whole. In other words, they were prone to advocate that developing countries needed more institutes of theoretical physics, molecular biology, or new generation computer technology. As one of the few resource scientists present, I dared to raise my voice and ask whether we should not also be concerned with availability and size of such resources as water, soils and mineral commodities of all kinds, including energy minerals, together with the environmental problems involved in their increasing development. After discussion, the Panel allowed me to present my opinion in a letter to the Director-General of UNESCO. The main substance of this letter was also the basis of a statement that I made at a major international conference of NGOs concerned with Science and Technology in Development (CISTOD) held in Tunis in April, 1983. The text of this statement forms the major part of this article.

Many of you will claim that I am merely reiterating things that have already been said, and which we all know anyway. This may be true for some earth scientists, but few in other disciplines, fewer economists, and perhaps still fewer political leaders have any grasp of the complex and inexorable system that links the problems of resource adequacy and environmental limits.

Let me give one example. A report was issued in the U.S. by the Carter Administration in 1980 entitled *Global 2000* which suggested that if present world policies continue, we should be deeply concerned about the future in terms of population, resources, and the environment. The three-volume study was large and unwieldy, yet it did present evidence for its point of view. Its effect on government, however, waned with the change in administration. Recently *Global 2000* has been answered. The following remarks are based on an article in *Science* by Constance Holden on July 22, 1983. This describes a discussion during the AAAS Annual Meeting in Detroit in May where a preliminary report was given on a forthcoming book, *Global 2000 Revised,* written by "world class" authors, and edited and introduced by Julian Simon, an economist at the University of Illinois, and Herman Kahn of the Hudson Institute (who died on July 7). It is reported that the executive summary of this book explicitly contradicts *Global 2000:*"If present trends continue, the world in 2000 will be less crowded, less polluted, more stable ecologically, and less vulnerable to resource-supply disruption than the world we live in now."Extrapolation is frequently made from the U.S. to LDC's, e.g.: "As people get richer, they will have more floor space in their homes". There is no room here to give further examples, except to point out that there is no mention of environmental considerations either in the energy or agriculture articles and it was not considered necessary to have a discussion on population growth. Kahn summed up his beliefs in the words: "everything that creeps or crawls exists for man's benefit". I should point out that the comments made below were written before the Detroit Meeting. I am nevertheless emboldened to give you my opinions, simple though they may be, although they are now voiced with an additional sense of embarrassment caused by this controversy south of the border among our nearest friends. How, one may ask, can wise men in a single country, from a single culture, arrive at such hugely disparate opinions concerning the future? I am reminded of the old dictum that the world is made up for the most part of fools and knaves.

Geologists should surely have opinions about such matters, as resources are the base from which all argument must (or should) proceed. I intend to pursue these matters further, and would welcome comments, favourable or unfavourable.

Resources and Development

In discussing the importance of resources and development the time may well be ripe to stand back from immediate issues and consider the condition of humankind as

a whole on planet Earth. Certain trends in evidence today make it possible that the long-range future from the point of view of resource availability might be satisfactory, but we face a short-term (say, 15 to 30 year) crisis of considerable seriousness. None of the issues raised in this paper are new, but currently they do not appear to be under consideration by technical or political leaders. A note of warning must be sounded that time is running out if we are successfully to adjust to the inevitability of the finite nature of Earth Resources, and if we are to protect the rights of posterity. In the words of Preston Cloud: "We must grant and protect the access of the now underprivileged and the yet unborn to a fair share of Earth's bounty" (Preston Cloud: *Cosmos, Earth, and Man: A Short History of the Universe*, Yale University Press, New Haven and London, 1978).

There are three inter-linked concerns of global importance. These are availability of natural resources and their distribution; population increase; and the levels to which development might aspire. The problems arising from these concerns may not have obvious solutions but, globally, they influence all decisions that we must make now and in the future. We must examine these concerns and point to the existence of limits imposed by exponential processes and the finite nature of earth resources.

The term "resources" includes all products of the earth, oceans and atmosphere used by man, including energy, metallic and non-metallic minerals, soils, water, the land surface, the oceans and the environment in which we live. Most are ultimately finite, and their rate of use is governed by population size and mean developmental level reached by that population. Their availability depends upon ease of extraction or use, including energy requirements, which is commonly expressed in economic terms. For example, recent developments show that depletion of richer ores will inevitably lead to greatly increased energy requirements for exploitation of remaining deposits which in turn may dictate lower limits for economic ore grades. Similar considerations apply to soils, land-use and water supply. In addition to physical limits, concern for the environment, itself a resource, dictates the need to achieve a balance between mineral resource use and preservation of the human habitat. Resources are unequally distributed and no region of the world is adequately endowed with all its needs. Already depletion in some regions is leading to a shift in economic balance, with inevitable increase in international tension.

The accelerating interaction of resource use, population size, and developmental levels constitutes an immediate crisis. Renewable energy resources, substitution and recycling of mineral resources, biotechnological innovation combined with major changes in agricultural practices should have important roles in the future in extending resource availability. It is not clear, however, that the impact of such changes will be felt in time to alleviate the crisis referred to above. Capital requirements alone will place severe restraints on the rate of change.

Population continues to grow exponentially. Even if the rate of increase was limited to replacement level, and there is no immediate prospect of this happening, the present population would increase by at least 50% before stabilizing. Certainly, there are no reliable trends that allow us to assume that all will be well by the next generation. The current rate of doubling is in the order of forty-two years.

Development for the most widespread common good lags in the world. Twenty-five percent or more of the population is below starvation level, and their share in resources is negligible. Hopes that improved resource distribution and use will correct this situation are contradicted by trends over the past fifty years, and there is little sign that, on a strictly global basis, the situation will change.

These three areas interact. The resolution of their continuing interaction, combined with their environmental impact, results in the human condition on earth—the ecology of humankind. Should the present, dramatically uneven levels of this condition improve, there will be a cost.

The key issue is the ecology of man—what sort of a world should we live in? At what level of resource use? and with what quality of life? Science and technology cannot answer these questions but it can suggest limits. We are dealing with exponentials: population increase continues, and therefore there are more people to use resources. If we succeed in raising the overall standard of living of this increasing population, then resource use will continue to increase. As resource use increases, energy requirements will accelerate, and both are finite in the short term. The future limits which vary hugely for different commodities have not been closely determined but for some they are fast approaching. Human beings have existed on earth for at least 100 thousand years. Today we face the future with a population kept alive almost entirely by technology, and dependent on massive resource use from depleting reservoirs whose limits are measurable in hundreds of years.

The problems are unique and urgent. They must be voiced, even though the solutions may be peculiarly drastic. First, gross regional disparity of resource use begs the question of what levels should be aimed at in arriving at an acceptable quality of life that the world can afford. Second, are those areas of the world which use resources at a higher level prepared to reduce their usage in an attempt to lower the current rate of increase? Finally, the ultimate problem must remain growth in population; while this continues, solutions to other problems will become increasingly intractable.

All of the above may appear to be unduly pessimistic, but the nature and magnitude of the problem must be stressed. Solutions must come from many disciplines, both scientific and social, and only a few tentative comments are offered here, from the point of view of an earth scientist. Global models may point to problems, but do not necessarily suggest solutions. Decisions must be made on the scale at which problems are best tackled. For instance, systems of resource exploitation and distribution might best be considered for regions defined by geological as well as economic considerations.

Systems of appraisal in probabilistic terms are being developed for many classes of resources and constitute a major research area in need of global support. One of the most valuable assets a country can possess must surely be a knowledge of its own resource base, its distribution, size and worth. Integration of such knowledge on a regional and worldwide basis would provide one necessary parameter in assessing the balance between exploitation, conservation, and the environment.

In the field of economics, perhaps the most pressing need is for an examination of the possibilities of a steady state economic model which might be combined with an examination of resource needs in development at various organizational levels, i.e., state, region, or globally. Many other areas of action might be suggested, but the fact remains that any solution to global problems facing humankind must be firmly based on a knowledge of total resources available and their distribution.

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