

Commentary



Pyroclasts

The Demise of Geology or the Rise of Earth Sciences?

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For the past few years, I have been a member of the Canadian Geoscience Council, an umbrella organization for geoscience associations and agencies in Canada, and have also been involved in the affairs of three scientific societies. At the same time, I served on the Natural Sciences and Engineering Research Council (NSERC) of Canada's Operating Grant Committee in Solid Earth Sciences. During this time, it has become apparent that many people are very concerned about the health of geology and geophysics, not only in Canada, but worldwide. The following discussion is not intended to be pejorative in any sense of the word. However, if we are to do anything about the current problems in our profession, we must explicitly recognize and address the principal issues, and not ignore them in the interests of political expediency. Unless we recognize the seriousness of the situation, the teaching and practice of the science

of geology will not survive very far into the 21st century.

GOVERNMENT AGENCIES

I recently heard an influential Canadian earth scientist ask the (rhetorical) question "Who is killing the great geological surveys of the world?" We are all aware that the governments of many G7 countries are fighting with huge budget deficits, and that a common approach to this problem involves the reduction of government expenditures. This has resulted in "down-sizing" (now referred to as "right-sizing") government agencies, and geological surveys have suffered severely in this process. Without debating the pros and cons of the actions, the result has been a reduction in size and a change in the priority of survey activities; fieldwork has been reduced, public-relations activities have assumed a much higher priority, and there has been loss of some of the more prominent scientists who have transferred to the academic community. Within Canada, a similar trend is apparent in the provincial surveys, and many traditional geological activities (e.g., petrography, mineral analysis) are now contracted out rather than done in-house. As government activities, geology and geophysics seem to be under attack.

INDUSTRY

During the period 1989-1992, net profits in the mining industry in Canada fell drastically. In part, this is due to the recent economic depression with its decrease in demand for base metals. However, it also may reflect high labour costs and increasingly strong environmental regulations, as many companies have shifted much of their activity overseas. This has resulted in decreased job opportunities for young geologists and geophysicists in the mineral sector, and it is my perception that the same situation holds true in the petroleum

industry. In turn, this has affected undergraduate enrollment in earth science programs, as students are inhibited from starting a degree in geology or geophysics by the poor career prospects in all parts of the geoscience community: government agencies, academia and industry.

EARTH SCIENCES

As is well known throughout the whole scientific community, geology underwent a major scientific revolution in the 1960s with the development of plate tectonics. This provided a cohesive framework for all of the sub-disciplines within geology and geophysics, and introduced the idea of cyclic processes as underlying the evolution of the solid earth. We are now undergoing an even more important revolution, the integration of geology and geophysics with oceanography, atmospheric sciences, and other closely related disciplines to form earth sciences, a coherent approach to the scientific study of the Earth. Historically, these areas have been considered distinct, possibly because their cycles of behaviour operate on very different time-scales. However, there is major flux-transfer between solid earth, oceans and atmosphere. In our study of the Earth, we have advanced to the stage where we can no longer ignore these interactions; a whole-earth approach is essential.

From a Canadian perspective, it is significant that several years ago, NSERC reorganized its operating grant program within the general area of earth sciences. Traditional sub-disciplines in geology and geophysics were joined by physical and chemical oceanography, various atmospheric sciences, soil science, and contiguous areas of microbiology. The evaluation and funding of earth and environmental sciences within Canada was transformed into a coherent and broad-ranging process. Sub-

sequent evaluation of the state of the earth sciences in Canada convinced every member of the committee that the whole-earth approach was the way of the future.

EARTH SCIENCES AND THE UNIVERSITIES

It is all very well to argue that we need to reorganize ourselves to the extent that we become earth scientists, but our employers are the ones who provide a mandate within which we, as individuals, operate, and the mandates vary from one organization to another. Can we see a way through this jungle of differences to a satisfactory scheme of action? If the answer is not "yes", we will not be left with a science for very much longer.

If we do not change, we are going to lose even what we have now, let alone what we have the potential to become. Already, there are signs of this. The chemical societies now have geochemistry divisions that are far more active and extensive than geochemistry activities within the traditional geological societies. The International Union of the Pure and Applied Physics is studying the possibility of establishing "physics of the Earth" as an area of interest under its aegis. In my view, this would split earth sciences down the middle, to the detriment of science in general. In looking at earth processes, one cannot focus just on the physics or the chemistry of the situation; to do so is to do trivial science. One must focus on all aspects of a particular problem or process; the time of the technique specialist looking for a problem to solve is over. Earth science requires an integrated multidisciplinary approach if we are to understand the Earth at a fundamental level, instead of merely scratching at the surface.

I believe that it is up to the universities to take the lead in this transformation from a scattered collection of sub-disciplines to a coherent earth science. The mandates of the government agencies are externally defined, primarily by political factors. The *raison d'être* of the industrial sector is to make money, as we must earn a living. It is only within the universities that we have the freedom to define our own directions in a fairly major way. We will have to fight for any major change, as there are many other interests competing for the resources necessary to make these changes, but

we have the freedom to try! There is a deep vein of conservatism within us that will resist these changes, primarily out of an innate fear of change itself. The universities, supposedly agencies of advancement and change, have become bastions of conservatism, with a reputation of "all talk and no action". We can no longer afford to be like this! We must change or wither away.

WHAT DO WE DO?

If university departments are to reflect contemporary developments in the earth and environmental sciences, if we are going to respond to society's demands for an adequate understanding of earth processes as a framework for economic and human development, we must evolve, integrating our geology, geophysics, oceanography, atmospheric sciences, soil sciences, etc. to form earth science departments. We need to augment our current activity in strategic areas, with this long-term view in mind. We need to re-evaluate our teaching, particularly with a view to broadening our breadth of coverage of earth sciences. I do not advocate not educating traditional geologists or geophysicists; these areas of expertise will continue to be essential to many sectors of our economy. However, we need to broaden the areas of expertise covered in our programs by developing general and optional specialized programs that truly reflect the breadth of the earth and environmental sciences.

Our own students are showing us the way to proceed. The recent upsurge in enrollment during the past two or three years has coincided with increased student interest in environmental sciences and changing patterns in graduate opportunities and employment. We are seeing some response to this student initiative as many departments are hiring in the general area of environmental sciences, and setting up "environmental" options within their current programs. In such times of financial constraint, we must expect that this expansion may be accompanied by contraction in the more traditional areas. There is no easy rational program for this. It is evolution; strong and vigorous traditional activities will survive, while weak and inadequate activities will be replaced by new areas. However, this change is not sufficient. It is also essential that we remove the factional interests that traditionally have plagued the sub-fields of

earth sciences. We must build earth science departments that truly reflect every aspect of what we study, the science of the Earth.