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THE SCIENTIST AND SOCIAL RESPONSIBILITY *

E. H. NICKEL
Division of Mineralogy, C.S.I.R.O.
Private Bay, P.O., Wembley, W.A. 6014, Australia

The Crisis of Science and Society

Our society is in a period of very rapid change. We have become accustomed to rapid technological change, but what is occurring now is a fundamental change in the way of thinking. A "revolution of consciousness" is the way Charles Reich puts it in his provocative and controversial book "The Greening of America" [1].

One of the aspects of this revolution is the changing attitude toward science and technology. Not so long ago, science was seen as man's great hope; the scientific method was regarded as a high-water mark in the development of human thought — a universal method that would infallibly serve to distinguish truth from error, right from wrong.

But now we hear over and over again that scientific and technological advances have ruined our environment. Are science and technology really the chief culprits? We scientists and engineers cannot afford to ignore this question. If we are guilty, then we must repair the damage; if innocent, then we must demonstrate our innocence beyond doubt. For, if the anti-science movement grows unchecked, there is more at stake than merely our prestige; there is a real danger that society will discard the tools that are vitally needed to repair the damage that has been done.

The disillusionment of society with science and engineering has not been entirely unforeseen. As far back as 1957 a committee of the American Association for the Advancement of Science predicted:

> "There is an impending crisis in the relationships between science and American society... This question demands the most urgent attention... of scientists generally [2].

This crisis is now upon us.

What went wrong? I am convinced that a major part of the problem is that many of us have let our actions be dominated by a number of scientific dogmas, and that we have helped to foist these dogmas on the public, somewhat like the purveyors of a new kind of religion. In my opinion Prince Philip was not far from the mark in an address to staff

* Presidential address given at the Annual Meeting of the Mineralogical Association of Canada, at Sudbury, Ontario, May 14, 1971.

members of the Sheridan Park Research Community, during his visit to Canada several years ago, when he said that science and technology have become one of the most powerful neo-religious sects in the world, and continued :

> "I sometimes wonder whether the high priests of science recognize any obligation on their part to notice the radical changes in the whole pattern of our existence or to make any attempt to monitor their broad effect ?" [3].

What are these scientific dogmas that prevent us from making an effective response to the growing problems that now confront us ? I believe there are three : "Science requires no justification", "there is no limit to growth", and "it's not my department".

The Three Dogmas of Science

Let us consider the first dogma, "Science requires no justification". A case has often been made for the pursuit of science for its own sake — what is commonly called basic, or curiosity-oriented research. Gerhard Herzberg, former chief of NRC's Pure Physics Division and one of Canada's most distinguished scientists, has referred to pure science as the goose that lays golden eggs, and has stated quite unequivocally that

> "it would be difficult to find a modern advance in technology that is not based on some discovery in basic research without any thought of possible applications" [4].

There is an element of truth in this, and I'm sure that we can all think of a number of examples that support this viewpoint. But I'm also sure that most of these examples would involve scientific discoveries made decades, often many decades ago, when science was young and much remained to be discovered. But now that we have already accumulated a vast body of scientific knowledge, the benefit-to-cost ratio of basic research shrinks alarmingly.

When, for example, the U.S. Pentagon recently wanted to discover how many of its operational systems sprang from basic research that they had sponsored, we are told that they could find so few examples that the American scientific community tried hard to keep their report — Project Hindsight — from reaching daylight [5]. When we think of enormously expensive pure research with a very low probability of useful applications, I suppose most of us think of such fields as particle physics, but we geologists and mineralogists have boondoggles of our own for which we try to get public financial support — the Mohole fiasco of several years ago, for example, or the very large effort currently being devoted to the study of the lunar samples.

I'm afraid that the vague generalities used to defend basic research are losing their appeal. The belief that all scientific achievements will

ultimately contribute to the welfare of mankind is a form of intellectual escapism, says the biochemist René Dubos, in his recent book "Reason Awake-Science for Man" [6]. The editorial writer of a recent issue of Science Journal was less tactful. He calls these attempts to defend pure research :

> "traditional arrogant rhetoric which is at best irrelevant to the issues at stake and at worst an irrational and deceitful pack of lies which can only add fuel to the already fiercely burning fires in the anti-science camp." [5]

L. E. Howlett, former head of NRC's Division of Applied Physics, said :

> "It simply cannot be argued that a scientist wishing to pursue a particular line of research as his interesting diversion in life imposes an obligation on society to support him in the financial degree to which he would like to become accustomed. The scientist has the right to all possible freedom in his scientific effort, but society, too, has very definitely the right, and even the responsibility, to enquire, before giving financial support, as to the purpose and aim of research and its likely profit to society as against the same money spent in other ways" [7].

The second dogma, that "*there is no limit to growth*" is held by many of us, but all too often we don't have a very clear idea of all the implications of growth. We argue, for example, about the various ways of increasing energy production (the demand for electrical energy, alone, doubles every ten years in Ontario), but we don't ask ourselves the far more basic question about whether the increased energy output is really necessary, or even fundamentally desirable — whether the dozens of shopping plazas surrounding every fair-sized town should be brightly illuminated all night, every night, for 365 days in the year, or, indeed, if there should be a washing machine in every house, a car in every garage, or an air conditioner in every room.

Every institution feels that it must demonstrate a certain rate of growth, and the faster the growth, the more successful the enterprise — whether it is a manufacturing plant producing gadgets or an educational plant producing graduates. Vivian Bowden, former minister of state for higher education and science in Britain, wrote :

> "If the rate of progress which has been maintained ever since the time of Sir Isaac Newton continued for another two hundred years every man, woman and child on Earth would be a scientist, and so would every horse, cow, mule and dog as well. It cannot go on like this much longer." [8]

Nigel Calder, in his recent book "Technopolis — Social Control of the Uses of Science", sees uncontrolled growth like this :

> "The impression is that we are passengers in a runaway train, hurtling faster and faster along a track. Some passengers try pulling the alarm signal, but nothing happens ; there seems to be no one in the driving cab. We do not know where the track eventually leads, but the direction is apparent for the time being. It carries us toward new weapons, new industries, new mechanical and electronic products, new

> drugs, new pollutants, new sources of noise ; it takes us away from nature and the simple life". [9]

There is no fundamental reason why we should expect the GNP to increase every year, or the population to grow ; why we need more miles of highways or faster cars ; why we require more chemicals to flavour our food and sweeten our breath ; why we should dig more ore than we did last year, or increase the size of our particular corner of the establishment. You hear more often now that we should think about achieving a "steady state" rather than being obsessed with growth and "progress". Even our prime minister, in a speech made in Vancouver two weeks ago, warned that society would have to give up its obsession with growth and the gross national product and replace it with a concern for the social consequences of the new technology [10].

The third dogma can be neatly summarized by the phrase, "*It's not my Department*". Tom Lehrer, the musical satirist, put it rather well in one of his songs in which he has Werner von Braun, the wartime German rocket expert who became the postwar American rocket expert, saying :

> "Once the rockets are up, who cares where they come down ; that's not my department", says Werner von Braun.

Traditionally, scientists have sought to evade responsibility by claiming that their job was to develop new knowledge and that the application of this new knowledge was someone else's responsibility. However, Elmer Engstrom, president of RCA, sounded this sombre warning in accepting the Procter Prize, awarded by the Scientific Research Society of America :

> "The introduction of new technology without regard to *all* of the possible effects can amount to setting a time bomb that will explode in the face of society anywhere from a month to a generation in the future." [11]

— and this from the president of a corporation that has done its share of introducing new technology.

In the last few years, scientists have become increasingly aware of their social responsibilities, and many groups have been formed to work in the interests of the public and to arouse a sense of responsibility in their fellow scientists. But what about geological fraternity ? Up to now most of us have considered our "department" to involve rocks and minerals rather than people, although within the last year or so some of the geological organizations have held environmental symposia, and the Geological Society of America has established a Standing Committee on Environment and Public Policy. This is a beginning, but only a beginning. The individual geologist still remains largely uninvolved. Where, for example, do we find

local groups of geologists set up specifically to warn the public about geological hazards — the geological equivalent of Pollution Probe, if you will?

Science for Selfish Reasons

In addition to letting our actions be dominated by the three dogmas that I have just discussed, I believe that there is another valid ground for criticizing the practitioners of science and technology — the very common tendency to engage in science for selfish reasons. This logically follows from the three dogmas: if the pursuit of science is good, and it results in growth (of whatever kind), and if we cannot be held responsible for the detrimental effects of this growth, then hurray for us, and why not practise our trade so that it will do us the most good? In fact, I sometimes wonder how often we accept the dogmas because it is to our personal advantage to do so.

Often it isn't obvious that we are engaged in our work for selfish reasons. Upon graduation we expect to land a well-paying job, and so do our parents and instructors. As a loyal employee we are expected to identify with the aims of our employer and to further these aims without question. We are rewarded for our loyalty by being moved up the ladder of responsibility and getting salary increases. This gives us material rewards and status in the community — at least in the part of the community in which we have chosen to live and whose values we share. In a recent survey conducted among engineers on behalf of the National Society of Professional Engineers in the United States, it was discovered that salaries and professional status stand out as problems of greatest importance among engineers [12], and this conclusion is certainly not at variance with my own observations.

"What's wrong with that?" you will ask, "This is our way of life." Indeed it is, but if these motivations consistently take precedence over the pressing needs of society, we are heading for trouble.

The Social Obligation of the Scientist

But why should I be picking on the scientist? Are not other members of society just as selfishly motivated — or more so — than scientists? Are not those who misuse the fruits of science and technology even more to blame than scientists? Certainly they must share the blame, but this does not absolve us. To begin with, it is the duty of every individual, scientist or not, to be alert to the dangers threatening our society, and to do what he can to prevent them. I believe that these matters of public concern are far too important to be left to politicians, bureaucrats or corporation presidents. They are too busy dealing with day-to-day crises, whirling

around in their squirrel cages, or building their own empires, to consider the long-range implications of the many complex factors impinging on society. Therefore each one of us — scientist and layman — must take on a share of the responsibility. But I believe that there are both moral and technical reasons why scientists and engineers have a special responsibility over and above that of the average citizen.

Because of his training to observe accurately and to make objective judgements, the scientist should be more able to foresee and prevent the possibly harmful effects of his work.

From a moral standpoint, he and his colleagues have devised the machinery and worked out the methods that have led to the degradation of the environment, and they therefore have a moral responsibility to reclaim it. Furthermore, the scientist occupies a special status in society — he has drawn more than his fair share of support from society in gaining his education, he is more richly rewarded, financially, than the average citizen, and his work is probably more interesting and intellectually stimulating than the work of the average citizen. The scientist has an obligation to repay society for granting him this special status, and must remember that he owes his special position to the tolerance of others. There is evidence that this tolerance is running out.

Philip Siekevitz, of Rockefeller University, wrote recently: "I see no greater immediate task, though it is a small step to take, than for scientists and their organizations to acknowledge their responsibility" [13]. What does this mean in practical terms?

— First and foremost, the scientist must develop an awareness of the broad implications of what he is doing — what are its social risks and social merits? — and he must inform the public. He should also search for opportunities to warn the public about hazards of which he is aware because of his own special competence. Geologists, for example, have a special responsibility to warn the public about geological hazards. Take the tragedy that happened near Chicoutimi last week, when 31 people were killed in a landslide. Geologists have long known the causes of such slides, but this knowledge has not been adequately communicated to the public. The tragedy of these deaths can be laid partly at our doorstep.

— The scientist must do his part in orienting science towards the benefit of all mankind, not just toward the benefit of his employer or his professional group. Dubos says that

> "modern scientists give much lip service to their social responsibilities but in practice they behave as if they were captives of an establishment which often appears asocial and not infrequently antisocial." [6]

Ralph Nader told the "Conference on Professional Responsibility" held in Washington early this year [14] that employed professionals are often among the very first to know about destructive or unethical practices by the organizations that employ them, yet they choose to remain silent or, worse yet, allow their services to be used in support of corporate or government abuses. What is the solution? Should you blow the whistle on your employer? This can be a risky and lonely business, you have no guarantee that your action will be effective, and you may well be subject to reprisals and scorn. In recognizing these difficulties, Nader has now set up a clearing house to receive information from troubled professionals in strict confidence. But blowing the whistle on your employer is not the only way to get him to change his ways. Galbraith [15] has demonstrated that decisions are not usually made by top management, but rather developed from below — within what he calls the "technostructure". If those of us comprising the technostructure — and this includes practically all of us — do our share in developing socially-responsible policies, it may not be necessary to blow many whistles.

— Universities should get their students involved in interdisciplinary mission-oriented programs related to the current and future needs of society [16]. The word is "relevance", I think — and there is plenty of room for improvement in many of our geology curricula [17]. Science departments should put more effort into designing special courses for non-science majors rather than giving simply watered-down versions of honours courses; in some cases these may be worse than nothing, because such courses tend to alienate students from science [18]. The faculty member should also probe his own motives — is he seeking to enlarge his department to gratify his own status needs, or does society really need all the graduates that he is turning out — all too often these days to swell the ranks of the unemployed?

— Finally, scientists must get involved in public debates and activities, even in areas not directly related to their specialties. Siekovitz [13] suggests that each scientist take ten percent of his time away from research or teaching to inform the public about scientific matters. One does not need to be an expert; one needs only know more than the general public. In a democracy of equal voters, this task of scientists becomes a duty.

Conclusions

What will happen if scientists do not rise to the occasion? At worst, we are told that we can look forward to a variety of different kinds of doom — just take your choice. At the very least, however, science and scientists will be discredited. Already there is a strong public impression that we

scientists as a class are callous and irresponsible, and that we must be watched every moment so that we won't perpetrate some new horrors. Serious suggestions have already been made that present research programs should be abolished in favour of a re-direction to cure the ills of technological gains and there have even been proposals that technological advance, and thus scientific research should be brought to a halt entirely, so that political and social means of handling the problems generated by technology can be made to work. [13]

I cannot agree with this. I still believe that the best hope for humanity lies in the scientific approach to human problems. But the time for complacency is past. A few scientists have put on the yoke of social responsibility, but it is not enough ; we must all become involved, difficult though it may be for many of us to re-order our priorities.

As George Mowbray, in a recent address to the Ontario Mining Association, said :

> "The major problems challenging the (mining) industry seem to me to be no longer financial, geophysical or technological, but social — problems of the human environment to which the industry must adapt or perish as a free-enterprise system." [10]

It is disconcerting to find that problems we were trained to solve are no longer significant, and that we are now asked to deal with problems outside our direct experience. And the rehabilitation of science and technology in the eyes of the public will not be an easy task, considering the serious mistakes that have been made in the past. It's going to be a long, uphill, struggle, but there is no better time for beginning than right now. Engstrom, to whose speech I referred earlier, put it this way :

> "For those of us who choose to listen, the voice of history in this era seems to be saying, 'T minus X and counting.' It is our task to ensure that X represents sufficient time to respond to the challenge". [11].

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