

PRESIDENTIAL ADDRESS

HOW DIFFERENT CAN WE BE?

Sven G. Frolland

Department of Biology, Augustana College

We have just convened as an organized group of persons whose collective purposes are to stimulate scientific research and education and to unify the scientific interests of South Dakota. We are all professional scientists or, at least, individuals who possess more than a passing interest in science. I am convinced that we as a group understand what is meant by science and technology. We have something, many things, in common. We seem to understand one another even though our individual disciplines or specialties differ. . . we are able to communicate. . . we take a distinctive pride in belonging to a segment of our society that has become identified with challenge and change, progress and overall benefit to mankind, and with broadening the horizons of knowledge for its own sake.

We are a part of Western culture that has been identified as the "fifth estate" by the retiring president of the American Association for the Advancement of Science, Dr. Paul M. Gross, in an address earlier this year. The term was originally coined by Dr. Arthur Little at the centenary celebration of the founding of the Franklin Institute. The five estates represent particular segments of society which seem to have an identity of their own. The system compartmentalizes people on the basis of their particular abilities, professional choice and walk of life. The first four estates each represent a profession or occupation outside the realm of science. We scientists constitute an additional, distinctive group. We move in a particular sphere and often, perhaps too often, become trapped in and by our sphere. . . our neatly blocked-out domain. . . the "fifth estate."

To use Dr. Little's original description, the community is composed of "those having the simplicity to wonder, the ability to question, the power to generalize and the capacity to apply. It is, in short, the company of thinkers, workers, expounders and practitioners upon which the world is absolutely dependent for the preservation and advancement of that organized knowledge which we call science." The "fifth estate," then, by definition includes only those having the simplicity to wonder, the ability to question, the power to generalize and the capacity to apply. The implication is that this description fits only scientists. Now, I would raise the question, are these the exclusive properties or attributes of men of science? I think not. There are learned people in many

other branches of knowledge who could be identified with the same set of criteria. They possess the same qualities of mind and character as those on the "inside." And yet, somehow, there is a difference which has become so marked as to constitute a barrier, an invisible, but very real barrier separating the sphere of the "fifth estate" from the world of the non-scientist. We all experience it daily both professionally and in our routine associations.

Not everyone, by any means, really understands what science and technology represent. As a matter of fact, not everyone really understands the difference between a scientist and a technician. It is good that we who are a part of the scientific world take pride in our work, that we are different, and yet this places certain limitations on us. There are warnings of impending danger. A great deal has been written in recent years concerning the so-called scientific image . . . the relationship of the general public to the scientific world, the responsibility of the scientist, the lack of communication between the humanist and the scientist, and even the morality of the scientist!!

It is not particularly difficult to reason why gross misunderstandings occur between the scientist and the non-scientist. For the great majority of the general population, formal education terminates with high school. The launching of Sputnik brought on a widespread self-examination of our educational structure. Studies clearly revealed a woeful inadequacy in the science education of most young people. There was not sufficient preparation on which to build any real understanding of modern science. Almost immediately, crash programs, born in fear, were developed in an attempt to correct the situation. Significant improvements have been made, but the effects will not be felt in the adult population for many years. Therefore, it is not strange that a lack of comprehension of science produces a distorted picture and creates a faulty image of science. The image is compounded of many diverse elements: respect and gratitude for the many benefits of science and technology, coupled with a continually improving standard of living; grateful appreciation, bordering on a downright worship of modern medicine and its spectacular advancements; admiration for the amazing achievements of satellites and space travel; awe and fear of the dichotomous aspect of atomic energy. . . the potential for undreamed of applications for the benefit of man, shadowed by the threatening cloud of literal destruction. These, and many more, help build the image.

Add to these the impact of two major events, which came within a short period of time and relatively unannounced, that were thrust upon a people ill-prepared for them: the bombing of the Japanese cities, and the launching of Sputnik. Abruptly, science became the dominating influence in the world.

The scientist, whether he liked it or not, suddenly became the superman and the prophet of the twentieth century. He had vastly changed the world, almost instantaneously, by unleashing unheard of power and by opening the possibility of space travel. Very shortly the scientist invaded government and management, military strategy, politics, education and philosophy. And whether people like to admit it or not, there is very little, if anything, that can be done in this day and age without some influence of science. Thus, the image continues to develop.

The image is compounded further if we examine another point of view, that of statistics. Scientists and technologists constitute a relatively minor group of the total population. Between 1900 and 1963 the scientific population of the United States increased slightly more than one percent of the total, in spite of the fact that the actual number increased from approximately 90,000 to 2.7 million. This still represents a small minority. On the other hand, federal support for research and development increased by more than 14 percent of the total annual budget during the same period of time, from 10 million to over 14 billion dollars. Additional large amounts are expended annually by industry, state and private universities and colleges. Thus the total expenditures on scientific work have increased disproportionately compared with the percentage of population increase. These figures, quite apart from any other considerations, pose some very serious questions. Who is to decide on the relative merits of the expense of an estimated 5 billion dollars to land a man on the moon as opposed to 50 million for biomedical research? Should we ignore the fact that the entire budget for the Atoms for Peace program is less than the cost of a single rocket shot at the moon? To produce one nuclear submarine costs more than our total annual budget for agricultural research, and this in a world that is hungry, with millions of people actually starving. There are no set formulas on which to base priorities. Clearly future decisions will require a higher order of statesmanship among our leaders, scientists and non-scientists alike, than has been demonstrated in the past.

When all these factors are considered it is small wonder that the general public has been overwhelmed. It is not difficult to understand the feelings of apprehension—bordering on fear and suspicion—that have crept into the minds and hearts of the majority of non-scientists.

What is the real significance of the non-scientists' attitude toward science? Some feel that such wholesale scientific and technological development must be controlled if it continues to result in pollution of air and water, in contamination of food with pesticides and their residues, in the hazards of radiation and the development of nuclear weapons for potential total destruction. Others

take refuge in a type of anti-intellectualism toward all scientific activity. Still others prefer a polite, but neutral position. Similar attitudes undoubtedly have been responsible for such arguments as presented by C. P. Snow and his warning of the development of a widening rift between the two cultures . . . between the "fifth estate" and those on the outside.

The upshot of it is, we scientists are different, and perhaps we should take pride in our differences, but this very factor places a particular and distinctive responsibility upon us. We must carefully guard against creating the wrong impression . . . an impression of aloofness, carelessness, indifference, irresponsibility, of amoral or unethical conduct in the discharging of both our professional and non-professional duties. We must do everything in our power as individuals to insure that we do not contribute to a further widening of the gap between the scientist and the layman.

There are many articulate spokesmen sounding the warning. Among them is the Rev. Theodore M. Hesburgh, president of Notre Dame University and a member of the National Science Board. In a recent article in *Saturday Review* (March 2, 1963, pp. 55-56) he raised this question: "Science is amoral, need scientists be amoral too?" He goes on to say, "None of us have written the script for the condition of mankind today. But we can, if we really believe in freedom and human dignity, help create in our day a new condition of mankind, a situation in which human freedom and dignity are at least possible. Never before in history has this been possible. The vast majority of mankind has ever been hungry, diseased, ignorant, poor, and badly housed. The great glory of science and technology in our day is that it provides the means of relieving this ancient human bondage, these cruel forms of universal human slavery.

"Scientists may blame the politicians who make the decisions. . . . Am I suggesting that scientists take over the governance of our country? Not quite, but I am more than suggesting that scientists and engineers cannot be oblivious to the moral quality and effects of their handiwork . . . I am speaking of values, and proportion, or perspective. . . . Science and engineering, in our times are anything but mediocre. Why then should the scientist and engineer allow them to be used for mediocre ends and to hide himself in the mass? Why should we pioneer in space and be timid on earth? Why should we break the bonds of earth and leave man in bondage on earth? Unless a true revolution occurs, future generations of historians may ask why our scientists and engineers did not really join the human race in our times, when the opportunities were so great, the means at hand so magnificent."

Here is a prominent citizen, not a member of the "fifth estate," asking some pertinent questions and expecting some constructive answers and action.

Another is Eric Hutchinson, who spoke of science and responsibility in an address before the Stanford Chapter of the Society of the Sigma Xi in June, 1963 (American Scientist, 1964, 52:40a-49a). As a part of his address he had this to say: "In the period following World War II we have seen a great expansion of government spending on science and technology to the extent that many young scientists regard public support for their work as a birthright. I am far from convinced that science, as a scholarly pursuit, has any claim on public support that cannot be made with equal validity by other scholarly disciplines. Science can claim to add to man's store of beauty and poetry, as can any creative activity. It can claim this . . . and no more. I have the feeling that the public would be less complaisant about the large sums of money being poured into academic science if it were properly aware that science deals only with theories about reality. The fact is, I suspect, that the public is not so much concerned about science as about the technology which can be extracted from science. Indeed, a gullible and uninformed public has been brought to believe that science and technology are one and the same. It is even a commonplace to hear highly placed academics stating that the country needs "x" thousand more scientists a year, when what is meant is that "x" thousand more technologists are needed. When an officer of NASA states that 73,000 scientists are needed for space programs in the coming fiscal year, one may take leave to doubt that even one percent of that number are either needed or used as scientists.

"There is risk enough in the public misconception that science is nurtured by anonymous, omniscient, omnipotent and omnibenevolent *Scientists*; but at least most scientists are disinterested, objective enquirers. There is far greater hazard in the public's being led to believe that technology is furthered by people of such idealized character; for technologists in general have heavy vested interest in their work. That both science and technology are practiced by *people* . . . people who are far from omniscient, far from omnipotent, and possibly very far from benevolent . . . is a fact so underemphasized as to pass practically unnoticed.

"The social hazard stemming from the confusion of science with technology is the greater, it seems to me, in view of the degree to which even academic institutions have become empires of technology based on government contracts, and it is with this hazard that I am mainly concerned, for we are clearly caught up in an authoritarianism based on science-technology. If, in addition to being responsible scientists, we claim to be responsible human beings we must be equally scrupulous in examining our cultural and social function, for our own vested interest, if for no higher motive. For, the cultural support which science enjoys today rests more on fear of foreign enemies and disease than upon under-

standing, and fear may not be a healthy or lasting foundation. It seems to me entirely possible that our society, which, for whatever motives, has invested not only immense sums of money but large amounts of spiritual faith in what it uninformedly conceives science to be, may become as thoroughly disillusioned and rebellious toward scientific and technological authoritarianism as early societies became rebellious towards regal authoritarianism. When science begins to move out in the public physical domain (upper atmosphere explosion, satellite microwave reflectors, etc.) into the public political domain (weapon testing), or the public social domain (enormous expenditures on space technology) it is, in my opinion, time for scientists to devote much more attention than they have in the past to the manifold responsibilities they bear in return for the large public support and privileges they enjoy."

When one carefully analyses such statements, coming from concerned and responsible people, scientists and laymen alike, there is cause for serious reflection. It is not so strange that uninformed people become alarmed and apprehensive of the emphasis placed upon science. The tremendous expenditures of federal aid for education, research and development have been heavily loaded in the direction of the sciences, with very little diverted to the non-science areas. It is small wonder that people at all levels, educators and others, are becoming alarmed at the emphasis of a crash program in the sciences. They are justifiably apprehensive at the prospect of dominance by the sciences. We are forced to admit it. There are no state or federal Visiting Humanists programs sponsored by the N.S.F. or a similar agency. As a matter of fact, there is no corresponding federally supported agency such as an N.H.F., National Humanists Foundation. Nor is there a program which makes possible a "roving language kit" or a "traveling history library" sponsored by funds from a federal agency and made available to state Academies of Social Science or Humanities for the strengthening of the teaching of these subjects in our secondary schools.

Fortunately, the NDEA does provide fellowships in a broad selection of disciplines, and this is certainly a step in the right direction. There is still a great deal to be done. Recently there have been other signs of awakening to the needs of the other disciplines. A recent issue of *Science* (1964, 143:1279) featured an editorial by Dael Wolfe on the needs of the Humanities. Among other things he had this to say: "There are several reasons why scientists should step forward and offer help to see that the needs are met. One is the matter of balance. It has sometimes been comforting, but is usually erroneous, to believe that government grants for science have enabled colleges and universities to use a larger fraction of their general funds in support of the humanities. . . . In many a

university the rapid expansion of science has been partly at the expense of other areas of university responsibility. . . . The better education of future scientists is involved. There is good reason for having . . . scientists broadly acquainted with areas of scholarship other than science. . . . We cannot expect . . . to be educated in the best way possible if scholarship in the humanities is starved out of existence. . . . Humanistic scholarship, like scientific scholarship, must be spread widely among universities and colleges if its purposes are to be maximally achieved.

"It is for the humanists to take the lead in seeking to meet the needs they have identified. However, as they do so, it is most urgent that the scientists join ranks with them, lending encouragement and support. The improvement of scholarship in all its branches of learning is our common cause."

Just a few short years ago we in the sciences were alarmed and worried about the status of science in the classroom. We were on the defensive then and took the offensive in an effort to gain stature for and attract attention to the needs of scientific education. We did what had to be done and we have achieved some measure of success at all levels. I would never suggest that this should not have been done. However, I would respectfully caution each of us to guard against becoming *personally offensive* as we continue to mount *the offensive*. Perhaps the time has come when we should now aid our colleagues in the other disciplines to secure the necessary support needed to strengthen the entire program of education and development in the nation.

I am confident that there will be changes forthcoming at all levels, changes which will expand the necessary support to include all disciplines. I am equally confident that scientists will be among the leaders in advocating and implementing such developments.

There is apparently a growing concern on the part of the leadership of the N.S.F. for the very point I am trying to make. . . the danger of an unbalanced subsidization. . . an overemphasis on science. Perhaps it would be more accurate to state that there is a movement underway which will begin to bring other disciplines into the picture so far as federal aid is concerned. At the directors meeting for consideration of N.S.F. grant procedures for the coming academic year the following innovations were announced. The areas of sociology, psychology, economics, and political science are to be included in the Visiting Scientist program supported by state Academies of Science for 1964-65. In addition, the professional society Visiting Scientist programs supported by N.S.F. funds and sponsored by professional scientific societies are to be phased out and the funds diverted to the state Academy programs.

There seems to be general acceptance of this trend among the various state Academies. There is widespread agreement that it will

enhance the program's success and make it more appealing to administrators and non-science faculty in our educational institutions. Your executive council has expressed its approval and endorsement of this program for South Dakota. Personally, I feel strongly that this is another step in the right direction. However, this also is just a beginning. The remaining disciplines must also be included in the near future.

Just as we were deeply concerned a few years ago about the level of science instruction, there is equal danger in overemphasis at the expense of other fields. Rather than be in competition, we must strive for a balance thru cooperation. Our ultimate concern must always be to achieve a high plane of excellence in all disciplines, not science alone.

What is to be done? What must be done? There is no question but that there is a challenge that must be met in the immediate future. I am sure we all feel it in one way or another. Indicators such as our statewide problem in the Academy of getting our high schools to take advantage of the Visiting Scientist program. Why is there a reluctance on the part of high schools to participate in a program of proven value? Are responsible people suspicious of us and our intentions? Why don't more students, particularly young men, get excited about science? What is the general attitude of administrators toward science? Yes, the problem is very real. . . it does exist. Somehow we within the "fifth estate" are not communicating with those on the outside.

As I stated earlier, perhaps a great deal of the misunderstanding results from the fact that we of the "fifth estate" are different. The very nature of science molds a particular type of person. Moreover, I am convinced that this difference is important. There is something crucial to the scientific process and to the human spirit in this differentness. It takes something more than neighborliness to appreciate and understand the mysterious process we call science.

The major breakthroughs in research were not the work of ordinary men. Perhaps this difference is why we communicate with one another, and also why there is a problem of communication outside the "estate." Distinctive occupations tend to make distinctive people. Outstanding people in any occupation are not like the average man or like each other; this is particularly true and as important for the scientist as it is for the artist, poet, author or musician.

I certainly do not advocate that we change this. However, we must do all we can as individuals to insure that we do not become "too different". . . so different that we forget we are also humans, as well as scientists. And that there are other humans with sensi-

tivities also. We cannot afford to become detached from the vast majority of humanity that exists outside the "fifth estate."

As I conclude my remarks, I am going to quote two well-known men, one a humanist, the other a scientist. The humanist, William Faulkner once said, "Our privacy has been slowly and steadily and increasingly invaded. Until now our very dream of civilization is in danger. Who will save us but the scientist and the humanitarian. Yes, the humanitarian in science, and the scientist in the humanity of man." The scientist, J. Bronowski, in an article in *Science* (Vol. 123, April 27, 1956) entitled "The Educated Man in 1984," wrote. "It is certain that the educated man in 1984 will speak the language of science. This is not the issue. The issue is something else. Will the educated man in 1984 be a specialist, a scientist or technician with no other interests, who will run his fellow man by the mean and brutal processes of efficiency of George Orwell's book? Or will he be a statesman, an administrator, a humanist who is at home in the methods of science, but who does not regard them as mere tools to efficiency? The choice between 1984 and an earthly paradise does not depend on the scientists but on the people for whom they work. And we are all the people for whom science works."

These two quotations illustrate very clearly what concerned people are thinking. I am convinced that our total culture and survival as a race depend on how well we learn to adjust to the differences that exist between the scientist and the layman, and how well we learn the hard lesson of getting along with our fellow man in all walks of life. We must insure that the "fifth estate" as a total group not only joins the human race, but takes pride in being a part of it in the generic sense, and maintains the "estate" in the specific sense.