PRESIDENTIAL ADDRESS

CAN WE MEET THE CHALLENGE?

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The title of this address is intended to be provocative, for its possible implications are numerous. How each person interprets it may vary during the course of my remarks, since the Academy roster shows such a wide variety of interests represented, and your position, experience, and philosophy will influence your reactions. Regardless of these variables, however, there are certain challenges of scientific importance that should merit the attention of all of us. Some that might be mentioned are basic research versus applied research; government, private, or public financing of research and science education; science planning by academicians or educationists; finding and encouraging science talent in our students, and the proper nourishing of it in our colleges and universities; good teaching as opposed to fair or indifferent teaching; general education or conventional courses in science; the responsibilities of scientists to society; interpreting science to the layman; keeping abreast of the times in our own and related fields; and specialization as

opposed to interdepartmental development of border areas. The literature of science and higher education is replete with articles that give mature, detailed, and sometimes humorous consideration to these problems.

But my challenge to you is simply this—Is your own scientific career as effective as you might make it? Do your contributions measure up to your capabilities? What goals have you set for yourself, and what obligations do you feel as a scientist? What attitudes and motivating forces direct your activities? What criteria do you use for measuring your achievements? In what possible ways can you increase your effectiveness? In presenting this challenge I fully realize that a psychologist or a psychiatrist, or even an educationist, might be better qualified than a biologist to suggest possible answers. I further realize that the Academy's distinguished scientists may already have adequate answers. But I am thinking of the average scientist—the category into which many of us fall—and the desirability of a periodic self-appraisal as the years hurry by. Too often we may fall into the pattern of daily routine, became involved in matters which are really not important, or develop a critical attitude without an awareness that our own activities may likewise be subject to criticism. To turn on the spotlight of self-evaluation occasionally can be a humiliating but refreshing experience.

If we are to increase our effectiveness in our chosen scientific careers, we first need to understand fully what is required of us in our current positions. Is teaching our primary responsibility? — or is it research? Or is it a combination of teaching and research? What other institutional obligations do we have? Do you sometimes feel that you are assigned to committee work or other duties for which you have no aptitude or interest? Those of us in faculty positions will attest to many hours spent in activities that seem far removed from our primary responsibilities.

There is an indication of a trend toward more effective use of individual talents on college campuses. Jean Hanway (1) states that "we ought to recognize that the modern university needs the services of many types of people on its faculty. We need many serious scholars, but we also need the professor whose scholarship, while essentially sound, may not be profound, but who does have the ability to dramatize his work and win the interest of the average student; we need the professor who is approachable and gracious and willing to promote the social activities of the students and offer them the kind of friendly help and counsel that they will never get in a guidance or psychological clinic; we need university hosts and hostesses. If we did not all try to be all things to all people, but if we recognized, and administrators recognized, where our particular abilities lie and assigned to us duties and responsibilities commensurate with them, more education might be going on in our universities than is the case today." If you are a scientist connected with a college or university, perhaps your effectiveness may be increased by trying to convince your institutional officers of how your particular talents may best be used. Certainly our efforts in this direction might lead to some interesting changes.

That scientists exhibit a wide range of capabilities is self-evident. The geniuses soon make a name for themselves in every field of scientific endeavor. Many first begin to realize their own potentialities during the concentration and specialization of earning the doctorate degree. Still others are stimulated to greater achievements by close association with outstanding scholars or research men. A few, perhaps too few, begin to envision their potentialities in the challenging atmosphere of the classroom or laboratory. It is claimed that many scientists, whatever their positions, are not as effective as their potentialities would indicate. Why do some scientists who seemed to show such promise while in graduate school have careers of apparent mediocrity? Each of you, I am sure, could cite factors from your own experiences, or those of your colleagues, which might serve as a partial answer. Leonard Carmichael in a recent article (2) analyzes the possibility that laziness contributes to unproductiveness. Inherent in his concept of laziness is the importance of our motives and attitudes. "Conflicts in motivation are bound at times to disturb the lives of all scholars. There is hardly a mature worker in the academic vineyard who does not realize retrospectively that he has had good and bad vintage years."

It is important then that we learn to manage our motives, control our emotions, and maintain the right attitude toward our work if we are to succeed. Perhaps even more basic, in my estimation, is the development of work habits geared to a realistic time schedule. The current philosophy of more and more leisure time does not apply to the scientist if he is to be successful. One occasionally also senses a new interpretation of the term *academic freedom* as meaning freedom from all obligations except the hours required in the classroom and laboratory.

But is it enough to avoid the pitfalls of laziness and poor work habits, or at least, to be able to crawl out if we should fall into them now and then? Another aspect, emphasized by R. E. Gibson (3), is that "an alert mind and a fertile and disciplined imagination are characteristics which are absolutely indispensable to the scientist whose work is to rise above mediocrity." Assuming an alert mind and a knowledge of how to keep it that way, I venture to suggest that many of us are short on imagination, at least, of the kind that may be called fertile *and* disciplined. Too often our flights of imagination about our endeavors are undisciplined in the sense that they are unproductive of results. Think how much more effective we might be if only we could learn to translate more of our best ideas into action!

Whether we ever reach and maintain our full potentialities will depend at least in part upon the goals we have set for ourselves. Obviously we cannot drift with the current, or even just maintain the status quo. We will have to hitch our wagon to a star, and even though we may never reach it we will be better for the striving. If your major function is teaching, be a good teacher; if it is research, don't be satisfied with less than the best. While our goals will be primarily concerned with our careers, we must not forget the importance of other activities, such as raising a family, and taking

part in the religious, cultural, and educational life of our communities. As scientists we cannot become recluses, as some folks picture us, and forget our other obligations. As Aaron J. Ihde (4) has stated, "the scientist, in addition to being professionally competent, should be able to live a personally satisfying life and a socially useful life."

Granting a well-motivated, well-adjusted, and productive scientific career, how do you measure your professional progress? A number of possible ways immediately come to mind—by the number of scientific papers you may have published each year; by the commendations of your superiors; by the increases in professional rank and salary; by the respect from your fellow scientists; by the ratings you receive on student polls; by the number of graduate students you have; by the number of undergraduate majors; by the number of addresses you are invited to give; by the offices in professional societies you may hold; by continued progress in a well-planned research program; by the sense of a job well done each day. Obviously, your position will determine which of these would apply in your own case. And yet I feel that here is an area that needs more careful consideration by all of us. Undoubtedly many scientific careers are less than fully productive because of false satisfactions resulting from criteria of achievements that lack validity.

There are certain broad responsibilities of a scientist, over and beyond the immediate obligations of his career. One that has become increasingly evident is the need for interpreting science to the general public. Consider if you will the world-wide concern over the recent hydrogen bomb tests. Must we leave to the physicists, the humanists, and the religious leaders the responsibility of interpreting the significance of such events? Or should we all, as scientists of every kind, feel an obligation for first thoroughly understanding and then interpreting to the best of our ability the major scientific issues of the day? Here is a challenge that I feel we cannot ignore, and yet it poses a number of problems. Most of us feel that it is difficult enough to keep up with advances in our own fields and that it would be almost impossible to be familiar with even the major advances in all fields of science. Of course, we read of many such advances and perhaps acquire a basic understanding of them, but their interpretation in relation to other fields of science is not always readily evident. Perhaps we should continue the practice of letting the experts in a field interpret its findings. A further problem is presented by the fact that not all scientists are equally adept at expressing themselves in print or from a lecture platform. Those who have such abilities, however, should be encouraged to use them at every opportunity.

But what about the rank and file of scientists who may not be so gifted? This group, large in number, needs to reconsider its philosophy in relation to interpreting science to the general public. By and large this group to date has felt no great responsibility in the matter. The amount of time and effort put forth by the majority in interpreting science in a popular yet accurate way has been very small. If the impact of the combined efforts of the

average scientists on public opinion is ever to be more significant, we will each have to realize that it will require more sincere attention than we now give to it.

I do not mean to suggest that we suddenly and enthusiastically begin to expound scientific interpretations to anyone who will listen to us. But I do think that we may fail to realize fully the opportunity we have every day to mold scientific opinion through our student contacts in the classroom and laboratory. We need to make more of an effort to stimulate critical thinking about current scientific events in all our contacts, both on and off the campus.

The need for our concern in influencing the public's rationality in scientific matters is put rather forcefully by Gibson (3): "The impact on the general public of guided missiles, rockets, radar, television and, above all, the large scale release of atomic energy has been to induce paralysis in the centers of higher thought and discrimination. There has been an abandonment of all restraints on imagination and credulity. After these spectacular advances, people are willing to believe anything and are unwilling to accept any of the restraints which established scientific methodology and sound engineering practice must impose on the trained mind. This is becoming an age of unbridled fantasy and superstition, an age devoid of critical discrimination."

Another viewpoint on the scientist's obligation to the public is expressed by the science writer, P. Ritchie Calder (5): "When I want to annoy my scientist friends I tell them they are illiterate, inarticulate, and irresponsible. Illiterate because the test of literacy is whether it enables one to communicate ideas. Inarticulate—well, go into some of the sections at big scientific meetings to see what I mean. And irresponsible —because they will not accept their responsibilities. They will neither consider, nor explain, how their work will affect ordinary people's lives—at a time when science is producing convulsive changes and dangerous stresses in our civilization. They are content to leave their discoveries like foundlings on the doorstep of society and disown all responsibility for the way they are used, misused, or not used at all . . . . A scientist should, and must, establish the facts of nature; but having done so he must 'put on his imagination' and consider how it may be used. And it is his duty to explain, or help to explain, his processes and their possibilities." Whether you agree with Calder or not, the fact would seem to remain that we should have a better understanding of the role of the science writer in helping us to interpret science.

We often accuse certain segments of the academic world with using confusing expressions, and scientific language also comes in for its share of criticism. One recent statement by John P. Parker (6) is worth repeating here: "Scientists can make their writings more attractive and hence more efficient by paying honest attention to basic interest factors. . . . Irresponsible simplification and unwarranted dramatization, the common faults of popularization, are intolerable to objective thinkers. But I can see no sufficient reason for deliberately deadening the interest of potential readers whether they be lay or technical."

Brief consideration of other ways to strengthen our potentialities as emissaries to the general public may be mentioned. We have already cited reading and studying as the most common method of keeping abreast of the times. Another opportunity is presented by visiting lecturers in other fields of science than our own—too frequently we do not take advantage of this opportunity. Nor do we seek the counsel of our own campus colleagues as often as we should. We have become too departmentalized in our thinking, and if we are to mold public opinion these barriers will have to be removed. Perhaps we need to encourage more fraternizing between the staffs of different departments, not so much merely to learn what your fellow scientists are dong, but to stimulate a better understanding of the implications of advances in all fields of science. Only in this way can we hope to attain gradually more professional prestige in the eyes of the public.

I would like to suggest that time be found in the program of our future annual meetings for a panel of experts in various sciences to present to the Academy members their interpretations of the impact on society of recent advances and how these may affect the individual scientist, whatever his specialty may be.

Teaching is a major responsibility of a large proportion of our membership. Certainly in periodic reappraisal of our careers, this area of our activities merits more than passing interest. Even a cursory examination of the literature of higher education will indicate the concern felt, at least in some quarters, for continuing research that will yield more than platitudes. As one who participated in two workshops of the N.C.A. Committee on Liberal Arts Education, I have spent considerable time in a study of the problems of teaching. Let me hasten to add that I do not consider myself an "expert." Permit me only to ask a few leading questions.

Whether you are young and full of vigor, old and mellow with a rich philosophy gained by experience, or somewhere in between—are you fully satisfied with the type of teaching you are doing? Do you sometimes question the wisdom of your procedures? Do you occasionally wonder how you can most effectively reach the variety of students that appear in your classes? Are you certain that your examinations really measure the accomplishments of your students? Do you sometimes feel that you have inadvertently become so much involved in other activities that your teaching is not receiving the full measure of attention it deserves? Are you satisfied with the status quo, or do you seek new or refined ways of doing the time-honored procedures?

It would be unusual to find uniformity in your answers and lack of discretion on my part to attempt an analysis of their implications. Instead I wish to rekindle your thinking in regard to teaching in general, and science teaching in particular, by selecting some commentaries from the available literature. Although they are not intended to be closely integrated, at least they are parts of the whole. My sincere hope is that some of these commentaries will be stimulating enough to warrant your study of the article from which they are quoted.

At least two former presidents of

this Academy have made pointed references to teaching. J. W. Neckers (7) admonishes us to "abhor slothfulness in teaching; permit no other activities and interest to assume primary attention. Give the best efforts and expect them in return. There is no substitute for competence and sincerity in college teaching." E. L. Stover (8) remarked six years ago that "there is an increasing number of science teachers who are attempting to conduct research in their teaching rather than to continue to wishfully think they are doing a good job of teaching. Research in teaching is equally important with research in isotopes and human physiology, provided the person conducting the research is well trained in the fundamental sciences." Roger Adams (9), another of our distinguished members, cited some of his reactions in a speech at the Centennial of Rockford College. "The attitude of the public toward teachers is incomprehensible. It is the exception when some teacher has not had a profound influence on the life of a student. The friendly suggestion of a teacher often directs the path that a student follows and gives him inspiration. Advice from a popular teacher is never forgotten. It is doubtful whether any country in the world brags about the educational opportunities offered to its citizens as much as the United States. On the other hand, there is no country where the teacher or the university professor has as little prestige with the public as in the United States and this in spite of the fact that the greatest ambition of a parent is for the education of his children."

The viewpoint of Jean Hanway (1), who is a professor of English, is also interesting. She says, "I wish we could get away from the idea that all professors have to be cut from the same stripe. The only common-denominator I have ever been able to find for the really good ones is a love of knowledge that drives them to acquire it and a willingness and ability to share what they have found."

How well do we measure up in our teaching to the challenge of Kraus (10), who suggests that "college should afford the student encouragement and inspiration rather than dull the student's enthusiasm with the mere accumulation of knowledge. And, above all, college should lead the student to take pride in intellectual achievement and to find satisfaction in intellectual activity." I am almost certain someone is thinking that first it would be necessary to have more students with enthusiasm for science and the intellectual capacity to make real intellectual progress!

Or is teaching really in the dilemma indicated by French (11)? "Science teaching is now supposed to serve two dissimilar masters at one and the same time. Originally introduced as exercise in logical thinking, many science courses have, under the pressure of demand for technical training, become in fact training courses for technicians in which semblance of logical thinking has had to give way to the necessity of cramming fundamental facts, formulas, symbols and principles into the absorbent cranial sponges of willing students." Many of you may question the use of his term "willing students"!

Perhaps one further excerpt, from Marshall's interesting book (12), will be sufficient. Among his con-

clusions we find that "above all, we must hold up, and hold to, the moral obligations of teaching, to guide and not to steer, to help but not to push, to study but not to indoctrinate, to analyze but not to conclude, and to teach but never to preach."

The above commentaries indicate the range of problems inherent in teaching, and our need for maintaining an awareness of these problems. Many of you already have a history of rich experiences in teaching the various sciences. But as a group we seem to be reticent about writing of these experiences, even though they undoubtedly would be stimulating to others. As an experiment, and to encourage more of you to validate your convictions in writing, may I suggest that at some future Academy meeting we have a section on science teaching? I am aware of the problems inherent in such an experiment, but I sincerely believe that the results would more than justify the effort. Such a section, by giving expression to the convictions of many scientists, might even have some influence on the philosophy of higher education! Such a section would afford us an opportunity to consider some of the problems of the high school science teacher and to suggest ways in which college scientists could be more helpful. If our high school science teachers are to stimulate budding interest in science among their students, they certainly need all the encouragement we can give them. A section on science teaching would involve the various sciences, and provide a common meeting ground for a better understanding between them. The more I think about this type of experiment the more convinced I am that it has considerable merit. Am I alone in this opinion?

By now I am sure you are convinced that my title—Can We Meet the Challenge? —is subject to various interpretations. In conclusion, my convictions may be summarized as follows: to be worthy of the name of scientist we need to examine our careers periodically with all their implied and related responsibilities, so that we may make effective adjustments as the years advance, to the end that others may say, "Job well done."

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