THE SCIENTISTS' PLACE IN THE FUTURE

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I appreciate ~~this~~ the opportunity of joining you on this occasion. It has more facets than the majority of meetings, consisting, as it does, of a program of the Illinois-Iowa Section of the American Chemical Society and the conference of chemistry professors from liberal arts colleges in the Midwest Conference area.

Further luster is added by the fact that your meeting is being held during Monmouth College's Centennial year. The celebration of an anniversary can have some interesting overtones. For an American liberal arts college, which has survived wars and depressions for a whole century, and has gained in stature through the years, extra felicitations are in order. While we in this country fortunately are somewhat impatient of mere age and tradition of institutions, we nevertheless pay them homage and look to them

for valuable lessons if they have shown real accomplishments and have been alert to their opportunities.

Monmouth College rates high in this respect. I am acquainted particularly with what she has accomplished in science training. After all, this meeting has a scientific background, and we need not wander into other fields about which I know little; and the subject of science gives me plenty of leeway for a talk.

Monmouth is typical of--or perhaps I should say, outstanding among--our better small liberal arts colleges which carry out a mission. You do not look to a paternalistic Federal or State Government for your funds or your inspiration. You depend upon your own initiative and the quality of your teaching to make your worthwhile contributions to education. It is most essential that we maintain the strength and freedom of our colleges to the end that our young men and women may be taught the truths of science, unfettered by prejudices and directives. That is why so many of us look askance at any broadening intervention by our Federal Government in matters of education. As Detlev Bronk has said,

"I for one do not find in governments superhuman powers to solve problems unsolvable by humans, for governments comprise but mortals."

How do state-supported institutions of learning fit into this picture? Fortunately, there has been relatively little tendency on the part of our state legislators, who hold the purse strings, to interfere seriously or to try to dictate as to what should be taught in a university. The danger is not entirely non-existent, however. Experience so far has been that our legislators have generally been sufficiently appreciative of our educational institutions (perhaps because their boys and girls attended those schools and thus educated their parents) to provide the operating funds without trying to do the teaching too.

On the other side, the state schools with their rather well-assured income have in recent years escaped many of the financial worries and headaches of our privately endowed and supported institutions. The number of these private institutions is large, particularly in the group of small colleges, and their contributions to our American life have been outstanding. Founded years ago by

public-spirited men who wanted to make this country a better place for their descendants, and to maintain freedom to think, work and strive, they established this type of institution with little or no national or state help. In no other country of the world do we have a similar system of higher education; it is as American as the town-hall meeting or pumpkin pie. But now they are in serious financial danger. Our heavy taxes have largely dried up the individual sources from which substantial gifts formerly were obtained. The impact of military rearmament, with its resulting loss of male students, has already been heavy.

I have not heard of a panacea for these troubles of the endowed colleges and universities; certainly no clear and complete solution is in sight. To remain as an integral part of our American life, ~~these institutions~~ they must go on supplementing their inadequate income by gifts and grants from public-spirited people and, in some cases, by such means as R.O.T.C. units, state grants for research, and broader drives for funds from industry through the rather new plan of pooling the efforts of the colleges in a single

federation. In the State of Illinois, this plan is being adopted this year by a group of 22 colleges, of which Monmouth is one. Part of the funds so raised will be divided among the participating colleges. In several other states in which the plan has been tried, it has been quite successful, as I trust it will be in Illinois.

Recently I had occasion to look over the astonishing record of Monmouth, in sending its graduates on for doctorates in chemistry and in medicine. Up to now, 55 of your men and women have gone on to obtain Ph.D. degrees, 45 have become physicians, and a comparable number have received other advanced degrees. I am glad to say that two Ph.D.'s who graduated at Monmouth, and several others with lesser training, are valued scientists in the employ of my Company. Such a high output of professional men has been attained by few colleges, and by fewer large universities.

Why is it that some small colleges can accomplish so much? It is not that they have more appealing campuses, or more beautiful girls, or better facilities, or even that they attract more young people with native ability. Rather, it is the inspirational spark

which is provided by some professor. I know that is true, because I chose chemistry on account of the inspired teaching of one man. At Monmouth you have had such a man, Professor Haldeman, and, no doubt you are fortunate enough to have still ~~a~~others to follow in his footsteps. A Philadelphia journalist expressed this as a parody on Lewis Carroll:

"Gather round, gather round,
the Professor is coming,
He's coming here to teach;
He'll teach us how to do such things,
as reaching beyond our reach"

"Reaching beyond our reach"--that expresses it better than anything I know. The rare man who can stimulate young people to do that has a gift beyond price.

There are thousands of men and women in our country who have thus been stimulated to devote their efforts to science. The freedom which they enjoy is to a considerable extent responsible for their accomplishments. Scientists, like all others, must qualify for that freedom, and must not masquerade license for it.

We hold high the concept of academic freedom, but that liberty does not, as Professor Hildebrand has put it, "exempt one from being a decent citizen, nor does it confer a peculiar right to support an organization subservient to an unfriendly power." Fortunately, colleges and universities have had only small infestations of those who abuse academic freedom, and the administrators and faculties have it in their own power to make the terms ~~get rid~~ of such undesirables untenable.

Since World War II it has been impressed on our nation that many of our marvelous technological developments have been possible because there was a large world storehouse of basic scientific knowledge on which we could draw. It has become obvious that we must put new fundamental knowledge and research back into that storehouse, for use by the next generation. ~~This can be done only by adequate support of our educational institutions.~~ Basic research is their natural bent. True, some fundamental research is carried on by industry, but at best only a small part of what is needed can be expected from industry. Generally, industry extends and applies basic knowledge, and passes on the results in the form of

"better things for better living".

University research is being helped in increasing degree by the numerous fellowships and grants-in-aid which industry supplies. A high percentage of these fellowships have no strings attached as to the problem to be worked on or the disposition of the results; their sole object is to extend basic knowledge and to assist in the scientific training of young men and women.

During the last year the National Science Foundation has begun operations. It had a stormy gestation and birth, because many people feared that it would be politically dominated and that its funds would largely be dissipated in the support of applied, including perhaps, military research. Fortunately, the Foundation has started excellently, distributing several million dollars to promising young scientists for unfettered work in a variety of fields so that they could continue their training and scientific output.

The scientist and technologist is sometimes blamed for the delicate and unsatisfactory state of the world today. By producing

such things as the airplane and radar, and especially the atomic bomb, he is charged with responsibility for the world's unrest. We can agree that the technologist must share with all others in the responsibility for national actions; but he deplores the misuse of his discoveries as much as anyone else. History has shown that wars are begun and fought with whatever weapons are at hand, and it is hardly realistic to suppose that world conflict would be avoided if we had less technology.

The potentialities for good exceed those for harm. Life for all has become more tolerable and pleasant because of the drugs which save life, and the mechanical contrivances which save labor and shorten the work day. Science and technology have brought their benefits to all classes of people; no other factor has had such broad favorable effects.

Bishop Hensley Henson of England has called attention to the drawing together of humanists and scientists. "Science and Christianity", he said, "are a distinctive feature of the civilization that has been cradled in Europe, and from Europe has been extended

all over the world. The principle of both is liberty, the expression is unshackled freedom of the innate powers of the human spirit, the expression and vindication of individuality". Let us never lose sight of that principle.

There are about 100,000 chemists in the United States, two-thirds of them being members of the American Chemical Society. There are perhaps 350,000 to 400,000 engineers in all categories, and thousands more of physicists, geologists, biologists, bacteriologists, and so on. Yet the need and demand for scientific effort has grown so rapidly that there is a shortage of nearly all types of scientists and engineers. Part of this, it is true, is due to the war situation, but that is by no means the entire answer. Scientific success breeds more possibilities for success, and the scientific world will never lack frontiers to explore and cross.

The number of scientists must conform to the law of supply and demand, just as do commodities in general. It has not been so long ago since we heard some people advocate artificial restrictions

on students in chemistry, because they feared that there would not be enough jobs to go around. I have heard the same argument about physicists, prior to World War II. Now it appears that at least for some years to come, our worries will be about shortages of scientific personnel of all kinds, especially if military service drains away from the colleges those young men who should now be preparing themselves for their places in the scientific fields. Sometimes, in moments of frustration, one feels that the military mind is indeed inflexible when it refuses to face the serious effect of present policies on our scientific and technological preparedness.

In the remaining minutes, let's turn from these several broader problems of science to the more specific things which we may expect during the coming years. First of all, I shall mention the gains which chemistry, bacteriology, and medicine together should be able to establish. To each of us, our health and our life are all-important. If scientific research can supply us with the means to live longer in a state of buoyant good health, each of

us has a deep personal interest. Already the life expectancy of a white male at birth has risen seventeen years in the last half-century, and that of the white female twenty years. It is true that much, though by no means all, of this gain has come about by saving lives during the years of infancy and childhood. Deaths from the principal communicable diseases of childhood (measles, scarlet fever, whooping cough, and diphtheria) have been dramatically reduced from 65.1 to about 2 per 100,000 since the turn of the century. Similarly, typhoid fever, tuberculosis, influenza, pneumonia and childbirth have been robbed of much of their death-dealing by the new chemotherapeutic agents and antibiotics made available by scientists for use by the physician.

At this point the horizon must lift further, because the life that has been saved in infancy and childhood must be protected from the diseases of middle and old age--heart disease, arterio-sclerosis, diabetes, and cancer. This frontier is being extended day by day, as the newer scientific developments are steadily making it possible to attack diseases which only the year before were the

masters of mortal man. There is no more reason for a man of 60 being old today than there was for a man to be old at 40 a half-century ago. Our people demand the means for good health for a longer period of their lives, and the scientists and industries based on science are steadily and rapidly making those means available to them.

We hear much these days about the high cost of living, and often reference is made to the high cost of medical care. As a matter of fact, the cost of medical care has risen considerably less than the cost of food or clothing. Drugs have risen very little during the past ten years; in fact, many of the most important medicinal agents, such as insulin, the sulfa drugs, penicillin and cortisone, have dropped materially, even drastically, in price.

Closely connected with this matter of health is the problem of world and national population. Our world is growing at the rate of almost 1% per year, and this increase has already brought us to a population of about 2-1/2 billion people. We see it in our own population figures, which show that we have about 20 million more persons in the United States than we had a decade ago. Our country,

with its wide expanses of fertile land and its blessings of other natural resources, can support many millions more. Added to this is our technology, the most advanced of all countries, which keeps our standard of living the highest in the world. There is no need for anyone in our country to go hungry or unclothed.

Unfortunately, much of the rest of the world is not so well off, and this fact is responsible for much of the unrest and the rash of wars which break out. The solution of the problem is not simple, but the alleviation of much of the difficulty is not beyond the reach of the people of our globe.

Two things immediately come to mind: more education and more technology. Both set off a chain reaction of beneficent results which are far-reaching. Better education leads to higher living standards, as does technology. Each of these factors tends toward better food supplies and more industrialization, and history has shown that both factors also tend to slow up population growth. Certainly the world can not go on indefinitely increasing its population at the present rate, else in a few centuries there will hardly be standing room, let alone enough food and resources to go

around. Technology, therefore, will be called on in growing measure to help solve the over-riding problem of where and how our descendants are going to live, if at all. The more quickly we can help other peoples, particularly the more backward ones, to industrialize, the more assured we may be of their and our own future welfare.

In all this search for new weapons to lengthen our useful lives, the scientists, including to an outstanding degree the chemists, have been the key figures. It is they who supply the physician and the nutritionist with the tools which they so expertly use. It is the scientists in university and industrial laboratories who make these things possible. It is they who make the discoveries, and then develop processes and improve them so that drugs like insulin and penicillin and cortisone, which at first are very expensive, rapidly fall in price so that the products are brought within reach of all. The facilities for scientific research are expensive. Yet there is no investment in the future whose results are more satisfactory.

I have used examples from the drug industry, with which I am

best acquainted. Very similar things can be said about the various other branches of science. Adhering to the chemical field for a moment, and selecting a few more examples at random, we can foresee the following: new synthetic fibers in growing diversity and number, which will satisfactorily supplement and often largely replace every natural fiber we know, including wool; plastics, both old and new, which will be called upon in ever greater measure in the home and in industry; ample supplies of industrial alcohols and benzene and toluene and other solvents and basic chemicals derived from cheap petroleum as a raw material; and finally, the development of chemical, physical, and electrical methods for using lower grade raw materials as we exhaust our available supplies of the better grades. I am thinking particularly of the recovery of our worn-out and eroded soils, which through generations of neglect and abuse have now begun to give us uneasy thoughts; and similarly, the use of poor grade minerals, like lower quality aluminum ores, and particularly the taconite iron ore, which in the next decade will become an immensely valuable natural resource, available in stupendous quantities within our own country.

Science in the coming years is also going to give us much more effective uses of atomic energy. Yes, we will have more powerful atomic bombs, but potentially more important for the future of our country and the world, we will have great advances and possibly appreciable application of atomic energy to our industrial power supply.

In speaking about radioisotopes, there is much more than atomic bombs and atomic-powered industry that comes to mind. We immediately think of the uses of these easily detectable isotopes in determining flaws in steel, as indicators of flow in oil pipelines, as means for determining chemical reaction mechanisms, as biologic tools, and as agents for detecting and sometimes curing human disease. Just to illustrate the latter, in a single small laboratory it is now possible in one week to make a quantity of a radioactive gold compound whose gamma rays are the equivalent of all the radium in the United States.

All the physical sciences are thus moving forward on a broad front. Improved methods of communication and recording, by radio,

television, microfilm and duplicating processes, should enable us to keep up with the vastly growing amount of assembled knowledge which will have to be organized, sorted, and selected before we, who are in scientific and engineering endeavor, will be able to use it properly and efficiently.

These limited remarks about the physical sciences in the years to come would be unbalanced if we did not refer to their counterpart, namely, the social sciences. These can not be as well organized or classified as the physical sciences, but unless we give heed to them, and foster and develop them, we may lose the benefits for which the scientists in our fields have labored and thought so hard. In this time of world tension, we need both material and idiological weapons, and our uses of the physical sciences must be leavened by the discipline which the social sciences are called on to provide.

Years ago Edmund Burke, in the English Parliament, after referring to the three estates, the lords spiritual, the lords temporal, and the commons, looked up at the reporters' gallery

and said that they constituted the Fourth Estate, more important than any of the other three. To this Dr. Arthur D. Little, a quarter of a century ago, added what he called a Fifth Estate, by which he meant Science, and which he believed was destined to play an even greater part than its predecessors in the progress of the world. "This Fifth Estate", said Dr. Little, "is composed of those having the simplicity to wonder, the ability to question, the power to generalize, 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 world needs most a new tolerance, a new understanding, an appreciation of the knowledge now at hand. For these it can look nowhere with such confidence as to the members of the Fifth Estate. Let us, therefore, recognize the obligation we are under. Ours is the duty and the privilege of bringing home to every man the wonders, the significance, and the underlying harmony of the world in which we live to the end that all undertakings may be better ordered, all lives enriched, all spirits fortified."

I can think of no better text for use by all of us. Perhaps meetings such as this one provide good occasions for us to take stock of where we are going and what we should do.