

(Address delivered by the Reverend Theodore M. Hesburgh, C.S.C., President of the University of Notre Dame, at the luncheon of the Board of Trustees of the Nutrition Foundation, Waldorf-Astoria Hotel, New York, New York, on October 3, 1956)

SCIENCE AND MAN

You may wonder why I have chosen to speak today not about science in the modern world, not about science and progress, not about science and the future, but about science and man. I have advisedly linked these two concepts of man and science together, because there is no reasonable or respectable future for science unless it be viewed as being of man, and by man, and for man. Correspondingly, there is no hope for real progress for modern man unless he keeps his science in the context of the totality of his human life.

This may sound like an ominous note upon which to begin to speak of science, for science is admittedly the darling of our day. In a sense, science and scientists can do no wrong. They have filled in our valleys and leveled our hills. They have fed and clothed and housed us as man has never been fed and clothed and housed before. Science has cured our diseases, lighted and warmed and cooled our homes, simplified our housekeeping. Science has brought close the ends of the world, given us a new view of the stars, transported our burdens on the wings of the air. It has given us printed words by the millions, entertainment at the touch of a button from an easy chair, conversation across continents and oceans. Science has brought hearing to the deaf, clear sight to the myopic, and the skin you love to touch. Who is to say that these are not blessings and that science is not the great benefactor of modern man?

Certainly, I am not going to say that all of these developments are not good things, nor am I going to depreciate the magic of the scientists. But,

someone must say, sooner or later, that man is more than his body and its comforts, that he does not live by bread alone. It is possible to be perfectly healthy and completely unhappy. It is possible for the well clothed, well fed man to be intolerant or unjust. People can multiply words in print or on television without really saying anything significant or even the truth. Unlimited entertainment is no sure cure for the boredom of a superficial human life. Swift travel across the world does not guarantee human understanding among nations. Simplified housekeeping does not insure happy marriages, nor can vitamins substitute for virtues.

All I am saying here is that there are limits to the power of science and that science is only one factor in the achievement of the good life - if man is more than matter and if there are human values higher than those of a material order. In saying this, one need not dislike science or fear it or bemean it. The only case I am making is that science is the tool of man, one of many tools that lead to his total perfection. Science is not a tool on the highest level of human values. Science may indeed destroy man and become his master, if science is not adequately understood for what it really is, not worshiped as a kind of false god, all out of perspective in regard to its true meaning and value in the total life of man.

Now perhaps you see why I began to speak of science and man, because the true meaning of science must somehow be related to man, his meaning and his destiny. Only man on earth is the scientist, and his science is not exercised in a vacuum but in the world of man. If science loses its proper

place in that world, man will lose, and so will science. All power is meaningless without direction. Worse than that, the magnificent power of science is dangerous, even deadly, if not controlled by human intelligence and integrity and wisdom. What then is this giant called science that walks in the world today - or rather what is this world of man that now begins to sense the great power of science?

Our Western World today is no simple reality - but the amalgam of many forces that have deeply influenced it over many centuries of time. One finds as a base the great intellectual heritage that comes from the classical age of Greece. Here was the earliest root of the intellectual fibre of the West - the zest for understanding and philosophical inquiry, the joy of intellectual discovery, the deep value of the things of the mind: truth, beauty, and the good. The Romans added another dimension to the tapestry of the West, the ideal of law and order and a stable society of men with great civic institutions and efficient administration of justice. Then there was the divine element of the Gospels, a new and bright light on man's nature and destiny, a fresh glimpse of the grandeur of the human person, new ideals of human thought, human achievement, and high goals for human conduct. These three elements meshed to form the fabric of Western culture. From this triple stock we have derived that rich and complex heritage that is Western man's. Whatever else man may become in the West in the years ahead, he will be poorer if in so-called progress he loses the soul of this heritage which is centered in a concept of the human person as never fully understood before - glorying in truth wherever it be found, strong and free under the law, cherishing beauty in all its forms, living

by high ideals and ready to die for the values that have made Western man unique in all the ages of men. Respect for the totality of truth, justice, beauty, and the inner dignity of the human person - this is the heritage that is ours to have and to hold.

This was the world of Western man into which modern science was first born, as far back as Galileo. Science can indeed bring another dimension to this world, can supplement the great contributions that have come from philosophy, and theology, literature and art, history, law, and the social sciences of economics, politics, and sociology. But this can never be if science is looked upon as a substitute for all that has gone before, for science is a quantitative, not a qualitative study like the others. Physical science deals with matter not mind, measurements not morals, nature, not the author of nature. It is a way of knowing, one of many ways. It brings us one kind of knowledge and truth, not all truth and wisdom.

Perhaps a more synoptic approach to the problem may be had by way of education, since education reflects our concern for preparing young people today for life tomorrow. The education that has best reflected our effort to give to youth today the heritage of the past, as well as visions for the future, is liberal education. If we can establish the place and value of science in liberal education, then perhaps we may gain an insight into the place of science in the world of man.

It would be presumptuous of me to define liberal education, for it is a dynamic rather than a static reality. A few generalizations may help, however. A beginning would be to say that a liberal education should liberate a young man

or woman from the bondage of ignorance, prejudice, and passion. It should broadly endow one to use to a high degree of excellence that intelligence and freedom which characterize man and differentiate him from the animal. A liberal education should enable a young man or woman to form a reasonably complete and accurate picture of mankind, some broad perception of man's situation and destiny. It should also engender some conviction that will enable the person thus educated to direct his or her life in accordance with this total view of man and of life. A liberal education should confront the maturing person with the really significant questions in life, the various live options, and the reasons for each, so that the person is enabled to make, with intelligence and freedom, the difficult decisions that rational life demands. Any liberal education worthy of Western culture should inform a student on the three great realities that focus on all of our problems: nature, man, and God.

It is possible to be educated on any one of these three great realities and ignorant of the other two. The danger which I indicated earlier, reinterpreted in this present educational context, would narrow the field of knowledge to the study of nature, and would restrict ways of knowing to the scientific method of induction and interpretation of experimental data, which is proper to science. We should admit in fairness that liberal education has often neglected science and the study of nature in the past. Only the modern age has given us the giant strides of progress in this field. This is a good development, an exciting adventure, and it has had startling results - both good and bad. My particular point here is merely to insist that while we

welcome this new dimension of science to the cultural history of Western man, we must ever be mindful that it has its limitations and should not be welcomed in the spirit of "winner take all."

All of the scientists working with the most startling scientific equipment of our day - electronic microscopes, mass spectrometers, nuclear reactors, electronic calculators, multi-billion volt accelerators - cannot give us ^{the answer} a clue to the most burning questions that have anguished mankind since man began to think: what is man? can he know truth and what is it? Is there a God, can we know Him, and what is our relation to Him? What is freedom and are we really free? Why do men marry, why do we live in society? Is the state for man, or is man for the state? As human persons, do we have inalienable rights? What are they, and why? What is justice and the function of Law? Are there eternal values, worth living for or dying for? What is the difference between beauty and ugliness? What really is love and are all men equal?

These are a few of the significant questions that must be answered if man is to live a truly human life. We may ignore them, but then we may also wonder at the wisdom of the Greek philosopher who said most wisely, centuries ago, that the unexamined life is not worth living.

Science does not necessarily lead to a world of purely technological civilization and purely material values if we wed our ^{to} study of science to the study of our total Western tradition, which brings many thoughtful answers to these deeper spiritual questions in its literature and history, in its philosophy and theology, in its pattern of laws and its development of social sciences.

My plea today is twofold. First, our young scientists should be liberally as well as scientifically educated, if the scientific leadership of tomorrow is to take account of the total human situation. If science is generally ^{areligious} ~~anti-religious~~ or atheistic or unmindful of the humanistic tradition of the West, then we will enter into a race for scientific supremacy which we may win, but which will not be worth winning if, in doing so, we have lost those great human values that give us reason for survival. The basic crisis of our times is ideological, rather than military. And the ideas we cherish were our possession long before the advent of scientific progress. Our basic conflict is for the soul of man - whether he was created in the image and likeness of God, with inalienable rights as a person with spiritual dignity and eternal destiny, with the state to buttress these rights, and with justice and charity as the guiding rule for man's relationship to other men. Against this Western heritage there is a counter idea of materialism full blown, wherein man is purely of the earth earthy, of time alone, soulless, without God or any rights except those granted by the state. In this scheme, man is a mere economic factor of material value alone, manipulated as a thing, not respected as a person, and justice is whatever is expedient for world conquest. We should be grateful that we have the support of science today in defending our claims to our way of life, but we should never confuse science or its material benefits and strengths with the spiritual substance of the heritage that we defend in a divided world. Indeed, the broader view has just lead this nation, with great wisdom and humanity, to place atomic power at the disposal

of the undeveloped nations as a great gesture of our will for peace rather than war. And we may hope that the reasonable control system inaugurated here may be a prelude to broader future controls that will safeguard the world from destroying itself with the tremendous power now at its disposal. This one example highlights better than anything to date how science wed to human wisdom in our Western tradition can work for a better world.

My second plea is a corollary of the first, but more in the interest of science. Once we are clear on the relative position of science in the total human situation, let us make sure that we give science its proper due. Here I would make several suggestions. Rather than promote science at the expense of the humanities, we have first suggested that science itself is one of the liberal arts, and that no person is well educated today without a reasonable grasp of science, an understanding of nature from the scientific point of view. The scientific method of induction, experimentation, and interpretation can bring new and real values to the classical concept of liberal education that somewhat neglected science. ^{Science} It gives us new insights into the material world and new control in that world. It gives us new respect for hard facts and an eagerness to interpret them. Humanly, science should teach us to respect the work of others, especially other nations, and lead us to collaborate with them fruitfully in the exciting experience of scientific discovery. Our physicists at Geneva last Summer were surprised at how easily and gainfully they could discuss nuclear physics with the Russians. Here was a neutral ground that went beyond the maneuverings of diplomacy. Scientific speculation also prepares the mind of the student for the more abstract study

of philosophy, which uses intelligent reflection in another way of knowing to derive truths unattainable to science as such. Science should also engender that respect for mind that underlies all rational inquiry and human culture. Other disciplines, like law, history, literature, philosophy and theology, use other specific methods, with other subject matters than nature, and using other data, to obtain other truths highly necessary to the cultured man - but always it is the mind at work. Disrespect for the mind, and current sneering at intellectuals and intellectual endeavor, is the quickest way to the destruction of all human culture. Scientific endeavor finally is a great school for discipline, humility in the face of fact and the unknown, patience to work steadily and persistently - all real values in the process of education.

One last word I would say, and this is particularly relevant to the work of the Nutrition Foundation which we salute today. Science is a broad term with many meanings. I have restricted my remarks on science to the physical sciences, although there is nothing unscientific about valid work in the humanities, since our tradition has often equated science and knowledge of all kinds. Speaking specifically of physical science though, I believe that one last caution is in order. People today often confuse pure science with applied science and technology. In like manner, our society today generally tends to give the largest measure of appreciation and support to applied science and technology, since they are the obvious ^{and} immediate source of material blessings from toasters to television. What I have said of science, however, is more fittingly applied to pure science, since pure science is that which aims directly at an understanding of nature. Applied science and technology could

not exist without this basic understanding, for the scientist must elucidate the physical principles that underlie natural phenomenon before the technician can use these principles to control and manipulate nature for the good of man. Once more, however, perspective is needed. If all our interest is in development, we shall soon run out of basic discoveries to develop, and technology will grind to a stop in its forward advance. Basic research must furnish the seed corn before applied science and technology can reap the harvest.

The statistics of financial support in this matter are perhaps the most striking index of where the national interest is focused today.

In a recent study of the National Science Foundation, we find that over five billion dollars a year are being spent for scientific research and development. ^{in this country} The largest share of this money ^{comes} ~~come~~ from American industry. The breakdown is very indicative. The latest available total figures for industry cover the 1953-54 period. Industry then spent 3.7 billion, of which only 4% or \$150,000,000.00 was in support of basic research. During a comparable period of 1954, the federal government spent 1.6 billion for applied scientific research and development, and only \$116,000,000.00, or 7%, of the total for basic research. Totaling the two figures from industry and government, we find \$5.3 billion for applied research and development, while \$266,000,000.00 were being spent for basic research. Nothing more need be said regarding the trend, but I believe that in view of the total needs of science, the Nutrition Foundation may be proud of its willingness and record in assisting basic research which, despite its fundamental importance, generally receives a pitiful percentage of

governmental and private support. And if I may, in conclusion, relate all of this to the larger problem of science and man which we have been discussing, I would be greatly surprised if the total annual private and public support for research in the humanities amounts to anything approximating one per cent of the annual total expenditures for research in the physical sciences.

I began, ladies and gentlemen, with a plea for perspective. Science is tremendously important in our day, but man is even more important. Science will have its greatest, most fruitful, most meaningful growth when man, in the totality of his humanity, grows with ^{science} ~~it~~ to a total perfection of which science is a part, but never a whole, a means not an end, a thrilling chapter, but certainly not the whole book.

I thank you.

Comments on Science and Man.

I think that the basic theme is very persuasively reasoned and presented. Empirical science is shown to be only a part of man's total effort. This is done in three different ways:

- a) emphasis on the riches of Western man's cultural heritage. Inference: if we are to remain authentically one with this heritage, we must set science in its proper context among human activities. (Possible rejoinder: maybe we should break with the past; maybe the future of mankind lies with a cosmopolitan culture whose universal acceptance is guaranteed by the intersubjectivity and immense practical success of empirical science. An effective counter to this objection would involve, I think, a fairly thorough analysis of cultural values, their roots and implications. Dawson's work might help on this).
- b) empirical science is presented as descriptive rather than normative. Thus some other sources must be sought (philosophy, theology...) for man's vitally important value-judgements. (This is a very controversial issue nowadays, since many philosophers and scientists hold that science must be the ultimate basis even of value-judgements, while others hold that these latter are purely subjective and thus lack any cognitive foundation in any way of knowing other than the scientific. To deal with this objection would probably take one pretty far afield into questions of natural law and philosophical method. It has been a frequent subject of debate in recent issues of the Bulletin of the Atomic Scientists).
- c) empirical science is only one among many ways of knowing reality and understanding it. It has to be situated in its context in the field of knowledge; a realization of this is vital even for the average working scientist (This is really the central issue. The only way of demonstrating it is to show what the other ways of knowing are, what questions they are designed to answer, and above all to prove that these questions are legitimate ones. This is one of the key problems of modern philosophy; positivists, pragmatists, empiricists, would deny that there are other ways of knowing. Their positions seem to me considerably more difficult to refute than the average scholastic philosopher realises).

There is one other way of proving your point which you have not touched upon, and it seems to afford a somewhat simpler logical and psychological approach than the others.

- d) the proper understanding of science itself involves problems which cannot be solved by the method of experiment-hypothesis-prediction-verification proper to empirical science. These problems are of different kinds. One set is concerned with the presuppositions of science and the scientific method; the type of induction used appears to require the assumption of some sort of uniformity in nature, for example. This uniformity is taken by many as something simply given, about which no question should be raised. But what justification can be given for such an arbitrary restriction of our power to enquire into the apparent intelligibilities we see around us? The one normally alleged is that such a question could not be handled by the hypothetico-deductive method and therefore should be excluded. But this is really no answer; when pressed back, it usually involves a vicious circle somewhere. Another set of problems concerns the kind of knowledge science actually gives us about the world in which we live. Does the average theory disclose to us any structure of the real, even in an indirect way, or is it merely a convenient way of cataloguing the data? This is clearly a question in which the scientist ought to be interested, though answering it will obviously carry him outside the bounds of his science.

I merely mention these points to underline the logical structure of the argument you are presenting. If you wished to make the speech even more

pointed, you could bring this structure more into view. However, it is probably better in the circumstances not to strain their logical capacities too far!

It would probably be best for me to mention a few points which could be amended without too much trouble.

Two general ones first. The introduction of the educational question on p.4 seems unwise. The answer to this question (what sort of education should be given to college students? what are the relative roles of science and the humanities in this education?) depends upon the answer to the more fundamental question you had earlier in the paper broached, namely, that of the relation between science and other branches of knowledge. You cannot argue in the opposite direction without involving some sort of logical circle. You say: "If we can establish the place and value of science in liberal education, then perhaps we may gain an insight into the place of science in the world of man." It would seem impossible to accomplish the former without having first attempted the latter. On p.6 you return briefly to the the central problem. Then you turn to making two appeals which are primarily concerned with education. I would suggest that you divide the paper into two parts, the first dealing with the relation between the scientific approach and other approaches. the second with the application of your answer in the field of education. I would keep these two separate and not attempt to use an "educational" argument to prove my first point. It is only a matter of a slight reorganization in the material.

A second general point is that the last section does not fit in too well with the rest (p.9-10), as it stands. If you wish to keep it, it might be modified somewhat in keeping with the educational context in which you will be delivering this speech. For example, you might speak of the part played by the university in the promotion of pure research. In any case, you should be able to present the point in this section as another facet of the educational aspect of your general theme, the place of science in human activity. Otherwise it might appear an afterthought.

Now for some more specific points. There is an ambiguity in the way you use the word, "science". Sometimes it means "physical science" and you contrast it with other disciplines, including the social sciences and philosophy (cf. bottom of p.6). At other times, you mean to cover the whole of modern empirical science, as opposed to philosophy or theology. It seems to me the latter is the only proper one in your context, if I understand it. You want to show that empirical science with its powerful but limited hypothetico-deductive method cannot give us all the understanding we seek. "Science" here includes the modern social sciences (but not ethics or philosophical psychology). No scientist would dream of denying the importance of social science, so that you might distract attention from the main issue by setting up a sort of subsidiary contrast within science, between the physical and the social sciences. It would be better to refer your argument to science, that is, empirical science as a whole -with special reference to the physical sciences, of course - than to just the physical sciences alone. If you chose the latter, much of your argument would have to be restated, I think. So you might delete the last phrase on p.6, for example.

On p.2, you speak of science as a "tool" which helps man to his perfection. Strictly speaking, a tool could not lead to perfection; science is rather a perfection of man, as a habit of the mind. I would be wary about saying that it is not on "the level of the highest human values", especially to your prospective audience. In a certain sense, science is at the summit of purely human values, sharing this summit with philosophy, as quite a number of recent Catholic writers like Dubarle and Caldin have been emphasizing. I would have

liked a short paragraph developing this point briefly. This would make the talk rhetorically more effective since it is implicitly rather critical of science and scientists as it stands. Science develops man's highest faculty and enables him to appreciate the intricacies and wonder of the creation...

The first paragraph on p.4 might be altered. The phrase about the social sciences could be omitted. It is not quite accurate to characterize science as "quantitative" as against all other types of "qualitative" knowledge. These words are not very clearly defined to begin with; if one takes any average current meaning for them, it can be seen that some of physical science is "qualitative" while some other disciplines concern "quantity", in passing at least, like music, for example. What distinguishes modern science is not that it studies "quantity" but rather that it begins from precise observation (where possible, experiment), formulates "laws" or generalizations, then goes on to correlate these laws in a hypothetical structure called "theory", makes predictions on the basis of these laws and theories, and attempts to verify these predictions as confirmations of the adequacy of the theory or the accuracy of the law. This complex process took a long time to discover, and it furnishes a type of explanation, proof, evidence, and knowledge quite unlike those found in philosophy, for example. The fact that science is predominantly interested in quantitative statements is due merely to the fact that laws based on such statements lend themselves much more readily to the prediction-verification type of confirmation. Science can deal with mind to some extent (this is what experimental psychology is doing)

P.5, line -6: phrase "induction..." might be amended, e.g. to "to the method of experiment, hypothesis and empirical verification of prediction."

The paragraph on the top of p.9 might have to be modified if you decided to say something earlier in the talk about the relation between science and other disciplines.