SCIENCE AND THE DEPRESSION*

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We are gathered for an occasion of considerable importance. Here assembled are the leaders of scientific thought for a great state of over two and a third million people. The work of this organization should have an influence on every profession in the state that accepts the cognomen "scientific." There are millions of dollars invested in the state to give benefit to the people through scientific endeavor. There are nearly 98,000 young people in the high schools of the state coming into an appreciation of a calling to citizenship. It is a part of our duty to point the way of success through high moral standards, through clean living, through the application of every research of physical laws, of plant life, of animal behavior, of human conduct that affect body and mind. Every student in the high schools will do well to take enough science to bring his eager mind to a realization that this world is not a world of chance but that there is order everywhere. That as the Creator has made night to follow day, so in all phases of our experience one phenomenon follows another with orderly sequence. Thus began the study of science. Thus it may be continued. Thus fear and chance flee away and confidence takes control—confidence with the ability to predict the coming of events with certainty supplants superstition that guides through fear and blind groping.

Then, too, there are thousands of college students preparing for a place of service. And may we remind you that there are signs that the state may not long continue to educate those who attend college for selfish purposes alone. How are these virile, ambitious young men and women best to serve? Do we as members of this academy carry a clear and abiding conviction that no person is prepared to serve until he knows well the environment in which he seeks to serve? High religious and moral standards are fundamental but they work best in practical life when well adapted to the Creator's life processes which he has ordained to function without change so long as man aspires to serve. The members of this academy should be interested in every educational program in this growing state. Research is one of the fundamental principles for which this organization came into being and for which it has been maintained. The pioneers in this academy were inspired by a never satisfied craving for new truth. The eternal truth has been their quest. Through the endeavors and inspiration of this academy young men and young women have made their first contribution to human good through new findings. If within the hearing of these words there is one who is interested in human progress in this state through scientific research and application, who has withheld the pittance we call our annual dues, may he be aroused at this time, at least, to keep up his membership if time health, or other circumstances keep him from all other contributions to science. There is but one Oklahoma Academy of Science. May we appeal to all who are interested in science to support this organization, that it may continue to find and publish new truth, that it may keep a record of achievement through its proceedings, that it may continue to aid farm and factory alike; that through the application of a better understanding of economic laws, it may give us greater comfort and happiness by means of applied engineering in automobile, in radio and a thousand other ways; that it may prolong our life through medical research; that we may push farther and still farther from our daily life the fear of disease and the misery of human suffering. If you are interested in these things and pray for their success, then the Oklahoma Academy of Science should have your membership and your sympathetic support.

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Next we ask how can we continue the worthy task that has been set for us to do. The financial depression has had its effects on many phases of our work. Salaries have been reduced and daily loads have been increased for the teachers and all who guide research. Stipends for fellowships and assistants have been cut or eliminated entirely. The finding of new truth has been greatly retarded. As a result, membership dues have fallen off. Greater difficulty has been encoutered in printing the proceedings.

It is well known that these hindering influences are not confined to this state alone. We are in a period of far reaching readjustment. It behooves every scientific thinker to lend the best he has in training and thought to the solution of the problem. In the past few months unbelievable changes in our national policy have taken place. On labor day, September 3, 1933, national administrator, Hugh S. Johnson, in a speech over the radio, spoke of the present national undertaking as an "Economic Revolution". On September 9, 1933, Arthur Brisbane wrote: "At this moment, the United States, with NRA, is trying the biggest revolution in the history of modern government, the government itself taking over responsibility for industry, wages, hours, prosperity, and employment.

"Nothing more revolutionary has happened since Louis the Eleventh in France absorbed in himself and the monarchy the powers that had been exercised by the great feudal lords." (E. M. News Sept. 9, 1933.)

The word revolution staggers our peace-loving people and causes us to take stock of our condition. We find a vast and far-reaching policy of national control is being organized that brings federal officials into contact with nearly every phase of our state, county and city life. The last congress set aside for relief alone, through public works, the immense sum of $3,300,000,000. When has a government undertaken a task so gigantic in social control? Here is federal money for your court house, for your city water system, for your community improvement, but only with the approval of federal officials through federal regulations. A vast program of federal reforestation is in progress. A national recovery act is in operation which fixes wages, which says how many hours some may work and whether others may work at all. Growing cotton is plowed under at a fixed price. Food crops are limited by federal regulation. 5,000,000 little pigs are hauled to slaughter. We have too much! We have too much! All this change has come in a land where a few years ago we were taught to save. This in a land where two generations ago mothers who had been brought up through privation taught their children that to destroy a morsel of food constituted a moral sin.

Do not misunderstand us. We are not attempting to condemn or to justify. We are calling attention to unprecedented changes. We have met here as an Academy of Science and it is fitting at this time for us to ask whether these or other changes are placing a blight upon the progress of science that has brought so much of happiness, of health, of comfort, of joy. To that end we shall first consider the federal government in action through the NRA, as it affects men of scientific training. One of the clearly defined objectives of the NRA has been to put the twelve million idle men back to work. It has been heartening to hear of thousands of laboring men being put back into the ranks of labor that once again they may buy bread and clothing. But almost at the same time we have received startling news of dismissals from the ranks of the technically trained.

During the past summer and this fall, Science Service, through the News Letter, has sent forth to all of us message after message to give us the trend of the times. At one stroke, as a matter of economy, a sum of $10,000,000 was cut from the National Science budget. This threw great apprehension in Washington into the scientific establishments of the government.

The economy axe hit the Bureau of Standards, and out of a staff of 974, there were 380 persons separated from the service. When men are separated from the service they may be put on indefinite furlough. They may hope to find, and indeed may find, a place in some other branch of government activity. Be that as it may, here was a personnel cut of 39 per cent in an institution whose work is known wherever scientific standards are used. The United States Bureau of Standards has been one of the most powerful institutions in all the world for dispelling guess work and the methods of waste by unorganized individual effort. Yet out of every one hundred employed, nearly forty men were listed to leave. This means a drastic reduction in many types of research and a complete elimination of other types. It was reported that similar distress was created in the Bureau of Fisheries, the Coast and Geodetic Survey and the Bureau of Lighthouses. The Department of Agriculture, with a consistent policy of research from its foundation, was seriously threatened. On July 15, the Bureau of Mines was reported to have lost one man in four from its staff. This means that nearly 200 men were to be discontinued or possibly placed on furlough. About seventy of those dismissed were of the technical personnel. This made many radical changes necessary. The scope of all activity has been curtailed, some work has been abolished. Since the beginning of this Academy, the workers in Geology have taken a prominent part. To Oklahoma, Geology is of fundamental importance. The work here has been vitally connected with the National Geological Survey.

In July, Science Service announced that 150 scientists had been dismissed from the National Geological Survey. Many of these are men of international fame.

In these few references, an effort has been made to call your attention to a large number of persons who have been added to an army of scientific unemployed just at a time when the government is launching a nation-wide campaign to put men back to work. It is to be noted that the scientific staff dismissed by the United States Government "does not consist of long-haired men with peculiar notions. Neither are they individuals with low efficiency ratings or those whose services are rated by superiors as unnecessary. They are being dismissed, or 'separated' or 'furloughed' for one reason only—lack of funds." (S.N.L. July 15, 1933, P. 38.)

It should be recalled that these reductions in the personnel of the National Scientific staff came at the same time that the government was putting on a campaign to put more men to work. But that is not all. It came at a time when the national government was launching an enormous public works program in which the services of the technically trained in nearly every field of endeavor will be required lest millions of dollars of tax-raised money be spent for poor material, used under inferior design, to become useless or antiquated before the construction bonds are redeemed.

The first of September brought us the announcement that Secretary Swanson had signed contracts for thirty-seven warships. The program calls for a navy second to none. Secretary Swanson is quoted as saying, "The president has acted generously with the navy and thinks that we should not only have a good navy, but that work should be given through naval construction." (Enid Daily Eagle 9-1-33, P. 12.)

It is to the point to add this quotation from Science Service (July 15, 1933, P. 35). "Under the so-called economy program of the Roosevelt administration, the expenditures for scientific research and service are being cut to about sixty per cent of what they were in the 1932 fiscal year. The millions of dollars poured into military activities past and future have suffered no decrease but will be increased greatly according to present indications. It seems probable that at least $500,000,000 of the public works funds will be devoted to the army and navy, so that in the years of peace, 1933-34, the military expenditures of the United States will rise to high levels."

It is claimed that in normal years, out of every dollar spent by Uncle Sam, less than one cent goes into the fruitful battle waged by scientific research. Contrasted with this, "in recent years war, past and future, has absorbed some seventy cents." "Without any pacifistic discussion of these large military expenditures from public works funds, it is being argued in scientific circles that the drastic cuts in scientific research and service in the federal government departments are fully as dangerous to Uncle Sam's military establishments as actual curtailments in military funds would be."

Unless the latest developments of science are built into the new navy it may be obsolete before it floats any one of the seven seas. Time forbids giving lengthy concrete illustrations of the effects of drastic changes in our research policy. However, we venture to give two that at first sight may seem to be far removed from the interests of this academy. Yet, as we develop a new policy of national control we certainly should develop a keener interest in national security. We take these illustrations from the Air Service, for in all phases of our life do the airplane and kindred devices become more and more important. It is a known fact that engines operate differently at changing altitudes. Tests on engine performance must be made to insure the safety of fliers and to give confidence and security to the public. For this purpose the government had built a plant at Arlington, Virginia, where airplane engines were tested and certified according to requirements laid down in specifications drawn by the Department of Commerce. It must be known how an engine will perform at a certain height—say 30,000 feet. The Department of Commerce requires either the actual altitude test or approximate altitude tests "corrected in a proper way." It has cost the government an average of about $60,000 a year to maintain this plant. In July it was announced that the men in charge of this plant were dismissed or technically speaking were "furloughed for an indefinite period". The work is being discontinued and experienced men are being lost to the government. It is reported that no manufacturer is now able to make the necessary tests at his plant. Airplanes are expensive; human life is priceless. If a testing laboratory could avert one single crash a year, perhaps a $60,000 annual expenditure would be fully repaid.

We are told that "the making of emulsions for films has always been considered an art". When the United States entered the World War we were at once confronted with the need of equipment for aviation photography. Photographs at such time must be taken at long range, with short exposure, through mist or smoke. The photographs must give details. There was a demand for better films and especially those sensitive at the red end of the spectrum.

Two men have built up this highly technical service. Secrets have been carefully guarded. It is reported that no university in the land is doing research in the same field and that no laboratory in a public institution has undertaken the work. Is this a public asset worth saving? In July it was announced in the Science News Letter that this work was to be discontinued as an economy measure.

Perhaps it cannot be said at this distance whether such acts are fully justified. But it can be said that organizations such as the Oklahoma Academy of Science should have members who are keenly alert and ever on guard to protect for posterity the truths that have been gained by sacrificial blood and brain by faithful men and women who have been impelled by but one desire and that is to render a service to their race.

In the past the evolution of human betterment has been slow and those who have attempted progress have been set staggering at every turn because even the shrewdest of minds see into the future but dimly. Who is to manage the machinery of our new social control? Will it be those with technical training or will it be those with political aspirations whose chief

influence is party loyalty? In the past we have depended upon persons of maturity and experience to stabilize our enterprises. In the recent few years we have seen "thousands of the skilled, the able, the brilliant pitched out of posts of trust and dashed down the slope too far and too late in life ever to have hope of climbing back. In their lives at least there will never be sunrise again." (National Whirligig E.M.N. Oct. 1, 1933.)

Thus we close the governmental aspect and turn to a consideration of industries. It was but a few years ago that the large corporations were sending representatives to the universities every year to contract for the keenest minds that our tax moneys had prepared. In 1930, the National Research Council's Research Information Service reported that in 1420 laboratories there were being employed 33,596 scientists. This year they collected information from 1467 laboratories and found that 21,464 scientists on their staffs. That means that approximately 12,000 highly trained industrial research scientists were released. If only a part of these have joined the army of the unemployed the loss is astounding. It is estimated that "the potential value of the lost services of these scientisis must run into millions of dollars annually." (S. N. L May 6, 1933, P. 281.)

Our whole system of public education so far as it applies to training men and women for the professions is challenged. It is nothing short of economic waste for the states to tax the people to the extent of millions of dollars to train men and women for highly technical service if that ability to serve is then ignored and they are accepted as public charges. This appears as a matter of maladministration comparable with the blunder at the opening of the World War of sending the technically trained brains and hands into the trenches to use pick and shovel.

A different cross section of the tendency of the times may be gotten by a study of the disposal of vast sums of money placed under the management of groups of men and designated as foundations. The trustees of the Twentieth Century Fund have seen fit to define a foundation "as a separate organization with its own board of trustees or directors . . . set up, not to make money, but to disburse it" and that "it must disburse its funds not exclusively in operating its own activities but at least, in part, through grants to outside beneficiaries". In these United States there are listed in the report of the Twentieth Century Fund, 122 organizations that come within this definition, with capital funds amounting to more than $850,000,000. The three largest are: Carnegie Corporation of New York, The Rockefeller Foundation, The General Education Board.

The latest data we have at hand compares the grants from the foundations for the year 1930 and 1931. For the latter year the grants for research were cut nearly nineteen percent, which made a total reduction of more than two million dollars. However significant this vast sum may be, for our purposes, it is of far greater interest to study the shifting of the purpose for which the bequests were made.

While medical *education* suffered a loss of more than thirteen million dollars it should be noted that the grants to medical *research* increased by about 40%. The report of the Twentieth Century Fund brings into conspicuous relief the shifting tendency in public interest. Will you note the following depreciation in grants:

Engineering grants decreased	12%
Humanities	28%
Physical Science	48%
International Relations	64%
Aesthetics	73%
General Education	78%

This decrease in general education is the more noteworthy when we consider the large sums that have gone into that field in the past. Still

more conspicuous do the changes stand out when one compares them with the fields and percentages where increases are shown.

Social Science received increased grants to the extent of	21%
Medical research	40%
Economics	49%
Social Welfare	205%
Government	263%
Agriculture and Forestry	264%

This is a most interesting array of figures showing in an imperfect way how a vast sum of over fifty million dollars is being distributed for the public good.

Whatever transitions are taking place, we have both a duty and an obligation to do our part to help conserve the treasures we have gathered through toil and privation. Let us hold fast the treasures of religion with its vast undertakings applied in the social sciences. Let us hold fast to the treasures of the exact sciences that have brought us facilities for living more in a week than the hermits of old lived in their three score and ten. Let us find in both religion and science new revelations to point us more truly to the destiny of the human race. You and I have a part to play—this academy has its part to play in bringing this economic revolution to such a termination that there shall be conserved for our children all known benefits of medicine, physics, chemistry, biology, geology and engineering in all their ramifications in our present life. We have a call not only to research but a call to applied patriotism.

Mid-summer put an attractive piece of color into the picture when it was announced that President Roosevelt had appointed a science advisory board composed of ten distinguished men to assist the government in this new era of reorganization and development. The men selected are from those who have made outstanding reputations in their respective fields. Most of them have had long and successful experience as executives in charge of outstanding scientific organizations.

It would be wrong, it would be to miss the mark, to close this address without calling attention to some of the marvelous advances that are being made in science even in the face of adverse conditions. Before the depression had spread its halting influence over the land research work had received some recognition commensurate with the benefits it bestows on the nation in art, in science, and in industry. The momentum acquired carried the work into and through 1932 with astonishing results. We outline here a partial list of achievements for which we are indebted to the Science Service. The findings have come so rapidly that if one had no task but to read he could not keep abreast the times. During the year 1932 there were

14 major advances in areonautics
14 major advances in psychology and psychiatry
22 major advances in geology and geography
23 major advances in engineering
24 major advances in astronomy
26 major advances in chemistry
29 major advances in biology
37 major advances in anthropology and archaeology
37 major advances in physics
39 major advances in medicine

No one assumes that this list is complete. No one assumes that there is any published record of hundreds of successful beginnings that will later bear their fruit. No one assumes that dollars and cents can place a value on the beneficial results from these major advances alone, touching

every field of science. Here was the discovery of the neutron, extensive researches in cosmic rays, further successful attacks on the atomic nucleus, yellow fever and typhus being fought by means of protective vaccines, evidence that virus diseases are caused by non-living chemicals, tooth decay dependent upon inadequate calcium, phosphorus and vitamin D and more about the nature of vitamins.

Then there were new advances in the nature of hormones with the possibility of determining of sex before birth.

The discovery of the treasure tombs at Monte Alban in Mexico, paralleled by the new finds of ancient civilization in the old world, gave rich findings in archaeology.

While the astronomers were searching the heavens for new truth, viewing a total eclipse and discovering a minor planet, our closest visitor, the engineers were launching the world's largest ship and the Soviet Republic was bringing to completion a great power plant.

Even with the retarding influences present, research has gone forward this year with very remarkable results. More than a hundred men in the field of physics have made their attack on the cosmic rays on every continent and from pole to pole at every possible altitude. Intensified attacks with high voltages have brought new finds in atomic structure. These workers present us now not only with the electron and the proton but the neutron and the positron. Thus in two years the number of building blocks has been doubled. These finds are not remote from our daily life for they make up the atoms of which we are made, together with all we eat, drink, breathe, and wear.

The dentists connect rate of tooth decay with components of water supply. Through a combined attack of biology and physics the Rockefeller Institute of Medical Research, by means of X-rays, have approximated the size of the gene. This unit which controls physical characteristics and passes them on in man and other living things, too small to be seen with the human eye, is as important to biology as atoms and molecules are to physics and chemistry. It has now come under a refined measuring stick and settles down to take a place of one quintillionth of a cubic centimeter.

It has been estimated that thousands are killed each year by carbon monoxide and by cyanides. They may now be arrested from their trip to the cemetery by the administration of methylene blue.

Researches to reach absolute zero, some 273 degrees C below freezing at which temperature it is assumed that the molecules stop their ceaseless dance and electrical resistance, approach the zero value. It is announced that they are within a quarter of a degree of the goal. To some this may seem to be a useless effort. But once the methods were devised, an attack was made on the behavior of bacteria at these low temperatures to find that no refrigeration, however low, will kill the bacteria. Here, then, comes a new vision of germ-carrying dust out through space being picked up by the earth in its endless cycles through space.

The children's Bureau estimates that one-fifth of the children are showing the effects of the depression through poor nutrition, inadequate housing, lack of medical care, and the blight of anxiety and insecurity. Here is a new task for social science. Here are problems more outstanding than the mere maintenance of price levels. Here is a crop more valuable than wheat or cotton or hogs.

With steady hands and keenly trained minds by the aid of science we have conquered fear of famine so far as production is concerned. By what means shall we now learn how to live with abundance? Are we now involved in a transition that will subordinate the will of millions to that of a few? Lest we crash in the experiment, may we search every city, every hamlet, for those who are technically trained for each new venture.

And we shall need to pray for mercy if we neglect to use those who are trained in social science and in applied religion.

The achievements for the year are too vast for enumeration here so we pass to another phase of our problem. A few years ago scientific research was just beginning to furnish the surgeon with safe means of performing operations. X-rays were unknown. There was no skin grafting. Brain tumors were left undisturbed. Gall stones were not removed. Anesthetics were not used. Infections were left uncontrolled. Today Dr. Crite is reported to have said "that every organ and tissue in the body is subjected to surgery, and the work is so delicately and precisely done that shock, hemorrhage, and infection are remarkably reduced." It is estimated that 1,000,000 operations are performed in the United States now every year.

Marvelous as all this development is with its far-reaching benefits, it seems paradoxical to predict that there will be fewer operations a year in the coming century than there are now. The new sciences of biochemistry and biophysics will tend to supplant the surgeon's knife.

The present advancement in the use of radium, X-rays and ultra-violet light are so rapid that even those connected with the professions in which they are applied find it difficult to keep abreast the times. A few years ago ultra-violet light gave the bather a beautiful tan, then they produced for him the coveted vitamin D. Now the same rays are put to work to dry his fruits, to test his paints, to bleach his clothes, to detect his forgeries, to test his varnishes, papers, dyes, rubbers, gasolines, tar-products and his foods. They are used to treat cows so they will produce vitamin D in the milk. They are used in greenhouses in winter to produce summer crops. But with special significance comes the report that an exposure of 15 to 20 seconds under ultra-violet light, of proper wave length, has cell-killing effects unequaled by an exposure of 15 hours of radium or 24 hours with high voltage X-rays. Space here forbids more than a partial enumeration of the uses of radiant energy.

In closing, we make an urgent appeal for the members of this academy to consider the needs and benefits of popular talks and demonstrations setting forth the essentials of scientific progress and the benefits to be derived therefrom. Interest can be aroused and knowledge disseminated. We call attention to the campaign of information employed by the American Chemical Society following the world war through which a vast amount of information was made popular. By means of films and audio amplifiers, such concerns as the Ford Motor Company delineate in a few minutes the processes through which coke and iron are transformed to play their part in rapid transit over our thousands of miles of paved highways. Medical films now are available showing the effects of X-rays and violet radiation on human cells, bringing vividly to the consciousness of the observer the delicate nature of our beings and the most wonderful advances of knowledge. These are but illustrations. You may find many such applications in your special field.

The more people know about science the more willingly do they accept its benefits and the more willingly do they lend their support; more boys and girls enter the science courses; more buildings and equipment are put to useful purposes, greater because the opportunity for research and the cycle closes with greater benefits for rich and poor alike.

More popular education is needed to banish the falacy that science is a foe to religion. How dearth would be the churches today if there were taken from the pews all who follow the pursuits of science and at the same time try to follow the teaching of Him who said: "Do unto others as ye would that they should do unto you." By God's mercy the wheels of science plant, harvest, haul to and from the mill, grind and purify, bake, deliver the daily bread consumed by the priest and peasant

alike. How much longer must we delay until through common knowledge, gained by popular lecture and demonstration, both priest and peasant may join in unison to thank the Creator for giving us men and women of genius who after thousands of years of waiting can at last read His thoughts to bring us revelations that inspire both heart and soul. When we leave this table may we leave resolved that there is committed to us a great task. It is ours. May this academy do its part.

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