RESEARCH, ITS OPPORTUNITIES AND REWARDS*

BY

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Taking Research as including experimentation, exploration, and invention, one is justified, from a survey of its many activities, in terming it an occupation that gives employment to tens of thousands while its results furnish gainful work to millions.

Our government is, I believe, the largest single research institution in the world. Several of its departments might be termed extension schools for the diffusion of knowledge. The Department of Agriculture alone carried on last year one hundred seventeen lines of investigation, covering various phases of science and employing twenty-six thousand persons, five thousand of whom were actively engaged in research. In addition there were four thousand county agricultural, home demonstration, and club agents, four hundred supervisory officers, and one thousand two hundred extension specialists. A topographic force, a water resource branch, co-operating in thirty-four states, the conservation branch, all have scientific forces. C. W. Washburton says: "Every state in the Union has its college of agriculture and its extension service and its state agricultural department." To all these the department is giving freely its stores of research information. Under this system every farm bureau agent becomes an employee of the government and every farm organization benefits. Another consequence is that four thousand high schools in the forty-eight states have departments of vocational education with an enrollment of nearly one hundred twenty-five thousand and receive the benefits of combined research. In Illinois ninety-five farm bureau advisers contribute their quota to sixty thousand members.

Last year the Department of War carried on nine hundred thirty projects, including fifty canals and waterways. Flood control and great waterway projects demand the most careful and exacting study by army engineers.

* Address of the Retiring President, read before the General Session, May 8, 1931.

The Interior Department has just established a Board of Education and Research for the national parks and monuments. In the department are such bureaus as the Reclamation and the Geological Survey, including large forces of scientists and employing research at many points. Thirty states benefited last year by the work of the survey and one can scarcely compute the value of the resources that it brought to light.

In the Department of Commerce are four research divisions and through its Bureau of Standards it operates an associate plan in research. The bureau's advisory committee represents fourteen national associations with twenty-four other groups cooperating. Ninety-six research associates are maintained at the bureau by forty-one separate organizations. In the aeronautic branch alone sixty lines of research were prosecuted last year. In all the activities of the bureau a large, thoroughly trained personnel is employed. Last year its patent office issued forty-five thousand two hundred forty-three patents, not including designs and reissues, disclosing that over forty-five thousand of our citizens, many of them not of college or university standing, had through study and concentration succeeded in creating something new and perhaps better than what had heretofore been used.

Research in Illinois

All the forty-eight states are carrying on research work. In Illinois the State Museum, the Natural History Survey, the Water Survey, the State Geological Survey, the Agricultural Department with its several divisions, the Department of Conservation, the Public Works Department with its flood relief, waterway, and road problems furnish fields for scientific investigation. Our Geological Survey in addition to its field and topographical work, has, very much to its credit, instituted field trips for teachers. Coming from many industrial leaders is a request for an intensive investigation by the Survey of the mineral resources of Illinois, and this is something that this Academy should heartily approve. All these fields require men competent to undertake research.

Seconding every effort of the State is our State University. The Agricultural Experiment Station alone, last year had two hundred eighty research projects under way. In Agronomy, in Railway Engineering—a recent achievement of which may save the railways $25,000,000 annually—in the sciences, and in many other lines the work is of a practical nature and through many publications the facts are given to the people.

Twenty-six other universities and colleges and the five Normal schools of Illinois are contributing their share. Chicago University has been an outstanding center of research and so has Northwestern and both have to their credit for the year a notable number of achievements. The aggregate of what the others have done is large. On the faculties of the four leading universities of the State are approximately three thousand instructors and they ministered last year to thirty-seven thousand eight hundred students. Seven hundred high schools in Illinois have science courses in greater or less degree, many of which vie with the colleges in their excellent equipment. Add to our educational agencies, the many private citizens interested in science and the several scientific associations and one comes to realize that a great upward movement is in progress. At the last meeting of this Academy one hundred twenty research papers were presented representing much patient and painstaking original investigation.

Industrial Research

As significant as any of the scientific movements of the day is that of Industrial Research, disclosing that our corporations are thoroughly aware that in it there are great possibilities. The National Council of Research reports that in 1920, three hundred industrial concerns had research departments; in 1925, five hundred twenty-six; in 1927, one thousand; and early in 1931, one thousand six hundred twenty-five. Many corporations did not answer the queries; others gave only the heads of departments, and some added the expression "and others," so that the total of twenty thousand engaged even in the research departments reporting is only a partial figure. Only a few of the great railroad companies, which maintain staffs, made returns; nor does the total include the laboratories of the Federal, State, or Municipal governments, or those of educational institutions, the great scope of whose work we have already indicated. Holland, in his work on Industrial Explorers, estimated that in 1928 in the industrial research laboratories thirty thousand were kept employed at a daily expense of $500,000. The Bell Telephone Company alone enrolls three thousand in its research activities. In 1930 approximately nine hundred were employed by the rubber products corporations of one city. In the various Du Pont industries over one thousand five hundred; in the General Electric over one thousand three hundred; in the International Harvester over six hundred, in the General Motors, four hundred forty-five; in the Standard Oil, five hundred; in the Westinghouse, five hundred; and in the Ford plants one hundred fifty technical men, mostly chemists, and a large force of assistants were employed. Over two thousand

research directors head these departments, which are handling four hundred thirty different products.

In addition the Bureau of Standards lists two hundred seventy-one commercial testing laboratories, and one hundred eighty-six college laboratories doing more or less research work.

The National Council of Research reports one hundred seventy-five industrial laboratories in thirty-six Illinois cities with a personnel of over two thousand three hundred. In Chicago alone there are one hundred fifteen laboratories and they are doing a wonderful work. In all our states is this effort in progress.

Research Organizations

Of institutions devoted to research we have a noble group. One might mention the Smithsonian Institution, the Rockefeller Institute for Medical Research, the Franklin Institute, the Bartol Research Foundation, the Arkwright Research Foundation, the Carnegie Institution carrying on forty lines of research, the National Research Council with a membership of accredited representatives of seventy-five national and technical societies, with its eleven major divisions, its fellowships, its careful selection of men for specific purposes, its co-operative activities and its encouragement of a high order of ability in research, and the Mellon Institute with one hundred forty-two fellowships in operation and linked with great industries. One could start with the Massachusetts Institute of Technology and go across the country to the California Institute of Technology, of late so much in the public eye, and find the country between dotted with research inspiring institutions. In medicine and surgery he would find such great hospitals as Mayos and John Hopkins and others of marked eminence and usefulness, the total number of hospitals for the country being close to six thousand seven hundred.

The National Academy of Science, the American Association for the Advancement of Science with its membership drawn from twenty-five state academies and fifteen other scientific organizations, the American Chemical Association with its membership of many thousands, and numerous other scientific organizations, some eighty in all, furnish incentives and opportunity for research workers while the papers and discussions tend to personal and public enlightment.

In the realm of engineering and architecture there is an ever expanding field. The $30,000,000 bridge over the Golden Gate; the $120,000,000 water supply project for San Francisco; the Liberty Bridge across The Narrows of New York harbor; the $4,000,000 dam

for Seattle's power enterprise; the gas pipe extensions from the southwest to large cities; the tunnels through mountains and under rivers; the long subways in crowded cities; the immense, towering blocks, like the Empire State Building of New York City; the great water supply and sanitary drainage problems; the creation and equipping of magnificent power plants; projects like the Hoover Dam; the gridironing of the country with hard roads; the intensive study of all construction material; all these and many other modern enterprises call for preliminary research and a comprehensiveness of technical knowledge never before equalled. The searchlight has been turned on our homes. We predict that one hundred years from now people will smile at our present day homes. Dr. Comstock announces a new method for cooling homes; windows may be omitted and electric sunlight used; there will be more perfect ventilation. Dr. Abbott may make sun cooking practical; the sun's heat may be stored for warming homes; building material will be fire-proof.

The World, the Field

The world is the field. Last year one hundred twenty-five expeditions went from this country, including altogether a large and courageous personnel of scientists. Great dangers and hardships attended many of these, as that of Byrd to the South Pole or of Andrews to the wilds of Asia. Their contributions to knowledge transcend estimate. At the same time there were scores of expeditions to parts of our own country under the auspices of colleges and universities. Think of Princeton's eleven thousand mile geological trip!

Among the institutions that are promoting research are the great museums. A dozen of these are justly famous. We are all proud of the record of Field's which last year carried on some twenty-six lines of research and extol that of the American Museum of Natural History which reported thirty-four enterprises. Scores of our cities maintain laboratories some of which are on a large and elaborate scale.

Also as promoters of research one must include the newspapers and magazines. Of great merit is the work done by the National Geographic and a host of scientific periodicals. Impetus is given by our great observatories, some fourteen in number, several of which are provided with the largest telescopes and the most perfect equipment in the world.

There is no standing still. Yale college has a gift of $500,000 for a research project; in Florida, Harvard is establishing a School of Geography; there is the Bamburger and Field gift of $5,000,000 for a

School of Research; Shedd's beautiful aquarium in Chicago, costing $3,000,000 is completed; Purdue has ordered a research foundation; the Rockefeller Institute has a new laboratory; the Duke Forest in Florida is dedicated to research; Mrs. Walter Graeme Ladd creates a $50,000,000 foundation for medical research; Ford establishes an industrial university; Julius Rosenwald donates $2,000,000 to the Chicago Academy of Science and Industry; Colgate adds the McGregor Hall of Chemistry; Cincinnati is to have a million dollar research food foundation; the Cleveland Museum undertakes an arboretum; Brooklyn's Medical Center will cost $100,000,000; Scripps Institution has a new $120,000 Ocean Laboratory; Cornell is adding a million dollar Science Building; a new research building for Mellon Institute is announced; a $5,000,000 hospital features Northwestern's year; a $2,000,000 Science Building for the University of California is completed; Chicago University possesses two new science structures; and in fact last year in gifts $100,000,000 was spread among one hundred seventy-two universities and colleges to enlarge their opportunities of service.

The Rewards

I have tried to visualize the field and its opportunities. Is it worth the while? There are financial benefits and they are not to be despised. There are awards one of which—that of the Popular Science Monthly—carries $10,000; there are the Salem Memorial of $2,500; the $1,000 award of the American Association for the Advancement of Science; and other prizes that betoken appreciation. Medals of distinction are bestowed. Dr. Karl Landsteiner wins the Nobel prize; Dr. C. W. Tombaugh achieves a British astronomical medal; Dr. Otto Folin is awarded the Scheele medal; Dr. J. A. L. Waddell is given the Clausen gold medal; the French Academy admits Dr. J. H. Breasted. There are fellowships in research institutions; honors from colleges and universities that create possibilities of greater service; there are leaves of absence and many grants, there are degrees that symbolize achievement and there are fame and grateful recognition for those who succeed.

A Growing Occupation

I am merely presenting a picture of a growing and ennobling occupation whose doors are swinging open to the nine hundred twenty thousand students in our approximately six hundred universities and colleges, to the students in the one hundred fifteen Normal schools and two hundred sixty junior colleges and to our several millions of high

school pupils. They need no longer follow Horace Greeley's advice: "Go west young man, go west," but many of them may qualify themselves for research opportunities.

We are still ignorant; the best is before us. The combination of brain and hand signifies advancement. Millikan says creation is constantly in progress in the infinite spaces; Hart says that a high intelligence is perceptible throughout the universe; Eddington says that the spiritual element in our experiences is our creative element; Boyd practically says that research is a creator of employment. Accomplishment is the end and reward of research.

I hope that the time will come when our government will establish not merely medal rewards, but substantial money prizes to be given annually to Americans who have made the most noteworthy and valuable research contributions, and that present limitations on the time of ardent research workers will be removed.

I have reason to believe that a bill establishing such awards will be introduced by an Illinois member at the next session of Congress, and I trust that this organization will be the first to approve it, not from any selfish motive, but as a grateful recognition of a great service rendered.