whose cortex has been destroyed may give all the signs of rage, though it is a blind rage and useless to the animal. With the brain intact the rage is directed. It is still a stereotyped response, but it is often the best response for the cat to make, since its cortex has not the capacity to plan more elaborately. In man, however, the cortex, when it is allowed free play, can be far more patent, and emotional reactions which force the behavior along one line and allow no scope for discrimination are far less so. Moreover, emotional reactions tend to spread through all the members of a group and to build themselves up to higher and higher levels.

There is no need to pursue a devious argument to its certain but commonplace conclusion—that our behavior will be most effective when there is enough emotional tension to arouse the activity of the forebrain but not enough to submerge it in a stereotyped response. We know well enough that our emotions can cloud our judgment, and the psychologists have shown that they do so far more than we suspect. We know that some interest is necessary, that moral indignation supplies the driving force for great reforms, but that rage does not help them. Need we care greatly whether the neurologist can produce a scheme of nervous mechanism which will account for these things?

Most of us, I think, would welcome the knowledge gained, but we might reasonably doubt whether it would make us more effective units of society. It is, in fact, unlikely that neurological research will give new methods of control over human behavior. What it will certainly do is to improve some of the methods which exist already—for instance, the control of behavior by drugs. Tea and alcohol are homely examples, and the new narcotics which can give peace of mind before a surgical operation have shown what we may expect in future from this method of regulating our brains. For more continuous action there are the drugs which the body manufactures for itself—the hormones. These, fortunately, have a place reserved to themselves in to-day's discussion.

But when all is said, a knowledge of physiology offers only one certain, though perhaps unattainable, method by which human behavior could be improved. That is to breed men with larger brains. Our cerebral hemispheres are not so much larger than those of the chimpanzee and contain no new structures, but our behavior is of a different order. We can pile one box on another without thinking; Professor Köhler's chimpanzees could succeed by chance, but the essentials of the problem were quite outside their mental range. It is tantalizing to think of the new relations we should see, of the new world of thought we should live in, if our brains were but twice their present size. Our behavior would then be superhuman! it would be determined by the same physiological factors, but the importance of the cortex would be so magnified that the result must be beyond the power of human thought.

SUMMARY STATEMENT OF THE WORK OF THE NATIONAL RESEARCH COUNCIL

By Dr. FRANK R. LILLIE
CHAIRMAN

THE annual report of the National Research Council is printed each year in the Report of the National Academy of Sciences, a Senate Document, by the Government Printing Office in Washington. As the report for the year ending June 30 usually appears in April of the following year, and is relatively inaccessible to the scientific public, a summary statement of the year's work has been published in SCIENCE in recent years.

The past year completes the twentieth year of operation of the National Research Council since its organization by the National Academy of Sciences in the summer of 1916 after the academy had offered its services to the Federal Government in the interests of national security. Since the termination of the world war the Research Council has endeavored to serve the interests of scientific research in this country as a mechanism of coordination operated by American scientific men themselves, in relation to academic, industrial and governmental interests in science. It is clear that the Council has little, if any, effectiveness apart from the use which these men may make of the facilities of such relationships, under the auspices and coordinated support which it offers.

The National Research Council is an agency of the National Academy of Sciences and operates under its Congressional Charter of 1863. During the year just passed the president of the academy acted also as chairman of the National Research Council. At the close of the year this arrangement was terminated, and Dr. Ludvig Hektoen, of Chicago, was elected chairman of the National Research Council.

I. GENERAL RELATIONS

GOVERNMENT RELATIONS

The charter of the National Academy of Sciences provides among other things: "The Academy shall, whenever called upon by any department of the government, investigate, examine, experiment, and report upon any subject of science or art." In order to be better prepared to meet these responsibilities a Government Relations Committee was set up in the National Academy of Sciences in 1925.

The executive order by President Wilson in 1918 requesting the Academy of National Sciences to perpetuate the National Research Council also strongly emphasized government relations, and pointed to the duty of scientific men to cooperate actively with the scientific and technical services of the various departments of the National Government.

From 1933 to the end of 1935 the National Research Council cooperated closely with the Science Advisory Board which was set up under executive order of President Roosevelt "acting through the machinery and under the jurisdiction of the National Academy of Sciences and the National Research Council to appoint committees to deal with specific problems in the various departments." The important work of this board under the chairmanship of Karl T. Compton is well known and is recorded in their published reports.

With the expiration of the period of appointment of the Science Advisory Board on November 30, 1935, its functions were combined with those of the Government Relations Committee of the academy in a new committee known as the Government Relations and Science Advisory Committee, related both to the Academy and the Council. This committee, which centralizes the federal relations of Academy and Council, is composed of twenty-four members with a smaller internal executive committee comprising a majority of the members of the Science Advisory Board; it has taken over certain continuing committees of the latter, and has appointed other committees on request of government departments.

Among these enterprises are the appointment of advisory committees to the Weather Bureau, to the National Bureau of Standards and to the Soil Conservation Service, certain assistance to the Navy Department, a study of the relationship of the United States patent system to the stimulation of new industries, the improvement of means for signalling for safety at sea, particularly in cases of fog; and means for the comprehensive abstracting of scientific literature in the field of biology. A report of a committee of the Science Advisory Board, completed last July for the Navy Department, on the design and construction of airships definitely recommended further experimentation in the construction of lighter-than-air aircraft with a view to the successful development of this method of transportation.

The National Academy of Sciences is also represented on the Science Committee of the National Resources Committee operating under executive order by President Roosevelt; and through this relationship is brought into contact with problems of general national importance, in which the outlook and resources of science are assuming increasing significance.

FELLOWSHIPS

The national research fellowships administered by the National Research Council with funds supplied by the Rockefeller Foundation since 1920 have proved to be one of the very strong factors in the recent development of scientific research in America. Many of the past fellows have earned distinction, and occupy leading positions in academic life, in research laboratories and government bureaus. The system of providing opportunity for uninterrupted research after attainment of the doctor's degree has come to be a settled factor in the American plan of training for advanced scholarship. Under the National Research Council during the current year (1935–36), 56 fellows were working in the physical, medical and biological sciences; 49 appointments have been made for the following year. These are much smaller numbers than previously, when there was a much larger potential outlet in academic fields for such highly trained individuals. Other agencies have entered the field of post-doctorate training in the meantime; and there seems no reason to expect a decrease of opportunity for advanced study on the part of really gifted and enthusiastic candidates. The leading part played by the National Research Council may be expected to continue, though on a smaller scale. To have led the way in the development of this essential addition to the older plans for advanced training has been a much prized privilege of the National Research Council.

A stage of transition has been reached in the administration of these fellowships, as in so many other affairs; and the experience gained in sixteen years must now be utilized in adapting the system to the new conditions with which we are confronted.

ABSTRACTING AND DOCUMENTATION OF SCIENTIFIC LITERATURE

The Council has long been concerned with this fundamental need of scientific research. Among other activities it fostered the establishment of *Biological Abstracts*. The financial difficulties of this indispensable journal, the rapid growth of scientific literature and the evidences of future different methods of scientific publication combined in a decision to hold a com-

prehensive conference on the subject, including in its membership editors of abstracting journals, librarians, publishers and other interests. The subjects considered were the place and function of abstracting and indexing in scientific documentation, the form and content of abstracts and the use of analytical indexes, the fundamental delimitation of fields and their relation to specific subjects, the methodology of abstracting and indexing, and means for the reproduction and distribution of abstracts.

As a result of this conference, which was held in Washington on December 9 and 10, 1935, a standing committee of the National Research Council was appointed "to represent the various scientific Divisions of the Council, with instructions to prepare and present a long-time program looking toward the effective support of abstracting agencies in the several fields of science."

Integration of the Sciences

Dr. Bowman, in his "Summary Statement of the Work of the National Research Council for 1934–35" referred to the consideration which had been given by the Administrative Committee to borderlands between the traditional scientific fields. This consideration has led to the formation of an interdivisional committee on borderlands in science between the divisions of physics, chemistry and geology. A similar committee in the biological sciences, if formed, would integrate numerous overlapping interests between biology, psychology and anthropology and the medical sciences.

These should be promising aids to the integrating functions with reference to the natural sciences, which it is the business of the National Research Council to exercise. The present time is an age of integration in which the functional, as contrasted with the purely logical, aspects of science are coming to the fore. There is an insistent urge to utilize all scientific knowledge obtainable for the public welfare in the innumerable ways now open for the application of knowledge in industry, in governmental administration, in public welfare and in other portions of our social order. Such problems do not accommodate themselves to the limits of the traditional fields of learning. They invade several fields at once and demand contributions frequently from a varied group of scientific men. Integration of knowledge from varied sources, brought to bear upon a single social purpose or end, is characteristic of the present scientific situation.

International Relations

The international unions to which the Council now adheres are the International Astronomical Union, International Union of Chemistry, International Union of Geodesy and Geophysics, International Scientific Radio Union, International Union of Pure and Applied Physics, International Geographical Union and the International Union of Biological Sciences.

It is gratifying to be able to report that the Federal Government through the Department of State is again undertaking the payment of dues in the International Council of Scientific Unions and that the continued participation of the United States in these essential coordinating mechanisms of international science thus seems assured.

Central Purposes or Functions

Whatever may be accomplished by the Divisions of Science and Technology in their respective fields certain central functions can be served only by the Council as a whole. Finance and administration is one on which all other functions depend. This granted, the main central function is to provide the auspices under which the scientific men of the country may meet to consider the promotion of research broadly or in special fields. Out of this all else will flow. Provision must, of course, be made for the meetings of the various administrative bodies. But, quite apart from that, the budget of the Council must make provision for rather frequent conferences of non-administrative kind. Funds for this purpose have been set aside for a series of years, and it is hoped that it may be possible to increase funds devoted to this purpose. A second central function in which the academy and council cooperate is the maintenance of appropriate government relations referred to above. This also requires special budgetary provision. A third central function is the support of special international scientific undertakings, in which the National Research Council should be able to cooperate.

II. THE DIVISIONS OF SCIENCE AND TECHNOLOGY

The preceding statements have dealt with certain general relations of the Council; but many activities of the Divisions of Science and Technology are of general interest. The following items are selected in a rather arbitrary fashion without reference to the separate divisions under which they are administered. As the number of committees under these divisions amounts to fifty-five it is only a small selection. Moreover, it omits entirely the broader divisional interests which are constantly pursued. It should be said that the divisions are very active organizations in contact with the leading developments of their respective fields.

Electrical Insulation

The growth of the Committee on Electrical Insulation is an example of one mode of operation of the National Research Council. Beginning as a small committee of the Division of Engineering and Indus-

trial Research about nine years ago, this committee has arranged each year for a symposium on the results of current investigations on dielectrics. At these symposia some 15 or 20 papers are ordinarily offered for discussion, and of late years the meetings of the committee, held in various industrial centers in the northeastern states, often in conjunction with other meetings of electrical engineers, have attracted large attendance. The meeting of last fall was held at Pittsfield, Mass., under the host auspices of the General Electric Company. Reports of these meetings are manifolded inexpensively and are circulated among electrical engineers both in the United States and to a considerable extent abroad.

The committee now contains an active group of about ninety members and an even larger number of additional correspondents. It has become an effective agency for the encouragement of research in this field, for the exchange of information on current developments and for the stimulation of new research on matters brought out in discussion at its annual conferences.

Laboratory Tours

The Division of Engineering conducted last fall the third of a series of laboratory tours designed to give industrial and financial executives an opportunity to see the relationship of research to industry as carried out in certain industrial laboratories. The institutions visited last fall were: General Electric Company, Schenectady, N. Y.; Eastman Kodak Company, Rochester, N. Y.; B. F. Goodrich Company, Akron, Ohio; Gulf Refining Company, Pittsburgh, Pa.; Mellon Institute, Pittsburgh, Pa.; Bell Telephone Laboratories, New York City.

The division has also lent its assistance this summer to the American Committee for the Third World Power Conference in the organization of similar tours offered to the members of the conference when it convened in Washington early in September.

Highway Research Board

The Highway Research Board represents a method by which the Research Council offers continuing assistance to the Federal Government in effecting coordination of non-governmental research agencies, such as the state highway commissions, engineering departments in universities and a number of industrial corporations which are concerned with aspects of the planning, building and maintenance of highways during this period when motor transport is dominant. The board now has contacts with all the state highway agencies and with some thirty-five technical and commercial associations and organizations of national scope. Its numerous committees represent problems of highway finance, transportation economics, design, materials and construction, maintenance, traffic flow and regulation, safety, and soils investigations from the point of view of the highway engineer and administrator.

The fifteenth meeting of the Highway Research Board was held in Washington on December 5 and 6 with an attendance of over 350 for the presentation and discussion of a large number of reports prepared under the auspices of committees of the board. In addition to the publication of the *Proceedings* of these annual meetings, the board also issues a monthly abstract leaflet, which gives advance information on important research in progress in this field, and digests of articles published in various journals which ought to be made widely available.

Sex Research

One of the most important projects undertaken by the National Research Council in the field of the medical sciences is the program which the Committee for Research in Problems of Sex has been conducting for over fourteen years and which has been supported by appropriations from the Rockefeller Foundation.

During the early years of these investigations studies in the physiology of reproduction with special reference to the sex hormones were emphasized. Of recent years increasing attention has been given to the psychology and psychobiology of sex. Altogether, over 760 papers have resulted from this work at the hands of some 66 collaborators in many institutions of the United States. During the past year the committee has had at its disposal a sum of $77,000, from which $72,050 was allotted in grants for eighteen projects located at sixteen institutions.

Early last January a conference of the committee and several of its collaborators was held in St. Louis to plan for the revision of the book entitled "Sex and Internal Secretions," edited under the auspices of the committee in 1932 by Dr. Edgar Allen, of the Yale University Medical School. A revised edition of this book is to be published later this year.

A valuable result obtained through this undertaking has been the development of independent centers for research in this field.

Narcotics Research

The Council's Committee on Drug Addiction has been engaged for the past seven years in a study of the chemistry of narcotic alkaloids and the physiological reactions of these substances for the purpose of obtaining precise knowledge upon the composition of these drugs and their effects in medical practice and in addiction cases. A strong laboratory has been created at the University of Virginia for analytical and synthetic studies of this group of chemicals. An-

other strong group has been built up at the University of Michigan for pharmaceutical studies of substances produced by this chemical laboratory. Up to this time about 300 new alkaloids have been prepared, the more promising of which have been fully tested physiologically with interesting and useful results in regard to several of the new substances as leading possibly to the production of more controllable and more beneficial drugs than opium and its derivatives. Several of these substances have been or are being patented and presented to the United States Government in the person of the Secretary of the Treasury.

All the clinical work in connection with the study is being carried out by the United States Public Health Service Division of Mental Hygiene at the New Narcotic Farm at Lexington, Ky., and at the State Hospitals of Massachusetts under the direction of the Department of Public Health.

The committee has been greatly aided in studying the underlying principles of narcotic drugs in relation to drug addiction by other universities and departments of the Federal Government and by several large manufacturing firms.

The comprehensive book prepared by Dr. Small and published by the Public Health Service forms a base line for all studies in this field, and permission has been granted for its translation into three foreign languages.

Medical Reports

The Division of Medical Sciences has sponsored the production of two significant reports which have been issued during the past year. One of these was a survey of research in progress in this country and abroad on the gonococcus and gonococcal infections. This study was undertaken in cooperation with the American Social Hygiene Association. The second report was a survey of the relative incidence of tropical diseases. This was published by the *American Journal of Tropical Medicine* in a volume entitled "A Geography of Disease."

Radiation Research

The Committee on Radiation, which is encouraging research upon the biological effects of ultra-violet light, x-rays and radium emanations, has supported a coordinated program of research in this field during the past seven years by grants of considerable funds contributed by certain foundations to collaborators now numbering about fifty. The committee has thus had a part in the introduction and adaptation for biological research of the new techniques of physics which have opened up large new areas for investigation, particularly with respect to genetics.

Last spring a two-volume treatise was published entitled "The Biological Effects of Radiation," which had been prepared under auspices of this committee, to present a comprehensive review of present knowledge of this subject.

Child Development

This year marks the transition to independent status of the program for the encouragement of research in child development which the Research Council has carried on for several years supported by funds provided by the Laura Spelman Rockefeller Memorial and later by the General Education Board. The systematic development of this field was begun by the Council by the appointment in 1920 of a Committee on Child Development. Between 1925 and 1933, four conferences were held for the discussion of the organization and course of research in this field. A full time director for the committee was maintained between the years 1926 and 1929; and in order to aid in the development of trained research personnel a series of post-graduate scholarships (under which 116 appointments were made) and a series of post-doctoral fellowships (under which 14 appointments were made) were maintained for several years. An abstract journal in this field, *Child Development Abstracts,* was established and is now in its tenth volume. Numerous research projects have been encouraged by the committee. Interest in this field developed rapidly, and at a conference held in Chicago on June 24, 1933, the committee brought about the organization of a Society for Research in Child Development. This society now has a membership of over 300 and has recently taken over most of the responsibilities of the Council's former committee.

The whole enterprise, through a preliminary phase of about five years and a more active later phase of ten years, is an example of the successful development of a new movement in science through stimulation of interest in an important subject and the coordination of support among workers in the field, until eventually a stage has been reached at which the movement can proceed on a self-supporting basis.

State Archeological Surveys

A similar movement is also in progress with respect to the career of the Council's Committee on State Archeological Surveys, leading to the establishment in December, 1934, of a Society for American Archeology which will be able in various ways to extend the purposes which the committee has had in view. As one of its first activities the society has undertaken the publication of a quarterly journal, *American Antiquity,* the first number of which was issued in July, 1935.

The Committee on State Archeological Surveys has endeavored to encourage and coordinate research in

American archeology, particularly in the Mississippi Valley and the Southeastern states. A number of conferences have been held by the committee for the correlation and interpretation of current findings and to promote a realization for the need of careful and well-advised exploratory field work. A series of informational bulletins has been issued from the office of the chairman of the committee. The committee has also been instrumental in arranging for the administration of government relief funds from the Works Progress Administration and the Tennessee Valley Authority for work in the Tennessee Valley for the recovery of archeological remains in regions soon to be inundated by dams now under construction or projected.

A large number of other undertakings of the Council might be added to this account, but it is not intended in this place to give a statement of all the activities of the Council during the past year. The full report will be published with the Annual Report of the National Academy of Sciences in April, 1937.

Grateful acknowledgment should be made in this place to the Carnegie Corporation and the Rockefeller Foundation for their aid in tiding the administration of the Council over a period of reduced income, in addition to their other large contributions.

SCIENTIFIC EVENTS

THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

ACCORDING to Science Service, the International Union of Geodesy and Geophysics is now meeting in Edinburgh, with representatives from thirty-five countries in attendance. Some thirty-five Americans are present, representing governmental bureaus, colleges and research institutions. Dr. William Bowie, chief of the Division of Geodesy of the U. S. Coast and Geodetic Survey, is president of the conference.

The fields of geodesy, seismology, terrestrial magnetism and electricity, physical oceanography, volcanology, meteorology and scientific hydrology are covered by seven associations of which the International Union of Geodesy and Geophysics is composed.

A few of the subjects to be discussed are: The aurora, the transmission of radio signals, the determination of the figure of the earth, isostasy, the Wegener theory of drifting continents, the variation of latitude, the prediction of weather, the variation of the compass, the making of a world magnetic map to aid navigation by water and air, the location of epicenters of earthquakes and the determination of the times of travel of earthquake waves, the determination of the configuration of ocean basins, the cause of volcanoes both on continents and on islands, the evaporation of water from land and lakes and the growth or retreat of glaciers.

Besides Dr. Bowie, the following representatives of the U. S. Government are delegates: Captain N. H. Heck and Walter D. Lambert, of the U. S. Coast and Geodetic Survey; Dr. Paul R. Heyl, of the National Bureau of Standards; Dr. Oscar E. Meinzer, of the U. S. Geological Survey; R. Hanson Weightman, of the U. S. Weather Bureau; Dr. Oliver R. Wulf, of the U. S. Bureau of Chemistry and Soils; Lieutenant P. W. Thompson, of the U. S. Army.

The Carnegie Institution of Washington is represented by Dr. Arthur L. Day, Dr. John A. Fleming, Lloyd V. Berkner, Harry D. Harradon and William J. Peters.

Other Americans expected include: Professor Harry Bateman, of the California Institute of Technology; Dr. James E. Church, University of Nevada; Professor Richard M. Field, Princeton University; Frank Goldstone, Shell Petroleum Corporation; Dr. Laurence M. Gould, Carleton College; Professor Beno Gutenberg, California Institute of Technology; Dr. William H. Hobbs, University of Michigan; Columbus Iselin, Woods Hole Oceanographic Institution; the Rev. J. Joseph Lynch, Fordham University; the Rev. James B. Macelwane, St. Louis University; Professor Edwin G. Conklin, Princeton University; Carl Elges, Nevada Agricultural Experiment Station; Roger Revelle, Scripps Institution of Oceanography; Dr. Carl G. Rossby, Massachusetts Institute of Technology; Dr. Harlan T. Stetson, Harvard University; Dr. William T. Thom, Jr., Princeton University; Professors Thomas G. Thompson and Clinton L. Utterback, University of Washington; Dr. T. Wayland Vaughan, Scripps Institution of Oceanography.

THE PITTSBURGH MEETING OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

THE autumn meeting of the American Society of Civil Engineers will be held in Pittsburgh, Pa., from October 13 to 17. The New England and New York State floods of 1936, as well as those of the Ohio River and its tributaries, their health and sanitation aspects and the problems of flood control in general, will be one of the chief topics on the program.

At the opening session of the technical meetings, on Tuesday morning, James J. Davis, United States Senator from Pennsylvania, will present a paper on "The Flood of 1936 in the Pittsburgh Region." In an afternoon session, the same day, "The Health and Sanitation Aspects of the 1936 Flood" will be discussed