factors of cerebellar ataxy." Nevertheless, we regard adiadochokinesis, dysmetria, asynergia and ataxia as important symptoms in the diagnosis of cerebellar affections, and they render good clinical service. Of course we shall not cease to seek better signs to enable us to perceive the functions and pathology of the cerebellum.

The localization of function is less well known in the cerebellum than in the cerebrum. What Bolk supposed on the ground of comparative-anatomical study, and what Rynbork, Rothmann and others made probable by experiments on animals was proved in the human cerebellum by Barany's physiological and clinical research, that there are areas of the cerebellar cortex which correspond to the extremities. In the first place, the muscles of the extremities are represented in the cerebellum by directions of movements, that is to say, there exist four centers, those for right, left, upward and downward. In the case of rest there goes from the four centers to the muscles of the extremities a tonising impulse; and thus equilibrium is maintained. If, for example, the left center is suddenly destroyed, the right extremity moves vertically to the right side, because the left center having disappeared, the right becomes overweighted. If the upper center is destroyed the extremity moves in a horizontal direction in analogous manner downward. The centers for all these movements are localized on the cerebellar hemispheres in the *lobus semilunaris superior et inferior* and in the *lobus biventralis*. Only the site of the center for upward movements of the arm is unknown. The action of these centers is like that of two bridles, the relaxation of one causing the overweight of the other.

If we now examine the cerebella of fish, we find that the apparatus for maintaining equilibrium of the body in the amphioxus, cyclostome and plagiostome is not yet well developed. The Teleostei have, in the medulla oblongata, large cells called Mauthner's cells, which have the function of maintaining equilibrium. Moreover, in this class of fish the "back-cerebrum" is also well developed, corresponding to the cerebella of other animals. We see further that the cerebellum is almost absent in a variety of skate which stays at the bottom of the sea practically motionless, while in the common variety which swims, it is well marked. It is also very interesting to see that the cerebella of fish have several different, sometimes very curious, shapes: standing up straight or lying down forward or backward, according to the species. The largest cerebellum is to be met with in Mormyridae, to which belong *Mormyrus kanume, Petrocephalus sp.* and *Gnathonemus cyprinoides,* inhabitants of muddy water and swimmers in thickets of water-plants. They do not swim quickly, but are very nimble and vivacious with constant movements of fins, as they wind their way between the aquatic plants. The cerebellum of the Mormyridae is most hypertrophic and overlies all other parts of the cerebrum in the same manner as the human cerebrum is excessive in growth compared with that of other mammals.

Let us consider the cerebella of mammals which live in water, such as the whale, the seal, the otter, etc. As compared with fishes they all have a much better developed cerebellum, especially the seal, which is less accommodated to life in water and whose nimble movements we all know. Life in water leads, generally speaking, to atrophy of the cerebellum and particularly of the vermis or middle lobe, while the hemispheres remain in good condition.

The human cerebellum is well developed for the purpose of upright walking, because it is much more difficult to maintain bodily equilibrium on two feet than on four. Moreover, in the human being it regulates the coordination of speech. Not only the movements of tongue, lips and vocal cords must be well coordinated, but also the superficial and deep sensibility of mouth, throat and larynx must be well developed. Great orators need not only a well-developed center for articulate speech in the cerebrum, but also a well developed cerebellum, so that the cerebellum shall work under the control of the cerebrum and vice versa.

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WORK OF THE NATIONAL RESEARCH COUNCIL

(Continued)

Division of Research Extension.—The council's division of research extension, which is especially interested in the promotion of industrial research, has been the special representative of the council in connection with its relation to the organization of the Crop Protection Institute, the Horological Institute and the important committees on corrosion problems, alloys problems, textiles research, the making and use of scientific instruments, etc. The officers of this division have also the special function of the active solicitation of funds from industrial concerns and other organizations and men for the support of any and all of the council's special projects which relate to the applications of science, whether these projects are directly under the control of the division of research extension or of other divisions, as those of physics, chemistry and chemical technology, biology and agriculture, etc.

The division has been specially active during the past year in arranging for certain important conferences, in promoting the financial support for the International Tables of Critical Constants and for the

Marine Pilings Investigations; in developing in cooperation with the U. S. Bureau of Standards and the American Home Economics Association a program for textiles research, in finding money from industrial companies for the preparation and publishing of a revised edition of the council's important bulletin on American research chemicals, and other similar undertakings.

Research Information Service.—The council's research information service, which serves as a clearing house for information concerning research work and workers, has built up a considerable equipment in the way of mechanisms for collecting, arranging, cataloguing and distributing information. During the past year it has answered about 2,000 outside requests for information, besides as many from the council offices and from institutions and men in Washington. It has compiled and published in the council's bulletin and reprint and circular series a considerable amount of information useful to research workers and scientific men generally, especially in the way of lists of published and unpublished (manuscript) bibliographies in various special scientific fields as well as a number of bibliographies both published and unpublished, but available for reference. It has also prepared and published an account of handling personnel data, and an account of methods of author's automatic abstracting.

The personnel file of American scientific investigators has been steadily increased during the past year. It now includes about 14,000 records. A summary of the activities of American psychologists has been prepared for publication. Progress has been made in the development of a general catalogue of sources. Progress has also been made on assembling matter for revisions of two earlier important informational publications of the service, namely, "Funds available in the United States for the encouragement of scientific research" and "Research laboratories in industrial establishments of the United States, including consulting research laboratories."

In the latter part of July and August, 1922, Mr. J. David Thompson of the service visited about three fourths of the industrial research associations in England, organized by means of government aid, and collected valuable data concerning their work, particularly their research informational activities. Mr. Thompson also prepared a special report on the scientific informational services of the world.

Division of Physical Sciences.—The council's division of physical sciences has devoted during the past year, as during the two years before, its principal attention and support to the work of the important series of special committees on various particular physical, astronomical and mathematical subjects or fields, whose work has been made possible by a gift of $30,000 from the Rockefeller Foundation for the first two years and an appropriation by the council of $5,000 for this past year. These committees have been composed of eminent specialists in their respective particular fields who have given much time and energy to the work of the committees. The following is a list of the fields of work of these committees: acoustics, algebraic numbers, atomic structure, celestial mechanics, electrodynamics of moving media, luminescence, mathematical analysis of statistics, orbit theory, parallaxes, photo-electric effects, physiological optics, quantum theory, radiation in gases, research methods and technique spectroscopy, theories of magnetism, thermo- and magneto-electrical effects, vision and photo-biology, x-rays and radio activity and x-ray spectra.

The carefully prepared reports of seven of these committees have been published during the past year in the council's bulletin series. Altogether thirteen reports have been published. The report of the Committee on the Mathematical Analysis of Statistics is to be published in book form by Houghton, Mifflin and Company.

Division of Engineering.—The council's division of engineering, through which the council maintains its contacts with the major engineering societies of the country and especially closely with Engineering Foundation, has been reorganized during the year consequent upon certain changes in the organization of Engineering Foundation. By the new arrangement, Dr. F. B. Jewett, vice-president of the Western Electric Company, becomes chairman of the division of engineering; and the president of the foundation becomes *ex-officio* a member of the executive board of the National Research Council.

The various activities and special research projects of the division of engineering are too numerous to mention with any approach to completeness in this report, but reference may be made to a few of them. Altogether there are now about twenty special boards and committees of this division.

The Advisory Board on Highway Research, which has been working in close cooperation with the U. S. Bureau of Public Roads, has made a number of reports of its work which have been published. It held its second annual meeting in Washington, November 23, 24, 1922, with a large attendance of leading highway engineers. Investigations of highway problems involving expenditures of more than one million dollars are now under way in America under the direction of various federal and state bureaus. The advisory board through its director and committees has been active in stimulating these investigations and has given much helpful information and advice in connection with them.

The work of the various committees of the Advisory

Board on Welding Research has made much progress during the year. The Committee on Pressure Vessels, for example, has been able to finance its work to the extent of about $15,000 by gifts from eight manufacturing concerns, and through cooperation with the U. S. Bureau of Standards, has completed a special research involving the testing to destruction of forty pressure tanks by the bureau. The committee on welded rail joints has instituted a comprehensive research involving, with contributed materials and services, the use of a sum exceeding $80,000. Steel companies, manufacturers of special joints, electric railway companies, university laboratories, U. S. Bureau of Standards, and various technical societies are cooperating in this work.

In connection with the work of the important joint committee of the Division of Engineering and the Division of Biology on marine pilings investigations, money and service contributions have been received from numerous sources. The most recent of these items has been the pledge of an appropriation of $10,000 each from the Quartermaster Corps of the Army and the Bureau of Yards and Docks of the Navy to be expended on work by the Chemical Warfare Service through two years.

The committee on fatigue phenomena on metals, which has been carrying on an important research in the laboratory and under the direction of Professor H. F. Moore, of the University of Illinois, has been well supported financially and has made conspicuous progress. In addition to original contributions of $30,000 each by Engineering Foundation and General Electric Company together with service, facilities and supplies from the University of Illinois and several corporations approximating $25,000, the General Electric Company has recently added $7,500 and informally indicated its willingness to appropriate $7,500 more if other industries will contribute a total of $15,000. Plans have been made for extending the investigation to non-ferrous metals besides continuing the studies on steels.

The committee on Neumann bands prepared a report which was published by the American Institute of Mining and Metallurgical Engineers. This committee is continuing its investigations with the cooperation of the Army and Navy to ascertain whether the presence of Neumann bands in steel is an evidence of weakness.

The committee on hardness testing of metals, the work of which is of especially fundamental nature, has made certain reports and has secured effective cooperation in its work from government laboratories, industrial companies and the American Society for Steel Testing. The committee on heat treatment of carbon steel has prepared a comprehensive report of its work which is to be published in the Transactions of the American Institute of Mining and Metallurgical Engineers. This committee has been recently reorganized for the purpose of completing the work originally outlined for it under the chairmanship of the late Dr. Henry M. Howe, and of planning new investigations of a fundamental nature.

The molding sands committee is making active progress with its work. Cooperation has been secured from state geological surveys for recording foundry sand deposits. Standard tests have been prepared for fineness and special progress has been made in determining standard methods for chemical analysis, rational analysis, permeability tests and sampling.

The full time services of a secretary have been provided for the committee on pulverizing through the cooperation of the U. S. Bureau of Mines, University of California and Massachusetts Institute of Technology. It is estimated that the total funds and services so far made available to this committee amount to more than $50,000 a year.

Division of Chemistry and Chemical Technology.—The council's division of chemistry and chemical technology has given much of its attention and energy during the past year to advancing the interests and work of the International Critical Tables of Chemical and Physical Constants. The present chairman of the division is the editor-in-chief of the Tables, and has associated with him a staff of two associate editors, two assistant editors and a group of ten corresponding editors representing as many European countries. This editorial board is now steadily at work and has completed its plan for the whole program. It has arranged with about a dozen physicists in as many different American colleges and universities to undertake special investigational work on the physical properties of various materials. Close cooperation with the international board of annual critical tables, with headquarters in Paris, has been set up. The total expense of the work of preparing and publishing the International Tables is estimated at about $200,000, of which about $100,000 in money and services have been so far pledged and partly paid in and rendered.

The division's committee on explosives investigations has been very active during the year and important reports of its work have been published. The committee has given a special attention to the matter of the utilization of surplus explosives now in the hands of the government and has shown by experimental demonstration how these explosives may be safely and advantageously employed in the industries. Through the work done by this committee on TNT, modified TNT and picric acid it is officially stated that more than $10,000,000 worth of useful explosives material has been rescued from waste.

The committee on chemistry of colloids has completed a bibliography of the literature in this field, containing eighteen hundred references together with brief descriptive statements of the ground covered by each paper. Also a list of research problems in colloid chemistry was prepared by the chairman of the committee and has been in great demand, the first edition having been already exhausted in meeting requests for it. The committee on research chemicals has arranged for a revision of the council's bulletin on "American Research Chemicals." Part of the expenses of this revision and its publication will be met by gifts which have been pledged by various chemical manufacturers. The first report of the committee on contact catalysis has been published in the Council's Reprint and Circular Series.

Division of Geology and Geography.—The council's division of geology and geography has, during the year, brought several of its current undertakings to approximate conclusion. The important work of Dr. Ernest Antevs on "The Recession of the Last Ice Sheet in New England," which was first taken up and supported by this division and later supported by other organizations, has been finished and published in the Research Series of the American Geographical Society. A bibliography of published geological bibliographies has been completed, in cooperation with the Research Information Service, and published. The work of preparing and classifying a list of American working geologists and geographers is practically completed. Considerable time has been given to cooperation with the Federal Bureau of Surveys and Maps in an effort to bring about the completion of the topographic maps of the United States.

In response to requests from petroleum geologists, working in the field, for means to enable them to be placed in touch with laboratory and university workers on the principles and theory of petroleum formulation and accumulation, a special committee of the division is undertaking to list and describe all researches in geology, physics, chemistry and biology which should be of use to the theoretical student of petroleum geology. Efforts have been made to encourage the preparation of geological abstracts. It has been definitely agreed by the division and the U. S. Geological Survey that the division will participate in the survey's undertaking to prepare a dictionary of the technical terms used in physiography.

Preliminary work has been done by the chairman of the division looking toward a plan for conserving and ultimately publishing the valuable scientific results of commercial explorations, especially by American companies, in foreign countries. There has been much unreasonable secrecy and ultimate loss of information in connection with such work. The publication of certain results of the House Inquiry jointly by the division and the American Geographical Society has been brought to completion. The division has approved as a project the preparation of a complete catalogue of all maps of Latin America by the American Geographical Society and the council has made a small appropriation through the division for this purpose. Considerable preliminary work has been done on a subject involving shoreline studies. The plan contemplates the cooperation of various government bureaus, several state surveys and state universities. The ultimate aim of the work is the forecasting of future changes of the shoreline.

The division arranged for four conferences to be held under the auspices of the division in connection with the mid-winter meetings of the various national societies of geology and geography. Three of these conferences have reference to the work of the division's committees on tectonics, sedimentation and geography. The fourth was a general round-table of geologists and geographers in which the work of the division was discussed.

Division of Medical Sciences.—The council's division of medical sciences has given much of its time and attention during the past year to the important matter of the administration of the research fellowships in the medical sciences which the council is enabled to maintain through the financial assistance of the Rockefeller Foundation and the General Education Board. Thirty-one fellows have so far been appointed. The chairman of the division, who is also chairman of the fellowship board, has recently made a trip of visitation to all the active fellows and he states that after careful inspection of the work of each one, after approximately six months of activity, he believes that no significant mistake was made in any individual appointment.

The division has carefully considered and approved a report of the Committee for Research on Sex Problems outlining the work accomplished during the past year and proposing a plan for the work in the future. (See reference to this committee earlier in this report.) The division's committee on abstracting current medical literature is recommending that all editors of medical journals in this country be requested to ask or require that an author's abstract of each article be sent with the article. This is in line with the important movement now being forwarded by other divisions of the council toward the development of an abstracting system in connection with scientific publication in this country.

The committee on investigation of deaths from tuberculosis in Colorado has presented a report which meets the warm approval of the division. This committee has undoubtedly made an important contribution to the epidemiology of tuberculosis and particu-

larly to the knowledge of the beneficial effect of climate in reducing the mortality from this disease. This extensive work has been carried out expeditiously and economically on the basis of a grant of $1,000 from the council.

Division of Biology and Agriculture.—The council's division of biology and agriculture has been much gratified by the recent successful outcome of negotiations with the Rockefeller Foundation which have resulted in the gift by the Foundation of $325,000 for the establishment and maintenance during the five-year period, July 1, 1923–June 30, 1928, of a series of research fellowships in the biological sciences, including anthropology and psychology. The special board of control has already been organized and has so far appointed nine fellows.

In addition the division has at its disposal nine special research fellowships for the scientific study of the uses of sulphur in agriculture, which are supported by certain industrial sulphur companies, and a single special research fellowship for the support of the work of Dr. Just, a negro biologist of Howard University, the funds for which are provided by Mr. Julius Rosenwald, of Chicago.

The division's committee on the Relations of Insects to Flowers carried on planned field work in Colorado last summer, the results of which have been published in a number of papers. This work was accomplished by the cooperation and support of the council, the American Museum of Natural History, Cornell University and the University of Colorado. The Committee on Food and Nutrition has carried forward and arranged for publication the work on protein metabolism in animal feeding begun under the leadership of the late Dr. H. P. Armsby. The results of investigations in the field of human foods carried on with the aid of a grant from the National Glass Containers' Association have been prepared for publication. Of the special funds available to the Committee on Food and Nutrition, $2,000 have been assigned to work on the relation of fertility to nutrition to be carried on under the direction of Dr. H. N. Evans, of the University of California.

The work of the Committee on Atmosphere and Man has made arrangements with the National Industrial Conference Board for the carrying on of extensive experimentation on the relation of atmosphere in factories to the efficiency of workers. The expense of the investigation will be provided by the National Industrial Conference Board.

As a culmination of the activity of the American phytopathologists over a rather long period and after a final conference in December, 1922, a project for the establishment of a scientific institute, to be known as the American Tropical Research Institute, was presented to the division and approved by it. The council has provided a small sum for an organizing meeting of a committee on phytopathology in the tropics and their advisers to formulate definitely the plans for the institute. Assurances of financial support have been received from commercial companies interested in tropical agriculture.

Division of Anthropology and Psychology.—The council's division of anthropology and psychology actively cooperated with the division of biology and agriculture and with the secretary's office in the negotiations concerned with the establishment of the research fellowships in the biological sciences, which are interpreted to include both anthropology and psychology, and which have been referred to earlier in this report.

The council's important Committee on Scientific Problems of Human Migrations, also earlier referred to in this report, had its origin in the division of anthropology and psychology and the division has given much attention to its program of work. An important conference on the subject of this committee's interest was held in the council rooms on November 18, 1922, which was attended by a distinguished group of men representing the fields of biology, psychology, medicine, public health, sociology and economics.

The division's important committee on vestibular research has been one of the council's most active committees and the results of its work have already been of high scientific value. It reports the preparation of an extensive comparative study of vestibular functions and the publication of experimental investigations on "Thresholds of Rotation," and the "Adequacy of Reflex Compensatory Eye Movements," and also "An Historical Survey of Vestibular Equilibration." The committee further reports the successful operation of the first clinical instrument for photographing the reflex vestibular deviations of the eyes of patients during rotation.

The Committee on State Archeological Surveys has prepared a brief manual to be used in connection with its work of interesting states in local archeological surveys. The Committee on Psychological Abstracts reports progress in its negotiations for the ultimate control by the American Psychological Association of an abstract journal which was initiated by the Psychological Review Company.

The Committee on Personnel Research in Business and Industry has cooperated in supporting the program of research on motivation in industry by Professor Elton B. Mayo, of Adelaide University, Australia, who has been in this country during the past year. The Committee has also cooperated with the Institute for Government Research in securing the services of Dr. L. L. Thurstone for the newly founded Bureau of Public Personnel Administration.

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