

# SCIENCE

FRIDAY, FEBRUARY 13, 1914

THE CARNEGIE INSTITUTION OF  
WASHINGTON<sup>1</sup>

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It is a source of satisfaction to record that the experience of the past year supplements that of a year ago in showing a general improvement in the relations which the institution sustains to other organizations and to the world of learning at large. The obviously rational tendency to take an objective view of the institution and its work and to measure them by the more permanent standards available is now everywhere distinctly visible. This tendency is manifested in many ways: by an increasing demand for exact information concerning the plan, scope and development of the institution as a whole; by an increasing critical interest in the investigations, the equipments and the programs of work of our departments of research; and by an increasing demand for precise knowledge concerning special apparatus and special technique developed by our departmental staffs. In addition to these numerous demands for correct information with respect to ways, means, methods and results, there are now presented also, not infrequently, requests for investigations in cooperative enterprises for which other organizations, or in some cases individuals, are willing to supply the necessary funds. This is a manifestation which, while not unanticipated, has developed somewhat earlier than expected. It calls for considerate attention, since it is likely to grow with time in proportion as the institution demonstrates capacity for trustworthy

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

<sup>1</sup> From the report of the president for the year ending October 31, 1913.

management of funds and for effective conduct of research.

On the death of Dr. Fletcher, November 8, 1912, editorial supervision of the *Index Medicus* was placed in charge of Dr. Fielding H. Garrison, who had long been associated as principal assistant with Dr. Fletcher in the publication of this work. Continuity of plan and purpose is thus assured in the perpetuation of this current bibliography, while the responsible editorship falls to one whose qualifications for the task have met the exacting standards of his eminent predecessors.

In accordance with the authorization voted by the Board of Trustees at its meeting of December 13, 1912, a department of human embryology, under the direction of Professor Franklin P. Mall, with a small staff of associates and collaborators, has been planned and is already engaged in active research. In arranging for this department the institution is peculiarly fortunate not only in enlisting the directorship of Professor Mall, but in starting from a foundation furnished by his remarkable collection of human embryos. It will be seen also that this enterprise is of far greater import than might at first appear, for it has fundamental relations to the science of anthropology as well as to those of anatomy, physiology and pathology, which latter, indeed, from some points of view, may not improperly be regarded as branches of the former widely inclusive science. The efforts of the institution to enter the domain of anthropology, to which reference is again made in a later section of this report, are thus in part realized in a most effective way.

Another noteworthy event of the year is the construction of two new buildings, a heating and lighting plant, and an additional laboratory, for the department of experimental evolution, authorized by the

board of trustees at their last meeting. Plans in illustration of these buildings, which are now nearing completion, will be found in connection with the annual report of the department in the current year book. Two of the many uses which this laboratory is designed to serve in the immediate future are those of housing and further experimentation upon the unique collection of pedigreed pigeons, studied for many years by the late Professor C. O. Whitman, whose researches the institution has undertaken to complete and to publish. In accordance with the agreement entered into with Professor Whitman's heirs this unrivaled collection of biological material will become the property of the institution, and arrangements have been made for its transfer to Cold Spring Harbor from Chicago before the end of the calendar year.

Similarly, two items from the current history of the department of terrestrial magnetism are worthy of mention here. One of these is the approaching completion of an office and laboratory building whose construction was approved by the board of trustees a year ago. Floor plans of this building are incorporated in the annual report of the director of the department in the current year book. The building is situated on a very favorable, elevated site of a little less than seven acres in the District of Columbia, near Chevy Chase, and near the western boundary of Rock Creek Park. It will be fire-proof, will furnish safe storage for the extensive records already acquired by the department, and will afford opportunity for experimental researches in terrestrial magnetism which may be confidently expected to give deeper insight into this obscure but at present highly utilitarian property of our planet. The other noteworthy event referred to is the near com-

pletion of a circumnavigation voyage of about three and a half years' duration and of courses aggregating upwards of 80,000 miles, by the non-magnetic ship *Carnegie*. Experience with this ship shows that a magnetic survey of the oceans is a somewhat less formidable undertaking than a magnetic survey of the continents, for the latter are still, on the whole, less accessible than the former since the advent of this non-magnetic nautical observatory. Great credit is due to Mr. W. J. Peters, commander of this ship, for assiduous attention not only to her safety, but also to the effectiveness of her mission in the immediate interests of the world's navigation and in the more important, though less obvious, interests of terrestrial physics.

Reference was made in the report of a year ago to the construction of a fireproof office building at Pasadena, California, for the staff of the solar observatory. This building has been occupied during the past year, and its characteristics are shown by illustrations in photo-perspective and in plan in the current year book. In addition to supplying adequate quarters for the departmental staff and safe storage for the extensive records of the observatory, it furnishes in its sub-basement a constant-temperature room in which will be installed a dividing engine designed especially to rule diffraction gratings for use with the other optical apparatus of the observatory. Such an engine has been constructed at the shops of the observatory during the past year by Mr. Jacomini, mechanic of the departmental staff, in collaboration with Dr. John A. Anderson, of Johns Hopkins University, who has supplied tests of precision which have led to a degree of perfection not hitherto attained in this excessively difficult and delicate kind of construction. It is gratifying to report also in this connection that the glass disk

for the 100-inch telescope, which a year ago had developed distortions indicating defective stability, is now meeting all essential requirements and giving promise of an optical surface equal to, if not superior to, that of the 60-inch mirror. Accordingly, work of construction for the foundation and for the mounting of this 100-inch telescope is now proceeding as rapidly as the conditions of safety and of efficiency in such a novel undertaking will permit.

#### OUTLINE OF RESEARCHES OF THE YEAR

As is abundantly indicated in previous reports, and as is evident to any deliberate reader of the bewildering miscellanies presented in the year books, the diversity and the complexity of the investigations going forward under the auspices of the institution preclude anything like a clear and complete summary of their scope, progress and prospective value within the limits of an administrative report. The general reader must take it for granted (provisionally at least) that these investigations are in the main worth undertaking and thus await the verdict of time through the aid of a growing critical public opinion; for in proportion as such investigations are fundamental, and hence worth carrying on, they will be difficult of exposition and more difficult of comprehension. Concerning this matter there appears to be prevalent a popular fallacy to the effect that writers untrammelled by competent scholarship, but who possess verbal facility, are better qualified to expound a technical subject than those who have developed it or contributed thereto; and along with this fallacy there is frequently coupled another to the effect that ours is an age of narrowing specialization, whose evil effects may be remedied by resort to literary views of phenomena and by re-

stricting the range of increasing knowledge. While patiently tolerant with these extremes of opinion, it is obviously inadmissible to adopt either of them here. We may neither pretend to exposition of knowledge not acquired nor deprecate the excess of knowledge possessed by experts in this or that field of science. It is hoped, therefore, that the brief summaries given in the president's reports may not be mistaken for adequate accounts of current progress or for sufficient recognition of the merits of the researches referred to.

#### DEPARTMENTS OF RESEARCH

In accordance with the views just set forth it seems appropriate at this time to limit still more narrowly than hitherto the brief summaries of departmental work and to invite attention still more directly to the departmental reports published in the year book. All of the departments of research of the institution hitherto reported upon are now well-defined organizations, each of them independent of and more or less isolated from the others, and each of them devoted to a field which, while in some cases related to, does not encroach upon the fields of others. Each of them possesses thus a degree of autonomy which calls for a corresponding degree of freedom in the rendition of annual reports and accounts of progress. But along with this autonomy, indispensable to the highest efficiency in such organizations, it is equally essential that there should coexist a fraternity of interest and a solidarity of purpose centering in the institution as a whole. First steps toward development of these latter desiderata were taken in December, 1909, on the occasion of the annual meeting of the board of trustees, when the administration building was dedicated and when the directors of departments of research were invited to give exhibits of the salient features of their work up to that

time. On the same occasion two related experiments were inaugurated, namely, that of a lecture to the trustees and their guests from the head of a department of research, and that of a conference between the directors of departments and the president. The results of these experiments have been so favorable that the plan of having an annual lecture, an annual conference, and exhibits of departmental work at intervals of three to five years, has come to be adopted by common consent. In addition to the exhibit held in December, 1909, another was held in December, 1911, on the occasion of the tenth anniversary of the foundation of the institution.

By reason of the decision of the board of trustees a year ago to take part in the Panama-Pacific Exposition, to begin in San Francisco in February, 1915, it is proposed to hold the next departmental exhibit in the administration building at the time of the meeting of the board of trustees in December, 1914. It will thus be practicable to bring together an aggregate from which (by aid of counsel from departmental representatives) a more restricted exhibit may be drawn for the Panama-Pacific Exposition. On account of this circumstance and on account of the fact that the departments on the average, as well as the present administration, will have completed a first decade in the institution's history a year hence, it seems desirable to reserve any more elaborate summaries of work accomplished and now under way, whether of departments or of research associates, until that time. Accordingly this section of the present report is limited to something less than the usual extent.

#### DEPARTMENT OF BOTANICAL RESEARCH

Studies of the Salton Sea,<sup>2</sup> carried on

<sup>2</sup> Often by earlier writers called Cahuilla Basin, more frequently called Salton Sink, and now

during the past seven years by this department in collaboration with a number of contributing specialists, have been brought together during the year in a volume now in press under the title "The Salton Sea: A Study of the Geography, the Geology, the Floristics and the Ecology of a Desert Basin," as publication No. 193. A great number of interesting questions in geography, geology, botany, chemistry, microbiology, plant physiology, climatology, etc., are discussed in this volume. Of these, an instructive abstract is given by the director in his current report.

Among many researches carried on by the director, mention may be made of his cultivation of second and third generations of mutants arising from ovarial treatments of plants and resulting in further noteworthy morphological and physiological departures from the original parent stocks. Of members of the departmental staff, Dr. Cannon has extended his fruitful studies of root systems of desert plants to include the corresponding characteristics of trees in the coastal climate of California and to the problem of treelessness in prairie regions. Dr. Forrest Shreve has given special attention to the factors involved in the transpiration of rain-forest plants and to the effects of mountain slopes and climatic conditions varying with altitudes and with exposures. Dr. Spoehr has continued his investigations of the action of light and heat in producing chemical changes in plant organisms, giving promise thus of important advances in the newer field of phytochemistry and photolysis.

Several collaborators have contributed to the varied work of the department during the year. Sections of the director's

called Blake Sea, in honor of Professor Blake, who, as geologist of the Williamson survey of 1853, first accurately interpreted this remarkable depression below sea-level.

report are thus devoted to accounts of the further experiments of Professor W. L. Tower on the evolution of chrysomelid beetles, for which facilities are provided at the Desert Laboratory; to the physical studies of Professor B. E. Livingston, formerly a member of the departmental staff, on the water relations of plants; to the determinations of autonomic movements in opuntias by Mrs. Shreve, whose volume on "The Daily March of Transpiration in a Desert Perennial" is in press as publication No. 194; to the investigation of Professor H. M. Richards on the acidity, the gaseous interchange and the respiration of cacti; to the surprising properties of the opuntias in fruit development, brought to light by Professor D. S. Johnson; and to the favorably progressing enterprise undertaken by the department, in collaboration with Dr. N. L. Britton and Dr. J. N. Rose, for a systematic determination of the distribution and relationships of the cactus family of plants.

#### DEPARTMENT OF EXPERIMENTAL EVOLUTION

The work of the year in this department records, among many other advances, additional contributions to the laws of human inheritance; the results of further and more conclusive studies of the transmission of traits in plants of the genera *Bursa* and *Oenothera*; and some preliminary indications of specially instructive investigations in the field of biochemistry. The director has divided his time between researches based on breeding experiments carried on at his station and studies of data bearing on human heredity collected under the auspices of the Eugenics Record Office, of which he is also the directing head. In addition to the researches carried on by Doctors Banta, Gortner, Harris and Shull of the resident staff, Dr. A. F. Blakeslee, Dr. G. C. Bassett and Professor John H.

Gerould have pursued investigations in collaboration with this staff. One of the most important of these cooperative enterprises is the joint investigation of Dr. Blakeslee and Dr. Gortner on the low organisms called mucors, from which it appears that sex-differentiation in these organisms has a determinate physical basis. This conclusion appears to bear a close relation to similar fundamental conclusions reached independently in other lines of work by our research associates, Dr. Reichert and Dr. Osborne.

The exigencies of his experimental work going forward at the departmental station have prevented Dr. Shull from completing the manuscript of his account of the work of Luther Burbank. It has been arranged, therefore, that he shall spend some months abroad, beginning with October, 1913, in order that uninterrupted attention to this manuscript may enable him to finish it without undue delay. The importance of the biochemical laboratory, in charge of Dr. Gortner in connection with the department, has been well attested during the year by the aid he has rendered in the complex studies evidently essential to further advances in the problems of plant and animal evolution. The more adequate provision for this laboratory adjunct furnished by the new departmental buildings, already referred to, will make it practicable to utilize still more advantageously the highly developed qualitative and quantitative methods and data of the older science of chemistry.

#### DEPARTMENT OF ECONOMICS AND SOCIOLOGY

Substantial progress toward completion of the several contributions from the twelve divisions of this department to their projected basis for a social and economic history of the United States is reported by Professor Henry W. Farnam, chairman of

the department. It is estimated by him that six of the divisions will be able to present final reports within the next fiscal year. These are the divisions of population and immigration, in charge of Professor Willcox; mining, in charge of Mr. Parker; transportation, in charge of Professor Meyer; domestic and foreign commerce, in charge of Professor Johnson; labor movement, in charge of Professor Commons, and social legislation, in charge of the chairman. Delays due to the requirements of their primary occupations, to ill health or misfortune in the case of some collaborators, and to demands of public service in other cases, have prevented the remaining divisions from bringing their work to a similarly forward state.

The chairman again calls attention in his report to the desirability of reorganizing this department and placing it on a basis similar to that of all other departments of research of the institution. As to the appropriateness of this recommendation, there now appears to be no dissent, either within or outside the department. It is hoped, therefore, that such a reorganization may be consummated as soon as the work now in hand may be completed in accord with the original plan, if it should not appear advantageous to make the obviously desirable change at an earlier date. There is no doubt that the field of opportunity for effective pioneer work by such a department is in great need of present-day cultivation and that it extends indefinitely into the future.

#### THE GEOPHYSICAL LABORATORY

The preliminary stages in the development of this hitherto unique establishment may now be said to have passed, since laboratories similarly equipped and for like purposes are now being set up under other auspices. That the merits of the methods,

the apparatus and the earlier published researches of the geophysical laboratory should have been thus early recognized is at once a source of gratification to the institution and an additional stimulus to fundamental work in the difficult but ever fruitful domain of geophysics. In his annual report the director gives instructive accounts of the effects of pressure in the formation of minerals, of progress in the perfection of adequate appliances for calorimetric measures of minerals, of the factor of temperature in optical studies of crystals, of the results thus far obtained in volcano studies, and of the important economic investigations (now under way at the laboratory) of the secondary enrichment of copper sulphide ores. It had been hoped that the signal success attending the studies of Kilauea a year ago might be followed up during the past year, but in this the staff has met disappointment, for the volcano has been inactive and gives no warning of renewed opportunities.

The activities and productivities of the laboratory staff are indicated impressively by the 52 papers issued during the year, or now in press, reviewed in the report of the director. These have been, or will be, published in current journals. Several of them appear as duplicates by reason of translations into the French or the German languages; of these, it is interesting to note that a translation into French by Professor P. Chappuis has been made (for the *Journal de Physique*) of the work of Day and Sosman on "High Temperature Gas Thermometry," publication No. 157 of the Institution.

#### DEPARTMENT OF HISTORICAL RESEARCH

The purposes to which this department is devoted and the programs it proposes to follow have been outlined in the director's annual reports of the past seven years. He

took occasion also, in December a year ago, when he gave the annual trustees' lecture, entitled "The Future Uses of History," to present a fuller statement of these purposes and programs, as well as to indicate the rôle which history may fittingly play in the evolution of the social organizations which must occupy the attention of our successors. This instructive lecture was rendered available to a wider circle of interested students of history by publication in *The History Teachers' Magazine* for February, 1913.

Briefly stated, the main purposes of the department are two: first, to furnish aids, guides and reports which may give appropriate direction to the writers of monographs and general histories; and, secondly, to furnish full textual publication of important historical documents. Under the first of these heads the director reports very favorable progress toward completion of a series of three guides to the materials for American history in London archives and in the libraries of Oxford and Cambridge universities. The first volume of this series was issued as No. 90 of the institution's publications in 1908, and the other two volumes, now nearly through the press, are designated 90A and 90B, respectively. As to this series the director remarks in effect in his report that no similar inventory of like extent, concerning archive materials which London possesses for the history of any other nation, has ever been issued. Two additional volumes in this first division of activities have appeared during the year, namely, publication No. 163, "Guide to Materials for United States History in Mexican Archives," by Herbert E. Bolton; and publication No. 172, "Guide to Materials for United States History in Canadian Archives," by David W. Parker. Under this head also progress is reported in the work of Mr. Leland on

materials for American history in Paris archives, in the work of Professor Hill in Spanish archives, and in the corresponding work of Professor Faust in Switzerland and in Austria. Under the head of textual documents the director refers in some detail to progress in the preparation of the projected collections of "Letters of Delegates to the Continental Congress," of "European Treaties Bearing on United States History," of "Proceedings and Debates of Parliament Respecting North America, 1585 to 1783," and to a preliminary report on papers of the Royal African Company in the Public Records Office of London.

Attention is especially invited to the director's interesting review of the work of the department during the first decade of its existence, completed with this fiscal year. Some idea of the extent of this work may be gained from the list of departmental publications cited, the number of these being 17, with an aggregate of over 5,000 pages; while the bulky correspondence of the institution as a whole is in some degree indicated by the fact that this department records an aggregate of upwards of 20,000 letters in its decennial inventory.

#### DEPARTMENT OF MARINE BIOLOGY

When the laboratory of this department was established on Loggerhead Key, Dry Tortugas, Florida, now nearly ten years ago, Fort Jefferson, on an adjacent island, was an important base station of the United States navy and transportation to and from points on the Gulf coast was a matter of daily occurrence. In the meantime, however, this station has steadily diminished in importance and is now virtually abandoned as a naval base. This change of conditions shifts the burden of transportation between the laboratory and the

nearest port, Key West, about thirty miles distant, wholly upon the department; and the resulting increased cost and inconvenience have led the director to recommend a gradual transfer of his laboratory and activities to a more favorable site. Preliminary investigations indicate that such a site may be had in Jamaica, where health conditions and transportation facilities have been much improved in recent years, where the cost of labor and subsistence is low, and where such an international scope as best benefits marine biology could be readily developed. It may be anticipated that definite plans for an advantageous change of site will be matured during the coming year and ready for submission to the board of trustees in December, 1914.

The department has suffered serious loss during the year in the untimely death of a remarkably able research associate, George Harold Drew. It has met with a reverse also in the temporary illness of another research associate, Dr. T. Wayland Vaughan. Drew and Vaughan had under way important investigations, originating at Tortugas, for the furtherance of which the departmental expedition of this year to Torres Straits was largely planned and authorized. Drew had made the discovery at Tortugas that the so-called coral mud in that vicinity is not due to corals, but has been precipitated through the chemical agency of a bacillus abundant in the surface waters of the tropical Atlantic. Vaughan, on the other hand, had made quantitative studies of the growths of coral organisms at Tortugas and of the closely correlated deposits or reefs. Jointly their investigations promised a solution of the long-vexed problem of the origin of such reefs and it was hoped that the expedition to Torres Straits and Great Barrier Reef would enable them to secure the additional data essential to final proof. In spite of

these adversities, however, the director and four associates sailed from San Francisco for Sidney, Australia, on July 23, 1913, and arrived at Torres Straits early in September. When last heard from, in September, the party was reported all well on Murray Island.

The laboratory season at Tortugas extended from April to June, inclusive, and twelve collaborators availed themselves of the facilities afforded for their researches. Summaries of these are given by the director in his current report, while more elaborate accounts are furnished by the investigators themselves in appendices to that report. Two additional volumes of contributions from the Tortugas laboratory are in press as publications Nos. 182 and 183.

#### DEPARTMENT OF MERIDIAN ASTROMETRY

On the death, October 5, 1912, of Professor Lewis Boss, director of this department since its establishment in 1906, his son, Mr. Benjamin Boss, long associated with his father in meridian astrometry, was made acting director. Adherence to the original program, so indispensable to the formidable enterprise this department has under way, is thus assured. The extensive computations essential in the derivation of the great number of stellar positions observed at the temporary observatory at San Luis, Argentina, are going forward at a favorable rate, so that the inclusive catalogue of precise positions for stars in both hemispheres may be expected in due time. Some instructive results of these computations, showing the stability of the San Luis meridian mark (mire), the diurnal variation of the clock corrections, and the changes of personal equation for day and night observations are given in the report of the acting director.

As in most lines of fruitful research, the

work of this department is noteworthy for its by-products, or for contributions it is making to allied lines of inquiry. Obviously, a first requisite to a knowledge of stellar motions lies in precise determinations of stellar positions at different epochs. The so-called proper motions of stars are thus brought to light, and from these it is possible to determine also the motion of our solar system. But now comes the surprising discovery that these proper motions, hitherto supposed to be of a random character, are of a systematic nature dependent in large degree, apparently, on the stage in evolution any individual star has reached and on the group to which it belongs. A new and peculiarly fascinating field is thus opened to astronomers of all kinds, and the by-products referred to seem destined to prove not less important than its primary object in positional astronomy. The world of astronomy, however, is anxiously awaiting the attainment of this object, as is well shown by the fact that the preliminary catalogue issued by the department three years ago is already out of print.

#### THE NUTRITION LABORATORY

One of the reasons which helped seven years ago to determine the location of this laboratory was found in the expectation that several hospitals would be erected in the near vicinity. This expectation has now been realized by the completion during the past year of the Peter Bent Brigham Hospital, the Collis P. Huntington Memorial Hospital, and of two hospitals for infants and children respectively. The environment and the opportunities for securing pathological subjects as well as clinical cooperation and counsel are therefore highly favorable for the researches undertaken by this establishment. That it has entered a fruitful field of activity is well attested by the wide interest shown in

its publications already issued, by the desires of experts at home and abroad to learn of the ways and means employed, and by the duplication in laboratories of other countries, as well as in those of America, of apparatus developed.

But science is cosmopolitan, and although many novel enterprises may be said to have originated with the institution, it may not lay claim to any monopoly in research; it can only contribute here and there in a limited degree to the ever-expanding aggregate of verifiable knowledge. In recognition of these limitations the director has appropriately adopted the plan of inspecting, at frequent intervals, the laboratories, the special apparatus and the technique developed elsewhere for the same and allied work. Thus he has made during the past year a third triennial tour of European laboratories, hospitals, etc., devoted to such work. This has afforded opportunity for numerous advantageous conferences with colleagues and for the selection of new apparatus of proved utility; while the director has been able during the same time to give counsel in respect to the adoption in other laboratories of apparatus and methods similar to those of the nutrition laboratory. The latter, therefore, like the geophysical laboratory, is no longer distinguished by its singularity, but must now enter upon a career of friendly rivalry with many cognate establishments.

For details of the investigations of the year, reference must be made to the director's report. They are summarized by him under thirteen principal heads, which range from studies of metabolism in infants, through those of normal metabolism in adults, up to studies of chronic starvation and diabetes mellitus. Many publications issued or in press during the year are also reviewed by the director in his report. Considerable new apparatus has been acquired

and earlier forms of equipment have undergone modifications suggested by experience. Interesting mention is made of visiting and cooperating investigators, of the special researches of the laboratory staff, and of the conferences had by the director during his trip abroad. The staff has been enlarged during the year by the addition of Professor Raymond Dodge, who will undertake work in the psychology of nutrition, and by Mr. E. H. Lange, who will serve as physicist for the staff.

#### DEPARTMENT OF TERRESTRIAL MAGNETISM

As already indicated in an earlier section of this report, one of the noteworthy events of the year for this department will be the completion of the second cruise of the non-magnetic ship *Carnegie*. She is now on the last stretch of this cruise and may be expected to arrive at a home port before the end of the calendar year, having been continually in service since June 20, 1910. The aggregate distance traversed in her two cruises will be in round numbers 80,000 miles. The corresponding distance covered by the chartered ship *Galilee*, in the Pacific Ocean during 1905-08, is 60,000 miles. Thus the total distance traversed up to date in the magnetic survey of the oceans is 140,000 miles, or about six times the circumference of the earth. Accurate magnetic data have been obtained thereby in all of the oceans between the parallels of 50° north and 50° south latitude, or near the courses usually followed by vessels. By reason of the expedition attained in deriving from these surveys the results of chief interest to mariners, it has been practicable for chart-publishing establishments to make prompt revision of defective sailing charts or to issue corrections thereto; and a distinct improvement in these aids to navigation is already noticeable in the charts issued by the leading maritime nations. The

more complete results of these ocean surveys are also in a forward state of preparation and it is expected that a full account of the work accomplished by the *Galilee* and the *Carnegie* will be ready for publication a year hence. In the near future it is considered that the *Carnegie* should make surveys in areas not yet covered and along some stretches already traversed where cloudy or stormy conditions have prevented the securing of adequate observations. She will at the same time cross her previous tracks as often as practicable in order to determine for such intersections the information now most needed by chart-makers, namely, the annual changes in the magnetic elements.

Magnetic surveys of land areas are also proceeding at a favorable rate. An expedition under Mr. D. W. Berky, assisted by Mr. H. E. Sawyer, has traversed the Sahara Desert, starting from Algiers near the end of October, 1912, and arriving at Timbuktoo May 12, 1913; and these observers are now extending their work into the territory of west and central Africa bordering on the Atlantic. Dr. H. M. W. Edmonds has led an expedition into Canada, west of Hudson Bay, near the location of one of the supposed poles of the earth's magnetic field. Mr. A. D. Power has made noteworthy progress in a survey of northeastern South America, including a trip along the Orinoco River and the Rio Negro from the mouth of the Orinoco to Manaos on the Amazon. Mr. H. F. Johnston is engaged in a series of determinations along a line running northward from Montevideo towards Manaos. Similarly, the magnetic survey of Australia and the adjacent islands is making efficient progress under the immediate charge of Mr. E. Kidson. Under his guidance Mr. E. K. Webb was trained for and supplied with instruments for the valuable magnetic work accom-

plished by the Mawson Antarctic expedition.

In the near future it is anticipated that the department will have sufficient data to permit the construction of a new set of magnetic charts, including all three magnetic elements (declination, dip and intensity), especially for that part of the globe included between the parallels of 50° north and 50° south of the equator. It will then be practicable to study the general problem of the earth's magnetism by aid of a large mass of homogeneous data surpassing in definiteness any mass hitherto available for this purpose. In anticipation of the need of experimental facilities for studies of this problem and others closely related thereto the office and laboratory building of the department was authorized a year ago and is now approaching completion, as explained in a previous section of this report. For the conduct of experimental researches the department has been fortunate in securing the services of Dr. W. F. G. Swann, late of the University of Sheffield. Mr. Charles R. Duvall, late of the U. S. Coast and Geodetic Survey, has also recently joined the office staff to fill the position of chief computer.

Attention is invited to the director's remarks on the present status of the department's work, to the account of his own researches of the year, and to his programs for further work. And in the interests of further possible work of construction of buildings under the auspices of the institution, it may be worthy of note that preliminary plans for the new laboratory were well matured by Mr. Fleming, engineer of the departmental staff, before consulting an architect, and that supervision of construction has also been assigned to Mr. Fleming. This method of procedure, which has been followed in several instances by the institution, appears to be highly advantageous for economy and for efficiency.

## THE SOLAR OBSERVATORY

From the date of its establishment nine years ago this observatory has been one of the most important of the enterprises fostered by the institution. It has called for heavy annual appropriations; it has grown with extraordinary rapidity and with equally extraordinary productivity; and it is now an organization whose staff of investigators, research associates and collaborators, constructors, computers, designers, mechanics and operators includes upwards of sixty individuals. By reason of the widespread popular and technical attention given to astronomical science, and by reason of the novel equipment of this observatory and the relatively new field entered by it, the world looks with special interest on its development, quite apart from the keen general interest in the contributions it has made and may be expected to make to astrophysics. This special interest centers in the fact that the experience of the observatory furnishes the details of an experiment on a large scale in a difficult field of inquiry, for which ways and means of corresponding magnitudes have been available. In general the means at hand for such enterprises have been incommensurate with the obstacles to be overcome, and progress has been hindered, delayed or blocked until necessity has devised some indirect way of surmounting these obstacles. But, on the other hand, this necessity has hitherto exerted a highly beneficial influence in stimulating discovery and invention, and one may perhaps question whether in the past ampler means for the pursuit of systematic research would have been on the whole advantageous for the advancement of knowledge. Some eminent authorities, indeed, still question the propriety of the endowment of research in any but educational establishments. Contemplative minds

are therefore awaiting the results of the experiment of the solar observatory with an eagerness only exceeded by that of the popular mind for information concerning the latest discoveries and advances in astronomical science.

In the meantime, with the installation of additional equipment and the application of appropriate methods of research, the observatory is increasingly productive. The principal results of the work of the past year are summarized by the director in his current report under seventy-two heads. No further summary of these results may be attempted here; attention may be given to a few only of the salient items of interest suggested by the report as a whole. The year has been one of minimum solar activity and noteworthy for a nearly complete absence of sun-spots. This has proved advantageous for the pursuit of studies of the sun's magnetism now definitely proved by work done at the observatory during the year. This advance in solar physics is of the highest interest by reason of its probable relations to terrestrial magnetism and to cosmic physics. Stellar and laboratory work have gone forward at a highly productive rate, and the subjects of solar, stellar and laboratory spectra and stellar velocities are among those instructively considered in the director's report. Evidence has been accumulated tending to show that light is absorbed in space, and that such a phenomenon will not only elucidate others hitherto obscure, but furnish means of measuring the greater depths of the visible universe. Professor Kapteyn has continued to act as research associate and adviser in the program of researches undertaken. The important results attained by Professor Störmer, who spent some time at the observatory as a research associate in 1912, in his investigation of solar vortices, and

those of other collaborators and members of the observatory staff, present features of special interest in the departmental report.

Favorable progress has been made in grinding the glass disk for the 100-inch telescope since the source of the obstacle encountered in this work was discovered about a year ago. The disk has been subjected to severely critical tests, which give assurances that it will meet requirements. The preparation of a 60-inch plane mirror for testing the 100-inch reflector has gone on simultaneously with work on the latter. The heavier parts of the mountings for the telescope are now under construction by the Fore River ship yards at Quincy, Massachusetts, while the foundations on Mount Wilson and the dome superstructure will probably be completed as soon as the disk and its mountings are ready. Allusion has already been made in a previous section to the new office building at Pasadena and to the remarkable success achieved in the construction of a dividing engine for ruling diffraction gratings. For adequate accounts of these and numerous other subjects of interest reference must be made to the director's full report.

#### WORK OF RESEARCH ASSOCIATES AND COLLABORATORS

As indicated in previous reports, the complexity of the relations which research associates and collaborators sustain to the institution is so great as to preclude any comprehensive explanation within the limits allotted to an annual administrative report. Their work embraces a wide range of subjects and varies in its conduct from individual independence to intimate collaboration with the departments of research and with the division of publications. During the past year more than twenty distinct

fields of research have been cultivated and a total of more than one hundred investigators have contributed to the output. Summaries of the work of associates proceeding independently are given by them in the current year book. Their publications of the year are cited in the bibliographical lists of later sections, and the work of many collaborators is mentioned in departmental reports. Attention may be called, among many important researches, to that of Professor H. N. Morse on the osmotic pressure of solutions, now approaching completion; to the investigations of Professor Mall and colleagues in embryology; to the completion of the edition of the *Arthurian Romances* by Dr. H. Oskar Sommer by the publication during the year of the seventh volume of this monumental contribution to early English literature; to the appearance during the year of a translation into German of the work on "Dynamic Meteorology and Hydrography," the institution's publication No. 88, by Professor V. Bjerknes; to the significant studies of Professors Osborne and Mendel in extension of their researches on the vegetable proteids; to the fundamental investigations of Professor Reichert, brought out in publications Nos. 116 and 173; and to the penetrating contributions to philology embodied in the series of researches of Mr. William Churchill, published in Nos. 134, 154, 174 and 184.

#### FINANCIAL STATEMENT FOR FISCAL YEAR 1912-1913

The sources of funds available for expenditure during the past fiscal year, the allotments for the year, the revertments made during the year, and the balances unallotted and unexpended at the end of the year are shown in detail in the following statement:

Object of Appropriation	Balances Un- allotted Oct. 31, 1912	Appropriation Dec. 13, 1912	Revertments Nov. 1, 1912, to Oct. 31, 1913	Total	Aggregates of Allotments and Amounts Expended and Transferred	Balances Un- allotted Oct. 31, 1913
Large grants.....	.....	\$816,972	\$21,287.75	\$838,259.75	\$838,259.75	.....
Minor grants.....	.....	116,800	8,229.48	131,242.97	125,980.41	\$5,262.56
Publications.....	\$6,213.49	60,000	5,315.33	82,196.51	66,693.30	15,503.21
Administration.....	16,881.18	50,000	5,000.00	55,000.00	55,000.00	.....
Reserve fund.....	.....	250,000	.....	250,000.00	250,000.00	.....
Insurance fund.....	.....	25,000	.....	25,000.00	25,000.00	.....
Total.....	23,094.67	1,318,772	39,832.56	1,381,699.23	1,360,933.46	20,765.77

The following list shows the departments of investigation to which the larger grants were made by the trustees at their last annual meeting and the amounts allotted from these grants by the executive committee during the year:

Department of Botanical Research.....	\$38,005.00
Department of Experimental Evolution.....	95,141.75
Geophysical Laboratory.....	78,000.00
Department of Historical Research.....	29,600.00
Department of Marine Biology.....	31,890.00
Department of Meridian Astronomy.....	25,180.00
Nutrition Laboratory.....	46,549.00
Division of Publications (office expenses).....	9,000.00
Solar Observatory.....	165,631.00
Department of Terrestrial Magnetism.....	210,263.00
Researches in Anthropology.....	7,000.00
Researches in Embryology.....	15,000.00
	<u>\$751,259.75</u>

The fields of investigation to which minor grants were assigned, the names of the grantees, and the amounts of the grants are shown in the following list:

Field of Investigation	Names of Grantees	Amounts of Grants
Astronomy.....	Kapteyn, J. C.....	\$2,000.00
Archeology.....	Bandelier, Adolf F..... Van Deman, E. B.....	2,000.00 1,800.00
Bibliography.....	Index Medicus.....	12,500.00
Biology.....	Riddle, Oscar..... Watson, John B.....	5,600.00 500.00
Botany.....	Britton, N. L., and J. N. Rose.....	6,900.00
Chemistry.....	Acree, S. F..... Baxter, G. P..... Osborne, T. B., and L. B. Mendel.....	2,000.00 1,500.00 15,000.00
	Jones, H. C.....	3,200.00
	Lorise, H. N.....	4,000.00
	Foyes, A. A.....	3,000.00
	Richards, T. W.....	3,000.00
	Sherman, H. C.....	1,200.00

Geology.....	Chamberlin, T. C..... Moulton, F. R.....	4,000.00 2,000.00
History.....	Osgood, H. L.....	1,200.00
Literature.....	Bergen, Henry.....	1,800.00
Marine Biology.....	Drew, G. Harold..... Vaughan, T. Wayland.....	2,000.00 3,300.00
Mathematics.....	Morley, Frank.....	1,200.00
Metalurgy.....	Howe, Henry M.....	500.00
Meteorology.....	Ejerknes, V.....	1,800.00
Nutrition.....	Tigerstedt, Carl.....	2,000.00
Paleontology.....	Case, E. C..... Hay, O. P.....	2,000.00 3,000.00
Paleography.....	Wieland, G. R.....	3,000.00
Physics.....	Loew, Elias A..... Hayford, J. F.....	1,800.00 2,000.00
	Nichols, E. L.....	3,000.00
Physiology.....	Barus, Carl.....	500.00
	Cooke, Elizabeth.....	1,900.00
Zoology.....	Reichert, E. T..... Castles, W. E.....	1,500.00 1,000.00
Administration	Naples Zoological Station.....	1,000.00
Building (ad- ditions)	.....	5,792.66
Reception, Na- tional Acad- emy of Sciences.....	.....	1,000.00
International Phytogeo- graphical As- sociation.....	.....	1,200.00
		<u>\$111,692.66</u>

The following grants for publication were authorized during the year:

Andrews, C. M.....	\$2,006.22
Barus, Carl.....	900.00
Benedict, F. G., and E. P. Cathcart.....	2,200.00
Bergen, Henry.....	170.00
Cannon, W. A.....	2,000.00
Case, E. C., S. W. Williston, and M. G. Mehl.....	1,200.00
Castle, W. E., and C. C. Little.....	2,100.00
Castle, W. E., and J. C. Phillips.....	650.00
Davenport, C. B.....	800.00
Churchill, William, and J. P. Finley.....	2,000.00
Huntington, E.....	3,800.00
Index of U. S. Documents relating to	

Foreign Affairs .....	12,000.00
Jones, H. C. ....	1,400.00
Jones, H. C. ....	1,500.00
MacDowell, E. C., and W. E. Castle ....	600.00
MacDougal, D. T., <i>et al.</i> .....	4,200.00
Osgood, C. G. ....	9,000.00
Papers from the Tortugas Laboratory..	3,800.00
Reichert, E. T. ....	1,094.68
Shreve, Edith B. ....	700.00
Smith, E. F. ....	4,800.00
Sommer, H. O. ....	6,500.00
Walcott, C. D. ....	272.40
Weed, L. H. ....	1,600.00
Wright, Albert Hazen .....	1,400.00
	<u>\$66,693.30</u>

The sources and amounts of the revertsments from November 1, 1912, to October 31, 1913, inclusive, are shown in the following list:

Large grants:

Transferred from minor grants .....	\$3,287.75
Revertment, Division of Publications .....	3,000.00
Revertment, Department of Meridian Astrometry ..	<u>15,000.00</u>

\$21,287.75

Minor grants:

Cooke, Elizabeth, Grant No. 878 .....	550.00
Drew, G. Harold, Grant No. 854 .....	2,000.00
Fitting, Hans, Grant No. 816.	1,800.00
Historical Research, Department of, Grant No. 794 .....	90.00
Osborne, T. B., Grant No. 692 .....	83.32
Reception, National Academy of Sciences, Grant No. 879.	381.16
Terrestrial Magnetism, Department of, Grant No. 798 .....	25.00
Vaughan, T. Wayland, Grant No. 855 .....	<u>3,300.00</u>

8,229.48

Publication:

Barus, Carl, Grant No. 872.	353.50
Benedict and Jones, Grant No. 820 .....	284.00
Bergen, Henry, Grant No. 826 .....	7.13

Burnham, S. W., Grant No. 803 .....	884.15
Callaway, Morgan, Jr., Grant No. 802 .....	11.00
Cannon, W. A., Grant No. 824 .....	531.70
Carnegie Institution of Washington, Grant No. 667 .....	218.73
Churchill, William, Grant No. 801 .....	851.08
Farlow, W. G., Grant No. 63.	365.00
Jones, Harry C., Grant No. 819 .....	33.05
Lancaster, H. C., Grant No. 814 .....	309.70
Loeb, Leo, Grant No. 821...	323.06
Researches of the Department of Terrestrial Magnetism, Grant No. 818....	<u>1,143.23</u>
	5,315.33
Administration:	
Revertment from allotted balance .....	<u>5,000.00</u>
	<u>\$39,832.56</u>
	R. S. WOODWARD

EDUCATIONAL INTERESTS AT WASHINGTON

I

ONE of my first impressions when I joined the Federal Bureau of Education at Washington, in the summer of 1906, was that of the cooperative friendliness of the various executive offices with which I had to do. Every door was open. My new-found colleagues in the Department of the Interior and its other bureaus, the higher officials of three or four other departments, with whom the business of my office soon brought me into contact, the public printer, the civil-service commissioners, the director of the census, officials of the Smithsonian Institution, the librarian of Congress, the White House staff, and the President himself—all were not only easy of access, but were prompt to welcome the newcomer and to lend him a helping hand.