SCIENCE

FRIDAY, FEBRUARY 28, 1913

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

THE CARNEGIE INSTITUTION OF WASHINGTON[1]

PRESENT STATUS OF THE INSTITUTION

ALTHOUGH the institution is quite young and must be considered as still, to some extent, in its formative stages, this first year of the second decade of its history marks an epoch worthy of something more than passing notice. During this year, to a degree hitherto impracticable, there has been opportunity for an objective view of the meaning of the extensive and varied experience, acquired by the institution, of the principles which have guided its development, and of the limitations, difficulties and dangers which may beset its future progress. During this year also, to a greater degree than hitherto, have appeared evidences from widely divergent sources of an increasing public tendency to take an objective view of the plan, scope, organization and development of the institution and to measure its efficiency by the results of its investigations already published or under way. From these objective views it appears that, in spite of a great diversity of opinion as to what research is and how it should be carried on (a diversity which seems destined to continue indefinitely), there is now a consensus of opinion that the institution has established its position and demonstrated the practicability of the conduct of effective research in establishments wholly devoted thereto, separate and apart from other establishments whose functions are primarily and commendably agricultural, charitable, com-

[1] Extracts from the report of the president for the year ending October 31, 1912.

mercial, educational, governmental, political, religious or social. Thus, in general, it may be said that, as regards internal and external relations and interrelations, the institution in its chosen field of activity has now reached a status approximating to stability of adjustment, wherein definiteness of aim, continuity of effort and concentration of energy and resources may be more productively applied than heretofore.

But while the work proper of the institution, namely, work of research, is in a satisfactory condition, as much may not be said of the adventitious work incident especially to the administrative office. For although this latter work is sometimes instructive and occasionally useful, it is generally fruitless and often excessively wasteful of time and energy which might otherwise be turned to better account. This work involves a vast correspondence concerning an endless variety of subjects and particularly concerning an endless variety of objects for which funds might be spent. In its higher phases it is the work of an intelligence office and may be accepted as a not unworthy though unintended function of the institution; in its lower phases it is in need of curtailment in the interests alike of all concerned.

The time for a detailed, or even summary, account of this highly complex and to some extent psychologically important experience has not yet arrived. Such an account must be left to historians interested in the evolution of institutions or to analysts, like De Morgan, in search of a mine of materials for a new "Budget of Paradoxes." It is plainly the part of wisdom, however, not to wait for verdicts of the historian and the analyst, but to make use of such inductions as may be safely drawn, not only from the experience just referred to, but also from that gained in the work proper to the institution. Most of the theories, ideas and sentiments involved are subject to the tests of statistical treatment which determine with sufficient accuracy the more fruitful methods of procedure. Of the many inductions which may be thus drawn out of the experience of the institution a few may be here set down as indicative of existing conditions and tendencies.

It is in evidence—

1. That there are the amplest room and the amplest opportunity for research establishments without danger of encroachment on establishments founded for other purposes; that it is not difficult for the institution to find appropriate ways in which to apply its income; that there are, in fact, in plain sight, ten times as many worthy, practicable subjects of research and ten times as many worthy investigators as the income of the institution can advantageously subsidize.

2. That there are many investigations of such magnitude and difficulty that they can not be carried on economically and effectively except by men untrammeled by other occupations. The common notion that research demands only a portion of one's leisure from more absorbing duties tends to turn the course of evolution backwards and to land us in the amateurism and the dilettantism wherein science finds its beginnings.

3. That it is inimical alike to the interests of society and to those of the institution to look upon it as a mere disbursing agency designed to meet emergencies or to supply deficiencies of other institutions and of individuals. The widely spread impressions that the income of the institution is sufficient to meet the aggregate of such emergencies and deficiencies, and that the institution can undertake to play the rôle of a special providence and thus anticipate the collective needs of deserving

individuals and organizations, have no foundations in fact.

4. That while there may be wisdom in a multitude of counsels, it becomes increasingly difficult of access as the multitude enlarges and is generally obscured, if not hidden, by a conflict of opinions. The current popular impression that discoveries and advances may be favorably promoted by the patient examination of a vast aggregate of miscellaneous suggestions is a fallacy abundantly demonstrated by the probably unequaled data available to the institution.

5. That it is neither practicable nor advantageous for the institution to undertake to perfect inventions, to secure letters patent for them, to defend inventors in suits at law, or to exploit successful inventions. The objects of the inventor are primarily egoistic and hence secretive; the objects of the institution are primarily altruistic and hence non-secretive; their divergence is so great as to render them mutually exclusive under existing conditions. The distinction between invention and investigation is rarely understood and is not always easily drawn. They are indeed closely allied; for the inventor is often compelled to make investigations and the investigator is often compelled to devise inventions. It should be said also that the egoism of the inventor which leads him to secretiveness and to seek state privileges through patent rights has its correlative in the desire of the investigator to secure priority of discovery and publication. The distinction is one of reversed attitudes and objects. The inventor is primarily interested in direct personal benefits which may come from the application of facts and principles in the perfection of useful devices, machines and processes. The investigator is primarily interested in the discovery of facts and principles which may be given freely to the world without expectation of immediate application or hope of direct personal benefit. It is claimed, however, that the party of the second part to be considered in all such matters, namely, society, is in general disproportionately the gainer over both the inventor and the investigator. The extensive evidence on this subject acquired by the institution shows clearly that the indirect advantages to the investigator arising from his altruism are generally much greater than the direct advantages to the inventor arising from his egoism. This evidence is, indeed, so convincing as to suggest the desirability, at some future date, of the organization of a department devoted to inventions, which, instead of being protected by patent rights should be protected, if at all, against them. It is plain, in fact, that if society could make use of knowledge now available the labors of the expert inventor could become far more fruitful and far more satisfactory to him than they are at present.

RÉSUMÉ OF INVESTIGATIONS OF THE YEAR

Departments of Research

It is now nine years since the earliest of the departments of research established by the institution were authorized and six years since the latest of them was authorized. This lapse of time has now fully demonstrated that these departments are all engaged in enterprises which, by reason of their magnitudes, were unlikely to be carried out under other auspices. They have grown very rapidly and have become highly productive. All of them tend continually, and in many respects properly, to expand as their several fields of investigation are developed. They thus tend constantly to press closely upon the available income of the institution and hence to become a source of concern by reason of their highly commendable progress. But the

remedy for this paradox does not lie alone in increased expenditures; to an equal extent, at least, it lies in increased efficiency under slowly increasing, or even stationary or decreasing, expenditures. It is a special duty of the man of science to show how more and better work can be done at less cost than has been practicable to his predecessors.

Although these departments of investigation, like the institution as a whole, have fallen short of popular expectations in the rapidity of their growth, it now appears plain, in the light of their actual experience, that this growth has been somewhat too rapid for safety. Along with this rapid growth and with the signal success of these departments in their several fields of research, there are now coming also numerous requests for cooperation with other organizations and with individuals. But while these requests are in general gratifying and often praiseworthy, they present some obvious hazards. There is need, therefore, of constant caution against the dangers of undue expansion and affiliation which lead to dissipation of effort and resources. It should be kept in mind that concentration on definitely limited programs, continuity of effort and energetic assiduity are the factors most essential to progress in the domain of research.

The plan referred to a year ago, of inviting one or two eminent specialists to become associated with each of the departments for limited periods of time, has thus far worked quite advantageously and promises to become increasingly fruitful. Eight such specialists have been connected with the departments during the past year by direct appointment of the executive committee, with varying compensations, as shown in the financial section of this report. Some other research associates have served without compensation and several collaborators have also partaken in departmental investigations or availed themselves of departmental facilities without direct expense to the institution.

As usual, in the president's report, reference must be made to the departmental reports, to be published in full in the current year book, for comprehensive accounts of departmental investigations, publications and plans for future activities, as well as for accounts of the work of departmental associates and collaborators. Only the briefest summaries, indicating some of the salient features of these accounts, are attempted in the following paragraphs.

Department of Botanical Research

The geographical range of the work of this department, which centers in the Desert Laboratory at Tucson, Arizona, has been extended during the past year to include certain portions of the deserts of northern Africa. Thus Dr. Cannon spent the late autumn and early winter of 1911–12 in the deserts of Algeria, while Director MacDougal and his engineer, Mr. Sykes, spent a good share of the winter of 1911–12 in the Lybian deserts. These expeditions enabled the department to acquire extensive information for comparative studies of desert areas, and Dr. Cannon's report on the results of the earlier expedition has been already received for publication.

Studies have been continued also at the Desert Laboratory, at the Carmel Laboratory on the California coast, at Salton Sea, and at various substations where observations are made on the phenomena presented by plants under strikingly varying conditions. The desiccation of the Salton Sea now under observation presents many instructive conditions which are being carefully studied in their climatic, biological and physical aspects. It will be practi-

cable, therefore, in the course of a few years, to furnish something like a detailed history of this remarkable basin, which has now been carefully studied at intervals since its discovery in 1854 by the late Professor N. P. Blake.

One of the most important investigations undertaken during the past year is that of a comprehensive study of the large and highly diversified family of cactus plants. Through the cooperation of Professor N. L. Britton, director of the New York Botanical Garden, and Dr. J. N. Rose, of the staff of the Smithsonian Institution, who have been appointed research associates, it will be practicable, by aid of the facilities of the department, to produce a monographic study of these typical desert plants.

Several volunteer associates and collaborators of the department have participated in departmental researches and contributed to the progress attained therein. Upwards of twenty individuals have taken part in one or more phases of this work.

Department of Experimental Evolution

The advances made by this department during the past year have been chiefly along the lines of studies in cytology, in the chemistry of pigmentation, in the factors of mutation, and in the problems of human heredity. These studies have been carried on by aid of experiments with plants and animals and by aid of rapidly accumulating statistical data concerning human traits and their transmission through successive generations. The director has been able to give much of his time to studies in human heredity by reason of his connection with the Eugenics Record Office, whose work has been liberally supported by Mrs. E. H. Harriman and by Mr. John D. Rockefeller. The experiments of the department proper with plants and animals are thus supplemented very advantageously by the extensive information already acquired by the Eugenics Record Office in respect to human heredity.

Very interesting chemical studies have been carried on by Dr. Gortner, a member of the staff, in respect to the chemical nature of pigments which determine color characteristics, especially of the plumage in birds, of the wool in sheep, and of the skin in men.

Dr. Shull has continued his fertile studies into the heredity of plants, including further investigations into the connection between heredity and environment in the case of corn. These further studies confirm his earlier conclusions and show also that the hereditary traits of different strains are maintained irrespective of environmental influences.

The director calls attention to the need of his department for additional buildings and equipments. A recommendation with respect to this need will be found in a subsequent part of this report.

Department of Economics and Sociology

According to the report of Professor Henry W. Farnam, chairman, the work of this department has now reached such a stage of advancement that the time of its completion depends mainly on the amount of leisure the collaborators may obtain in the near future for consecutive attention to their several contributions to the "Economic History of the United States." By aid of the special appropriation for payment of salaries (made by the board of trustees a year ago), it is now practicable for some of the collaborators to devote part of their time and attention consecutively to this work, and two or three of them will doubtless be able to give at least half-time under this plan during the ensuing year.

The present status of the investigations of the several divisions of the department is set forth in detail by the chairman in his report.

The attention of the trustees is especially invited to a paragraph in Professor Farnam's report calling attention to the desirability of a more permanent organization of this department before its present program of research is completed. He recommends an organization similar to that of other departments of the institution, which would involve the appointment of a salaried director and a permanent staff. The experience of the institution leaves no doubt as to the wisdom of this recommendation on the score of continuity and efficiency for this as well as for other departments of the institution. Further reference to this subject will be made in the budget section of this report.

Geophysical Laboratory

The list of twenty-six publications which have emanated from the geophysical laboratory during the past year, and which are briefly reviewed by the director in his annual report, furnishes the best index of the activity of this establishment. Two specially noteworthy publications of the laboratory have been issued during the year by the institution, namely, No. 157, "High Temperature Gas Thermometry," and No. 158, "The Methods of Petrographic-Microscopic Research." The purpose of the first of these was to give an account of the apparatus and methods for accurate measurement of the critical temperatures incident to mineral combinations; and the object of the second is to place, so far as practicable, microscopic study of minerals upon a quantitative basis. Attention has hitherto been called to this characteristic feature of the investigations of the geophysical laboratory, which is a characteristic feature of all of the advancing sciences. The work already accomplished demonstrates the practicability of achieving this object for the science of mineralogy. This advance requires that special attention be given to accurate measurements of high temperatures and high pressures, as well as to their simultaneous effects upon mineral constituents. Much study, therefore, continues to be given by the laboratory staff to the development of effective apparatus and technique for the measurements essential in this work.

Special attention is called in the director's report to extended studies on quartz and other forms of silica which is the most widely diffused ingredient in rock masses; to further experiments on the conditions of association of the three oxides, lime, alumina and silica, which in addition to being the commonest components of igneous rocks are also incidentally the three principal ingredients of the so-called Portland cement; to mineral sulphides, which are often of great economic importance; and to mineral and rock densities.

Perhaps the most interesting of the more recent investigations of the laboratory are those of the physics and chemistry of active volcanoes undertaken tentatively a year ago and pursued with very gratifying success during the past summer. It has proved practicable for members of the staff to descend into the crater of Kilauea and to collect considerable quantities of gas as it emerged from the liquid lavas of the crater. Specimens of gases were collected in glass tubes without contamination from the air, and these have been brought to the laboratory at Washington for detailed study. There seems little reason to doubt that the phenomena of vulcanism will be ultimately revealed by the methods, appa-

ratus and technique developed by the staff of the laboratory.

Department of Historical Research

Naturally a department devoted to historical research is chiefly concerned with the preparation of publications, and these latter for the department in question may be classified under the head of reports, aids and guides concerning materials relating to American history and under the head of textual publications of documents. Under the first head attention may be called to Professor Marion D. Learned's "Guide to the Manuscript Material relating to American History in German State Archives," No. 150 of the publications of the institution, which has appeared during the year. Two other volumes, namely, publication No. 90A, "Guide to the Materials for American History, to 1783, in the Public Record Office of Great Britain," and publication No. 163, "Guide to the Materials for the History of the United States in the Principal Archives of Mexico," of the institution are now in press. No. 90A has been somewhat delayed by reason of a reclassification to which large sections of the British Public Record Office were subjected after this work had been started by Professor Andrews. Another work in press by the department is Mr. David W. Parker's "Guide to the Materials for United States History in Canadian Archives," publication No. 172 of the institution.

Further progress is reported in respect to the work in charge of Mr. W. G. Leland, of the departmental staff, on materials for American history in the archives of Paris. Search has been made also in several other European cities for sources of American history. The director of the department spent the past summer in Europe and took occasion while there to devote special attention to the materials derivable from the five French-speaking cantons of Switzerland. Assistance has been rendered to the department during the year by several collaborators who have been called by the director to his aid in the preparation of the proposed atlas of historical geography of the United States, to which reference has been made in preceding reports.

Dr. Burnett, of the departmental staff, has been engaged chiefly upon the series of "Letters of Delegates to the Continental Congress," while Miss Davenport, also of the permanent staff, has been occupied nearly continuously in the collection of "European Treaties having a bearing on United States History." These documents promise to furnish much material hitherto inaccessible to students of American history.

Department of Marine Biology

The independent transportation facilities furnished by the staunch new vessel *Anton Dohrn,* and the repairs and improvements to the laboratory completed a year ago, have proved highly advantageous to the department of marine biology. By means of the *Anton Dohrn* the entire Gulf and West Indian region becomes open to investigation by the department. The director records with appreciation a gift to his fleet by Hon. John B. Henderson, of Washington, D. C., of a 23-foot, 6 horsepower launch, which has already proved a very useful adjunct in the diversified work of the department, since many different investigations are carried on simultaneously by different individuals at the laboratory headquarters.

During February and March of the current year the director established a temporary laboratory at Montego Bay, Jamaica, a region which sustains important biological relations to the vicinity of the

Tortugas group of islands. In addition to the director, nine other investigators pursued researches at this laboratory. In May the director and three collaborators visited the Bahamas, making a successful cruise of 570 miles with the *Anton Dohrn*. This expedition was of special aid to Messrs. Drew and Vaughan in their studies concerning oolite deposits and corals.

The director of the department has issued, as No. 162 of the publications of the institution, an additional volume of his series on the jelly-fishes of the world, the title of this volume being "Ctenophores of the Atlantic Coast of North America." Sixteen of his collaborators have presented papers for publication, which will furnish two more volumes of the "Researches from the Tortugas Laboratory."

Department of Meridian Astrometry

After the meridian instrument was brought back from the temporary observatory at San Luis, Argentina, to the Dudley Observatory at Albany, it was thoroughly reexamined to make certain that it had undergone no change on account of the relatively rough handling it necessarily received during this journey from Argentina to America. The reexamination was completed about the beginning of the present fiscal year and proved conclusively that the instrument had suffered no damage in any of its parts. Along with this good fortune to the department and to the Dudley Observatory, this instrument thus becomes noteworthy in the annals of astronomy, for no meridian circle has been so thoroughly proved to retain its stability under such a variety of varying conditions. After the preliminary tests referred to, observations with the instrument were begun on November 13, 1911, and have continued throughout the year, in accordance with the program explained hitherto in the departmental reports.

In the meantime special attention has been given to the reduction of the meridian observations made at San Luis, Argentina. The determination of the two coordinates of stars from this work, namely, right ascension and declination, have proceeded simultaneously. The assignment of stellar magnitudes, however, must await the photometric determinations which have been made at San Luis since the meridian measurements were completed. Late advices from Mr. Zimmer, who has charge of this photometric work, announce that it will be completed by the end of the present calendar year, and he and his assistant are expected to return early next year.

The department reports with great regret the death, on November 19, 1911, by accidental drowning, of Mr. William Hunt, who served initially as Mr. Zimmer's assistant. Mr. Hunt was a young man of much promise, and his untimely loss was a source of shock to his colleagues and a cause of temporary delay to the photometric work.

Much attention has been given by the director of the department and by Mr. Benjamin Boss to studies of stellar motions for which the extensive data accumulated by the department are furnishing evidence. These studies and those made by the solar observatory of the institution, along with corresponding investigations in many other observatories, indicate that the progress of astronomy in the future is to be no less brilliant than it has been in the past.

The great quantity of priceless observational and derived data accumulated by the department rendered it imperative that special provision should be made for their safe storage. Accordingly the executive committee authorized the department to expend, from its last annual allotment, the

sum of $2,000 for the construction of a fireproof vault within the walls of the Dudley Observatory. This vault is now ready for occupancy and the records will be placed therein as soon as practicable.

Nutrition Laboratory

Although investigations began immediately on the establishment of the nutrition laboratory five years ago, the novelty and importance of its field have called for continuous additions to its equipment, while added experience has suggested many improvements in the apparatus used. Thus during the past year two balconies have been added to the calorimeter laboratory, a treadmill designed to measure severe muscular work has been provided for a respiration chamber, and numerous modifications have been made in the calorimeters and respiration apparatus of the laboratory. More detailed studies of the bicycle ergometer, which has hitherto proved so useful in experiments on the metabolism of man during excessive muscular work, have rendered the apparatus available over a wider range of experimentation and with a higher degree of certainty than hitherto. The importance and success of the experiments already undertaken at the laboratory have created a widespread interest in the medical profession, and this interest has led to many cooperative investigations undertaken during the past year. The novel equipment of the laboratory has been the subject of much inquiry also, and many investigators from other laboratories have sought to secure copies of the apparatus used and to learn more of the technique developed by the director and his staff.

One of the most interesting of the many investigations under way during the year is that of the metabolism of a subject who underwent a prolonged fast, extending to thirty-one days without food, and who drank only distilled water during this time. This investigation required the cooperation of a number of chemical, pathological and psychological experts. A detailed report on this elaborately observed experiment is at present in preparation. Another noteworthy investigation of the year is that on metabolism during severe muscular work, undertaken by Dr. E. P. Cathcart, of the University of Glasgow, who was a research associate of the institution during the winter of 1911–12. Amongst other important results of the latter research is the measure it affords of the mechanical efficiency of man. An account of this investigation is likewise in preparation for publication.

In addition to the numerous papers which have appeared in current journals from the laboratory, two volumes, Nos. 166 and 167 of the institution's series, have been issued during the year. The first of these is devoted to "The Composition of the Atmosphere with Special Reference to its Oxygen Content," and proves the remarkable fact of the essential constancy of this element in the atmosphere.

Department of Terrestrial Magnetism

Highly effective progress has been made by this department during the past year in its magnetic survey of the globe. By means of the non-magnetic ship *Carnegie* it is now easier to make a magnetic survey of the ocean areas than of the land areas, for the former are now more readily accessible than the latter. At the end of the preceding fiscal year the *Carnegie* was at Batavia, Java. On November 21, 1911, she set sail for an additional circuit of the Indian Ocean, whence she proceeded to Manila, Philippine Islands, where she arrived February 3, 1912. From Manila she proceeded to Suva, thence to Tahiti, and is now en route to Coronel, Chili. During the fiscal year she traversed about 28,000

miles. Her courses are arranged to intersect as frequently as possible her own previous tracks, those of the *Galilee* and those of previous expeditions on which magnetic elements were observed. Valuable checks on the determinations of these elements are thus secured, and in case of considerable intervals between the dates of different determinations, data for secular variation of the magnetic elements are also obtained. As related in the report of a year ago, unexpectedly large errors were found in the best magnetic charts of the Indian Ocean and for some parts of the Pacific Ocean. In order that corrections may be speedily applied to such charts the results of the cruises of the *Carnegie* are promptly made known to the principal hydrographic offices of the world. It is expected that the *Carnegie* will complete her present circumnavigation of the world near the end of the next fiscal year.

Observations have been continued simultaneously on land areas, embracing portions of five continents and about twenty different countries. Many noteworthy series of transcontinental stations have now been completed. Of these, one extending across the entire continent of South America, beginning at Para, at the mouth of the Amazon, and extending to Callao on the Pacific coast, by way of the Amazon and Ucayali rivers and Lima, has been finished during the past year.

The first volume of researches of the department, giving the results of land observations from the time of its establishment in 1905 down to the end of the year 1910, is now in press. The final computations of the ocean observations made during the various cruises of the *Galilee* and the *Carnegie* are also well advanced for a second volume. Many improvements in instrumental appliances have been made during the year in response to needs and suggestions arising from the extensive experience of the department on land and sea. One of the most important of the new appliances devised is that called an "earth inductor," which permits the measurement of the dip of the magnetic needle with increased precision and decreased labor over devices previously used. An attempt is now being made to apply this apparatus, which has proved completely successful on land, to the determination of dips on the *Carnegie*.

Solar Observatory

The past year has been one of minimum sun-spot activity; but effective progress has been made in many other branches of solar and stellar research undertaken by the observatory. The wide range of this work may be indicated by the fact that the results of the investigations of the year are summarized by the director under thirty-five different heads. The new tower telescope has been completed and important auxiliary apparatus has been added to the equipment of the 60-inch reflector. A fireproof office building, which will afford adequate quarters for the staff and safety for the original records and photographic plates of the observatory, has been constructed and made ready for occupancy during the year.

The 150-foot tower telescope with its spectrograph and spectroheliograph has been tested and found to be quite up to expectations. The 60-inch reflector has proved increasingly effective in the wide variety of work undertaken with it. Between forty and fifty new spectroscopic double stars have been found; and amongst the many stars whose radial velocities have been measured is one which surpasses all other hitherto observed, its velocity being about 150 miles per second.

Two eminent research associates, namely,

Professor Kapteyn, of Groningen, and Professor Störmer, of Christiania, have taken part in the work of the observatory during the year. Professor Kapteyn, who has served in this capacity for several years previously, has been of great service to the department, especially in the planning of a program of work with the 60-inch reflector, so that it may yield a maximum return alike for problems of stellar distribution and stellar development. Professor Störmer, who is one of the highest authorities concerning auroras, has sought to determine especially the connection of these phenomena with the sun. Of their connection with the sun and with the earth's magnetism there is little doubt, and the recent demonstration of the atomicity of matter in general and the atomic nature of electricity in particular may be confidently expected to lead to distinct advances in our knowledge of these phenomena in the near future.

The laborious task of shaping and testing the glass disk for the proposed 100-inch telescope has proved a disappointment in showing that this disk, which was accepted provisionally from the makers several years ago, will not answer the requirements. At this writing it appears possible that some expedients may be adopted to overcome the instability of this disk; but the probability that it may be made to work satisfactorily is small. In the meantime the makers of such large disks have not succeeded in making one of sufficient uniformity in density. In view of these difficulties the director is disposed to try a thinner disk if one can be found possessing the requisite degree of homogeneity. Thus this project must suffer further delay, although it is practically certain that the difficulties presented may be ultimately overcome.

Investigations of Research Associates and Collaborators

The relations of research associates and collaborators of the institution are so diversified and complex that they are difficult to specify at any given epoch. Individuals who have received direct aid during the year to their investigations through grants are mentioned in the preceding financial section of this report. Those who have received indirect aid through grants made for the publication of their researches are also mentioned in the section just referred to. Many collaborators and assistants have received compensation directly from research associates in charge of investigations, while some research associates and many collaborators have received no direct compensation. It appears to be neither desirable nor practicable at present to seek any higher degree of correlation of this work, since it is carried on by many individuals in many different parts of the world. The best evidences of the quantity and quality of the results accomplished are to be found in the publications listed in part in a subsequent section of this report and more at length in the general bibliography of the year published in the current year book. The work of the year has extended to an aggregate of more than twenty different fields of research and has occupied the attention of more than a hundred investigators. Many of these have rendered special reports to be published in the year book, while reference is made to the work of many others in the reports of the larger departments of research.

FINANCIAL STATEMENT FOR FISCAL YEAR 1911–12

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

Object of Appropriation	Balances Unallotted or Unexpended Oct. 31, 1911	Appropriation, Dec. 15, 1911	Revertments Oct. 31, 1911, to Oct. 31, 1912	Total	Aggregates of Allotments and Amounts Expended and Transferred	Balances Unallotted or Unexpended Oct. 31, 1912
Large grants	.....	$641,100	$8,122.06	$649,222.06	$649,222.06	.....
Minor grants	$5,000.00	172,400	1,000.00	178,400.00	172,186.51	$6,213.49
Publications	15,324.33	60,000	4,465.78	79,790.11	62,908.93	16,881.18
Administration	20,561.22[2]	50,000	3,137.60	73,698.82	53,791.13	19,907.69[2]
Reserve fund	.....	250,000	.....	250,000.00	250,000.00	.....
Insurance fund	.....	23,000	.....	23,000.00	23,000.00	.....
Total	40,885.55	1,196,500	17,725.44	1,254,110.99	1,211,108.63	43,002.36

unallotted and unexpended at the end of the year are shown in detail in the above statement.

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 ...	$37,905.00
Department of Economics and Sociology	12,500.00
Department of Experimental Evolution	37,477.00
Geophysical Laboratory	75,000.00
Department of Historical Research ...	26,600.00
Department of Marine Biology	18,000.00
Department of Meridian Astrometry ..	26,316.00
Nutrition Laboratory	48,539.06
Division of Publication	10,000.00
Solar Observatory	254,075.00
Department of Terrestrial Magnetism	97,810.00
	$644,222.06
Transferred from Nutrition Laboratory to unappropriated fund	5,000.00
	$649,222.06

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:

DETAILS OF MINOR GRANTS

Field of Investigation	Names of Grantees	Amount of Grants
Astronomy	Gale, Henry G.	$1,000.00
	Kapteyn, J. C.	2,000.00
	Störmer, Carl	1,800.00
Archæology	Bandelier, Adolf F.	2,000.00
	Frothington, A. L.	750.00
	Van Deman, Esther B.	1,200.00
Bibliography	Index Medicus	$12,500.00
Biology	Riddle, Oscar	4,400.00
Botany	Britton, N. L., and Rose, J. N.	3,400.00
	Rose, J. N.	3,600.00
	Fitting, Hans	1,800.00
Chemistry	Acree, S. F.	2,000.00
	Baxter, G. P.	1,000.00
	Osborne, T. B., and Mendel, L. B.	15,000.00
	Jones, H. C.	2,200.00
	Morse, H. N.	4,000.00
	Noyes, A. A.	3,000.00
	Richards, T. W.	3,000.00
	Sherman, H. C.	1,200.00
Climatology	Huntington, Ellsworth	4,000.00
Exp. Evol.	Dept. of Exp. Evolution	851.75
Geology	Chamberlin. T. C.	4,000.00
	Moulton, F. R.	2,000.00
History	Dept. of Hist. Research	3,000.00
	Osgood, H. L.	500.00
Literature	Bergen, Henry	1,800.00
	Sommer, H. Oskar	2,000.00
Marine Biology	Watson, John B.	500.00
Mathematics	Dickson, L. E.	500.00
	Morley, Frank	1,200.00
Metallurgy	Howe, Henry M.	500.00
Meteorology	Bjerknes, V.	1,800.00
Paleontology	Case, E. C.	2,000.00
	Hay, O. P.	3,000.00
	Wieland, G. R.	3,000.00
Paleography	Loew, Elias A.	1,500.00
Physics	Barus, Carl	500.00
	Hayford, J. F.	2.000.00
	Nichols, E. L.	3,000.00
Physiology	Cooke, Elizabeth	500.00
	Reichert, E. T.	1,500.00
Terrestrial Mag.	Dept. of Ter. Mag.	3,600.00
Zoology	Castle, W. E.	2,500.00
	Naples Zool. Station	1,000.00
Adm. Building (additions)	.....	6,462.70
		199,064.45
Transferred: Large grants	.....	3,122.06
Unappropriated fund	.....	50,000.00
		172,186.51

[2] Unexpended amount.