Some Cases of Excessive Damping of Torsional Vibrations: K. E. Guthe, Iowa State University.

The decrease of the logarithmic decrement with the amplitude, frequently observed in torsional vibrations, is usually extremely small. It is considered as closely connected with the elastic after-effect. Wires of platinum-iridium which are practically free from such after-effect have not alone a large logarithmic decrement, but show also a decided decrease of decrement as well as period with decreasing amplitude. This is especially pronounced in a 40 per cent. platinum-iridium wire whose logarithmic decrement decreased from 0.0137 to 0.0025, while the amplitudes decreased from 5.7 to 0.85 degrees. The corresponding change in the period was from 7.350 to 7.175 seconds. The decrease in amplitude is nearly proportional to the square of the amplitude. With different moments of inertia suspended from the wire the values of the decrement remained the same for the same amplitudes.

Similar effects, though less pronounced, were observed with wires containing a smaller percentage of iridium and in drawn wires of other materials. It was attempted to explain the phenomena by the assumption that the disappearance of the elastic after-effect is very rapid.

The increase of the logarithmic decrement upon drawing was explained by Beilby's theory of the effect of mechanical hardening. A carbon filament was shown to have a large decrement; the electrolytic deposition of hydrogen upon palladium increased the logarithmic decrement fivefold. In conclusion, it was pointed out that the conditions under which a wire is annealed by heating greatly influence its elastic properties.

F. N. Cole,
Secretary

(To be concluded)

The Carnegie Institution of Washington [1]

Referring to the individual reports of the heads of departments for a more adequate account of the year's work on the numerous and diverse fields of departmental activity, the following summary may suffice to show the trend of current progress.

Department of Botanical Research

This department is engaged on a series of problems whose elucidation can not fail to be of the greatest interest and value, whether applied to the restricted field of botany or to the broader domain of biology. By means of observation, experiment and measurement it is proposed to determine, as nearly as may be, the conditions of development, growth, distribution, migration and variation of desert plants. Thus, in addition to systematic studies of the forms and distribution of these plants, there must be carried on studies of the factors of temperature, rainfall, evaporation, soil moisture and anatomical and physiological adaptability. The location of the desert laboratory in a country affording a wide range of plant forms, as well as a wide range of conditions in altitude, temperature, soil moisture and soil composition, presents unequaled opportunities for such studies.

Along with these lines of work, the anatomical, physical and physiological researches of the department staff have already resulted in noteworthy contributions to biological science. Among these, reference may be made especially to publication No. 81, in which Director MacDougal gives an account of the production of a new species of plant by an application of chemical fluids to the parent plant seeds during the period of germination. This remarkable achievement must be regarded as one

[1] From the annual report of the president for 1907.

of the noteworthy advances in modern biology. Mention may be made here also of the important contribution of Professor Lloyd, formerly an associate of the department, on the "Physiology of Stomata," now in press as publication No. 82 of the institution. Scarcely less important and promising in their ultimate applications are the descriptive studies of the desert flora of Professor Spalding, the investigations of the physics of plant life by Dr. Livingston, and the histological researches on hybrids by Dr. Cannon. In the last-named work Dr. Cannon has derived valuable assistance from Mr. Burbank, whose unrivaled production of hybrid plants furnishes ample and varied material for the histologist as well as for the horticulturist.

DEPARTMENT OF ECONOMICS AND SOCIOLOGY

As may be inferred from its name, this department includes a wide range of work and requires a correspondingly large corps of collaborators. During the past year 185 individuals have participated in its work. Its investigations are under the following titles: Population and Immigration; Agriculture and Forestry; Mining; Manufactures; Transportation; Domestic and Foreign Commerce; Money and Banking; The Labor Movement; Industrial Organization; Social Legislation; Federal and State Finance, including Taxation; The Negro in Slavery and in Freedom.

The names of the experts in charge of these divisions and the abstracts of progress given in the report of the director afford a sufficient guaranty of an abundant harvest from these varied fields of research. Many preliminary results have already been published and many more are forthcoming.

One of the first necessities which confronted this department was that of a systematic search for early as well as recent economic material in the official documents of the several states of the United States. To meet this need the preparation of a classified index of economic material in the state documents has been undertaken for the department by Miss Adelaide Hasse, of the New York Public Library. Three volumes of this important work, namely, those for the states of Maine, New Hampshire and Vermont, have been issued by the institution during the past year, and volumes for New York and Rhode Island are now in press.

DEPARTMENT OF EXPERIMENTAL EVOLUTION

The work of this department is progressing favorably along lines explained in preceding reports, the principal problems under investigation being those of heredity in plants and animals. Old as these problems are, it is only recently that their study has risen to the level of the older physical sciences in which measurement and calculation are so advantageously applied. It is now clear, however, that these powerful adjuncts of research may be applied with equal advantage in biological investigations. Thus the more important work of our Departments of Experimental Evolution, Botanical Research and Marine Biology serves to mark the advance of biological science from the qualitative to the quantitative stage.

One of the most interesting and gratifying results flowing from the larger projects undertaken by the institution is the stimulus they are producing amongst individual investigators at home and abroad. This is especially the case with the Department of Experimental Evolution, whose location close to the main routes of travel makes inspection of its work somewhat more easy than in the case of other departments. The reciprocal advantages arising from visits to our departments of experts in similar lines of work are of the highest significance. Indeed, it appears not improbable that the

indirect results arising from such conferences may prove to be in the aggregate of as great value in the advancement of knowledge as the direct results of departmental investigations.

THE GEOPHYSICAL LABORATORY

The completion and occupancy of the Geophysical Laboratory mark a noteworthy advance in the progress of the novel and difficult experimental work carried on in this department of research. This work was started in a tentative way by Dr. Day, now director of the laboratory, while he was a member of the staff of the U. S. Geological Survey. The results of his preliminary investigations and the limited quarters available in the survey building rendered the construction of a special laboratory essential to adequate development and prosecution of the work. Accordingly, as explained more fully in my last report, provision was made by the board of trustees at their meeting in December, 1905, for the purchase of a site and for the construction and equipment of such a laboratory. In compliance with the contract made in July, 1906, the laboratory was completed and ready for occupancy within a year, so that the director and his staff were in possession of their new quarters early in July of this year. At the present writing the equipment of the laboratory is also nearly secured and installed.

Attention is invited especially to a description, with appropriate illustrations, of this laboratory, to be found in the report of Dr. Day on pages 85–96 of this volume. It may suffice here, therefore, to remark that the building is in many respects no less novel than the work for which it is designed. Substantially, though economically, built, nearly fire-proof, admirably situated as regards isolation, elevation, light and ventilation, it is worthy of inspection by those interested in physical laboratories in general as well as by those interested in the special work to which this one is devoted.

Naturally the time and energies of the staff of the laboratory have been absorbed largely by the duties of construction, transfer and installation of equipment and by the attendant preparatory work. Several publications from members of the laboratory staff have been issued, however, as explained in the director's report and as recorded on pages 46–54.

DEPARTMENT OF HISTORICAL RESEARCH

With many departments devoted to as many different fields of research there must be of necessity a corresponding diversity of aims, methods and results. It is impossible, therefore, to measure adequately departmental activities by any common standard. This diversity and this lack of common terms of comparison are forcibly suggested in passing abruptly from the physical to the historical sciences. But the work which the Department of Historical Research has entered upon is not so remotely allied to the physical sciences as might at first appear. It is, for example, in one respect, strikingly similar to the work of the Department of Meridian Astrometry; for while the latter has for one of its main objects the construction of a catalogue of the positions of the stars for the use of astronomers and navigators, the former has for one of its main objects the construction of a comprehensive series of catalogues of historical documents for the use of historians and investigators in American history.

In addition to the line of work just named, the department serves also as a sort of American clearing-house for the dissemination of historical data and for the promotion of historical research. Thus the guides in preparation to materials of American history found in the archives of Can-

ada, Cuba, Mexico, Spain, England and other foreign countries, as well as in the United States, seem destined to prove of great aid to a wide circle of contemporary and future investigators in this field of history. A guide to materials in Cuban archives, by Mr. Luis M. Pérez, has been published during the year; a similar guide to materials in Spanish archives, by Professor W. R. Shepherd, is now in press; while others are in a forward state of preparation. A revised and much enlarged edition of the "Guide to the Archives of the Government of the United States at Washington" is also now in type, and will soon be issued.

For an outline of prospective as well as current work under this department, attention may be called to the full report of Director Jameson, to be found on pages 97–105.

HORTICULTURAL WORK OF MR. LUTHER BURBANK

The experiments and investigations of Mr. Burbank and the work of preparing a scientific account of his methods and achievements are progressing as favorably as the available division of time and labor will permit. Being necessarily and properly very busy with his own affairs and overburdened by importunities of the public, the amount of time available for conferences concerning the origin and the history of his productions is limited.

Dr. Shull, of the staff of the Department of Experimental Evolution, who is collecting the data for the account just referred to, has been at Santa Rosa for two series of conferences during the year, and plans to spend a portion of each year there until this work is completed. Dr. Cannon, of the Department of Botanical Research, has also spent a portion of the year at Santa Rosa, studying especially the physiology of some of the numerous hybrids developed by Mr. Burbank.

One of the most important results which may be expected to arise from Mr. Burbank's work and from the interest in it taken by the institution is a general stimulus to scientific horticulture. That contemporary society is ready to appreciate and utilize such a stimulus is a noteworthy sign of the times. Thus, many individual and governmental enterprises are giving attention to the economic advantages to be gained from rationally conducted experiments in this field, while biologists in increasing numbers are devoting their studies to the more recondite laws which govern plant, fruit and flower developments.

DEPARTMENT OF MARINE BIOLOGY

As explained more fully in my preceding report, the unique conditions under which this department must carry on its work have led to a similarly unique development, the more essential features of which are the absence of a permanent scientific staff and the closing of the laboratory at Dry Tortugas during the autumnal and winter seasons of the year. But these features do not diminish the efficiency or limit the extent of the work peculiar to the department, since the pelagic life of the region can only be investigated advantageously during the spring and summer seasons.

During the past season, as hitherto, the department has extended its laboratory and collecting facilities to specialists in zoological research, eleven such guests having availed themselves of the opportunities afforded at Dry Tortugas and in the adjacent regions accessible by means of the vessels of the department. Signal aid is thus rendered to investigators in localities whose exploration is often attended by dangers as well as by difficulties.

Publication No. 47, on "Rhythmical Pulsation in Scyphomedusæ," by Director

Mayer, has been issued during the year, and he has submitted for publication a comprehensive monograph on the medusæ of the world. Manuscript for two volumes of researches by associates of the department is also now ready for the press.

DEPARTMENT OF MERIDIAN ASTROMETRY

The work of this department during the year was mainly devoted to preparations for its larger enterprise of a comprehensive catalogue giving accurate positions of all stars from the brightest to the seventh magnitude, inclusive. Amongst these preparations is a preliminary catalogue, embracing the precise positions for upwards of 6,000 stars, which has been brought to substantial completion during the year. This will not only be of great service to the department, but it will be of signal aid also to astronomical science in general.

Preparations for the establishment of a temporary observatory in the southern hemisphere are likewise approaching completion. An exhaustive study of the meridian instrument to be used at this observatory has been made, so that its constants and peculiarities may be well known before observations with it are begun.

The exquisite and penetrating precision of modern stellar research is not alone interesting and useful by reason of its applications to geography, geodesy and navigation. It is illuminating also many recondite questions concerning the constellations, the motions, the masses and the relative distances asunder of the universe of stars. Some of the possible investigations to which these questions may give rise are referred to in the report of Professor Boss, director of the department.

THE NUTRITION LABORATORY

In conformity with provision made by the board of trustees at their last meeting for the establishment of a laboratory to be devoted especially to an extension of the physical and chemical investigations in nutrition carried on hitherto under the direction of Professors Atwater and Benedict, steps were taken early in the year to select a suitable site and to prepare tentative plans for the building. Since experiments on men in an abnormal as well as in a normal condition of nutrition are contemplated, one of the first requirements of a site was proximity to hospitals whence pathological cases may be furnished. Among other requirements, those of moderate cost of land and the availability of water, gas and electric current had to be considered; while favorable climatic conditions and convenience and cost of living for the laboratory staff were important desiderata. After preliminary consideration of this project by the executive committee, the matter was referred to its subcommittee on nutrition, and the latter committee in turn requested the president and Professor Benedict to examine and to report upon the relative advantages of various available sites in the cities of Boston, New York, Philadelphia and Baltimore. A week's time was devoted to this task, and, after further consideration by the subcommittee, it was decided to locate the proposed laboratory in the city of Boston, on Vila Street, near the power house of the Harvard Medical School.

The site selected was purchased from the corporation of "The President and Fellows of Harvard College" on March 13, 1907. The area of this site is 14,312 square feet, and the price paid is $10,466.70.

On the date just mentioned Messrs. Shepley, Rutan and Coolidge, architects, of Boston, were engaged to prepare plans and specifications and to superintend the construction. Preliminary plans were presented by them to the executive committee at its meeting of April 8, 1907, and were approved and the president was authorized

to make the contracts and attend to other necessary details. Bids from four independent firms of contractors were submitted early in May, and on May 14, 1907, a contract was entered into with Messrs. Horton and Hemenway to do the work of construction for $68,334, and a similar contract was made with Messrs. Buerkel and Company, of Boston, to supply the heating and ventilating apparatus at a cost of $14,825. These contracts required that the building be completed by February 1, 1908. The construction was begun early in July and the building is now rapidly approaching completion.

Through the courtesy of the authorities of the Harvard Corporation, the laboratory will be able to secure heat, light, power and refrigeration, at the cost of production, from the near-by power house of the Harvard Medical School. The site of the laboratory is also near to existing and contemplated hospitals, and the location appears to be in every way extremely favorable for the prosecution of the arduous researches required to improve our knowledge of the physics, chemistry and pathology of nutrition.

THE SOLAR OBSERVATORY

The work of this department is still largely in the preparatory stage, and is thus as much a work of engineering as of astronomy. The novelties of construction, equipment and program of research for the observatory, along with the initial difficulties presented by a mountain site, conspire to make the undertaking a formidable one. In spite of many obstacles, due chiefly to unprecedented precipitation during the past winter and to labor troubles on the Pacific coast, the work of construction has gone rapidly forward.

The optical parts of the 60-inch reflecting telescope have been made ready for mounting, but owing to the labor strikes at San Francisco the completion of the dome for the telescope may delay its erection until the spring of 1908.

The novel tower telescopic apparatus, part of which is above and part of which is below the ground level, has been substantially completed. This consists essentially of a vertical telescope with a 12-inch objective and 60 feet focal length in combination with a Littrow grating spectrograph of 30 feet focal length, thus furnishing a powerful component in the battery of instruments for direct observations of the sun.

Preparations for grinding, figuring and testing the 100-inch reflector, whose construction, as explained in my preceding report, was rendered possible by the gift of Mr. J. D. Hooker, have likewise gone forward. A fire-proof building for this work has been constructed and the necessary grinding-machine is nearing completion. In the meantime it is expected that the Plate Glass Company of St. Gobain, France, will soon have the large disk for this reflector ready for shipment, since it was successfully cast on August 28 last. In the rough this disk will weigh about 4.5 tons.

Simultaneously with these varied works of construction, daily photoheliographic and spectroheliographic observations have been made by aid of the Snow telescope. Daily studies of the sun and sun-spot spectra have supplemented these observations, and to them have been added pyrheliometric and solar magnetic measurements, along with numerous laboratory investigations bearing directly on the physical properties of the sun.

DEPARTMENT OF TERRESTRIAL MAGNETISM

The year for this department has been one of varied activities and one specially fruitful in the quantity and quality of the results attained. The operations have em-

braced magnetic surveys of the North Pacific Ocean; surveys on land in Alaska, Bermuda Islands, Canada, Central America, China, Mexico and South Pacific Islands; and office work combined with special observational studies at Washington, D. C.

The ship *Galilee,* used in the magnetic survey of the Pacific, started from San Diego, California, on her third cruise on December 22, 1906. Sailing by way of the Marquesas Islands, Samoan Islands and Yap Island, she arrived at Shanghai, May 8, 1907. From this point she sailed east to Midway Islands, and thence to Sitka, where she arrived July 14, 1907. Leaving Sitka, August 10, she started on a cruise to the South Pacific by way of Honolulu, Jaluit, Marshall Islands and New Zealand; returning thence by way of Callao to San Francisco. It is expected that she will complete this cruise about May 1, 1908, when she will be returned to her owners.

Up to September 1, 1907, the *Galilee* had traversed nearly 50,000 miles in the Pacific Ocean along courses where few magnetic observations have been made hitherto. Complete measurements of magnetic declination, dip and intensity were secured at intervals of 200 to 250 miles along these courses, as well as at numerous points on islands and at prominent ports. All of the results of this extensive survey available in March of the present year were furnished to the U. S. Navy Department and incorporated in a magnetic chart issued in May last by that department for the benefit of mariners. Important errors in previous charts, amounting in cases to as much as 5° in magnetic declination along some main routes of transportation, were thus corrected.

For an account of the work done at the numerous and widely separated land stations during the year, reference must be made to the director's report to be found on pp. 154–166 of this volume. Similar reference must be made also for an account of the computations and special investigations carried on at the office by Dr. Bauer and his staff. Attention is invited likewise to the annual bibliography for a list of the departmental publications. One of the latter, however, is worthy of special mention and commendation here, namely, a quarto volume of 629 pages, giving the detailed results of the magnetic, tidal, astronomical, and meteorological observations made by Mr. W. J. Peters while serving as a member of the Ziegler Polar Expedition of 1903–5. Mr. Peters has been in charge of the *Galilee* since January, 1906, and as his duties at sea have prevented him from attending to the publication of his work, the task of editor has been assumed by his colleague, Mr. John A. Fleming. The handsome volume issued under Mr. Fleming's editorship has been published under the auspices of the National Geographic Society by the estate of William Ziegler.

RESEARCHES UNDER MINOR GRANTS

Many researches begun by aid of minor grants made during the past six years have been carried forward during the current year. Twenty-one volumes giving the results of these researches have been published during the year, and several more are in press. In addition, as may be seen by reference to the bibliography on pages 46–54, many briefer or preliminary papers have been published in journals.

A list of the volumes issued during the year will be found in the next section of this report. Of the works in press, attention may be called here to a second volume giving the archeological and physiographical results of explorations in Turkestan under the direction of Professor Raphael Pumpelly; to two works on engineering, on

high steam pressures in locomotive service and on the performance of screw propellers, by Professor W. F. M. Goss and Professor W. F. Durand, respectively; to the Vulgate Version of the Arthurian Romances, by Dr. H. Oskar Sommer; to a reproduction, with translation and annotations, of "The Old Yellow Book," the source of Browning's "The Ring and the Book," by Professor Charles W. Hodell; to a monograph on The Fossil Turtles of North America, by Dr. O. P. Hay; to a treatise on dynamic meteorology and hydrology, by Professor V. Bjerknes and Mr. J. W. Sandström, of the University of Christiania; and the report of the California State Earthquake Commission.

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GRATUITOUS DISTRIBUTION OF PUBLICATIONS

In his report for the year 1905 the president indicated that the distribution of the publications of the institution was likely to present some difficulties. Under provisional rules approved by the executive committee in January, 1905, and published in the annual report for that year all publications of the institution except the "Index Medicus" are sent free of charge to a list of about three hundred leading libraries of the world. This list was compiled with great care from a much larger list selected by a competent librarian, with a view to include every important library of educational and learned institutions of the world. Pains were taken also to secure as effective geographical distribution as practicable.

In accordance with the same rules, authors, in addition to receiving 25 copies of their works, were authorized to designate 100 addresses to which complimentary copies might be sent by the institution. The president was also given discretionary authority to distribute gratis 100 copies of any work. The possible maximum free list for any work was thus about 525 copies.

The standard edition of our publications approved by the executive committee at the same time is 1,000 copies; and copies not disposed of in the ways just mentioned were offered for sale at a cost only sufficient to cover the expense of publication and transportation to purchasers.

While the rules referred to have been justified by the necessity which confronted the institution at the time of announcing some mode of distribution, many difficulties have been met in their application. The most serious of these arise from the importunities of institutions and individuals claiming rights to the free receipt of all our publications or to the free receipt of certain of them. No amount of courteous endeavor or painstaking research into the relative merits of applicants for such favors can overcome these difficulties. The simple fact is that the demand for a gratuitous distribution of the publications of the institution is much larger than its income can bear. An attempt to meet this demand in a limited way by means of editions of 5,000 to 10,000 copies of our works would require, at the present rate of issue of 25 to 30 volumes per year, a quarter to a half of our income.

Some serious objections have developed also against the liberal terms accorded to authors in the distribution of complimentary copies of their works. One of these objections rests on the charge of favoritism brought against the institution by many who have not been thus complimented; a second rests on the complaint of book-dealers who, having filed orders for books published by the institution, find their clients disposed to cancel such orders by reason of the receipt of presentation copies; while a third rests on the fact that

complimentary copies and copies for review are finding their way unduly early to the shops of second-hand dealers.

There appears to be but one way, alike equitable and effective, to check the increasing importunities of individuals and institutions for the free receipt of sets of our publications and to avoid the abuses which have arisen from an attempt to deal generously with authors in the distribution of complimentary copies. This way is to limit the omnia list to its present dimensions and to cut down the authors' list to a minimum which will prevent those abuses. The executive committee at its meeting of October 23, 1907, authorized such a restriction of the omnia list and the president desires to recommend in the near future a similar restriction of the presentation lists.

STORAGE AND SALE OF PUBLICATIONS

As shown in the earlier parts of this report, the publications of the institution have accumulated at a rapid rate. Assuming that something like a stable state of affairs is now attained, it would appear that with an appropriation of one tenth of the annual income for publications an average of 25 volumes per year may be advantageously published. If these are issued in editions of 1,000 copies each, books must be expected to accumulate at the rate of 10,000 to 15,000 volumes per year for some years, unless sales increase more rapidly than during the past three years.

Provision must be made, therefore, for more adequate storage room in the near future. Such room is provided for by the plans for the proposed Administration Building, which it is hoped may be erected within two years. In the meantime use is being made of the available storage room in the attic of the Geophysical Laboratory, where the risk of loss from fire is much less than in the present office quarters of the institution.

As to the possibilities of sales of publications, it appears plain from a study of existing trade conditions, as well as from the accumulating experience of the institution itself, that 500 to 700 copies of each volume of our published works will be needed to meet a normal commercial demand; so that to supply the omnia list and the trade our standard edition of 1,000 copies is essential. But to secure this normal commercial demand the institution must strictly limit the gratuitous distribution of its books and let them pass on their merits through the legitimate channels of trade. Believing this method of distribution to be the best one in the interests of society as well as in the interests of the institution, it is hereby recommended for early adoption.

SCIENTIFIC BOOKS

The World Machine. By Carl Snyder. New York, Longmans, Green & Co. 1907. Pp. xvi + 488.

The perusal of this volume calls to mind the clean-cut dilemma in which a recent writer[1] shows we are placed when we examine the question of man's relation to his environment in a way sufficiently comprehensive to include the problem of his consciousness and his knowing as well as that of the physical objects of which he has knowledge. Either knowledge itself and all mind and consciousness are in some sense a product of inorganic and organic evolution, or, conversely, this physical evolutionary process is in some way conditioned by that very act of knowing or existence of mind. Either "matter" or consciousness must be chosen as the "end-term." The former position seems to appeal most to the "scientists," although it is found by the far-thinking among these to meet with certain serious difficulties in its completion. On

[1] Professor F. J. E. Woodbridge in Studies in Philosophy and Psychology, "The Problem of Consciousness," Houghton, Mifflin & Co., 1906.