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REPORT ON COOPERATIVE EDUCATIONAL AND RESEARCH WORK CARRIED ON BY THE SMITHSONIAN INSTITUTION AND ITS BRANCHES

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CONTENTS

I. HISTORICAL AND GENERAL

The announced policy of the Smithsonian Institution has ever been one of cooperation. In the plan of organization as given in the first annual report (1847), "It is proposed—(1) To stimulate men of talent to make original researches, by offering suitable rewards for memoirs containing new truths; and (2) To appropriate annually a portion of the income for particular researches, under the direction of suitable persons," the "suitable rewards" to consist of money, medals, etc., offered for original memoirs on all branches of knowledge. As examples of objects for which such appropriations might be made, the following was given:

(1) Systems of extended meteorological observations, for solving the problem of American storms.

(2) Explorations in descriptive natural history, and geological, magnetical, and topographical surveys, to collect materials for the formation of a Physical Atlas of the United States.

(3) Solution of experimental problems, such as a new determination of the weight of the earth, of the velocity of electricity and of light; chemical analyses of soils and plants; collection and publication of articles of science, accumulated in the offices of government.

(4) Institution of statistical inquiries with reference to physical, moral, and political subjects.

(5) Historical researches, and accurate surveys of places celebrated in American history.

(6) Ethnological researches, particularly with reference to the different races of men in North America; also, explorations and accurate surveys of the mounds and other remains of the ancient people of our country.

In the report for 1854 this point is again emphasized:

It is the policy of the Institution to furnish all the means in its possession to aid scientific research, and not to hoard up its treasures or confine their use to those who may be immediately connected with the establishment, or who may be supported by its funds. *Cooperation* and not *monopoly* is the motto which indicates the spirit of the Smithsonian operations.

And again:

With scarcely an exception, every exploring expedition of any magnitude has received more or less aid from the Smithsonian Institution. This has consisted in the supplying of instructions for making observations and collections in meteorology and natural history, and of information as to particular desiderata; in the preparation, in part, of the meteorological, magnetical, and natural history outfit, including the selection and purchase of the necessary apparatus and instruments; in the nomination and training of persons to fill important positions in the scientific corps; in the reception of the collections made, and their reference to individuals competent to report upon them; and in employing skillful and trained artists to make accurate delineations of the new or unfigured species. Much of the apparatus supplied to the different parties was invented or adapted by the Institution for this special purpose, and used for the first time, with results surpassing the most sanguine expectations.

It is apparent from these and other extracts that might be made from the annual reports that cooperation on the widest scale was, from the outset, the prevailing motive of the Institution. It is proposed in the following pages to give the result of recent investigations made with a view of ascertaining how far these early promises had been carried out.

II. THE SMITHSONIAN ORGANIZATION

The following named organizations are conducted under the administration of the Smithsonian Institution: The United States National Museum; the Bureau of American Ethnology; the Na-

tional Gallery of Art, including the Freer Gallery of Art; the National Zoological Park; the Astrophysical Observatory; the International Exchange Service; and the International Catalogue of Scientific Literature.

III. COOPERATION: DEFINITION OF THE TERM

By cooperation, as here used, is understood the act of assisting in any way the advancement of knowledge, let it be through the direct solution of a problem, or indirectly through supplying aid, funds, or material, or the giving of any form of personal services.

For purposes of clear presentation the matter may be considered in the following order:

(1) By conference and advice through correspondence and otherwise.

(2) By furnishing materials (a) for investigation, as gift or loan, (b) for teaching purposes.

(3) By furnishing facilities.

(4) By furnishing personal assistance, expert or otherwise.

(5) By furnishing funds.

(6) By furnishing means of publication.

(1) Cooperation through Advice and Correspondence

It is a safe affirmation that scarcely a day has passed since the organization began actively to function but that letters are received from, or personal interviews held with, those who wish aid or advice on matters relating to some one of the many subjects involved. The full importance of this work cannot be estimated, but as years go on it has become of ever increasing magnitude. The following taken from the ninth and tenth annual reports of the Secretary of the Institution (1854-55) show the early stand of the Institution in this line of work:

Correspondence.—During the past year the Institution has received a large number of communications asking information on a variety of subjects, particularly in regard to the solution of scientific questions, the names and characters of objects of natural history, and the analysis of soils, minerals, and other materials which pertain to the industrial resources of the country. Answers have in all cases been given to these inquiries, either directly by the officers of the Institution, or by reports from the Smithsonian colaborers. Very frequently certificates are requested as to the value of certain minerals, with a view to bring them into market; but in these cases the inquirers are referred to certain reliable analytical chemists, who make a business of operations of this kind. The information procured and given at the expense of the Institution is such as relates to the general diffusion of knowledge, and not

to that which may immediately tend to advance the pecuniary interest of individuals. Requests are often also made to have experiments instituted for testing proposed applications of science to the arts; and provided these can be tried with the apparatus of the Institution and the results which may flow from them are to be given to the public without the restriction of a patent, the request is granted.

And again:

The correspondence during the last year has been more extended than that of any preceding period. The character of the Institution becoming more widely known, the number of applications for information relative to particular branches of knowledge has been increased. The correspondence relates to the exchanges, the collections, the publications, the communication with authors and the members of commissions to which memoirs are submitted, answers to questions on different branches of specimens of natural history, geology, etc.; also explanations of the character of the Institution, the distribution of its publications, its system of meteorology, etc.

And yet again:

As the collaborators of the Institution generally reside at a distance, the business with them is principally carried on by mail. The same is also the case in regard to all the exchanges and consequently the record of nearly all the transactions of the Institution is contained in the correspondence. Besides those relating to official business, hundreds of letters are received during the year, containing inquiries relative to the various subjects on which the writers desire information. If these cannot be immediately answered without much research, they are referred to collaborators who are experts in the various branches of knowledge, and who can readily supply information in regard to subjects within the range of their special studies. (Annual Report, 1868, p. 51.)

In previous years requests have frequently been received from foreign governments, especially those of Japan and China, and of Central and South America, for the selection of persons to carry on certain operations, particularly those relating to engineering and mining geology, nearly every year bringing at least one call of this character. To this the year 1879 furnished no exception, the Government of Salvador, through the American minister, Mr. George Williamson, having asked to be supplied with an experienced geologist to explore the recently discovered gold fields of the state. Of course in such cases the advice of experts is always solicited, and several of these uniting on the name of Mr. Goodyear, a resident of California, and formerly connected with the geological survey of that state, he was selected for the mission in question, and has already entered upon his duties (Annual Report, 1879, p. 57.)

(2) Cooperation through Furnishing Materials

This is an important and ever-increasing phase of the work of the Institution. It appears that as early as 1849 the regents made an appropriation for the purchase of a telescope for the use of the

Gillis Astronomical Expedition to Chile, and in the report for 1854 the purchase is announced of four entire sets of apparatus for determining the direction and intensity of magnetic force which were lent to various observers, including those of the Grinnell Expeditions of 1850-55 and the U. S. Coast Survey. "It is the purpose to keep these instruments constantly in operation for the purpose of comparing results with other observations of a similar character."

Coopération with meteorologists the world over was one of the earliest undertakings. In the second annual report of the Institution for 1848 (1849) it is stated that the sum of $1000.00 was appropriated for the commencement of a series of observations, particularly with reference to the phenomena of storms. It was proposed to enlist the services and cooperate with voluntary private and public individuals and institutions, including the United States Navy.

> With the instruments owned by private individuals, with those of the several military stations, and with the supply of the deficiency by the funds of the Smithsonian Institution, it is believed that observations can be instituted at important points over the whole United States, and that, with the observations which we can procure from Mexico and the British possessions of North America, data will be furnished for important additions to our knowledge of meteorological phenomena. As a beginning to this extended system, six sets of instruments have been forwarded to the coast of Oregon and California, for the purpose of establishing periodical observations on the western side of the Rocky Mountains. Also a set has been forwarded to Bent's Fort, and another to Santa Fe. Circulars have been prepared and will shortly be issued for the purpose of ascertaining the number and locality of all those who, with or without instruments, are willing to join in the enterprise.

Obviously, here was laid the foundation of the United States Weather Bureau as it exists today.

It is not alone through furnishing apparatus that cooperation is carried on. In the form of gifts and loans for the purpose of research and study, thousands of specimens are annually distributed to investigators and students the world over. "Applications for such assistance," wrote Professor Baird in his report for 1854, "are constantly being received, and always met with all possible promptness, so that scarcely any natural history monograph or memoir of any extent has been published in this country within a year or two which has not been indebted in this way to the Institution."

(3) Cooperation through Furnishing Facilities

"It is a part of the plan [*i. e.*, of the Smithsonian Institution] to give encouragement and assistance to original investigators, and persons who visit Washington for the purpose of studying the collection are furnished with all the facilities which the Institution can afford." (10th Annual Report, 1855.) These "facilities" included not merely access to the collections, library, and laboratories, but in numerous instances the early investigators were actually given living rooms in the building. Within recent years the last-named practice has been discontinued, but the others mentioned endure. As early as 1855 the chemical laboratory of the Institution was utilized by Dr. J. L. Smith in examination of minerals, and by the Treasury Department in investigations relative to the kinds of molasses imported into this country.

(4) Cooperation through Personal Assistance, Expert and Otherwise

Aid in the identification of material is perhaps of all forms of cooperation the most common. A large share of these requests come from individuals, and while time-consuming, leave no tangible results for permanent records. Those from museums, scientific workers, and departments of the Government require expert knowledge of a much higher standard, and often find their way into the printed reports. A very large amount of work of this nature is done in cooperation with the U. S. Geological Survey, Bureau of Fisheries, and Department of Agriculture. Decisions relative to the establishment of National monuments, and to materials for Government structures are often asked. As long ago as 1856, Professor Henry was appointed to cooperate with Colonel Totten, A. J. Downing, the Commissioner of Patents, Prof. A. D. Bache of the Coast Survey, and Captain Meigs, to examine and report on the marble submitted for use in the Capitol extension, and for over 20 years he cooperated with the Lighthouse Service in the investigation of fog signals and other aids to navigation. Prof. S. F. Baird, while Assistant Secretary of the Institution, in 1871, began the long series of cooperative studies on the food fisheries of the country which resulted in the establishment of the U. S. Fish Commission, to which he gave his services without other salary than was attached to his duties as Secretary until his death. Other instances are given in detail in another section of this report.

(5) Cooperation by Supply of Funds

The income from the Smithsonian Institution endowment has never been sufficient to allow financial grants of large size. As early as 1855 it is stated:

> In anticipation of the great fair in Chicago of the Illinois State Agricultural Society, it was proposed to secure and exhibit full collections of the natural history of the State on that occasion. Accordingly, Mr. Robert Kennicott was selected by the Society to travel throughout Illinois, especially along the lines of the Illinois Central Railroad, and not only to make collections himself, but to instruct the employees of the railroad company and others, so as to enable them to assist in the work. Aided by a small appropriation by the Institution, in addition to the facilities furnished by the society and the railroad company, Mr. Kennicott collected in a few months the finest cabinet of Illinois specimens ever brought together.

The custom thus inaugurated has been followed out with increasing magnitude, involving the Philadelphia Centennial of 1876, the Chicago Exposition of 1893, and, on a smaller scale, those of Atlanta, Ga.; New Orleans, La.; Buffalo, N. Y.; Charleston, S. C.; Cincinnati, O.; Seattle, Wash.; Omaha, Neb.; St. Louis, Mo.; Portland, Oreg.; and San Francisco, Calif. For most of these, special grants of funds were appropriated by Congress.

With the endowment of the Institution through private bequests, other allotments have been possible. By grants from the Hodgkins Fund the Institution has been able to cooperate with Dr. Leonard Hill and others in investigations on the influence of the atmosphere on human health; with Wolfgang Ritter on the flight of insects; E. W. Scripture on the construction of a vowel organ; with C. G. Abbot on Arequipa pyrheliometry, the pyranometer, and solar variability; with Anders Ångström on atmospheric radiation; with E. Duclaux on atmospheric actinometry; with J. B. Cohen on the atmosphere of towns; with Carl Barus on atmospheric nucleation and ionized air; with Lord Rayleigh and W. Ramsay in their investigations on argon; with H. de Varigny on air and life; with O. Lummer and E. Pringsheim on the ratio (x) of specific heats; with V. Schumann on the absorption and emission of air for certain light wave lengths; with M. W. Travers and others on the attainment of low temperatures, etc.

(6) Cooperation on Publications

No insignificant proportion of the funds and energies of the Institution have been devoted to the publication of works of scientific and educational value, but from the sale of which no satisfactory financial return could be anticipated. This form of cooperation, inau-

gurated in 1847 and bearing its first fruit in the publication of Squier and Davis' *Ancient Monuments of the Mississippi Valley* (1848), has continued until the present day, and, as a result, a very considerable proportion of the papers comprised in the 35 quarto volumes of the Smithsonian Contributions to Knowledge, the 74 volumes of Miscellaneous Collections, the 63 volumes of Proceedings, and upward of 120 Bulletins are by writers not connected, or but indirectly connected with the Institution.

IV. SPECIFIC INSTANCES OF COOPERATION BY THE SMITHSONIAN INSTITUTION AND ITS BRANCHES

The following annotated list of some of the principal cooperative operations carried on is here given in order that their magnitude and often involved character may be better understood. Owing to the somewhat complex nature of many of them, a strict form of classification has been found impossible, though as a general rule they are arranged by departments or divisions. It may be further stated that while a very considerable proportion are wholly one-sided, the Institution profiting little, if at all, thereby, there are others in which, through the enrichment of the collections, the National Museum profits largely.

The National Museum

This branch of the Institution is naturally brought into active cooperation with practically all divisions of the National government, with those of foreign countries, with public and private museums and other educational institutions, and with individual students of the sciences. At the present moment (1923), facilities for the storage of collections, office and work rooms, are afforded to the following: The paleontologists and paleobotanists of the Geological Survey occupy 13 double rooms, comprising 15,600 square feet of floor space, and utilize upward of 15,000 standard drawers; to the Biological Survey is assigned 7,019 square feet of floor space, with facilities for storage for 126,240 specimens; and to the entomologists of the Department of Agriculture, 9 rooms, aggregating 5,539 square feet of floor space.

With limited finances the Museum is unable to inaugurate regular lecture courses, but all governmental agencies and all scientific and educational societies have the free use of its auditorium and the adjacent rooms for congresses, lectures, etc. Space is also furnished for special exhibits of scientific or educational importance.

A line of cooperation, the value of which, while great, it is impossible to estimate, is the distribution to schools, colleges, and private workers, of specimens of all kinds to aid in their studies. The report of the Institution for 1867 states that 249,233 specimens of all kinds had been distributed up to that early date. During the 46 years from 1876 to 1922, there were distributed upward of 771,000 specimens, bringing the total number to upward of 1,000,000.

Cooperation with educators and students does not end with the furnishing of materials for their natural history and other studies. The exhibition collections are all designed with the view, not merely to attract the public, but to aid the student, and members of the staff of certain departments frequently conduct classes through the halls explaining the uses of the objects exhibited. The study series are always at the service of accredited students, and the publications are supplied free of cost. Lectures are delivered before schools or other organizations, and have also been prepared for delivery throughout the country in cooperation with the Young Men's Christian Association and like organizations.

The following more detailed instances of cooperative work will show to an extent the wide range and varied nature of the projects undertaken by the Museum.

DEPARTMENT OF BIOLOGY

North Pacific Fur-Seal Investigations.—The cooperation of the Museum with the various Government agencies concerned in the investigation of the North Pacific fur-seals and fur-seal industry dates back to 1882, when a project jointly undertaken by the National Museum, the U. S. Fish Commission, and the U. S. Signal Service was carried into effect by sending Dr. Leonhard Stejneger to the Commander Islands, a group of fur-seal islands belonging to Russia and situated off the coast of Kamchatka. He remained 18 months on the islands, surveying the rookeries, studying the habits of the seals, managing a third-class meteorologic station, and making large collections of the animals and plants for the Museum.

In 1895 the U. S. Fish Commission, on account of the tremendous inroads on the fur-seal herds caused by pelagic sealing, desired a thorough investigation of the whole question, and for that purpose obtained the detail of Drs. F. W. True and Leonhard Stejneger, both of the National Museum, the former to visit the Pribilof Islands, the latter the Commander Islands. The whole summer was spent on the islands, and upon their return, each submitted a voluminous report, which was published.

In 1896, Messrs. F. A. Lucas and Leonhard Stejneger, both of the National Museum, were appointed members of the Fur-seal Investigation Commission, which, under Dr. David S. Jordan as Commissioner in charge, was intrusted by the U. S. Treasury Department with studying and reporting upon the whole fur-seal problem with special reference to the effect of the award of the Paris Tribunal on the rehabilitation of the seal herds and the regulation of pelagic sealing. Mr. Lucas remained during the entire summer with the Commission on the Pribilof Islands, taking the census of the rookeries, studying the habits of the seals both on shore and at sea, investigating the problem of the abnormal mortality of the young, etc., while Dr. Stejneger again proceeded in the Fish Commission S. S. *Albatross* to the Commander Islands where he inspected the rookeries and supplemented his observations of the previous year. From there he continued in the *Albatross* to the Kuril Islands of Japan, in search of seal rookeries which might possibly have escaped the destruction inflicted upon them by raiders and pelagic sealers. He then proceeded to Robben Island, the Russian seal island, in the Okhotsk Sea, off the east coast of Sakhalin, which was inspected, mapped, and photographed.

The Commission was continued during the season of 1897, but the investigations were conducted that year under the auspices of the Department of State, and in collaboration with a similar commission from Great Britain. Messrs. Lucas and Stejneger were again detailed and spent the season, the former investigating the Pribilof herd, the latter the Commander Island seal industry. The results of this cooperation was embodied in the four-volume report published in 1898-1899 by the U. S. Treasury Department under the title "The Fur Seals and Fur-seal Islands of the North Pacific Ocean."

As the seal protection treaty of 1911 may become abrogated in 1925 if denounced 12 months before by any of the four contracting powers, the Department of Commerce desired to obtain first-hand information as to the status of the fur-seal herds of the Commander Islands and Robben Island. In the spring of 1922, the Department therefore requested the Museum to detail Dr. Stejneger for the purpose of inspecting the North Pacific fur-seal rookeries. He was consequently attached to the party accompanying Mr. C. H. Huston, the Assistant Secretary of Commerce, on his tour of investigating the fisheries of Alaska and far eastern Asia, which left Seattle, Washington, on June 20, 1922, in the Coast Guard cutter *Mojave*. During this cruise he visited the Pribilof Islands, the Commander Islands, and Robben Island, returning to Washington by way of

Japan on September 18. A preliminary account of his findings has been submitted, and the elaborate report is now in preparation.

It thus appears that the Department of Biology for more than 40 years has cooperated with the various Government departments which have had the investigation of the important fur-seal problem in hand, having had members of its staff detailed for the purpose during six seasons, viz.: in 1882, 1883, 1895, 1896, 1897, 1922. Moreover, after their return, they prepared elaborate reports which are among the most valuable contributions to the literature on the subject. The numerous publications on the history of the Asiatic Seal Islands, due to the cooperation of the Museum, form practically the only available information about these islands which are of so great importance both scientifically and economically.

Investigations on the life history of the lobster.—Under the date of May 20, 1918, the Department of Commerce requested the detail of a member of the Museum force to the Bureau of Fisheries for the purpose of investigating the life history of the spiny lobster of the Pacific Coast. In this connection it was stated that, while the spiny lobster on the west coast possessed considerable economic importance as an article of food, it had been "so steadily declining in numbers on the coast of California that the market supply was chiefly by importation from the coast of Mexico, and that an elucidation of the life history of the form would undoubtedly be a proper step in arriving at and termination of the measures of protection or propagation necessary to insure the conservation of the species."

This detail became effective for three months beginning August 1, during which period important collections were made, and several interesting facts established. Brief preliminary reports of the work were published, but the final summary is not yet completed.

The Geographic Society of Baltimore Expedition to the Bahamas.—This expedition was conceived and conducted by Mr. George B. Shattuck, then of Johns Hopkins University, and sailed from Baltimore on June 1, 1903. Among the Government and other experts detailed for the purpose of studying the natural history, soil, sanitation, diseases, etc., of the islands were Messrs. B. A. Bean and J. H. Riley of the National Museum. The cruise extended over a period of nearly two months, but opportunities for collecting natural history specimens at individual landings were very brief. A general report upon the expedition was published by the Society, including a list of all the birds recorded from the Bahamas, contributed by Mr. Riley. The Museum paid for the subsistence of its two representatives.

Harriman Alaska Expedition.—By invitation of the late Edward H. Harriman, a number of naturalists joined him in an expedition to Alaska in the summer of 1899. The National Museum was represented by Dr. W. H. Dall, Mr. F. V. Coville, and Mr. R. Ridgway, who made collections in their respective fields. From Seattle the party proceeded to various points on the coast of Alaska, making occasional trips inland, and also touched at Hall Island, St. Lawrence Island, and St. Matthew Island in Bering Sea, stopping also at Plover Bay, Siberia. The expedition was not operated on a schedule planned for making natural history investigations, and stops at most of the points were quite brief, but Mr. Ridgway was able to secure 319 specimens of birds and a series of eggs, from various localities. No report on these has been published, but records have been incorporated in various volumes, and one new form described.

Doctor Coville, assisted by other members of the expedition, made extensive collections of plants. These, supplemented by earlier collections in the National Herbarium, and by the results of subsequent field work by several Government departments, incidental to a study of the geography and natural resources of Alaska, have been studied critically by several botanists, and the final results brought together for publication as volumes 6 and 7 of the Harriman Alaska series, now under control of the Smithsonian Institution.

The Zoological Expedition of Dr. Theodore Lyman to the Altai Mountains, Siberia and Mongolia.—During the summer of 1912, by the invitation of Dr. Theodore Lyman, of Harvard University, the National Museum was enabled to participate, in cooperation with the Museum of Comparative Zoology, in a zoological expedition to the Altai Mountains of Siberia and Mongolia. The expedition was under the personal direction of Doctor Lyman, and the National Museum was represented by Mr. N. Hollister, assistant curator of mammals. The party left America in May and returned in September. From the last Russian outpost near the Mongolian border, Kosh-Agatch, the frontier range to the southward was explored for a month. The collecting was done chiefly on the Siberian side of the range, but expeditions were made to the Mongolian slopes for great game, and down to the Suok Plains, in the country of the Kirghiz. On the return trip, stops were made on the Chuisaya Steppe and in the heavily forested Altais between the desert and the great Siberian plains.

The collections of mammals were worked up by Mr. Hollister; the birds were studied by Doctor Bangs at Cambridge. The specimens

were then divided between the National Museum and the Museum of Comparative Zoology.

General Survey of the Mexican Flora.—From 1897 to 1911, Dr. J. N. Rose, associate curator of the National Herbarium, carried on extensive botanical explorations in Mexico, in cooperation at different times with the New York Botanical Garden, the New York Aquarium, the U. S. Department of Agriculture, the Bureau of Fisheries, and the Mexican government, with a view to making known the diverse flora of that country. During this work, many thousands of plants were collected, hundreds of which were new to science and to the collections of the National Museum and of other institutions to which they were distributed.

Through the cooperation of the U. S. Department of Agriculture and the New York Botanical Garden, some of the more interesting forms were grown in greenhouses in Washington and New York. Many new species have been described, and important critical genera and groups revised by Doctor Rose, either alone or in collaboration with Dr. N. L. Britton, in various publications.

Study of the Cactaceae.—From 1912 up to the present time, Dr. J. N. Rose has been engaged with Dr. N. L. Britton, director-in-chief of the New York Botanical Garden, in an investigation of the Cactaceae of North and South America, a study begun several years previously, but since 1912 chiefly financed by the Carnegie Institution of Washington, with the cooperation of the New York Botanical Garden, the U. S. National Museum, and the U. S. Department of Agriculture. Besides the earlier Mexican exploration, field trips in northern, western, and eastern South America have yielded valuable material bearing on this project. The results of the investigation are being published by the Carnegie Institution of Washington in four large, profusely illustrated volumes, entitled "The Cactaceae." In this study the authors have had the valued cooperation of a large number of botanists and botanical collectors throughout the western United States and all tropical America, as well as of many institutions and special students of this family in Europe.

Exploration of northern South America.—In the early part of 1918, a cooperative plan of exploration in northern South America was entered into by the New York Botanical Garden, the Gray Herbarium of Harvard University, and the U. S. National Museum, for the purpose of obtaining through joint field work a better knowledge of the rich and varied flora of northern South America, and of

bringing together well preserved herbarium material that would afford not only general information relating to the systematic botany of these regions, but would also provide exact basic information regarding many plants capable of yielding commercial timbers, drugs, oils, dye-stuffs, food-material, fibers, and other economic products whose sources are in many instances obscure or unknown. The investigation was planned to cover Ecuador, Colombia, Venezuela, the Guianas, and several adjacent Caribbean islands, regions in which no coordinated botanical exploration had ever been conducted, and from which material is urgently needed in connection with similar studies of the botany of the West Indies and Central America. In pursuance of the plan, several expeditions have gone into South America for the benefit of the three institutions mentioned.

Trees and Shrubs of Mexico.—In partial response to the pressing demand for a synoptical treatment of the woody plants of tropical North America, Mr. Standley has utilized the unrivalled Mexican collections of Pringle, Palmer, Rose, Purpus, and others in the National Herbarium in preparing a manuscript on the "Trees and Shrubs of Mexico." Botanists of several institutions have assisted in this work, and much aid has been rendered also by the Mexican government, chiefly in the transmittal of botanical material obtained during the biological survey of that country now in progress, all of this being submitted to the U. S. National Museum for identification. Similar material is being received through cooperation with several able Mexican botanists, notably Dr. C. Conzatti of Oaxaca City.

Flora of Central America and Panama.—Upon the practical completion of his manuscript upon the trees and shrubs of Mexico, Mr. Standley took up the project of preparing a synoptical treatment of the phanerogamic flora of all Central America and Panama. The collections from these regions in the National Herbarium, though large, are mainly from Guatemala, Costa Rica, and Panama. For the purpose of obtaining material from a part of the intermediate area, Mr. Standley was detailed to field work in Salvador, in December, 1921, and spent five months there and one month in eastern Guatemala, with funds provided by the cooperation of Prof. Oakes Ames, the New York Botanical Garden, the Gray Herbarium, and the U. S. Department of Agriculture, and with the hearty assistance of the Salvadorean government. An enumeration of the entire collection will be published jointly by Messrs. Standley and Calderon in Salvador under Government auspices.

In furtherance of this project additional field work is contemplated in Honduras, Nicaragua, Costa Rica, and Panama, official support of the undertaking being assured in several quarters.

Studies in West Indian Ferns.—During several months in three years, Mr. William Maxon, associate curator of the National Herbarium, collected pteridophyta extensively in Jamaica, in 1903 in company with Prof. L. M. Underwood of the New York Botanical Garden, in 1904 for the National Herbarium alone, and in 1920 in company with Mr. E. P. Killip on behalf of the National Herbarium, the New York Botanical Garden, the Gray Herbarium, the Field Museum, and the University of Illinois. The material thus assembled affords the basis of a descriptive volume on the pteridophyta of Jamaica, which will be published by the British Museum (Natural History) as one of the series on the Flora of Jamaica by Fawcett and Rendle.

North American Flora.—About twenty years ago the New York Botanical Garden undertook the publication of a descriptive work upon the flora of North America, intended to cover all the plants growing independently of cultivation in continental North America (including Panama), Greenland, and all but the southernmost of the West Indian islands. This work, entitled "North American Flora," is to be complete in 34 volumes. Botanists of many American institutions, including those of the National Herbarium, are cooperating in this work.

Biological Survey of the Panama Canal Zone.—Beginning in 1910, the Smithsonian Institution, with the assistance of several Government departments and outside institutions, undertook to sponsor a biological exploration of the Canal Zone and adjacent parts of Panama, the expenses of the field work being met by a special fund contributed by patrons of the Institution. For the botanical work Prof. H. Pittier and Dr. A. S. Hitchcock were detailed by the Bureau of Plant Industry, and Mr. William R. Maxon, by the National Museum. Partial results of the work have been published.

Flora of the District of Columbia.—In connection with a study of the local flora for 40 years past there has grown up at the National Herbarium a collection known as the District Herbarium, to which many students of local natural history have contributed. To replace Museum Bulletin 26, known as *Ward's Flora,* and long out of print, local botanists joined about ten years ago in an effort to prepare a new manual of the local flora. In all, about 25 individuals actively participated, mainly members of the staffs of the National Herbarium and the Bureau of Plant Industry. The outcome was

the publication of the "Flora of the District of Columbia and Vicinity," under the editorship of A. S. Hitchcock and Paul C. Standley, dealing with the ferns and flowering plants of this region. Supplementary work, including similar treatment of the lower cryptogams, is under way.

Flora of the National Parks.—At the request of the National Park Service, Department of the Interior, Mr. Standley was detailed in the summer of 1919 to make a botanical survey of Glacier National Park, Montana, the expenses of the work being shared between the National Museum and the Park Service. The very large number of plants and plant photographs obtained have served as the basis of two reports, one a technical paper published as Part 5 of volume 22, Contributions from the U. S. National Herbarium, the other a profusely illustrated manuscript of a non-technical nature to be published eventually by the Park Service.

Flora of the Pacific Coast.—An illustrated Flora of the Pacific Coast (Washington, Oregon, and California), to appear in three or four large volumes, is being prepared under the direction of Prof. LeRoy Abrams, Department of Botany, Leland Stanford University, California. Messrs. William R. Maxon and A. S. Hitchcock have collaborated in this work.

Cooperation with the U. S. Department of Agriculture.—The relationship existing between the Department of Agriculture and the National Herbarium is naturally a very close one. Not only are thousands of specimens transferred to the National Herbarium by the Department each year, but the herbarium is used constantly by many members of the staff of the Bureau of Plant Industry and Bureau of the Biological Survey, and in many instances, extensive work of identification of material for these bureaus is performed by the staff of the National Herbarium. Until recently nearly all botanical material collected through the wide activities of the Bureau of Biological Survey was so determined, and at the present time all specimens collected in the national forests of New Mexico under the auspices of the Forest Service are referred here for identification. In 1912, the grass collection maintained by the Bureau of Plant Industry was transferred to the custody of the Smithsonian Institution, office and herbarium space being provided at the National Herbarium, of which the collections thus became an integral part. The staff, consisting of Dr. A. S. Hitchcock and Mrs. Agnes Chase with two assistants, is thus maintained by the Department of Agriculture. A large number of monographic and regional papers on grasses by Doctor Hitchcock and Mrs. Chase have been published in the Contri-

butions from the U. S. National Herbarium, and the cooperation is in other ways particularly close.

This relationship is equally close in other divisions of the Department of Biology. Cooperation between the Division of Mammals and the Biological Survey began in 1889 and has continued actively in force to the present time. During this period (to December 31, 1922) the number of specimens of mammals alone brought to the Museum by the Survey has been 126,240, besides thousands of specimens of other classes. The mammal and bird material, by agreement made June 10, 1889, is kept separate from the Museum collection proper, and is reserved for the use of the Survey. For handling this collection the Museum has furnished services in cataloguing, cleaning, and numbering the specimens. The Survey has taken charge of the arrangement and general management of its collections, employing for this purpose a force which has averaged, during the past ten years, five persons.

The work of the Division of Insects and that of the Bureau of Entomology are so closely related that it is difficult at some points to draw a line of separation. The Museum affords office space to 14 specialists of the Bureau staff, and about 12 preparators, typists, indexers, etc. The primary function of these specialists is to determine material sent in by the field workers of the Bureau throughout the United States. This makes it necessary that they should have access to correctly named and extensive collections. Hence it has been arranged that each should have charge of the group in the Museum's collections in which he specializes.

Mississippi Pearl Fisheries.—In 1907 Dr. Paul Bartsch was detailed to the Bureau of Fisheries to undertake an investigation of the pearl fisheries of the Mississippi. This survey resulted in the accumulation of material which threw light upon the then existing distribution of the various species of fresh water pearly mussels, their abundance, and likewise their utilization. Information was also gathered pertaining to the output of fresh water pearls and the pearl button industry.

Research work on Shipworms.—In cooperation with the American Wood Preservers Association, Dr. Bartsch has been called upon in connection with various topics covering the shipworm, a pest which causes an annual loss of millions of dollars in American waters.

He has also been called upon to identify the material taken by the New York Committee on Marine Piling Investigations of the National Research Council in their reconnaissance work.

Experiments in heredity.—Since 1912 Dr. Bartsch has been engaged in a series of experiments in heredity under the joint auspices of the Smithsonian and Carnegie Institutions. Mollusks were collected at the Bahamas, Porto Rico, and Curacao and transplanted to the Florida Keys and the Tortugas. Many points of cross breeding have resulted.

Cooperation with the Chemical Warfare Service.—Through breeding experiments conducted by Dr. Bartsch upon local land mollusks during the years from 1899 to 1907 was made possible the demonstration of a method by which the garden slug could be used as a poison gas detector. Dr. Bartsch was detailed to the Chemical Warfare Service for a period of 11 days working upon this problem.

Other cooperation by the Division of Mollusks.—Dr. W. H. Dall reports cooperation with the Wagner Free Institute of Philadelphia in preparation of a report on the Florida Tertiary Collection; with the Bishop Museum of Honolulu on the Molluscan fauna of the Hawaiian and Palmyra Islands; with the Museum of Comparative Zoology on the Blake and Albatross dredgings and the Wild Duck collections; with the Department of State on the Alaskan Boundary (the conclusions of this report were exactly adopted in the subsequent arbitration); with the California Academy of Sciences in a study of the landshells and fossils of the Galapagos Islands; with the Peruvian government; the Brooklyn Institute, and the Harriman Alaska Expedition and with the U. S. Fish Commission in a study of the Molluscan fauna of Porto Rico.

DEPARTMENT OF GEOLOGY

Services as Expert on Structural Materials.—In 1881-1882 the Head Curator of Geology was detailed for work with the Tenth Census in connection with the building stone industry. This work involved the identification of several thousand specimens and the compilation of the matter relating thereto as finally published in the quarto volume relating to this industry. During the Twelfth Census he was again detailed for similar work, the results of which are to be found in the report on Mines and Quarries (1912). In 1913 he was detailed for services with the Lincoln Memorial Commission in inspection of the quarries at Yule Creek, Colorado, and of the material as delivered on the grounds in Washington. For like services he has not infrequently cooperated with the Engineer in charge of Public Buildings and Grounds; the Architect of the Capitol; and the supervising architect of the Treasury; and with associations and

committees in charge of large structures. Among these may be mentioned the St. Albans Cathedral in Washington; the new City Hall in New York City; the New National Museum; the City Post Office, and other post office buildings; the State Library at Hartford, Conn.; and the columns on the east front of the Treasury building.

Resurvey of the petrified forests.—During the season of 1911, the Head Curator was detailed, at the request of the Commissioner of Public Lands to make a resurvey of the territory included in the Petrified Forest National Monument with a view of reducing its limits so far as practicable. The work was accomplished under the joint auspices of the Smithsonian Institution and the Land Office, assisted by an outfit furnished by the Santa Fe Railroad, whose property was in part involved. The resurvey resulted in a reduction of the total area of 40½ square miles without detriment, and the turning back of the remainder to the original owners.

Petrographical work in Montana.—During the field seasons of 1907 and 1908, Dr. Merrill, at the request of Dr. A. C. Peale of the U. S. Geological Survey, was detailed to accompany him into the field for the purpose of identifying and otherwise studying the eruptive rocks within the area known as the Three Forks Sheet, all expenses aside from salary being borne by the Survey.

Studies of the so-called Meteor Crater of Arizona.—During the summer of 1907, the Head Curator was detailed in accordance with an invitation from the Standard Iron Company of Philadelphia to make studies of the remarkable crater form depression near Canyon Diablo. The expenses on the ground were paid by the Iron Company, and all the necessary facilities and materials furnished. The results were published in the Smithsonian Miscellaneous Collections, vol. 50, 1908.

Mineralogical Services during the late War.—In the course of experimental work being carried on by the Navy, particularly along lines involving the piezo electric properties of minerals, there early arose an emphatic demand for the mineral quartz in sizes and qualities not then obtainable from dealers. The collections of the department of Geology were practically drained of such minerals in the furtherance of this and other experimental work, and the Head Curator was therefore detailed to secure a sufficient supply of the needed material, not only for the U. S. Government, but for Great Britain and France as well. The search was actively and successfully carried on until the close of the war.

Cambrian and Ordovician Paleontology and Stratigraphy of Virginia.—The study of the great Cambro-Ordovician limestone series

of the Appalachian Valley, long mapped as a single formation, was undertaken by Dr. R. S. Bassler in 1905 in cooperation with the Virginia Geological Survey, with the intention of discriminating the stratigraphic units thought to be present in this hitherto undivided series. After several seasons of close mapping and collecting of fossils, a new geologic map of Virginia west of the Blue Ridge, and a volume of 309 pages, fully illustrated, were published by the State.

Cooperation with the Geological Survey of Maryland.—Cooperative work with this organization has been actively carried on since 1901, Dr. Bassler alone, or in collaboration with Dr. E. O. Ulrich, having prepared a number of reports on the paleontology and stratigraphy of the state. The results of their work have been published in six of the reports issued by the Survey. The expenses of the work were borne by the State, and the types of the described fossils became the property of the National Museum.

Geologic studies in Central Tennessee.—Cooperation with the State Survey of Tennessee has resulted in two seasons of field work on the part of Dr. R. S. Bassler in working out the stratigraphy of a critical area—the Franklin quadrangle of 250 square miles just south of Nashville. The results of this work will be published by the State Survey.

Cambrian Paleontology of Wisconsin.—Active work on the Cambrian faunas of Wisconsin in cooperation with the State Geological Survey is now being carried on by Dr. C. E. Resser with the help and advice of Secretary Walcott and Dr. E. O. Ulrich, both of whom have made extensive collections in that state. The results of Dr. Resser's work will be published by the State Survey, but the type specimens will remain in the National Museum.

Permian Paleontology of the Island of Timor.—In cooperation with the Dutch government, Dr. Bassler has undertaken the study of the fossil Bryozoa of the Island of Timor.

Studies in Recent and Cenozoic Bryozoa.—By cooperation with the Bureau of Fisheries, the Carnegie Institution of Washington, and other organizations, Dr. Bassler, in collaboration with the leading bryozoologist of Europe, Ferdinand Canu, has engaged in extensive studies on the Recent Bryozoa of the Philippine Islands; the Tertiary Bryozoa of North America; and the Cenozoic Bryozoa of the West Indies and Central America.

Cooperation with the Geological Survey of Canada.—Since 1910 Secretary Walcott has been in cooperation with the Canadian Survey in the study of the pre-Devonian stratigraphy and faunas of the Rocky Mountains.

The classic Silurian area, the Island of Anticosti, was made the subject of detailed geological and paleontological surveys by the Canadian Geological Survey, in cooperation with various specialists. To Dr. R. S. Bassler was assigned the study of the large collections of Bryozoa and Ostracoda, the results to be published by the Canadian Government, but the type specimens to remain in the National Museum.

At the request of the Canadian Survey, Mr. C. W. Gilmore was detailed for a period of two months for the purpose of studying and describing dinosaurian remains in the collections of the Survey at Ottawa.

Vertebrate Studies with the National Park Service.—At the request of the National Park Service, Mr. Gilmore was detailed to conduct a paleontological survey of an area temporarily withdrawn from settlement and known as the "Mastodon National Monument," in north central New Mexico. As a result of this investigation and unfavorable report, the area was returned to the public domain.

Studies of North Carolina Vertebrate Fossils.—On the invitation of the State Geologist of North Carolina, Mr. Gilmore prepared a report on the Extinct Reptilia of the state, to be a part of a forthcoming publication on the geology and extinct life of North Carolina.

Vertebrate Studies at the University of Alberta, Canada.—For two months during the year 1922, Mr. Gilmore was released from his duties at the National Museum to assist in the arrangement and installation of the fossil specimens in the museum of the University of Alberta, and to describe the dinosaurian remains.

Cooperation with the U. S. Geological Survey.—Cooperative work between the Department of Geology and the U. S. Geological Survey is so constant, and the relationship so close, that specific instances are difficult to enumerate. About one-half of the space allotted to the department is occupied by members of the Survey staff whose work requires access to the classified collections, utilized as office rooms and for storage of their materials, paleobotanical library, etc. Since the Survey has on its staff no research workers in vertebrate paleontology, all of their collections of this nature must be sent here for identification, and members of our staff have been detailed to accompany their field parties in order to identify vertebrate remains and thus assist in the proper determination of formations. In this connection mention may be made of trips by Mr. Gilmore with Messrs. Lee and Stanton in northeastern New Mexico, in 1909; with Mr. Lloyd in the Judith Basin, Montana, in 1917; and to northeastern

Montana in 1913 to investigate the reported occurrence of vertebrate fossils in the Two Medicine formation, which work resulted in the acquisition of a good collection and the establishment of the first vertebrate faunal list of that formation. Extensive collections made by Survey parties in the San Juan Basin, New Mexico, in 1914-1915, were studied and described by Mr. Gilmore, thus establishing definite vertebrate faunas for the Ojo Alamo, Kirtland, and Fruitland formations. In 1921, Mr. Gidley, in cooperation with the Survey, made extensive collections in the San Pedro Valley, Arizona, thus settling certain involved questions of stratigraphy regarding the late Tertiary and early Pleistocene deposits on which the Survey had been working for a number of years. In all of the studies mentioned, the preparation of the material is done in the Museum laboratory.

Dr. R. S. Bassler has also cooperated with the Survey in mapping quadrangles in areas where his special knowledge of the rocks has made this work advisable; the Head Curator visited Florida in 1905 to investigate economic resources for the Survey, and Messrs. Foshag and Shannon of the divisions of mineralogy and economic geology are almost constantly in cooperation with this organization in determinative and descriptive work.

DEPARTMENT OF ANTHROPOLOGY

Archeological Investigations in Guatemala.—In 1914, Mr. Neil M. Judd was asked to participate in archeological investigations at Quirigua, Guatemala, conducted under the direction of Dr. Edgar L. Hewett. One of the objects of the expedition was the reproduction in plaster of several of the huge stone monuments at Quirigua. This work was assigned to Mr. Judd, who, with his assistants, completed casts from six of the colossal stelae by the use of glue molds, a material never before employed for this purpose in the torrid zone.

Archeological Investigations in New Mexico.—An important exploration was begun by the National Geographic Society in cooperation with the Museum. The Society appropriates $75,000 for five years' work in the ancient ruin of Pueblo Bonito, Chaco Canyon, New Mexico, under the direction of Mr. Judd, the specimens secured becoming the property of the Museum. This is the largest scheme of cooperative work ever engaged in by the Department, and is looked upon as opening up great possibilities for further exploitation by the National Geographic Society.

Anthropological Studies at the Panama-California Exposition.—By arrangement between the Institution and the Panama-California Exposition, Dr. Hrdlička of the division of Physical Anthropology

was given charge of the preparation of the anthropological exhibit. This important cooperation necessitated explorations in Alaska, the United States, Peru, British Guiana, South Africa, Siberia, and other countries, for procuring physical and ethnological material, the latter being shared with the National Museum. As a feature of this cooperation, there was prepared in Washington a collection illustrative of the science of Physical Anthropology, which is now shown in the San Diego Museum under the direction of the School of American Archeology.

Anthropological work with the Rockefeller Foundation.—Under the auspices of the Rockefeller Foundation and the Peking Medical College, Dr. Hrdlička visited several countries of the Far East during 1920. During this trip he continued studies on the origin of the American aborigines, examination of the oldest skeletal and other human remains in Japan, furthered the interests of medical and physical anthropology in China, and made a visit to the rapidly disappearing full blooded Hawaiians. Dr. Hrdlička assisted in the development of medico-anthropological work at the Union Medical College and the organization of the Anatomical and Anthropological Association of China.

Work with the Department of Justice.—In the spring of 1916, Dr. Hrdlička cooperated with the Departments of Justice and Interior in investigations in which the rights of Indian lands were involved. Some three months were consumed in the work and large areas of land restored to their original ownership.

DEPARTMENT OF ARTS AND INDUSTRIES

This department cooperates with other Government bureaus, with educational establishments, with publishers and authors, and with trade associations and industrial enterprises.

The *Divisions of Mineral and Mechanical Technology* are concerned with the interpretation of the efforts of the engineering professions in applying the results of scientific research to industry. To conduct the work, the most logical means is cooperation with industrial enterprises for the technologic aspects, and with Federal statistical bureaus for the economic aspects. Since the inception of the division, cooperation has been carried on with many firms engaged in the exploitation of mineral resources, as well as those engaged in more specialized industrial operations. As an example of educational work mention may be made of cooperation with the Pennsylvania Department of Education and Mr. Samuel S. Wyer, of Columbus, Ohio,

in the preparation of a book on the natural resources of Pennsylvania, prepared expressly for and presented to the seventh and eighth grade geography teachers of the state. The book is an application of the Museum's methods to a single state, and, as far as possible, the data are derived from the Museum's exhibits.

The *Division of Textiles* presents another phase of the important resources and industries of the United States. The collections, by their accurately recorded data, have served individual firms for settlement of patent litigation; have been used to illustrate the arguments of trade associations before the Ways and Means Committee in Congress; and are at all times available as reference materials for the use of the Tariff Commission or others presenting technical questions to legislative bodies. The division acts in cooperation with other Government bureaus in doing for them certain propaganda work in bringing their aims before the public by means of specially prepared exhibits; in preserving for them valuable historical materials which must be often consulted and in which the public has an interest; and in the identification of commercial raw materials. It cooperates with trade associations, corporations, and individuals in the presentation of exhibits illustrating the industries of the United States.

The *Division of Medicine* cooperates with all agencies by the visual presentation of the most recent advances in sanitary science and the health of man; with the National Medical Associations in the development and presentation of educational exhibits illustrating the history of medicine and pharmacy in America, and the part played therein by different schools of thought and practice; and with the War Department in the identification of narcotic drugs.

The *Division of Graphic Arts* cooperates mostly with manufacturers and others to increase and perfect educational exhibits in which the technical as well as the artistic side of the various processes and trades known as the graphic arts are displayed.

Bureau of American Ethnology

Other branches of the Government, the U. S. Supreme Court, both branches of Congress, educational and scientific institutions, and hundreds of individuals all over the world, have called on this Bureau for ethnological information. Its library is used constantly for study and consultation by students; exhibits have been prepared for various expositions; and the following detailed list covers some of its cooperative undertakings.

National Park Service.—Excavation and repair of the prehistoric ruins on the Mesa Verde National Park, Colorado.

University of Texas.—Study and excavation of antiquities in Texas.

Davenport Academy of Sciences.—Excavating prehistoric mounds near Fairport, Iowa, and making ethnological collections among the Fox Indians for that institution.

American Museum of Natural History.—Conducting ethnological researches among the Tlingit and Haida Indians of Alaska.

Columbia University.—Collecting material from the west coast of North America, and publication of results.

Museum of the American Indian (Heye Foundation).—Study of West Indian collection at that museum and field work in the Antilles. Work at Hawikuh and Nacoochee.

Illinois State Historical Society.—Investigating the Peoria-Miami Indians.

School of American Research, Santa Fe, N. M.—Studies in ethnogeography, ethnozoology, and ethnobotany.

Department of Justice.—Detail of a member of the staff to translate Spanish documents bearing on Indian land claims at the Tejon Ranch, California.

Agricultural Department.—Identification of plants to which certain Indian names are given.

Board of Geographic Names.—Services of chief as a member of this Board in collaboration with many other departments of the Government.

Studies of the Haida Indians of British Columbia and Alaska.—An expedition to study the Haida Indians, financed jointly by the Jesup North Pacific Expedition and the Bureau.

It is felt that the above work stimulates public interest in the various industries of the American aborigines, and by the preservation of the ruins of their former habitations, gives impetus to the movement called "See America First." The Bureau is frequently called upon by business companies for translation of Indian names, and for pictures, etc., for commercial use. It also aids Camp Fire Girls, Scouts, etc.

The National Gallery of Art

The National Gallery of Art is now in the third year of its existence as a separate unit of the Smithsonian Institution, and energies of the limited staff have been devoted mainly to the care, cataloguing,

labeling, and installation of the collections. Cooperation with other galleries and other institutions interested in art has been carried out as opportunity offered:

(1) By correspondence devoted to art subjects.

(2) By exchange of photographs of art works.

(3) By contributing matter relating to the collections for publication.

(4) By publication of illustrated catalogues of the collections.

(5) By lectures on the collections delivered in educational centers throughout the country.

(6) By the temporary loan of art works for exhibition.

(7) By circulating exhibits shown in art centers throughout the country.

(8) By permitting the copying of art works; by permitting teachers to instruct their classes in the Gallery; and by permitting portrait painters to hold their sittings in Gallery rooms.

(9) By exhibiting art works belonging to artists and collectors seeking public attention, and by the care and display of collections belonging to other galleries during periods of repair or construction of buildings.

National Zoological Park

The National Zoological Park is constantly cooperating with other government departments and with non-government scientific establishments throughout the world. The following specific instances of such cooperation are typical of its service to other institutions:

(1) Cooperates with the Biological Survey in establishing breeding experiments.

(2) Furnishes animals to the Bureau of Animal Industry and the Public Health Service for pathological investigations.

(3) Has at numerous times aided the Bureau of Engraving and Printing in obtaining portraits of animals for use on notes, bonds, etc.

(4) Has furnished large quantities of fertilizer, etc., to the office of Public Buildings and Grounds.

(5) Furnished needed materials for experimental work to the Bureau of Standards.

(6) Furnished birds, etc., and cared for birds and reptiles belonging to the Pan-American Union.

(7) Furnishes anatomical material to educational and scientific institutions throughout the country.

(8) Through members of Congress, and otherwise, furnishes information to public institutions in various parts of the United States,

especially plans for construction of buildings, cages, enclosures, care of wild animals, etc., and cooperates constantly with zoological societies and similar public and private organizations in various activities.

The Astrophysical Observatory

The present work of the Astrophysical Observatory is of special interest to meteorologists, for since the temperature and other weather conditions of the earth depend upon the sun, the variations of the sun may probably produce predictable changes in weather conditions.

For several years past, the monthly records of solar radiation have been furnished to the United States Weather Bureau for publication in its Monthly Weather Review. Since December, 1919, telegraphic reports of the daily observations at the Chile observing station have been sent to the Weather Service of Argentina, and have been employed there for forecasting purposes. The Argentine Government, at present, publishes weekly a forecast, one week in advance, based upon the Chilean observations of the Smithsonian Institution.

Frequent requests for information in regard to matters of solar radiation, physics, and astronomy are answered by the Astrophysical Observatory. (See also under Hodgkins Fund, p. 8.)

International Exchanges

Perhaps the most far-reaching of the forms of cooperation in which the Smithsonian has taken a leading part is that universally known under the title of the Smithsonian International Exchange Service.

This system was established early in the history of the Institution, at first purely as a channel for the interchange of scientific publications and specimens, and therefore as a direct means for "the diffusion of knowledge," a means which has proved to be a great benefit to the scientific institutions of the world, and incidentally to Congress, in building up the unequaled collection of works of reference deposited in its library.

In order to convey an idea of the present magnitude and character of the exchange transactions, it may be stated that during the year 1889, 17,218 packages were mailed to correspondents in the United States, and 693 boxes, containing 58,035 packages, were shipped to agents abroad for distribution to correspondents in nearly every civilized nation of the earth. The total number of packages received was 75,966, of which 34,996, or nearly one-half, were governmental exchanges. In 1922, the number of packages handled had

increased to 383,157, weighing 592,600 pounds. The following table will show the consignments for foreign countries during the year 1921-22.

CONSIGNMENTS OF EXCHANGES FOR FOREIGN COUNTRIES

Country	No. of boxes	Country	No. of boxes
Argentina	119	Italy	121
Austria	203	Jamaica	3
Belgium	89	Japan	80
Bolivia	3	Latvia	12
Brazil	49	Netherlands	80
British Colonies	15	New South Wales	43
British Guiana	1	New Zealand	28
Bulgaria	9	Nicaragua	2
Canada	30	Norway	47
Chile	36	Paraguay	4
China	164	Peru	22
Chosen	1	Poland	49
Colombia	26	Portugal	22
Costa Rica	18	Queensland	17
Cuba	5	Rumania	32
Czechoslovakia	128	Salvador	4
Danzig	5	Siam	2
Denmark	41	South Australia	25
Ecuador	16	Spain	48
Egypt	11	Sweden	86
Esthonia	11	Switzerland	91
Far Eastern Republic	2	Syria	4
Finland	20	Tasmania	12
France	201	Ukrainia	2
Germany	523	Union of South Africa	30
Gt. Britain & Ireland	364	Uruguay	23
Greece	17	Venezuela	14
Guatemala	3	Victoria	50
Haiti	6	Western Australia	14
Honduras	2	Yugoslavia	69
Hungary	54		
India	7	Total	3,215

THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE

Still another form of cooperation which is widespread in its numerous ramifications is found in the International Catalogue of Scientific Literature, which, dating from 1901, is an outgrowth of *Catalogue of Scientific Papers* published by the Royal Society of London. The prime initiative in this work may be ascribed to Professor Henry, who, at the Glasgow meeting of the British Association in 1855 brought the matter up for consideration. A full his-

tory of the movement is said to be contained in the first volume of this catalogue issued in 1867 by the Royal Society. The possibility of preparing a complete index of scientific literature by international cooperation was first taken into consideration by the Royal Society about 1893. An international conference for considering the matter was held in London in 1896, at which there were present delegates from Canada, Cape Colony, Denmark, France, Germany, Greece, Hungary, India, Italy, Japan, Mexico, Natal, the Netherlands, New South Wales, New Zealand, Norway, Queensland, Sweden, Switzerland, the United Kingdom, and the United States. It is not necessary to go into the details of the final arrangement other than to say a "Regional Bureau" was established under the auspices of the Institution, entrusted with the duty of indexing and classifying titles of all scientific papers published in the United States, the same to form a part of the International Catalogue issued by the central bureau in London.

V. CONCLUSION

It is impossible to estimate either the value or cost of the numerous and varied forms of cooperation mentioned above. The work has become largely a matter of routine and cannot be considered independently of other duties, often carried on at the same time. *"The most important service by far which the Smithsonian Institution has rendered to the nation from year to year since 1846—intangible, but none the less appreciable—has been its constant cooperation with the Government, public institutions, and individuals in every enterprise, scientific or educational, which needed advice, support, or aid from its resources."* This statement by Dr. G. Brown Goode[1] is felt to be fully borne out by the foregoing pages. While much has been omitted that might properly have found place among the enterprises here recorded, it is thought that sufficient instances have been given to show the character and wide scope of the work. A list of institutions or names of private individuals with whom the Institution has cooperated would run into the thousands, and their publication serve no useful purpose. Suffice it to say that the Institution's cooperative activities are continuous and world-wide in distribution.

GEO. P. MERRILL, *Chairman,*
Committee on Cooperation.

May 16, 1923.

[1] Rep. Smithsonian Institution, 1897, Pt. 2, pp. 320-321.