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MEMOIR

OF

SPENCER FULLERTON BAIRD.

1823—1887.

BY

JOHN S. BILLINGS.



READ BEFORE THE NATIONAL ACADEMY, APRIL 17, 1889.

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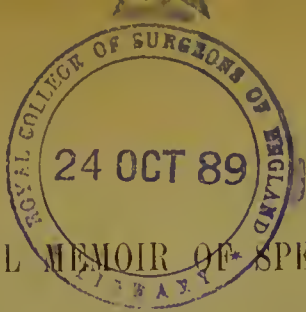
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BIOGRAPHICAL MEMOIR OF SPENCER F. BAIRD.

A memorial of a scientific man, prepared for a scientific association, does not, as a rule, refer so much to the personality of the individual, or to his biography in the ordinary sense of the term, as to his contributions to the common stock of existing knowledge, and to the relations he has had to, or the influence he has exerted upon, the progress of science. It does not often consider him from the social or family point of view, and in fact, in the great majority of cases, there is little to be said about the quiet, uneventful life of the scientific worker. The particular thread of warp or woof formed by his existence in the variegated tissue of human progress is often not conspicuous during his lifetime, though it is usually of fast colors; and when one comes to trace it carefully it is often surprising to see what an important part of the pattern it makes, and how it expands and ramifies as the web goes on.

Occasionally, however, such a memorial has to treat of a man distinguished not only for his own scientific work and original contributions to knowledge, but for his strong and wide-spread influence upon the work of others, through his connection with the organization and development of institutions which every one recognizes to be of national interest and importance. In such a case we want to know, not merely the little string of dates which mark the beginning, turnings, and end of such a life, or the list of the books and papers which he wrote, but how he managed men, avoided controversy, obtained means, and overcame obstacles—in short, the methods as well as the results. It is of such a man that I have been requested to prepare a memorial for the National Academy, and one of the difficulties which I have met with in attempting it has been excess rather than deficiency of material.

The biographical sketches and eulogies of Professor Baird, which have already appeared, prepared by intimate and admiring friends, give full details of his published contributions to science, and set forth the breadth and depth of his knowledge, the amount of his labor, and the perfection of his character, with such feeling and eloquence that any subsequent account must either simply copy

them or seem cold and critical by contrast. It has, therefore, seemed to me that I could best use the limited time at my disposal by omitting biographical and bibliographical details to a great extent, and considering mainly some of the indirect results which he produced, and some of the causes of the powerful influence which he wielded.

SPENCER FULLERTON BAIRD was born February 3, 1823, at Reading, Pennsylvania. His remote ancestors were English, Scotch, and German—an excellent combination for both business and science. His father was a lawyer, and, as is not unusual in this profession, was also a lover of nature, and his tastes strongly influenced those of his son. Spenceer entered Dickinson College, at Carlisle, Pennsylvania, in 1836, being then thirteen years old, and graduated in arts in 1840, at the age of seventeen. He then began the study of medicine and attended one course of lectures, but was drawn aside from this profession by his interest in natural history. He had formed the acquaintance of Audubon while yet a student, and in 1842 received from him a part of his collection of birds, including many types of new species. The next three or four years were spent mainly in long tramps through the country collecting specimens, and in the study of systematic zoology.

In 1845 he was chosen Professor of Natural History in Dickinson College, and the next year became also Professor of Chemistry. He was strongly influenced by Agassiz, who came from Switzerland in 1847, and who, very soon after his arrival, projected a work to be carried on with Professor Baird on the fresh-water fishes of the United States, which, however, was never published.

In 1848 he obtained from the Smithsonian Institution one of its first grants for the promotion of original research, which was to be applied to the exploration of bone caves in Pennsylvania. These caves, and especially some in the vicinity of Carlisle, always had a great attraction for Professor Baird, and he often spoke of his desire to go back and take a rest from routine work by continuing their exploration.

In 1850, mainly through the influence of the late George P. Marsh, he was appointed Assistant Secretary in the Department of Natural History of the Smithsonian Institution, which had been organized in 1847. Professor Baird brought with him his extensive collections, chiefly of skins of mammals and birds, of birds' nests and eggs, and of alcoholic specimens of reptiles and fishes, with

some skeletons and fossils. At that time the Institution had a few boxes of minerals and plants, which were of little importance. These collections of Professor Baird formed the nucleus of the present National Museum, which was at last definitely established in 1857 by the formal transfer of the collection of the Wilks Expedition from the Patent Office, and which has been organized and managed on the methods devised by the young naturalist for his own private collection.

When Professor Baird was appointed Assistant Secretary the immediate duty to which he was assigned was the charge of the library and the department of exchanges. His tastes and training were very different from those of Professor Henry. He cared little for physical or experimental science, was no mathematician, and had no taste for laboratory work. He was a naturalist, an explorer, and a collector, taking immense pleasure in out-of-door work and in getting his materials at first hand, and almost equal pleasure in classifying and preserving them. It was the possibility of creating a great museum of natural history that induced him to come to the Smithsonian, and he never lost sight of this object; but for a long time he had to work largely by indirect methods. He did not directly oppose the policy of Professor Henry, and always worked harmoniously with him, but he lost no opportunity of increasing the collections, and constantly urged that the best way to induce Congress to grant the means of caring for such things was to accumulate material worth caring for until its amount and value should be such that public opinion would demand ample accommodation for it.

So early as 1853 we find him writing to his friend, Mr. Marsh, about a scheme for a national museum, and a year later he got so far as to consider plans and size of buildings, having in view apparently something like the Crystal Palace. He was not working aimlessly all those years. He could not have what he wanted just then, but he had faith in the future, and meantime went on with his duties, which Mr. Marsh characterized as "answering of foolish letters, directing of packages to literary societies, reading of proof-sheets, and other mechanical operations pertaining unto the diffusion of knowledge."¹

In 1871 he was appointed to the position of United States Commissioner of Fish and Fisheries, an office specially created for him,

¹ Life and Letters of George P. Marsh. N. Y., 1888. Vol. i, p. 262.

since the act required that the commissioner should be taken from the civil officers or employés of the Government; should be of proved scientific and practical acquaintance with the fishes of the coast, and should serve without additional salary. This position opened to him a field of work which, in most respects, precisely suited his tastes; it gave him opportunities of making immense collections, of which he was not slow to avail himself, and there was enough utilitarianism in the work, that could be appreciated by every one, to make it easy to secure ample appropriations from Congress for carrying it on. He gradually became more and more absorbed in this part of his occupation, and during the last four or five years of his life thought of but little else.

In his earlier years of study Professor Baird did a vast amount of bibliographical research, especially with reference to synonymy and the geographical distribution of species and genera, and the results of this are evident in his published works, although these do not by any means include all of his memoranda and notes upon such points, which were wonderfully complete, considering the difficulties which he must have had in getting access to the voluminous literature of the subject. No doubt the library of the Academy of Natural Sciences of Philadelphia was the chief source from which he drew for this purpose.

The most important field of labor of Professor Baird during the first twenty years of his service in the Smithsonian Institution was in connection with the various Government explorations and surveys which were from time to time sent out. In most cases he drew up the descriptions for the natural history of the results of such expeditions, practically selected the collectors, and edited a large part of the zoological reports. In the Annual Report of the Smithsonian he described the work of such expeditions during the year, and this is the only continuous record which we possess of what the Government has done in this direction. It was mainly through these channels that he secured a large part of the material for the National Museum, and, at the same time, induced Congress to make increasing appropriations for its care, until at last the large gifts of specimens which came from the Philadelphia Exposition of 1876 led to the fulfillment of the plans at which he had been working for a quarter of a century, in the granting by Congress of funds for the construction of a separate building, and to liberal appropriations for obtaining, preserving, and displaying specimens.

Upon the death of Professor Henry, in 1878, Professor Baird succeeded him as Secretary of the Smithsonian Institution. He effected some changes in its policy, more especially in the distribution of its funds, which will be referred to hereafter, but in the main his thoughts and labor continued to be devoted to the Fish Commission and the National Museum.

He was a man of fine physique, which had been well developed by his early habits of pedestrianism, but great muscular development has its inconveniences and dangers if its demands for exercise are not complied with. Muscle and nerve form one organ, the proportions of which, if normal, are adapted to each other, to the appetites which belong to them, and to the organs of circulation. If the muscle does not receive its due amount of exercise it not only degenerates, but throws extra work on other organs. When Professor Baird, as a young man, walked from forty to fifty miles a day for two weeks in succession he not only developed the muscles immediately concerned in locomotion, but also a heart of increased size and power, capable of dealing with the rapid circulation of blood demanded by it, and an appetite and digestion suited to provide the force exerted.

The heart built for its work not only muscle, but an enlarged framework of fibroid tissue about the mouth of the great vessels suited to withstand the constant pull and strain. When he changed his mode of life to almost constant desk work the muscle diminished, but the scaffolding did not also lessen in the same proportion, for this fibroid connective tissue is more permanent. So also the appetite for food continued, but the supply was no longer consumed by muscular effort, and had to be gotten rid of through other channels, which had too much work to do. Before he had been five years in the Smithsonian his heart began to trouble him, especially after clerical work,¹ and this condition slowly progressed, aggravated by his mode of life, until it gave him a weak, flaccid heart, stretched on a framework too big for it and unable to respond to any sudden demand for extra work. When at last, twenty years later, he perceived that the "edge of the dark" had passed over him it was practically too late to change his mode of life, his interests, or his work; he could only make provision for

¹See Report No. 141, 33d Congress, 2d session, House of Representatives, page 80.

assistants and for a successor, avoid effort and strain, and seek relaxation and rest in that branch of work which most interested him—namely, the Fish Commission. When the shadows grew so deep that he knew the inevitable end was near, he went to the laboratory he had created at Woods Holl, and there, surrounded by fellow-workers and friends, he died August 19, 1887, at the age of sixty-four.

The characteristics of Professor Baird which I propose to notice are his unusual qualifications as an original investigator in natural history, his tact and skill in subordinate positions, his capacity for managing men and for organization and administration when placed in charge, his persistent labor, and his modesty and usefulness in his devotion to the particular branch of science in which he was interested.

As an original investigator he did an enormous amount of work during the twenty-six years from 1843 to 1869, which he specially devoted to study of the mammals, birds, reptiles, and fishes of North America. As to quantity, Professor Goode has filled a volume of nearly 400 pages with the bibliography of his published writings up to 1882, including 1,063 titles, of which about 200 relate to formal contributions to scientific literature, while in addition to this he furnished much material in the shape of notes of unfinished work and suggestions for further inquiry to be utilized by others. His reputation as a scientific naturalist was established by the publication of Vols. VIII and IX of the Pacific Railroad Reports, containing the descriptions and classifications of the mammals and birds of North America. These contain not merely descriptions of a large number of new species, but a general revision of the classification and nomenclature, and the principles upon which these were founded have for the most part stood the test of time, showing the keenness of his insight into what may be called fundamental morphology. These large volumes are still the standard works on the subjects of which they treat, and the additions which have been made to them are mainly the work of his own pupils and in his own manner and methods.

The circumstances of his position confined his work mainly to descriptive morphology, systemization, and nomenclature, but his early training as a field naturalist and collector and his keen powers of observation of the actions of living animals in the wild state entirely removed him from the category of the mere species

describers. For example, when, as one of the Trustees of the Corcoran Art Gallery, he was called on to see Richard's picture of a scene on the New Jersey coast obtained for that collection, it was not the rush of the waves, the seething spray, the dull glitter of the lonely beach, or the flying drift of the clouds, which are the chief features of the painting, which caught his attention, but the fact that the gulls were depicted with a plumage which these birds do not have at the season represented, and this error to a considerable extent spoiled the picture for him. The determinations of genera and species made by him are founded mainly on bones and skins, which formed the bulk of the material available at the time, and it was not until the laboratory of the Fish Commission was organized that he was able to do much in embryology; nevertheless, he personally made many dissections of smaller animals and reptiles, such as are preserved in alcohol, and left many unpublished notes of the results. It is not an easy matter to estimate fairly the importance of this kind of work and the influence which it has on scientific progress and general culture, and it is very likely to be either under or over valued by those who are not familiar with the study of living organisms. Classification, description, and naming of the different forms are the essential foundations of scientific biology, for until this has been done identification of particular forms is either difficult or impossible, co-operative work on the part of scattered students is greatly restricted, and broad generalizations can only be put in the form of theories and conjectures. Such work as was done by Professor Baird in this direction gives a starting point to many observers and investigators in different localities, stimulates farther inquiry, and, when done on the extensive scale on which he did it, based on the examination and comparison of a large number of specimens from widely different localities, exercises a powerful influence for years to come on lines of exploration, collection, and critical research. To those who have never tried it, it may seem an easy matter to sort out specimens of different kinds when a large number are brought together, or to prepare descriptions sufficient to enable another man to identify his specimen; but in reality it requires not only much experience and careful study, but a certain aptitude, power of grasping salient points, and of putting aside unessentials such as is rarely possessed by any man.

On the other hand it should be remembered that this is foundation work only, and that its importance and value depends on the

structure to be reared upon it, upon the higher generalizations with regard to the relations of size, color, form, etc., to each other, to the environment, and to the functions of the living organism, and that mere names and descriptions, however well done, are only the bricks with which true science builds.

It is, however, usually true that the man who can rightly classify and describe can also best deduce conclusions from the results of such studies. As an example of Professor Baird's ability in this direction, take his paper on the distribution and migrations of North American birds, published in *Silliman's Journal* for 1866. In this paper he maps out the country into regions corresponding to the distribution of different kinds of birds, discusses the relations of these regions to surface topography, altitude, temperature, mountain chains, etc.; points out that there are certain correspondences in the distribution of reptiles and fishes, and draw the conclusions that North American birds of wide distribution in latitude, whether migrants or residents, will be found to be larger the higher the latitude of their place of birth, and that this is also true within certain limits of mammals and even of man; that specimens from the Pacific coast are apt to be darker in color than those from the interior, and that specimens from near the line of junction of two well-marked provinces or regions often show the influence of hybridization. When he comes to discuss migrations it is in their relations to the laws of the winds of the Northern Hemisphere that he studies them, and concludes that the transfer of American birds to Europe is mainly due to air currents. Finally he says, and this is the germ of the Fish Commission, which came five years later, "a region deprived of its spring birds or fishes by extermination will only be filled up again in the course of a long period of time. The result, however, can be greatly accelerated by artificial propagation in the places to be supplied."

Professor Baird did not himself produce much of this sort of scientific literature, for he had not the opportunity, since at the very period of his career when he was best fitted to make such studies he had to give almost his whole time and energy to routine administrative duties; but this paper alone is sufficient evidence of his capacity for generalizing from a series of isolated facts.

With regard to his deportment in the subordinate position of Assistant Secretary of the Smithsonian, especially in the earlier years of his connection with that Institution, it is noteworthy that,

while he did not yield his opinions or change in the least in his tastes or preferences for natural history investigations, he did thoroughly well the work which was assigned to him, and never allowed his personal pleasure to stand in the way of carrying out the plans of the Secretary and of the Regents as far as they related to the division under his charge. For a time he threw all his energy into the organization and expansion of the Bureau of Exchanges, so much so that his friend, George P. Marsh, in some of his charming letters to him, half jokingly and half seriously remonstrates with him on his enthusiasm over the increasing number of boxes and packages sent out and received, the number of letters he was writing, etc., and expresses doubts and fears lest he should become a first-rate packing and shipping clerk. Professor Baird himself, however, never shirked this mechanical drudgery, never publicly bewailed that he could not do just what he wanted to do, never smote his breast and rent his garments and called on the world to witness that he was a remarkable scientist, and that as such he ought to be made much of and be allowed to blow his own horn exclusively, even if he did receive pay for doing something else.

The system of Smithsonian exchanges was practically an extension of those carried on by the American Philosophical Society and the American Academy of Arts and Sciences for some forty years, and its establishment was one of the first definite acts of the Smithsonian Institution. Previous to this there had been some exchanges made under an act of Congress approved July 20, 1840, and also by the National Institute. When the Smithsonian was organized, one of the most urgent demands made upon it was that it should take charge of, expand and improve this system of exchanges. It was difficult for the newly formed and rapidly organizing scientific and educational institutions in this country, and still more so for isolated and comparatively unknown workers in special fields, to establish communication and exchange with the scientific institutions and students of other countries; there was no organized express system, the custom-house delays were long and vexatious, and there was little certainty that packages which could not be sent by mail would ever reach their destination.

Mainly through the energy and incessant labor of Professor Baird, the Smithsonian was soon able to render most important aid in this direction; it not only had its own agents in all the principal cities of Europe, but American ministers and

consuls everywhere were induced to interest themselves in receiving and forwarding packages; the Treasury Department allowed its parcels to be forwarded without delay; many lines of shipping and railroads gave it free transportation; and so it soon came to pass that scientific men in this country had better facilities for exchange with Europe than European countries had with each other. All this was done with comparatively small expenditure, the average annual cost to the Institution prior to 1867 being only about \$2,000. In 1867 Congress placed the system of exchange of Government publications under the charge of the Smithsonian, and the expense rapidly increased, so that for the years 1878-'80 they averaged \$10,000, or nearly one-third of the entire revenue of the Institution. In 1881, through the influence of Professor Baird, Congress granted \$1,500 towards the cost of exchanges, and this sum was rapidly increased in succeeding years to \$15,000, as was fair and just.

But, while doing this routine work, and doing it so well as to lift it out of the region of routine, Professor Baird never for a day lost sight of his plan for a National Museum, never neglected a possible opportunity to acquire material for it, never ceased the studies which were his chief delight, and yet never came into unpleasant collision with his official superiors who had other interests and views. This was not because he concealed his opinions, but because he did all that was given to him to do and more, and used his remarkable power of managing men in behalf of his official work as well as of that which he had more immediately at heart.

Of his capacity for organization and administration, the National Museum and the work of the Fish Commission are sufficient evidence. He had the full confidence of those very distrustful bodies of men, the Committees on Appropriations of the House and Senate, and while he never seemed to be urgent in his demands, he almost invariably obtained from Congress all that he desired. One reason for this was that he did not try to go too fast, and managed to educate public opinion so that the demands when made met with almost unanimous support. In fact he offered suggestions rather than demands, and preferred to have others take up the suggestions and deal with them as if they were their own original ideas, while he remained quietly in the background ready to furnish information when desired, but taking no apparent part in discussion or controversy, and absolutely indifferent as to who should

have the credit, so long as the work was done. The wide-spread net-work of Smithsonian correspondents which he had established was of great use in this preliminary education of public opinion. The fact that he always got the fullest money's worth for his expenditure was also well known to Congress. A distinguished Senator remarked, "I am willing to vote the money asked for by Professor Baird, for he will get two dollars' worth for every dollar we give him—one-half by direct purchase and one-half by gift." He was in fact a hard bargainer in exchanges, aiming to get as much and give as little as possible; but this was for the Government collections as a whole and not merely for the National Museum, and least of all for himself. For example, in dealing with the Army Medical Museum there was no chaffering; he gave more than he got, and willingly, because he considered the Medical Museum as a valuable branch of the National Collection; the only point he insisted on was that whatever came to the Medical Museum in the shape of dress, weapons, or utensils of savage life, be it much or little, should be sent to the National Museum, where it could be better used and placed.

His personal presence, including his size, his uniformly quiet, simple manner, evident honesty and sincerity of purpose, and perfect readiness to answer all questions had a powerful effect on the committees. Another cause of his influence was the fact that a very large proportion of the legislators with whom he had to deal were men whose youth had been spent in the country, and who as boys had become somewhat interested in the animals, birds, and fish which they had hunted or entrapped. In Professor Baird they found a man who recalled some of the pleasantest days of their youth, who could answer many of the questions which had puzzled them in days gone by, who was a hunter and a fisherman as well as a collector, and who could make his plans and wishes not only intelligible but full of interest to them. He had good soil in which to plant, and he was a skillful cultivator; no wonder that the crop was large. Take, for instance, the growth and development of the Fish Commission, which originated in a holiday season spent in the vicinity of Woods Holl, where he amused himself with the rich marine fauna of the vicinity and with talks with the fishermen round about. When he gathered and repeated the stories of the growing scarcity of some important food fishes he had plenty of interested hearers in the Senate and in the House, men who were

fishermen themselves and were quick to grasp the idea of the possible benefits to be derived from a careful study of the causes of this scarcity. Argument and solicitation were almost unnecessary, the mere suggestion was sufficient, and after the publication of his first report the increase of the work was rather forced upon, than demanded by him.

With regard to those not immediately connected with the institutions of which he had charge, he had grasped the open secret that one makes friends quite as much by asking and receiving as by giving, provided it be clear that the asking is not for personal benefit. Most men, in this country or abroad, were glad to reply to Professor Baird's innumerable letters of inquiry, to obtain for him this or that particular bird or mammal or reptile. He made them feel personally interested in the completeness of the collection, that it was partly theirs, and that they should have full credit for their work. By his own immediate staff of assistants he was respected, trusted, and beloved to an unusual degree. He exacted full work and was rigidly economical in salaries as in all other expenditures, and personal feelings were never allowed to interfere with what he believed to be for the best interests of the work under his direction; but changes in the staff were very few, every one was sure of the most cordial assistance in his work if he showed zeal and ability, and his charity towards short-comings and moral delinquencies was, if anything, excessive. He let his assistants work in their own way, ready to help or advise when called on, but never fussily interfering or dictating minutiae of methods; so that each one felt that he was to a great extent independent, and therefore, to a corresponding extent, responsible for good work and plenty of it, to which the constant example set by himself was a powerful stimulus.

He was not an active worker in any of the scientific societies with which he was connected. He did not like to read papers, or to take part in formal discussion, and, above all things, he hated the necessity of sitting still for two hours with nothing to do but listen to papers which in the great majority of cases had no relation to his work, under which circumstances he usually went to sleep. Nevertheless, he was always interested in the prosperity of such societies, always ready to furnish materials and suggestions to others who would make use of them in papers or discussions, and in fact to do almost anything except to attend, to talk, or to fill any official position in them. It is said that the only time he was

ever seen on the platform in a public assembly was when he received the honorary degree of LL. D. from Harvard. The only communication which he presented to the National Academy was the paper on the distribution and migration of North American birds, read in 1865, to which reference has been made.

I have already alluded to the views of Professor Baird with regard to the use to be made of the Smithsonian funds, and these are clearly indicated in the change which took place in the character of the expenditures after he became Secretary. The average annual expenditure for original research for 1850 to 1877 was a little over \$2,000 a year. After Professor Baird took charge, in 1878, it fell to \$802.80 for each of the next three years, and then ceased entirely. In like manner the expenditures for apparatus and for laboratory were soon cut off after 1878, while, on the other hand, the expenditures for collection and for explorations more than doubled, being in the main for the benefit of the National Museum. The character of the publications also changed; the cost of the Smithsonian contributions to knowledge, which from 1870 to 1877 averaged \$8,140.71 per annum, fell to an average of \$3,270.83 annually during the next ten years, while the cost of the annual reports more than doubled in the same time. The physicist, the chemist, and the naturalist will differ in opinion as to the wisdom of this change, but all must admit that it was no ordinary amount of tact, of management, and of executive ability which so rapidly effected such a change in the policy of the Regents of the Institution.

The relations of the Smithsonian Institution and of the National Museum to each other, and to science and scientific man in this country, have been and still are very intimate; the work of their founders and organizers forms an integral part of the history of science in America; they have had a powerful influence in educating public opinion and in shaping the legislation which has provided for skilled explorations and investigations in so many branches of the Government, and everything connected with them and their directors must always be of special interest to this Academy.

In the light of subsequent events it may be said that the course pursued by the Smithsonian authorities has been in the main a wise one. It would not have been well if the whole income of the trust had been turned at once into one channel, and it is best turned in different directions at different times. No better work can be done

by such an untrammelled trust than to commence investigations, collections, or publications, do enough to demonstrate their practicability and utility, educate popular opinion to their support, and then leave them to the care of others to develop by gemmation and not by segmentation. There is now no need for the Smithsonian to expend any of its limited funds on books or on specimens of art or natural history, but it should not be forgotten that this is so because for a number of years it did make such expenditures, and thus stimulated and made possible the national libraries and museums of to-day, and in this part of its work Professor Baird stands pre-eminent.

It is also well that we should have, not a National Library and a National Museum, but National Libraries and Museums. The scheme of the ambitious collector to gather every book into one library, or a specimen of everything relating to science or art into one museum, is not a wise one. Differentiation is as necessary as accretion for development and production of the greatest utility; true wisdom consists in so adjusting these processes as to secure the greatest interest in and utility of the several groups.

The provision by Congress that there should be a chemical laboratory is a sign of the times; they did not know anything about any other kind of laboratory, not even a physical one. Under the same circumstances to-day a biological or a physical laboratory would be prescribed, if any. When the Smithsonian began its work some wanted it to form a great library, some to create an art gallery, some to make a museum, others to collect meteorological data. As matters now stand, we have an art gallery whose income is greater than that of the Smithsonian, a meteorological bureau which costs about \$900,000 a year, the Congressional Library with an annual appropriation of \$71,000 (which will no doubt be much increased as soon as room is provided for its urgent needs), and the Fish Commission with its annual appropriation of \$277,000—all of which are entirely independent of the Smithsonian Institution and of each other. Then there is the National Museum with its annual expenditure of \$175,000, and the Bureau of Ethnology with its annual allowance of \$40,000, which are still under the direction of the Smithsonian. The question is sometimes asked, and it is a proper one for scientific men to ask, whether the time has not or soon will come when these last institutions should also be put on an independent footing, and the officers of the Smith-

sonian be allowed to turn their undivided attention to other channels of usefulness? This is not the place for an attempt to answer it; but in considering this matter it should be constantly borne in mind that it is not to be settled on the abstract principle of giving to each branch of science a certain proportion of aid from the Smithsonian funds; we must also bear in mind certain points of expediency with which only those actually engaged in the management of these great trusts can be thoroughly familiar. In his last annual report, the Secretary remarks that the Institution has placed in the Museum property acquired out of its private fund (and to which it has apparently the same title) which is probably now more than equal in value to the whole of the Smithsonian bequest—that is to say, more than half a million dollars; so that even on mere pecuniary grounds it has much interest in the way that these things are cared for and used; while, on the other hand, it is clearly to the interest of the Museum to retain its present relations to the Smithsonian Institution in order to secure funds and the permanency of its staff.

It should also be remembered by those who think that it is time that the physical and chemical sciences should receive more stimulus and aid from this source, that for the last twenty years it has been able to do little more in the higher branches of biology than it has done for what they call the exact sciences. The work of exploring, and of collecting, classifying, naming and displaying specimens in a natural history museum, relates almost entirely to morphology—to the shape, size, arrangement, etc., of organs or parts; but the chief interest of these from a scientific point of view is in their relation to function—that is, to physiology. Do not understand me in saying this as depreciating the value and importance of morphological studies; on the contrary, they are one of the essential foundations of scientific biology, just as meteorological records are essential for a science of meteorology; but the scientific interest of the structure of an animal lies mainly in its relations to the functions of the living organism, and the data of structure must be combined with those obtained from vital chemistry and experimental physiology to obtain the higher and broader generalizations of scientific biology. The most minute dissections, the most careful study of thin sections of dead embryos, animals or tissues, can never take the place of direct experimental investigation of the actions of the living mechanism under varied conditions of environ-

ment, and it is for such investigation that there is now the most urgent demand, and the best reasons to hope for important results, from the point of view of pure science as well as of practical utility. Just at present, in this country, embryological and morphological research is fairly well provided for; but physiological chemistry is not, and it is precisely in this direction that there is the greatest need of original work to determine some of the many unknown relations between structure and function in so-called vital processes, and thus to indicate new problems and new methods of research in both physiological and pathological biology.

The main points which require consideration at present are that the Smithsonian Institution has almost no funds available for scientific research; that it is highly desirable that it should have a special fund set apart for experimental research in chemistry, physics, and biology, and that if the National Academy sets to work in earnest to see that such a fund, yielding about \$20,000 per annum for the purposes indicated, is provided by the General Government as a permanent addition to the Smithsonian fund, there is good reason to believe that its efforts will be crowned with success, and that the result will be to greatly expand the sphere of usefulness of this most important Institution for the increase and diffusion of knowledge among men.

The two men who have exerted the strongest influence upon natural history studies in this country are Louis Agassiz and Professor Baird. In many respects they were very unlike; circumstances gave them widely different fields, and they worked on different plans and by different methods. They began their public career in this country almost together; but Agassiz was already famous, as the result of seventeen years' incessant work, while Baird was an almost unknown youth. Agassiz was a born teacher, a fascinating lecturer, gifted with eloquence which won its way everywhere; Baird could only speak freely in the presence of a few, and for the most part taught only by the pen and by example. Each of them created a great museum in spite of many obstacles, the first winning the means largely from private contributions, which were a tribute to his eloquence; the second gaining his end more indirectly, through his connection with the Smithsonian Institution and the Government. Each of them gathered around him young men who were stimulated and encouraged by his example, who followed his methods, have continued his work, and have taught

others, so that there are now observers and workers almost everywhere. The first made great use of the microscope and of embryology; the second very little, for he had to use the material available. The first had a vivid imagination which led him to frame many theories and hypotheses to be verified or disproved by future investigation and research; the second classified the facts before him, but theorized very little. Professor Baird's career as an original investigator was hampered and finally stopped by his administrative work, but in proportion as this latter increased he was able to furnish materials and opportunities for others. The pupils of Agassiz and Baird are the working naturalists of to-day and the teachers of those who are to come, and the two methods of study are being combined and developed to produce results of which we already have good reason to be proud, and the end of which no man can foresee.

Allusion has been several times made to Professor Baird's power of continuous labor, which was in fact one of the main reasons of his success. As in most similar cases, it was not merely that he had a capacity for labor, but a longing for it; an urgent necessity to be doing something during every waking moment grew upon him with years, until finally there was no other amusement possible to him, and the only relaxation was a change from one kind of work to another. There was always something going forward, and this is a large part of the whole matter. Most men work for pay, some from a sense of duty, some to deaden sorrow and bring forgetfulness, a few for pleasure, and of these last was Professor Baird. This labor was carefully systematized, such a thing was done at such an hour, and there were never any vacant quarters of an hour; and every mechanical device for saving time, such as stenographers, the telephone, etc., was freely employed. He centralized all administration in himself, supervised all correspondence, and attended to small details. The wisdom of continuing to do this as the work expanded is more than questionable, for it was unnecessary waste of force; but to a man of his somewhat peculiar nature, having at the same time a keen sense of responsibility for the proper expenditure of the funds which his influence had obtained, it was probably impossible to do otherwise with comfort.

His success as a collector, organizer, and administrator was due to concentration of purpose, perseverance, tact, and constant labor. He had a clear, definite idea of what he wanted, and he did not

scatter his energies. He did not meddle with other people's business, and thus avoided one great source of hostility; and unless a matter was in some way actually or prospectively connected with the subjects in which he was interested he had no time to give to it. He gave advice when it was asked for by any of the executive officers or legislators of the Government, and it was asked for much oftener than any one knows; but he rarely volunteered it.

He had great opportunities, but he made most of them for himself, and made the most of them when obtained.

Upon the roll of the illustrious dead of the National Academy of Sciences his name stands out as that of a scientific man of high attainments, uniform purpose, and indomitable energy, whose work has already added to the comfort and pleasure of hundreds of thousands of his fellow-men, and which bids fair to be a most important factor in supplying the necessities of millions yet unborn.





