

The Macmillan Co. \$1.25). Professor Bonney's book is an exceedingly appreciative and instructive work.

2. The student who wishes to know how Lyell's work fitted in with that of other great men in the development of modern science will do best to read Miss Arabella B. Buckley's "*Short History of Natural Science.*" (New York: D. Appleton & Co.) Miss Buckley was for a long time secretary to Sir Charles Lyell, and her work—the best of its kind ever written—is dedicated to the memory of Sir Charles and Lady Lyell.

3. Professor Duncan's "*Heroes of Science—Botanists, Zoologists, and Geologists,*" is practically a history of the development of the sciences of botany, zoology, and geology. The author is himself a distinguished geologist. The concluding chapter of the book is devoted to an account of the life and work of Lyell. In great part this chapter is made up of Lyell's own writings. (New York: E. & J. B. Young & Co.)

Louis Agassiz

XIII. LOUIS AGASSIZ

1807-1873

BIOGRAPHICAL STUDY

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The year 1848 was made memorable in the history of science in America by the coming of a naturalist to Harvard University who was to revolutionize the methods and direction of studies of natural science. A robust man, forty-one years of age, a chief among the devotees of zoology and geology in his native Switzerland, he came to this country in the full vigor of his life, equipped with the rich experience of comprehensive researches, endowed with a marvelous memory, gifted with never-flagging interest, and glowing with a personal magnetism which drew every one toward him in enduring friendship. Such a massive chest, crowned with head of corresponding magnitude, marking a brain of unusual grandeur, and withal the soft, warm heart abounding in expression of refined and tender nature, gave him at once the mental grasp of a giant with the gentleness of a child. He was naturally a moving force in scientific progress, both in thought and

action. His time was devoted to the discovery of plans in nature, and he could never be satisfied so long as materials were wanting to fill out the extensive theories which were frequently arising in his mind. In the old world he spent the earlier years of his manhood in studying the fishes of Central Europe and those collected in Brazil by Spix and Martius. Such extensive resources for investigation might have disconcerted a less tenacious mind, but Agassiz brought order out of this mixed assemblage, and found time besides to fit together and classify the exceptionally large collection of fossil fishes gathered by the efforts of his friends. His beautifully illustrated work on these fossil creatures still remains a classic in this branch of inquiry. While professor at the Academy of Neufchatel, he was the leading spirit, incessantly active in building up a school of the natural sciences; and, in spite of slender pecuniary support and frequent drawbacks, he succeeded in establishing an institution which not only drew to it the most distinguished students of Switzerland, but also made it one of the scientific centers of the world.

It was here, in the year 1836, that his attention became directed to the wonderful phenomena displayed by the glaciers in the valleys of the Alps. He was not the first to make observations upon the movements of the glaciers, but by his acute perception and persistent study he was enabled to build up and establish the theory of a once extended thick mantle of ice which covered Europe from the north to a point as far south as the shores of the Mediterranean Sea. Such an astonishing theory met with immediate opposition from many of the most accomplished geologists; but further studies in company with distinguished scientists prepared the way for wider knowl-

edge of the subject, so that later his main propositions met with general acceptance.

In the midst of a most honorable career, after he had succeeded in publishing several important illustrated books, and when he had brought the pictorial representation of fishes and other creatures to an unexampled degree of excellence, financial distress put a stop to his progress and caused him to look abroad for the means to continue scientific pursuits. To this crisis America owes the presence of the "Master Teacher" who sacrificed his former plans in order to advance learning in his adopted country. Coming to Boston to deliver a course of lectures under the patronage of Mr. Lowell, he became so acceptable to the authorities of Harvard University that he was invited to accept a professorship of zoology and geology in the newly founded Lawrence Scientific school. To make himself more readily accessible to the American people he lost no opportunity to become fluent in speaking the English language. In this he was so successful that in a short time he had acquired great readiness therein, and, although never entirely freed from a slight foreign accent, this peculiarity served only to give a pleasing picturesqueness to his expression. As a speaker his ready command of language was remarkable, his voice rich and clear, his eloquence stirring, and his logical directness forcible and conclusive. His popular lectures were delivered without the use of manuscript and were always fully illustrated by painted sketches or by chalk drawing on the blackboard. He drew forcibly and with facility while speaking to his audiences in a very audible tone.

Prior to the arrival of this gifted naturalist natural science in America was almost confined to the descriptive

stage, content with making known the superficial characteristics of the curious or remarkable animals so abundant in the new world. No far-seeing vision of the succession of life from the beginning to the consummation of later times had been revealed. But Agassiz had not been long in this country before students began to realize that hidden lines of structure held together large groups of creatures which apparently had close affinities. From this time forward Agassiz was gathering about him a group of young naturalists, who, stimulated by his ardent enthusiasm and spurred by his determined will, labored with indomitable energy to discover the underlying ties of relationship which bound animals in natural groups. Plan of structure was the appeal of his instruction, and his assistants were expected and encouraged to pursue and extend the methods of study which he had disclosed.

His method of teaching in the laboratory was intended to draw forth the capabilities of the student by causing him to observe details of structure with extreme care. A single specimen of some natural object was placed before the beginner and he was asked to examine it carefully in order to give soon after an account of his observations. By skillful questioning the professor next drew from his pupil such particulars as he had noticed; and then successively he was drawn on to see more and more of the deeper-seated elements, until at length he had recognized the plan of structure of the creature. A single valve of an oyster or clam, the shell of a crab or sea-urchin, or the body of a fish, told the story of a great group of the animal kingdom, and his student must be trained to perceive and recognize its plan. No book was allowed to be used for

reference in this work, and no other specimens were supplied for comparison. The training of the eye and awakening of the attention were fundamental, and the discipline, however protracted, was thorough and never to be forgotten. To discover and to equip a naturalist was a triumph in the estimation of Agassiz.

Wherever he went crowds flocked to the lecture hall and listened with enthusiastic interest to his eloquent presentation of the peculiarities of the types of the animal kingdom. His own unassuming lecture room in the Museum of Comparative Zoology at Cambridge was the meeting place of poets and authors, as well as the classroom of his assistants and students. There might be seen Longfellow, Holmes, Wyman, and other eminent scholars of the neighborhood, dwelling with rapt attention upon the vivid pictures of animal life which he was presenting. If the subject were the nautilus, a specimen of the creature would be held up to show its general form, then one after another in regular order the several points of structure would be displayed, drawings of allied objects made, and then a comparison of the known living species of this type developed. Every essential part of the creature was shown and finally traced back through all its modifications to its first appearance. It was his custom to carefully consider his subject, and to arrange it in mind before entering his lecture room. In doing so he paced forward and backward in some one of the large study rooms of the museum for about fifteen minutes, then going from one room to another inviting his assistants to attend the lecture.

Agassiz's devotion to his adopted country was intense. No sordid thought found a lodgment in his mind. Even when offered the lofty position of professor of palæon-

tology in the Museum of Natural History at Paris by the Emperor of France, he declined to accept it because he knew that the great work of his life was centered in America; that here he could be more widely useful and the results of his labors more enduring than any which might be accomplished within the limitations of imperial influence. But at this time (1857) Professor Agassiz still lacked adequate facilities for the preservation and display of the large collection of animal forms already brought together in his laboratories. Only a small building, constructed of inflammable material, liable to be destroyed at any moment, was at his service. Undaunted he pursued his way with undiminished activity, and by degrees men began to appreciate the grandeur and importance of his purposes and the value of his services as a popular educator. He needed money to place before the public his precious collections, but he was obliged to expend vital energy in securing it for immediate use, and so his mind was continually drawn away from most important life work of investigation to urge feebly appreciative men to realize the necessity for a substantial building and appliances to make these precious objects useful. A "magnificent beggar" he was called by some of his most appreciative friends, but never did he request a penny for himself; the money was wanted to educate and uplift the people.

Perhaps the grandest conception of his fertile genius was the plan of a universal museum of natural history, to be arranged comparatively and historically. It was to embrace a systematic series of the whole animal kingdom, both fossil and recent; then a collection of forms peculiar to each fauna of the earth's surface; and, finally, an assemblage of types of all the great groups of animal life,

for the ready reference of teachers. The establishment of this great plan began to be realized in 1860, when the first wing of a large brick building in Cambridge was made ready for occupation. Thus the first stage in the great purpose of his life was made possible, and Agassiz unaided could not arrange and display the vast number of animal forms which he had already brought together. By the aid of his assistants, even before the end of the first year, many of the rooms in the museum were stocked with instructive and typical representatives of the animal kingdom. Vast numbers of wooden trays and boxes held the corals and fossils, long ranges of glass jars, kegs, and bottles, contained the creatures in alcohol, and numerous wooden boxes were stored with insects and crustacea. Arrangement of the collections proceeded with vigor, and they were exhibited in the glass cases of the several rooms, in accordance with the instructions of Professor Agassiz. Ten years later money for an extension of this building was available, and again the overworked and almost exhausted Agassiz was occupied anew with the great problem of correctly exhibiting the vast collection of animal forms which he had continued to gather. With the passage of time his plans have been more fully carried out under the direction of his son and successor, Professor Alexander Agassiz, so that to-day the museum which was the object of his deepest and most solicitous thought stands as the best exponent of animated nature that has yet been produced for the instruction of humanity.

Tablets have been reared to his memory in some of the great universities of the country, and one of the granite boulders from his own native Switzerland covers his dust in Mount Auburn; but the most enduring tablets yet con-

secrated to his immortal being are graven on the hearts of those who assisted him, and who have helped to distribute to later times the fruits of his spirit which ripened in their labors.

LOUIS AGASSIZ

SELECTED STUDIES AND REMINISCENCES

AGASSIZ'S EARLY LOVE OF NATURE

Agassiz's love of natural history showed itself almost from infancy. When a very little fellow he had, beside his collection of fishes, all sorts of pets: birds, field-mice, hares, rabbits, guinea-pigs, etc., whose families he reared with the greatest care. Guided by his knowledge of the haunts and habits of fishes, he and his brother Auguste became the most adroit of young fishermen,—using processes all their own, and quite independent of hook, line, or net. Their hunting grounds were the holes and crevices beneath the stones, or in the water-washed walls of the lake shore. No such shelter was safe from their curious fingers, and they acquired such dexterity that when bathing they could seize the fish even in the open water, attracting them by their little arts, to which the fish submitted as to a kind of fascination. Such amusements are no doubt the delight of many a lad living in the country, nor would they be worth recording except as illustrating the unity of Agassiz's intellectual development from beginning to end. His pet animals suggested questions to answer which was the task of his life; and his in-

timate study of the fresh-water fishes of Europe, later the subject of one of his important works, began with his first collection from the Lake of Morat.

As a boy he amused himself also with all kinds of handicraft on a small scale. The carpenter, the cobbler, the tailor, were then as much developed in him as the naturalist. In Swiss villages, it was the habit in those days, for the tradespeople to go from house to house in their different vocations. The shoemaker came two or three times a year with all his materials, and made shoes for the whole family by the day; the tailor came to fit them for garments which he made in the house; the cooper arrived before the vintage, to repair old barrels and hogsheads, or to make new ones, and to replace their worn-out hoops—in short, to fit up the cellar for the coming season. Agassiz seems to have profited by these lessons as much as by those he learned from his father; and when a very little fellow, he could cut and put together a well fitting pair of shoes for his sisters' dolls, was no bad tailor, and could make a miniature barrel that was perfectly water-tight. He remembered these trivial facts as a valuable part of his incidental education. He said he owed much of his dexterity and manipulation, to the training of eye and hand gained in these childish plays.—ELIZABETH CARY AGASSIZ, in "*Louis Agassiz—His Life and Correspondence.*"

AGASSIZ AS A STUDENT AT MUNICH

"I soon found myself engaged four or five hours almost daily in painting for him fresh water fishes from the life, while he was at my side, sometimes writing out his descriptions, sometimes directing me. . . . He never lost his temper, though often under great trial; he remained self-possessed and did everything calmly,

having a friendly smile for everyone, and a helping hand for those who were in need. He was at that time scarcely twenty years old, and was already the most prominent among the students at Munich. They loved him, and had a high consideration for him. I had seen him at the Swiss Students' club several times, and had observed him among the *jolly* students; he liked merry society, but he himself was in general reserved and never noisy. He picked out the gifted and highly learned students, and would not waste his time in ordinary conversation. Often, when he saw a number of students going off on some empty pleasure-trip, he said to me, 'There they go with the other fellows; their motto is, "Ich gehe mit den andern" ["I go with the crowd"]. I will go my own way, Mr. Dinkel,—and not alone: I will be a leader of others.' In all his doings there was an ease and calm which was remarkable. His studio was a perfect German student's room. It was large, with several wide windows; the furniture consisted of a couch and about half a dozen chairs, beside some tables for the use of his artists and himself. Dr. Alex. Braun [subsequently his brother-in-law] and Dr. Schimper lodged in the same house, and seemed to me to share his studio. Being botanists, they, too, brought home what they collected in their excursions, and all this found a place in the atelier, on the couch, on the seats, on the floors. Books filled the chairs, one alone being left for the other artist, while I occupied a standing desk with my drawing. No visitor could sit down, and sometimes there was little room to stand or move about. The walls were white, and diagrams were drawn on them, to which, by and by, we artists added skeletons and caricatures. In short, it was quite original. I was some time there before I could discover the real names of his friends; each had a nickname,—Molluscus, Cyprinus, Rhubarb, etc."

From this glimpse into "The Little Academy" we return to the thread of the home letters, learning from the next one that Agassiz's private collections were assuming rather formidable proportions when considered as part of the household furniture. Brought together in various ways, partly by himself, partly in exchange for duplicates,