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AGASSIZ AND THE SCHOOL AT PENIKESE[1]

IN establishing the Anderson School of Natural History, Agassiz transferred his methods of instruction from his brick and iron-girded museum in Cambridge to the wooden barn-like structure at Penikese. The work was to be based on observation and experiment. Animals alone were to be studied, and in every instance the animal was to be under the eye of the student; nowhere was a list of books suggested for reference or consultation, and recitations consisted in answering the questions asked by the teacher as to what the student had observed in his studies. As in the Cambridge Museum the student had set before him a long, shallow tin pan, and in it was placed a fish, crab, lobster or some other animal, alive or dead, alcoholic or dry, and he was required to study and dissect it. Scudder, the entomologist, gave an amusing account in *The Atlantic Monthly* of his initial experience as a student of Agassiz in Cambridge. His previous natural history studies had been almost exclusively confined to butterflies and after his experiences with these dry and charming creatures he had placed before him a big fish which he was required to haul out from a jar of alcohol which was charged with the odoriferous juices of many previous specimens. This bad smelling object he had to examine for three days and to tell Agassiz what he had seen. Among other results this method taught students to use their eyes, an art already acquired by Scudder in his previous study of insects.

Agassiz realized in opening this school what temptations would arise in living near the sea side, and in an early circular he suggests the stipulations he required of the students by saying, "I must make hard work a condition of continued connection with the school, and desire to impress it upon the applicants for admission that Penikese Island is not to be regarded as a summer resort and relaxation. I do not propose to give much instruction in matters which may be learned from books, I want, on the contrary, to prepare those who shall attend to *observe for themselves*. I would, therefore, advise all those who wish only to be taught natural history in the way it is generally taught, by recitation, to give up their intention of joining the school." This sound advice was

[1] Address at the celebration of the fiftieth anniversary of the founding of the school at Penikese, Wood's Hole, August 13, 1923.

generally followed, although at the outset three young men ventured to relieve their animal spirits, or to "cut up," under the plea that "boys will be boys," and were promptly requested to leave the island, which they did. Recreation at the proper time was allowed, however, and we all went in bathing or sauntered over the island. I recall very vividly the first Sunday of the term; it was gloomy to the last degree. It reminded one of Taine's definition of London on Sunday, "a huge but well-regulated cemetery." The students kept rigidly to their rooms. On the second Sunday I induced Professor Wilder and other teachers to join me in a game of croquet (tennis was unknown in this country at that time), and this example by the teachers changed the whole complexion of things and the students came out of their rooms and roamed over the island, or collected specimens along the shores. In the evening we all joined with the students in a singing fest out of doors. If I remember rightly, the songs we sung were the good old-fashioned hymn-tunes, and this performance satisfied the more religiously inclined.

Some of the teachers had brought their families with them, and my little boy, four years old, was fond of wandering through the laboratory and curiously examining the contents of the dissecting pans. At one table Miss White, a teacher from New Bedford, was studying the gross anatomy of a cat. The creature was eviscerated, and Miss White was hard at work on the body with her dissecting scissors and needles. The boy came along and looked over the disemboweled creature, and the teacher, expecting some exclamation of disgust, leaned back in her chair curious to know what observation the child would make. Finally after a critical examination of the remains and the dissecting implements, he turned to her and asked, "Miss White, are you trying to mend that kitten?" Certainly a most natural question, as the cat was evidently in need of extensive repairs.

Many of our students became professors of natural history in our colleges and universities. David Starr Jordan became president of the State University of Indiana and, afterwards, of the Leland Stanford, Jr. University of California; Charles O. Whitman became professor at the University of Chicago, and for years was the able director of this laboratory during its greatest period of emergency; William K. Brooks occupied the chair of zoology at Johns Hopkins University and Charles S. Minot became professor of embryology at the Harvard Medical School.

At Penikese, Whitman and I were engaged in the study of the Ascidian Perophora and on comparing our drawings of this animal I found that his drawings were better than mine and, remembering this fact several years after, I appointed him as my successor to the chair of zoology in the Imperial University of Tokyo, where he introduced section cutting, the staining of tissues, etc.; new methods which he had learned at the University of Leipsig under Leuckart.

It is interesting to observe that among a class of zoological students a number seem to absorb intuitively the salient points in every investigation, and others seem totally blind to the significance of what they study. Simple figures even escape their memory. I recall a story told of Professor Cleveland, of Bowdoin. He always showed irritation at the inattention of students, and in one of his lectures on chemistry he interrupted his discourse by peremptorily asking an inattentive boy, "How many elements did I say there were?" Of course the student did not remember a figure that he had probably heard a hundred times and nudged a student next to him who whispered "sixty-two," the number of elements then known. All he caught was "two" and this number he called out promptly and loudly. The professor gave him a contemptuous glance and resumed his lecture. The student realizing that the professor had been greatly annoyed went down to the platform after the lecture and in order to placate him asked him, "How poisonous did you say cyanide of potassium was?" The professor with much emphasis said, "I told you that cyanide of potassium was so poisonous that a drop on your tongue would kill a dog." Certain students attend courses of lectures and are utterly unable to carry away a single fact. Sir Michael Foster told me of an experience he had in a course of lectures before the Royal Institution on human anatomy, illustrated by diagrams and objects. At the end of his course, one of his auditors asked him whether the cerebellum was inside or outside of the skull! and he further added that Huxley had told him of a similar experience. He was also lecturing on human anatomy and at the close of one of his lectures an auditor came to the platform to ask him some question and noticing a human skull lying upside down on the table incidentally remarked, as he poked his finger into the foramen magnum, "Many a good chunk of bread and butter has gone through that hole!"

Naturalists are born, not made. Sir David Gill, the director of the Royal Observatory at the Cape of Good Hope, in a review of a memoir on "Double Star Observations," in speaking of the authors, said, "It is a special faculty, an inborn capacity, a delight in the exercise of exceptional acuteness of eyesight and natural dexterity, coupled with the gift of imagination as to the true meaning of what he observes, that imparts to the observer the requisite enthusiasm for double star observing." These words may truthfully apply to the work of the naturalist.

Agassiz fully imbued with the classification of

Cuvier emphasized the importance of the study of examples illustrating the four types of Cuvier and the students had in turn a radiate, a mollusk, an articulate and a vertebrate to dissect and study. He not only lectured on these subjects but gave to the school a course of brilliant lectures on the glacial theory. At this point I must emphasize the fact that Agassiz was a wonderful teacher. The charm of his manner and his speech, rich as Apollo's lute, as Governor Banks said at the dedication of the museum, with its slight foreign accent, enabled him to talk on radiates, for example, to a lot of hard-headed Massachusetts farmers at the General Court and secure appropriations of thousands of dollars for his museum at Cambridge. He strongly opposed Darwin's views, but few realized the leading cause which probably animated his strenuous opposition. In 1859 Longman published a separate volume of Agassiz entitled "An Essay on Classification," which had formed the introductory chapter to his "Contributions to the Natural History of the United States." In this essay he had insisted that classification was natural, that the various categories of classification—branch, class, order, family, genus and species were as distinctly created as the individual. Simultaneously with the appearance of this valuable essay appeared Darwin's immortal work on the "Origin of Species," in which it was shown that classification was artificial, not natural, that categories of structure were the results of slow and diverging modification—in other words, that natural selection and not special creation was the cause of all this diversity of animal life. De Candolle, the illustrious French botanist, when he became acquainted with Darwin's view remarked "That it was not a theory, nor an hypothesis, but the explanation of a necessary fact, to deny which would be to deny that a round stone would not roll down hill farther and faster than a flat one." However, Agassiz's essay with the unhesitating endorsement of the views of Von Baer unwittingly supplied the strongest material for Darwin's views and led Agassiz's students, one after the other, to embrace them.

Among the various accounts that were published about the Agassiz School at Penikese was one by David Starr Jordan in *The Popular Science Monthly*, 1892, Vol. XL. In this article, Dr. Jordan gives extracts from a journal which he kept when a student at Penikese, wherein he had recorded sentiments and expressions of Agassiz given in his lectures and comments to his class.

The distinguishing feature of the Anderson School of Natural History lies in the fact that it was the first one of its kind organized in the United States and furthermore that this initial experiment was under the direction of the greatest teacher of natural history in the world. Other schools of a similar nature under the auspices of colleges and universities sprang up in various parts of the country. I do not know the chronological sequence of these summer schools of natural history, but, if I mistake not, the Salem Summer School came next, in 1876. Among the teachers of this school were three who had been associated with Agassiz at Penikese—Packard, Putnam and the present writer. Of all the summer schools in the country the Marine Biological Laboratory easily comes first in the number of its instructors, buildings and equipment, and superadded to this foundation its proximity to the United States Fish Commission gives it unparalleled advantages over all other schools of this nature.

EDWARD S. MORSE

PHYSICS AS A CAREER[1]

IT is said of the famous Clerk Maxwell that throughout childhood he continually asked the questions, "What's the go of that? What does it do?" Vague answers did not satisfy him but aroused the more distinct demand, "But what's the *particular* go of it?" Maxwell had the opportunity of devoting a life to the answering of this question, many times repeated, and of rendering such service to mankind that he will be forever highly honored among those known for their important contributions to the field of physics. Do the incipient Maxwells of to-day have in America a similar opportunity? They do, but there is danger that this fact is either unknown to them or not known sufficiently early in life.

A boy does not know of a physicist in his community and the stories of achievement in physics which he may read refer to very distant realities. Moreover, so far as he is aware, physics is not a profession. As he surveys his known opportunities for a life-work, engineering may be the only profession that seems to have an interest in the "particular go" of things. The purpose of this article is to present briefly and with directness the opportunities in physics in our country to-day. It is assumed that, given the possibility of earning a livelihood, one will choose the career which most nearly satisfies his intellectual requirements. Since the aptitude for physics is usually distinct, a comparison of the profession of physics with others is thus unnecessary. The follow-

[1] This is one of a series of articles which are being published in SCIENCE and in *The Scientific Monthly* describing to young men and women in American colleges and universities who contemplate entering upon a professional scientific career the opportunities in various lines of scientific work. This series has been prepared at the suggestion of the Division of Educational Relations of the National Research Council.