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AGASSIZ, HYATT, WHITMAN, AND THE BIRTH OF THE MARINE BIOLOGICAL LABORATORY

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ABSTRACT

This paper establishes that the MBL began as a self-consciously American marine laboratory, following the lead of its American predecessors. In particular, Louis Agassiz's School of Natural History at Penikese Island and Alpheus Hyatt's Laboratory for instruction at Annisquam, Massachusetts, directly inspired the MBL. Archival sources reveal the connections and the MBL's goals. Teaching and research were accepted as the dual and compatible goals for the Laboratory, and it was left to the first director, Charles Otis Whitman, to work out how best to combine the two. These emphases and the clientele thus attracted clearly distinguished the MBL from the European laboratories, such as the Naples Zoological Station, which concentrated on independent research. In part the MBL achieved success because both the teaching and research focused on shared basic questions, namely developmental questions posed within a solid morphological tradition. Epigenesis and preformation, the role of cells in development, cell lineage study of early egg organization: such themes ran through most of the work done at the MBL in the first year.

DISCUSSION

Over the years a number of myths have appeared about the early history of the MBL, some better than the truth—as is the way with myths. One such story, reported to the *New York Times*, is representative. There David Starr Jordan, who was then a biologist at Stanford, discussed the founding of the MBL. He reported that "Senator F. Baird, Secretary of the Smithsonian Institution, . . . and his associates met in 1888 and formally organized a corporation, separate from the Bureau of Fisheries, to carry on the work" of marine biology (Jordan, 1926). Fortunately Jordan was a better biologist than he was an historian. Actually Spencer (not Senator) Fullerton Baird had died in 1887 so was unlikely to have done much incorporating in 1888. Other myths include the claim that the MBL was simply a copy of the Naples Zoological Station (Lillie, 1944, pp. 14–15).

I shall examine more closely the foundation of the MBL, and concentrate on two points: (1) The MBL was established as a self-consciously American marine laboratory, even while it reflected influence from Naples, and (2) despite the declared desire to include all of biology, it was the concentration of research and instruction around shared concerns, particularly developmental problems, which brought about the MBL's early—and continuing—success.

Beginning with the first claim, that the MBL began as an American effort, I shall discuss briefly the several cornerstones in the lab's foundations. These include the influence of Louis Agassiz, of Alpheus Hyatt, and especially, of Charles Otis Whitman. Others then constructed a strong edifice on the solid foundation.

Agassiz's summer school at Penikese Island provided the initial vital stimulus. As the MBL's first director Whitman said repeatedly, the MBL was a lineal descendent of its genetic ancestors, Agassiz's Penikese School and Hyatt's Annisquam

laboratory (Whitman, 1883, 1903). For some time, Agassiz had considered the prospect of running a summer school to provide students of natural history with practical experience. In 1873, he finally gained financial backing from a wealthy New Yorker and opened the Anderson School of Natural History on Penikese Island. The clientele was to be school teachers who sought field experience to inform their classroom instruction; thus the lab was oriented toward instruction rather than original research (Agassiz, 1885, chapter 25; Wilder, 1907; Morse, 1923; Conklin, 1927; Wright and Wright, 1950; Dexter, 1974). The school opened in 1873 with about fifty attendees. According to one report the women were very "schoolma'amy" and "the gentlemen are not a whit behind" ("Penikese Island," 1873, p. 378). Yet the group appeared earnest and eager, the same reporter acknowledged, and the group included four individuals of particular importance for the MBL: Alpheus Hyatt, William Keith Brooks, Charles Otis Whitman, and Cornelia Clapp. Hyatt was a lecturer rather than a student, and it was Hyatt who was to become the real father of the MBL (Dexter, 1974, p. 159).

Agassiz was a master of publicity and made the first day a real show—unlike the first day at the MBL. The students and a number of guests met on the dock in New Bedford and went together by steamer to Penikese. There all were treated to a dinner in the newly (and rather hastily) constructed buildings and to an inspiring informal convocation. One student admitted that after the guests had departed and the show was over that the reality of the island proved a bit discouraging. There they were stuck on an island about ⅔ mile long and ⅓ mile wide, which was virtually barren of trees or other accoutrements (Anonymous, 1895, p. 21). The student did not have long to fret, however; work began immediately the next morning and consumed all available time for the duration of the summer—except Sundays when most of the students refused to carry out ungodly biological studies.

Some popular accounts give the impression that the students spent their days wandering idly about the island collecting things without purpose. It is true that the instruction was highly individualized, with each student spending a good part of each day exploring, collecting, observing, recording, and generally studying nature rather than books—as Agassiz instructed. Yet good books, not mere repetitive textbooks, did have their place. So did lectures. Agassiz invited a number of important biologists to lecture to the group on a range of natural history topics (*Popular Science Monthly*, 1874). In fact, each day began with structured lectures, followed by an hour or so of dissection. Afternoons often brought freedom to roam and collect, but students spent most evenings attending lectures, dissecting by candlelight, and writing up their notes from the day's work. Such a system obviously worked best for those students capable of framing their own questions and following through with relevant collecting, but Agassiz and his invited speakers helped articulate appropriate problems as well.

Not everyone approved of Agassiz's school. The highly respected British naturalist E. Ray Lankester admitted that what he called "the spasmodic descent upon the sea-coast" offered a very nice vacation for naturalists who could not otherwise afford such luxuries. Such trips might even result in collection of a few new species, he admitted. But, Lankester insisted, "it is not in this way that the zoology of to-day can be forwarded" (Lankester, 1880, pp. 497–499). A naturalist needs to work at settling "important questions," he believed. Even Whitman recalled that at first he found Agassiz's methods unproductive, but that he soon came to admire them and, indeed, incorporated some into the approach of the MBL (Craig, 1910).

Agassiz's Penikese School continued for a second year, despite Louis's death in 1873 and his son Alexander's illness in the second session of 1874. Then it closed.

Not for lack of funds, as Jordan and others have claimed, but more for lack of anyone's having taken the initiative to keep it going (G. R. Agassiz, 1913, pp. 129, 131).[1]

In 1879 one of the Penikese students, Alpheus Hyatt, began another seaside lab in Annisquam, on Cape Ann in Massachusetts (Dexter, 1952; Boston Society of Natural History; Kohlstedt, 1979). This laboratory had a purpose closely following that of the Penikese School. Intended to provide opportunities for science teachers to observe and study marine animals, the lab was also the inspiration of the Boston Society of Natural History and was supported by the Woman's Education Association of Boston. Hyatt served as director, with the Boston Society Assistant B. H. van Vleck (who had been a student at Penikese) as instructor. After two years in Hyatt's house, the lab moved to a separate location nearby in 1881. Then, with the continuing financial aid of the Woman's Education Association, the Annisquam Laboratory operated as a department of the Society of Natural History. Clearly Hyatt's ideals helped direct the effort, but the specific purpose of providing educational opportunities for instructing science teachers came from the Boston Society, for which Hyatt was the Curator. At times the level of the students' commitment and preparation seemed hopelessly low. As Mrs. Hyatt wrote to Alpheus while he was at sea on an expedition, the group was very uninteresting, even tedious. They were essentially raw recruits, hopelessly elementary students who were beginning to drive van Vleck to despair (Dexter, 1956–1957). But the school did attract a few men such as Thomas Hunt Morgan who certainly became a serious researcher and one of the backbones of the MBL.

In 1887, the Woman's Education Association decided that the project had succeeded and that they would withdraw support since they held the goal of seeding projects until they caught on, then leaving them on their own (Hyatt, 1887). The Annisquam project seemed a success. But Hyatt was rather tired and wished to develop an American marine laboratory on an independent basis: an institution separate from the Society of Natural History and from himself as director. He also felt that a new site would prove preferable to that of Annisquam, which was becoming polluted. Thus came the move to Woods Hole.

Why Woods Hole? The answer lies largely with Spencer Baird. For several years, Baird had wanted his friend Hyatt to move the Annisquam school to Woods Hole, which had purer water, more abundant marine life, a congenial setting and, not coincidentally, was home of the United States Fish Commission which Baird headed (Galtsoff, 1962; Boston Society *Minutes*, 1888, pp. 563–564). Baird wanted to attract researchers and students to form a research community at the Fish Commission. In some details he seems to have been influenced by the research emphasis of the Naples Zoological Station, opened in 1872. At first his efforts seemed to be succeeding (Galtsoff, 1962, p. 29; Whitman, 1883, p. 97; Parker, 1946, p. 136). But the connection of the Fish Commission with the government and its mandate to investigate practical fisheries-related questions made it very difficult for him to develop in the same way as the more independent Naples Lab. Baird did attract cooperation from the Johns Hopkins University, which sent Professor William Keith Brooks and some students to the Fish Commission, and from Princeton and Harvard. Yet Baird failed to gain the necessary financial support to

[1] G. R. Agassiz says that Alexander was always against the Penikese lab and that the financial situation became impossible when Anderson withdrew his support after the second year. Letters from Alexander, May 30 and June 23, 1888, indicate that he probably felt—probably not quite fairly—that he had tried to maintain the Penikese and other marine labs and had received no support from others.

attract other researchers and to establish a permanent research lab in the 1880's in Woods Hole.

In 1887 as Hyatt, the Woman's Education Association, and the Boston Society of Natural History began to consider sites for their laboratory, they did find Woods Hole attractive. Baird had helped the Annisquam school by sending specimens. He had urged a friend to buy land, near the Fish Commission, which was held for the benefit of any educational institution that might build there. He had welcomed Hyatt at Woods Hole. When the MBL was incorporated in 1888 the Trustees chose Woods Hole as their site, and looked to the Fish Commission for further encouragement.

With Hyatt as president, the MBL trustees decided to hire Johns Hopkins Professor of Zoology William Keith Brooks as the first director (MBL *Minutes,* 1888, pp. 11–13). Hyatt knew Brooks, and had recommended him for his job at Hopkins (Gilman Papers). Perhaps Brooks would take the job without pay, Hyatt suggested, and perhaps the Hopkins would lend financial support to the laboratory effort. Now, you know that the first director was actually Charles Otis Whitman. After all, there is no Brooks laboratory building at the MBL these days. Brooks turned down the offer. Why, you may ask? Why would anyone turn down the opportunity to become first director of America's first permanent research laboratory for marine biology? Why would anyone reject the chance to summer in Woods Hole?

The Trustees offered no salary at first, but that alone probably would not have deterred Brooks. Who was this man, then, who rejected his chance to become immortalized at the MBL? Brooks was, quite simply, the zoologist with the best job in America at the time. He was the only professor of morphology at *the* American research university. A student of Agassiz's and participant in the Penikese School, he was teacher of Edmund Beecher Wilson, Thomas Hunt Morgan, Edwin Grant Conklin, Ross Granville Harrison, and others who assumed central importance for MBL history and for the history of biology in general. He was also founder and director of the most significant marine research lab in America to date, the Chesapeake Zoological Laboratory, run by the Johns Hopkins (McCullough, 1969; Benson, 1979, 1985; Gilman Papers). The Chesapeake Laboratory was an informal arrangement each summer where Hopkins graduate students, usually accompanied by Brooks, explored marine life in one or another location, ranging from Beaufort, North Carolina to Jamaica or Bermuda (Chesapeake Zoological Laboratory Reports, Gilman Papers). Brooks's reports to the Hopkins President about these sessions reveal his enthusiasm, but clearly show that his leadership style was best for a very few specially selected men at the Chesapeake Laboratory (and one woman, once—Emily Nunn, later Whitman's wife). Brooks liked the summer research trips, and he liked Woods Hole during his visits at the Fish Commission. But Brooks was one of the most unassuming, retiring, and unlikely-to-be-director sorts of men imaginable. Perhaps he lacked vision. He did *not* believe that Woods Hole could support, or should support, two research labs in marine biology. He chose rather to ally the fate of his Chesapeake Zoological Laboratory with the Fish Commission.

After Baird's death in 1887, the next Fish Commissioner, Colonel McDonald, wished to expand investigation at his lab. He encouraged Brooks to work there as a consultant and researcher and to bring a few of his students as well (Gilman Papers). Brooks was happy with the Fish Commission and was therefore never convinced that the MBL was a good idea. He believed in 1888 that McDonald was making progress in improving the Fish Commission as a research facility. No other

lab was needed, he felt, and especially not in Woods Hole. As he wrote of the MBL idea,

> I said all that I could to convince Sedgwick [one of the MBL Trustees] that the Boston Laboratory would be much more valuable if some other place than Woods Hole were selected, so that naturalists might have the benefit of stations at two points, and if McDonald is able to carry out his plans and to open this laboratory to investigators in future years, I do not believe that the other laboratory can succeed.[2]

As I said, perhaps Brooks lacked vision. Presumably his convictions led him to turn down the directorship of the MBL. Perhaps he was also tired after years of running the Chesapeake summer sessions. Perhaps he did not wish to take on a lab with a very weak financial base and fight the inevitable battles for funding, with no obvious general support. Evidently he felt uneasy about having women in his biology classes and laboratories, and women would be hard to avoid at the MBL because of the laboratory's connection with the Women's Education Association. For various reasons, then, Brooks rejected the MBL offer.

Immediately after receiving Brooks' rejection, the Trustees forwarded an offer to Charles Otis Whitman, then director of the Allis Lake Laboratory in Milwaukee, Wisconsin (MBL *Minutes,* 1888, p. 27). Hyatt probably knew Whitman through Whitman's two summers at Agassiz's Penikese school and also from the years that Whitman spent at the Museum of Comparative Zoology at Harvard. Though certainly not as prestigious as the Johns Hopkins, Whitman headed the other American biological research laboratory at the time. Immediately, Whitman accepted the MBL offer. With only vaguely articulated goals, the Trustees instructed Whitman to begin the lab within a few months: to open in July of 1888. They circulated an announcement to solicit students and support.

The Women's Education Association donated the equipment from Annisquam to the MBL and also helped the MBL Trustees raise money for the new laboratory. Van Vleck served as first instructor, as he had at Annisquam, so the MBL maintained connections with its founders. Yet Hyatt led the Trustees in making it clear that change was also in order, that the lab should offer both instruction and individual investigation, and that as director, Whitman should develop the lab as he saw appropriate. As Frank Lillie later wrote, this decision worked well, for in Whitman "the trustees had found a man not only fitted to carry out their purposes but possessing imagination adequate to transform their shadowy ideas, the zeal and determination required to give them form and substance, and the courage to face whatever difficulties might arise" (Lillie, 1944, p. 36).

The first year began inauspiciously. Cornelia Clapp, who had also attended the Penikese School, arrived on time for the new session and found the carpenters still at work building the lab. Whitman had not yet arrived, reportedly because of family illness. No equipment had arrived; it remained side-tracked somewhere along the way. No one had made arrangements for boarding or lodging. In short, there really was no lab. But Clapp, buoyed by her enthusiasm and by the arrival of the other attendees—about half and half male and female—stayed and waited. Finally, the equipment from Annisquam arrived, Whitman appeared, the one laboratory building was completed, and aside from such troubles as tripping at night over the many boulders in the paths, that first session of the MBL proceeded successfully, if quietly.

[2] Letters, Brooks to Gilman, no date, Gilman Collection, and Brooks to Gilman, December 1980, on the need for a summer lab in the southern United States since he did not regard the MBL as satisfactory. Alexander Agassiz, letter, May 30, 1888, shows his opposition to the new laboratory.

During those first years, the Fish Commission proved very helpful in sharing specimens, providing sea water, a boat, nets, etc. And the Fish Commission men (for unlike the MBL group, they were all men) visited and discussed projects. Clapp recorded that Whitman taught basic techniques and how to observe productively and to get results in morphological research. As she enthused about that first year, the year before the appearance of Wilson, Conklin, or Morgan, "The atmosphere of that laboratory was an inspiration; the days were peaceful and quiet; there were no lectures nor anything else to distract the attention from the work at hand" (Clapp, 1927). That she fell in love with the MBL experience is clear from her life-long active association there. This remarkable woman went on to obtain a second Ph.D. degree with Whitman when he became chairman of the new University of Chicago biology department in 1890 (Rossiter, 1982, pp. 19–21, 86, 88). That the MBL succeeded in attracting such loyal and able supporters undoubtedly contributed to its early success.

The MBL had begun. At the same time that the MBL attracted more researchers and students, the Fish Commission began to have problems with private researchers. In effect, the government bureaucracy wanted the Commission to emphasize fisheries research and did not wish to allow private investigators (Gilman Papers). Brooks' predictions about the redundancy and failure of the MBL soon proved wrong; the MBL soon became the preeminent marine lab in Woods Hole and in the United States. With success, the Trustees and especially Whitman began to have greater aspirations for the lab.

So far, it should be clear, this lab had American roots. It was clearly a biological laboratory for America—the first such permanent facility. The particular mix of instruction and research, with the resulting communication among the students, young faculty, and established researchers, was peculiarly American, possible only in a country which had no established hierarchy in research.[3] The inexperienced learned from direct contact with the more proficient. Thus, those who taught the courses at the MBL could introduce a new generation to the problems and methods they saw as important. Many untrained American scientists received that practical learning with nature which Agassiz had sought—as they could not have at the European stations. The democratic control by a corporation of scientists overseen by interested trustees came only after some reform and struggle in 1897, but the organization was uniquely American and surprisingly successful. The lab had achieved truly national support. The links between that character and that of the Naples Station remain to be examined.

I come now to my second theme: that interest in development (broadly conceived) served as an important unifying focus for the MBL. Despite the expressed goal of including all of biology, the success of the MBL depended on the way the shared problems, namely developmental problems, brought the participants to work together and to communicate in an exciting, productive, and cooperative way.

The fact that developmental questions dominated early work at the MBL and to a lesser extent subsequent work as well is not entirely surprising. Both Whitman and Brooks concentrated on developmental questions, and these two exerted the greatest influence on the young researchers who worked at the MBL in the first decades. More generally, the morphological tradition had come to regard marine invertebrates as particularly useful for revealing homologies as well as evolutionary histories, or phylogenies. By 1890, many MBL researchers had focused on the

[3] W. D. Russell-Hunter has pointed out that the Milport laboratory in Scotland offered an example parallel in some respects; this suggestion calls for further careful study.

question of how the egg becomes fertilized and begins development. Specifically, a number of American researchers began to ask whether development follows a pattern which is predominantly inherited or which is acquired and hence emerges only gradually: that is, whether preformation or epigenesis predominates. In particular, Whitman focused on the question: to what extent does the egg cell already experience organization? (Whitman, 1896; Maienschein, 1985).

It is not easy to answer that question. What sorts of things might even count as evidence that either preformation or epigenesis occurs? What sorts of work should be done to attack the problem—careful descriptive observation of prepared materials or experimental manipulations to acquire new sources of data? Such questions led to intense debates by the 1890's, which I do not have time to discuss here. But the intensity of debate and the concentration of research around exciting problems clearly added to the MBL atmosphere.

Whitman believed that some early organization occurs, that the egg is not simply a "blank slate," but he left open the question of how much such organization occurs and whether cytoplasm or the nucleus is the center of organization. He also suggested how to attack such questions, namely through cell-lineage studies (Whitman, 1878, 1887). Cell-lineage does just what it sounds like—traces the lineages of each cell through every cleavage stage until the investigator gets tired of the tedius effort or until the cells become too difficult to identify further.

In 1890, Edwin Grant Conklin was at the Fish Commission examining early developmental stages. He heard that Edmund Beecher Wilson, at the MBL, was doing something similar. So Conklin walked across the street, talked to Wilson, and both were astonished at how closely their results agreed. As Conklin reported, "Wilson was as excited by those results as I was and he reported this to Whitman. Whitman at once sent for me to come over to see him in the office. . . ." (Conklin, 1968, p. 116). Of course, Conklin rushed right over, and Whitman said he would like to publish Conklin's work in his journal, *The Journal of Morphology*. Others joined in, including Thomas Hunt Morgan and Ross Harrison, though they never actually published their cell lineage work (Costello, 1967). As Whitman's student and second director of the MBL, Lillie, said, when Whitman told him of the people working on cell-lineage and of their findings, "I accepted his advice to take up this subject: and worked on freshwater *Unio,*" for which he had to take the train back and forth to a little pond in Falmouth, Massachusetts, carrying his heavy wading boots and a heavy bucket (Lillie, 1926). Cell-lineage work served as a rallying point and attracted researchers to the MBL for a specific purpose (Maienschein, 1978).[4]

By the mid 1890's, cell-lineage work had begun to pale. Several researchers at the MBL turned to other morphological questions and to problems of regeneration, and to physiology and related problems (Werdinger, 1980; Maienschein, 1976; Haraway, unpub.). Also, the experimental work of Jacques Loeb and Charles Manning Child in physiology of development and by the German developmental experimentalists began to attract more attention as a possibly productive method for attacking those same questions about epigenesis and preformation, or whether the egg is organized as a mosaic or develops regulatively. Stimulated by successes from Germany and Naples, biologists became increasingly enthusiastic about the promises of experimental manipulation, which seemed to many to offer quicker and more dramatic results than more traditional methods such as cell-lineage work.

[4] Publications in journals edited by Whitman, *Biological Lectures* and *Journal of Morphology*, report the results of the cell-lineage work.

As Herbert Spencer Jennings later reflected, this led to a mad rush toward experimentation by some. He said of the period:

> . . . their tales disagreed radically. They tried for a long time to convince each other, but failed. And the reason was that there was no way of deciding which, if any, of the tales were correct. But what hath the man of science of all his labor and of the vexation of his heart, if it leads to no general agreement, to nothing that can be demonstrated? And so, the zoologists gave it up; they looked upon the works that their hands had wrought, and behold all was vanity and vexation of spirit. Henceforth, they said, we must so work that our results and conclusions can be tested; can be verified or refuted. We must be able to say: Such and such things happen under such and such conditions, and if you don't believe it you may supply the conditions, you may try it for yourself, and you will find it to be true. But that is precisely experimentation; and so they flocked with enthusiasm to experimentation. (Jennings, 1926, p. 98)

This led to a good deal of argument, with experimental evidence cited as proving one or another point of view. As Jennings later reflected, that period seemed a bit like a comic opera with everyone dancing about singing frenetically "You are right and I am right and he is right and all are right" (Jennings, 1926, p. 99). Not everyone had embraced experimentation, of course. And the turn to experimentation did not, in fact, solve all the problems as some had hoped.

The rush to experimentation settled down, but the concern with shared problems remained into the twentieth century. The cross-fertilization of ideas and exchange of methods really did dominate developmental work at the MBL, as revealed in the *Biological Lectures* published from the Laboratory. By 1910, things had begun to change, as they have continued to do since. Research has steadily diverged in different directions with resulting proliferation of more specialized research projects, courses, and publications—which is another story. The early sense of shared developmental concerns, which provided such a strong foundation for the first permanent American marine laboratory has faded, for better or for worse. As Conklin suggested, such changes in biology have not always advanced biological understanding. Biologists, he said, have become a lot like squid. They have come to progress rapidly backwards while excreting large quantities of ink (Conklin, n.d.). Squid, like ink and progress, have played an important role in the MBL's history.

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