Centennial Lecture II: The MBL and the Fisheries—A Century of Cooperation in Woods Hole

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Friends and colleagues, I am more than formally pleased to have this opportunity to speak on the occasion of the Centennial of the Woods Hole Laboratory (WHL). The reason for that will be evident in the change of titles. Dick Hennemuth, who suggested to me at a relatively late date that this lecture might go forward, also provided me with the title which I've preserved for my posterity. His suggestion was, "Contributions of Marine Biological Laboratory to Marine Ecology and Fisheries." I considered that and told Dick "inappropriate," but I didn't tell him why. I will now tell him why, and my remarks in the succeeding half-hour or so will be an expansion of the why.

It is, that while there may well have been contributions of the MBL to the Fisheries[1] over our long joint history in this village, the contributions, I think on balance, of the Fisheries to the MBL are overwhelmingly greater. That is not so in the immediate and recent past when literal contributions of one place to the other have been relatively minor. But, in fact, a large part of the early history of the MBL, its intellectual and physical history, are almost coincident with the intellectual and physical history of the Fisheries. And that is in many ways so important a story that I decided to exemplify it for you today, without benefit of displays and historical photographs, but, using instead the words of a selection of MBL founders and leaders.

These words were written at a time when biologists and other scientists were more careful about the use of words, rather more sparing, than they are now. The words have meaning. My theme is therefore cooperation of these two institutions at the time of the founding, in context of the subjects that interested the founders and the leaders of both institutions, the changes in the character of the cooperation that followed the expansion of the science of biology altogether; and finally, some comments about where that cooperativeness stands now, and what I, at least, hope might happen in the future.

First, a personal interjection, for which I apologize, but I'd like it to be clear to those of my colleagues who don't know how long my family and I have lived in this town, at least in the summers, that although what I say may appear to be mere reading from a collection of reports put together with the help of our librarians, it isn't that at all. The cooperation I am going to discuss, in short, is exemplified perfectly by my own career in this place.

I came to Woods Hole in the late 1940's, while still an undergraduate and in a state of uncertainty about what to do with myself. I was a student at the University of Pennsylvania, and had initially no interest in science, was in fact actively hostile to it for various reasons. But, in the course of a tentative major in English at Penn, I was put off by the standard of behavior among academic literary types, and even more so by the standard of nonacademic behavior of successful writers, with whom I had opportunities to deal since I hosted visits of a number of then-popular novelists.

Forced by the curriculum of the University of Pennsylvania to take one year of science, I chose to get rid of the obligation in what was understood to be the easiest way—by taking the one-semester introductory course in Zoology and one more biology course. I calculated that having suffered through a semester of Zoology, I might as well take another course in that department. And so I did. The introductory Zoology course was, as everyone predicted, intensely boring. For the second course, I took General Physiology, taught by Victor Heilbrunn. There was nothing boring about Heilbrunn's course. It was provocative. It often made me angry because of what I, from my still-literary point of view, saw as unsupportable assertions. Nevertheless, it was one of the most exciting events of my college years because, whether he was right or wrong, Heilbrunn was always honest. He was surrounded by a group of students who seemed to me to know how the world worked, at least the living world.

As a result, I decided to ask if I could come to Woods Hole to work for him, knowing as I did that he had some grant money for summer helpers. He agreed to let me come to Woods Hole, but only as a dishwasher and possibly as a maker of lantern slides, since I had acquired some facility in graphics and photography. When I came here, I discovered that I could do all the assigned jobs in about an hour a day, leaving a large part of the remainder for going to the beach, to ogle the girls, or to do something useful. There was, however, no laboratory space. The MBL situation then was not much different from what is now. Heilbrunn, recognizing the sincerity of

[1]The author often uses "the Fisheries" to refer to the NMFS Woods Hole Laboratory in this Lecture.

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my wish to have a little private space, asked Paul Galtsoff whether there was any at the Woods Hole Laboratory. As always (at least in those days) there was.

There was, in fact, a splendid large space on the top floor of the Fisheries building, a room full of tanks with at least twenty species of marine animals kept decently in them. That space was being held for one or another of Galtsoff's projects, but in it the Fisheries also hosted me and four other MBL people, one of whom had the benefit of frequent visits from a thesis sponsor who is sitting here today, one Sears Crowell, an energetic young thing who came up a couple times a week to see how his student was doing.

My sponsor didn't, because I wasn't a real graduate student at that time; but Galtsoff did, and indeed so did a few Fisheries people. One of those, a photographer named George Lower, not only told me much that I didn't know, but also taught me a great deal about photography. It was a halcyon summer for me, followed by a second one at the Fisheries. In that period I decided to become a biologist. That sort of cooperation, I have discovered on looking through the records, began at the beginning of both our institutions and continued for a very long time.

The cooperation has not vanished, but for reasons I am about to touch on, the goals and purposes, and even the machineries of operation of the two institutions have diverged. Nevertheless, I have deep personal gratitude to the Fisheries Laboratory and its staff, and it is fair to say that the MBL as a whole (if the whole can be personified) has similar gratitude. That is the theme of what I want to say in the remaining time.

Let me start that, however, by reminding you of the growth of "biological science" in the interval since the Fisheries Laboratory was built—not since it began, but simply since it was built in 1885. For biological science as a whole, if you exclude from that the applied biological sciences (and those include medicine and agriculture), the rate of growth in the past hundred years approximates 5 percent per annum. It doesn't sound like an enormous growth rate, but in fact it is. If you take 1.05 and raise it to the 97th or 100th power you will find that the number of people, the physical resources, the commitment of time and effort to biology, are now 100 times greater than they were in those days. Remember, now, that none of us has had a marked increase in the number of waking hours per day, or a marked improvement in the quality of mind, during the past century. So, with the same minds we have had for the past hundred years and about the same fraction of each day devoted to eating, sleeping, and other necessary activities, the amount of time to comprehend the subject is unchanged and the size of the subject has increased by a hundredfold. The fraction of life science that any one of us can command is trivially small, then, compared with the fraction that the founders of your institution and mine could be masters of. The cliché that we know more and more about less and less is the truth.

But, in another sense, the growth of science is so much faster than the growth of almost all other organized activities of civilization as to have made it a requirement of success that we should know more and more about less and less; and therefore we should diverge. The nature of cooperation between our two institutions at their beginnings, and of cooperation now, reflect a hard numerical reality. The fact is that the founders, beginning with the great first founder of everything at Woods Hole, Spencer Baird, were zoologists. There weren't really biologists, for most of them didn't pay too much attention to botany, but they were zoologists. And it was really possible in 1885 for a scholar to have command of the field; to know the entire contemporary literature and a good deal of the history of the subject; to think about all of the current and salient issues, and possibly to make contributions to many of them in the course of a career.

The story of the Fisheries effort in Woods Hole is therefore the story of the zoologists gone right and zoologists gone wrong. Gone wrong in the sense that they allowed themselves to be involved with government and all the troubles that are a consequence of government. Of course, all their material growth is a consequence of the same. Last year, Dean Allard wrote a very nice paper on Spencer Baird and his founding of marine science in America. He was indeed the founder. In that piece, Allard (1985) calls attention to something that was once common knowledge here but has almost been forgotten: What Spencer Baird really wanted to do was to establish the MBL.

I will read you Allard's words: "Baird's overall plan was spelled out in 1882 in a personal letter to Daniel Gilman, President of John's Hopkins. The Fish Commissioner proposed to make available excess land in the vicinity of his buildings to universities and colleges desiring to erect special laboratories or summer schools of natural history. And as a further inducement, he suggested that the occupants of the tables in the Fish Commission's Laboratory should offer lectures to combined classes. Additionally, Baird offered to construct a common mess (dining facility), and presumably the rich scientific collections to be brought in by the Commission's vessels would also be available for this informal University of Biology."

Allard goes on to say how and why the Fish Commissioner's vision was not fulfilled. It's a long story. It had mostly to do with disputes in the Cleveland administration about whether Baird was getting too much money for frills, such as residences for himself and Fisheries personnel. He and all those personnel were vindicated in the succeeding administration; but during the time of the fuss, there was really no chance for Baird to materialize the dream of a Biological University of world significance, specializing in marine life and contributing to the economic exploitation of it based on science.

Allard noted that a significant part of Baird's dream would be realized in 1888-89, when his long-time friend and summer associate, Alpheus Hyatt, took a leading role in establishing the Marine Biological Laboratory. Baird didn't live to see that happen. But those who established the MBL, who were in fact as often Fisheries people as they were independents, were keenly aware of Baird's dream. It seems to me from reading the records, more so even than

the ideas that animated the great Naples station of Anton Dohrn, that it was Baird's ideas about how biological research should be organized in the village of Woods Hole that set the pattern. Baird's ideas animated the first design and the early management of the MBL. The evidence for it is very strong and it is in the records of the MBL.

As a consequence of the shift of that design from the Fisheries Laboratory to the MBL, there was very early a commitment to combine education and research, the two inseparable, and also an extraordinary flow of assistance from the Fisheries relatively well off after 1885 with their magnificent building and facilities, to the MBL: Poverty stricken and struggling, but embodying an ideal of intellectual life in this place that was in fact Spencer Baird's.

Here is some evidence of this. I will quote from the first Annual Report of the MBL Director, Charles Otis Whitman, who was, as I have indicated, sparing of words but thoughtful about their meaning. This is the report of the first summer of the MBL in which, under circumstances that were marginal to say the least, eight students and seven faculty came to study and work. Most of the report is devoted to Baird's ideas, and to the hope that there will be not rivalry but cooperation between the two institutions. Extracts from the Whitman (1890) comments:

"I have the best authority for saying that Professor Baird could never understand why naturalists did not flock to the Fish Commission station which he established in Woods Hole. . . Presumptions seem to be that an open station, with rare facilities for collecting material, would prove an attraction sufficiently strong to draw together the best working forces in the country. Such was the expectation. It has certainly failed of realization, and the fact is now as evident as time and experience can make it that something more has yet to be provided to constitute a biological station."

Whitman went on to describe what more was required:

"No imposition of programs by the leadership on those who come to work in the place."

A beautiful idea, one that survived for about 10 years. He went on in this report, six or so printed pages, to restate Baird's idea and the arguments for it, and then came to this point:

"Fortunately, there are no grounds on which antagonistic feelings could long survive even if they should in any possibility arise. The scope and aims of the two organizations (Fisheries and the MBL) are quite distinct. From the nature of things, they must remain so and yet the two are so closely allied as to ensure the maintenance of most amicable and stimulating relations. The Fish Commission pursues economical purposes."

That was a proper use of the word "economical" in those days. It meant "applied science," on a basis broad and liberal enough to claim a considerable part of the domain of pure science.

"Such a policy is worthy of every encouragement and the more liberally carried out the greater will be the reason for rejoicing," said Whitman.

"The work before the Fish Commission is one of gigantic proportions, possibilities. . .are open to it in many directions."

He went on in such laudatory terms, and then added,

"But, it must not be forgotten that the Fish Commission is economic. Its organization and support must continue to be directed and gauged as always by practical benefits expected from fish culture."

What he meant by "fish culture" was all of fisheries biology.

"No one has anything to say in derogation of such work; on the contrary so far as I know all approve both its character and its aims."

The point of all this is that Whitman, at the beginning of the MBL, was both hopeful that the Fisheries and the new institution would live and work together, and apologetic that the new organization should be doing something that the great founder of the older one wanted so much to do, and for various reasons hadn't done. This seems to have been the MBL's last apology.

There follow in the next 10 years a series of short but obviously sincere notes of thanks in the records of the MBL for favors which, when their reality is analyzed, must have been of considerable magnitude. I want to read just a few. These are sentences from the Annual Reports of the Laboratory, which for many years included a Trustees' report separate from the Director's report. (The differences between those are interesting.)

In 1888, the first year, the Trustees (MBL, 1888) said that,

"Colonel Marshal McDonald, Commissioner of Fish and Fisheries, greatly forwarded the work of the laboratory during the season by many courtesies to the Director, the instructors, and the students. The Trustees are also indebted to him and to John A. Ryder, Naturalist in Charge of the laboratories of the United States Fish Commission at Woods Hole, as well as to Superintendent Maxwell."

". . . for the use of boats and other collecting apparatus, of material and aquaria, the cooperation of the Commissioner and Superintendent Maxwell was particularly important and valuable since the saltwater service of the laboratory for the whole season was obtained by arrangement from the tanks of the Commission, thus affecting a saving of much machinery and not a little pecuniary outlay."

A modest statement of a serious point, which is that most of the technical services supporting the MBL for almost the first 10 years were borrowed from or were on direct line from the Fisheries Laboratory across the street. In the Second Annual Report, a year later, the Trustees said,

"To the Fish Commission, through the courtesy of Colonel Marshall McDonald, we are indebted for a supply of saltwater and other favors."

They give special thanks to John Ryder and Maxwell "for favors unnamed." Five years later, the Fifth Annual Report:

"The saltwater supply, the freshwater supply, physical support in many forms continues and the Trustees are grateful."

As indeed they might have been in those troubled times, when they had to take up a collection each summer, among already impecunious biologists, in order to pay the salaries of the workmen who kept the MBL functioning.

A rather touching comment by the Trustees in their Sixth Annual Report bears on this matter. They are describing here the common dining facilities in Woods Hole, always a subject of contention:

"The village of Woods Hole is so constituted that it is essential to have a dining club with the laboratory and managed by its officers. . .(here they compliment a Miss E. B. Richardson for managing the details). . .And if the results fell short of the standard we wish to maintain, the cause must be attributed to circumstances beyond her control."

In one of the most civilized comments on institutional food service I have ever encountered, they report:

"The kitchen is but a tumbled-down old woodshed with uneven floors and a leaky roof, ill-arranged, badly ventilated and destitute of modern appliances. There is no fresh water on the premises, that is being obtained from the Fish Commission and the drinking water being brought in buckets."

They then argue the need for a proper MBL dining facility. Two years later, in the Eighth Annual Report, one notes that a dining room has been organized and that most of its customers are Fish Commission personnel. The Trustees say here that:

"The dining room club during the past season was improved in many respects under the satisfactory management. . ." of now "Mrs. M. S. Connors. Some 30 persons from the U.S. Fish Commission have used it, and a number of students have also been admitted, making the total average number very large, 170 daily. It may be advisable hereafter to put some restrictions on use of the club by persons not working either at the Laboratory or at the Fish Commission."

This was therefore a crucial cooperative venture of the two laboratories, and it survived for a good many years.

In 1896 and 1897, the MBL leaders, looking with collegial and friendly, but also jealous eyes on the splendid physical facilities of the Fisheries and sideways at their own already decaying wooden structures, tried to interest the government in moving the two institutions closer together, although they were beginning already to diverge in respect to their scientific programs. I won't read the fascinating minutes, but from the record I sense that they were observing that independent growth of the MBL and regulated growth of the Fisheries had been sufficiently parallel to justify serious consideration of recombining them, along something like Baird's original design. It never happened, but it was clearly a matter that the Trustees of the now strong MBL, almost 9 years old, were considering very seriously.

By that same year, the number of services rendered the MBL scientific community by Fisheries had increased greatly. It was no longer a matter of water supply and the "mess." According to the records, all the pounds for keeping fish, all the maintenance techniques for collected specimens that were not to be used immediately, and full wharf privileges had been made available by the Fish Commission and by the staff of its Laboratory to the MBL. Moreover, among the leaders of the MBL teaching program were such as Herman Bumpus, who were in fact members of both institutions, and who were responsible for the rapid growth of instructional programs of the MBL. In 1897 and 1898, embryology and physiology, however intellectually important they were to become for biology, were far less significant drawing cards than were the natural history and the zoology which were taught by those people having joint membership.

Among the records, perhaps the best indicator of what kinds of work was going on in the two places is a summary written by Francis Sumner (1905) of the Fish Commission for *Science*. I'm not sure why this was done in 1905, but in any case he wrote a lengthy and eloquent summary of research being done at the Fisheries. There are two interesting points about it. One is that half of the scientists working at the Fisheries that year worked without salary. They belonged someplace else, but gave effort to research in the Bureau of Fisheries. And secondly, that their fields of research were indistinguishable from those of the MBL at the time. I'll read them off to you as he listed them, but I won't read the long list of distinguished people who were doing these things in Woods Hole at the Bureau of Fisheries Laboratory:

"Faunal and floral distribution," that is, survey work, the original purpose, under Spencer Baird; "taxonomy, embryology, ecology exclusive of animal distribution, general physiology exclusive of behavior" (and I don't know why the exclusions; probably because there was somebody doing behavior or distribution someplace else); "regeneration." There were 37 people in the Laboratories here in 1905, and of those, 15 were unpaid. If I were to read you a list of the courses or of the titles of investigation at the MBL that year, they would be indistinguishable from Sumner's list.

And that perhaps makes the point. The kinds of work done for the first 20 years of the two institutions in Woods Hole diverged, but at a slow rate. It was possible for a member of one not only to be involved closely with members of the other institution, but in fact to be competently conversant with everything going on. The field was still small enough. One could be a zoologist, even as late as 1900, and know everything that was going on in zoology; if not in detail, then at least in principle. Twenty years later, there was no hope of that for any zoologist. But, in those days the two institutions had congruent missions and congruent personnel.

Now let me touch on congruency of people, which is perhaps, for our own sense of the history, even more important than the congruency of programs.

There was a great International Zoological Congress in 1907, an important Congress for many reasons, including the regularization of taxonomy, recognition of the rise of physiology, and fears for the decline of systematics, although it wasn't called "systematics" in those days. This was a significant Congress, held in the United States, and I read you what the Eleventh Annual MBL Director's Report says of it:

"The season of 1907 is most memorable for the visit of The Seventh International Zoological Congress to Woods Hole. Some foreign members of the Congress came early to America to avail

themselves of the opportunity to work in Woods Hole. Others made a relatively long visit. The official visit of the Congress was made on August 25, 1907. Fifty members came down by special invitation on the preceding evening and were entertained by the Forbes family at Naushon, by the Bureau of Fisheries, and by members of the MBL at their homes. The balance of the members came the next morning and all were greeted by Professor Whitman for the MBL and Dr. Sumner for the Bureau of Fisheries. Inspection of the laboratories followed, lunch was served at the mess, and in the afternoon the U.S. Fish Commission steamer *Fish Hawk* carried the party to New Bedford where they embarked for New York."

Well, what about the changes? I would say that in the decades from 1920 to 1940, with ominous tremors of a new war heard, toward the end, even in Woods Hole, people began to specialize their interests and to look to the details of their own work. Formal cooperation between the two institutions didn't cease, and even material help didn't stop flowing, but the interests represented by people working in the two places did begin now quite visibly to diverge.

One touching note on the material cooperation, though, comes from the MBL Director's Report of January 1921, where he says, again with the terseness that characterized him.

"In March 16, 1920, the dining hall, kitchen, and laundry of the laboratory were entirely destroyed by fire which started in the machine shop of the Bureau of Fisheries across the street and blown by a strong west wind directly on to our buildings. Although the fire started at 4:30 a.m., the entire town turned out and by hard work succeeded in saving the other buildings. A meeting of the members of the Board of Trustees, resident in New York and vicinity, was hurriedly called on March 20th at the home of Mr. Crane and voted that the officers of the laboratory be empowered to make necessary arrangements to replace the buildings and equipment destroyed by fire, enlarging the same if deemed advisable. These operations were taken charge of by Gilman Drew, assisted with the utmost graciousness by the leadership and staff of the Fisheries, and the buildings were indeed replaced in time for the next summer session with no loss of time."

Another Congress is worthy of mention: The great International Physiology Congress of 1929, a year of the fission process that resulted in an independence of biochemistry or, as it was then known, "physiological chemistry," from the rest of physiology. That was a watershed year for physiology. It was also a year in which the International Congress was held in the United States, and almost all members came to Woods Hole where they were entertained jointly by the Fisheries and the MBL. In fact, the major scientific demonstrations, which were made in August 1929, took place at the U.S. Bureau of Fisheries.

Let me now deal briefly with the matter of persons; leaders of the MBL, of American science, indeed of biology of the 20th century, and their relationship to the two original institutions of Woods Hole. I do this by means of a single biographical example, reading from the standard memorial minute for deceased members of the MBL Board of Trustees, written, in this case, by E. G. Conklin, in memory of T. H. Morgan. This minute is representative of any I might choose from among 30 or so that are in the early records of the MBL. They memorialize important persons who got their start at the Fish Commission. I won't read the entire minute; just the closing paragraph:

"From his acquaintance with marine biology at Annisquam and to the end of his life, T. H. Morgan was closely associated with marine laboratories, especially during his summer vacations. In 1888 and 1889 while still a graduate student, he occupied the Johns Hopkins table at the laboratory of the U.S. Fish Commission at Woods Hole. Those were the first two years of the MBL and although he is not listed as a member of this new laboratory for those years, he was closely associated with it from the beginning, for relations between these two laboratories in those days of few workers were very intimate. In 1890, Morgan became an active member of the MBL, occupied a room in the laboratory, gave lectures in a zoology course, and one of the evening lectures, and became a member of the Corporation."

There follows a list of Morgan's activities on various committees of the two institutions. I would add here that from his early fascination with marine biology, and with the generous support and encouragement that Morgan had from the Fish Commission and from the leadership of the MBL, particularly from Whitman and E. B. Wilson, Morgan became prepared to publish broadly in marine biology. It was at a relatively late stage of his career that he discovered the fruit fly. With the fruit fly came not only the first clear and correct explanation of sex determination, but also the entire foundation of modern genetics. That couldn't have happened in Woods Hole, however, had there not been in this place a large group of distinguished cytologists, including McClung and Wilson, whose researches on chromosomes had made it possible.

What happened after the divergence accelerated in the 1930's and 1940's is less a matter of record, because there aren't many records of it, than a matter of my interpretation of those records and also to some extent of recall, although in the 1950's and 1960's I was a very junior character around the place, too busy with my own research to pay attention to history or politics. My sense of what happened is that the inevitable expansion of the disciplines, specialization, and new processes of funding made it necessary for working scientists in the two institutions to pay closer and closer attention to their immediate professional connections, to their own societies. Therefore, their personal interests diverged and the styles and techniques of research diverged as well. I distinguish that from people doing applied vs. "pure" science. That distinction is a red herring. I find very little practical difference, no matter how hard I try to make it for other purposes, between the applied science of a population dynamics group in Fisheries, for example, and the kind of modeling that is done for ostensibly pure analytical ecology at the MBL.

There are so many specialties now, and so many people involved in them,

that almost every subdivision of biology has its own professional organization, official or unofficial, and the languages these organizations speak tend, as always, to become jargonized. Hence, the institutions diverge.

I would like, in fact, to turn the whole issue on its head and look at it another way. Ask what relationship fisheries biologists in Woods Hole, whichever institution they happen to be in, have with molecular biologists in Woods Hole, and how closely they cooperate, and then ask how the members of any single large department of biology in the United States with a similar spectrum of interests relate to one another.

Some of you, I am sure, have worked in universities recently, and so have some experience to confirm this assertion: That most whole organism, globally-minded biologists have little to do intellectually with the reductionist biologists (and that's not a pejorative in my vocabulary). The ecologists and the cell biologists in a typical university biology department have almost no regular, professional intercommunications. Our ecologists talk occasionally to microbiologists and physiologists, and even to molecular geneticists, but those are exceptional cases.

The science of the two institutions has thus diverged neither more nor less than the two ends of the biological spectrum have diverged within the MBL. In both institutions, it is remarkably good science on the whole, by any measure, including funding, publications, stature, recognition of the people, that is done. But it has diverged. The institutions have not parted in the sense of cooperative attitudes and friendly relationships. The directors meet, not very regularly, but often enough so that we are reminded that we have things in common. When problems arise, we deal with those problems in a way that, since my arriving in this job at least, has been perfectly cooperative. Would that there were that sort of impetus among all the working scientists in the Woods Hole institutions. But it is not so because of those professional drives and associations which tend to isolate people within their particular peer groups. We seem to rub along nicely with each other and to be helpful when necessary. The relationship is, obviously, very different from the one at the beginning.

Perhaps that is as it should be, but I don't think so. It seems to me that there are collaborative possibilities for the future, in the kind of science we do in Woods Hole that are better than mere rubbing along. There isn't time, really, to deal with the subject of what might happen in Woods Hole in the coming decade, among all the institutions. That would be a separate lecture which I would like to give some day. But let me touch on one of the salient points of it.

The center of MBL's interests has moved toward cellular and subcellular biology. Some of the people who do that sort of thing here year-round and in the summer are exceptionally distinguished, and the instructional and research programs are internationally acclaimed. The Fisheries people, many of whom do fundamental biology in almost the same fields, nevertheless do it with a particular programmatic thrust that is indeed "economic." So far as I know, there isn't a better place in the world for that kind of work. Is there not some central scientific territory that we could inhabit again, rather than simply mechanical and administrative cooperation? I can think of several, but among those the most important, it seems to me, are the conjoint fields of marine animal medicine and mariculture.

We in Woods Hole are not being serious enough about that. We all have our own things to do. I don't know how you talk about these things at the Fisheries, but at the MBL what I get when I promote mariculture is a sort of friendly agreement that it is useful. But it's obviously not the thing that most people at the MBL really want to worry about. I suspect that the same thing is true, with the exception of a small group, at the Fisheries. Likewise in marine animal medicine. We have cooperated in mounting the "Aquavets" course. Fisheries people have been faculty in MBL courses in this field. But the level of interest in both institutions is relatively low. In fact we have a group of highly talented young people coming to Woods Hole every year to study marine animal medicine, and it is their clinical approach to health of marine animals that will some day be the equivalent of sophisticated veterinary medicine for terrestrial food and fiber animals (if, that is, we ever get really to "farming" the sea).

We are not going to farm the sea literally until fisheries biologists, with their special skills in population dynamics, analysis, population genetics, reproductive biology; and pathologists, cell biologists, and geneticists (who now know how to do genetics literally in the test tube) get together. When and if they do, we will be able to begin to farm the sea, as our civilation began with the aid of science to farm the land about a hundred years ago. And marine veterinary medicine will be as indispensable as veterinary medicine is to agriculture.

I don't know if it will happen. There is interest in some quarters, and there are a few laboratories around the country supported by government to do that sort of thing. But none of the activity seems to be on a scale consistent with the urgency of feeding the people who are going to be hungry 25 years from now. No matter what fools start what wars, no matter what population-reducing cataclysms there may be, we are going to need vast additional food resources that are simply not available on the land. In that effort, I think that our two laboratories could rejoin in the kind of working, intellectual cooperation that made it possible for the MBL to live in its first decade.

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