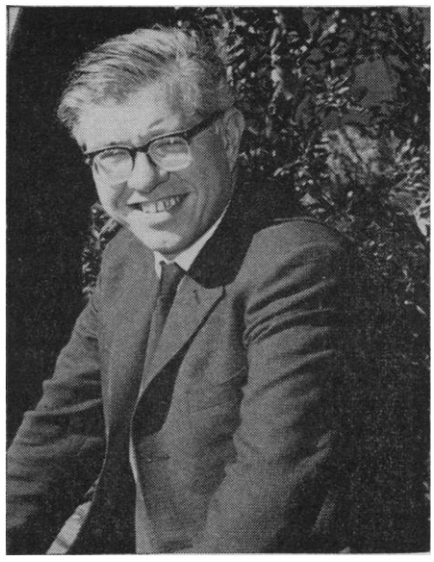

Fred Hoyle

during the coming academic year. And it is thought that word of the institute will get around in other ways.

Financing of the institute for the first 5 years will come through a combination of government, private, and university money. The Wolfson Foundation has contributed about $500,000 to build and equip the two buildings. Of the $1.75 million required for the first 5 years of operation, the government's Science Research Council (SRC) is to contribute 40 percent, the Nuffield Trust 40 percent, and the university 20 percent. The SRC contribution will go essentially to meet the cost of buying and running the computer.

Running costs of the computer will be paid in part by payments from other university users. The Cambridge molecular biology research unit, financed by the Medical Research Council, is the main example, having agreed to pay some $36,000 a year for use of the machine 4 hours a day for the next 2 years.

When the grants run out at the end of 5 years, new financing arrangements will have to be made for the institute. Customarily, projects which are started by the SRC and which flourish are taken over by the University Grants Committee, which distributes government funds to the universities. Hoyle admits that the institute's prospects after 1972 depend to some extent on the state of the British economy and the prevailing attitude toward basic research.

General control of the institute is vested in a committee of management made up of members representing interested departments in the university, the SRC, the Wolfson Foundation and the Nuffield Trust.

The work at the institute can be expected to be influenced by Hoyle's interests and reputation. Continued close contact with American institutions is indicated, particularly with Caltech. Hoyle estimates that in recent years he has been spending as much as a third of his time in the United States.

The new institute will put the Anglo-American interchange on a solid two-way basis, since American astronomers are sure to be drawn by the opportunity to use the computer and by the attractions of the institute and the Cambridge university community.

To Hoyle, the most important thing seems to be that the institute "will prevent you from training graduate students and then immediately losing them." The expectation is that most research fellows will move on to other posts after a few years at the institute, but they will have had the chance to make the most of their productive postdoctoral years, to the profit of themselves and of theoretical astronomy.

As for astronomy in general, Britain would appear to be riding a wave of balanced development. Outside Cambridge, a small group in theoretical astronomy has been formed at the new University of Sussex, around Professors W. H. McCrea and R. G. Taylor. Sharing of computer facilities at Greenwich Observatory is contemplated.

In radio astronomy Britain has been conducting a world class effort, with groups at Jodrell Bank under Bernard Lovell (*Science*, 1 May 1964) and at Cambridge under Martin Ryle. Now optical astronomers, who have felt themselves stepchildren for years, have had their prospects brightened by an agreement between Britain and Australia to share equally the cost of building a 150-inch telescope at Siding Spring Mountain in New South Wales.

All in all, there is a feeling in government and university science circles that in astronomy, at any rate, an antidote to the brain drain has been administered.—JOHN WALSH

# Woods Hole: Summer Mecca for Marine Biology

*Woods Hole, Mass.* This Cape Cod village, situated on a finger of land 75 miles southeast of Boston, protrudes into waters that contain an abundant and varied marine life. For this reason, it has long been a major center for investigations in the marine sciences. Of the three research institutions clustered here, the one which historically has had the greatest influence on the American scientific enterprise is the Marine Biological Laboratory (MBL), established in 1888.

The others are the Bureau of Commercial Fisheries Laboratory, founded in 1885, and the Woods Hole Oceanographic Institution (WHOI), established in 1930 with the help of MBL's leadership. WHOI, whose current budget of about $9 million is several times greater than MBL's, has been developing rapidly and is now a leader of large-scale research programs in oceanography. But it is MBL, with its tradition as a place for summer research by independent investigators from universities and of intensive courses for advanced students, that has exercised a formative influence on several generations of biologists.

Moreover, much significant research has been done at MBL, although often the laboratory must share the credit with the investigators' universities, where the work may have started or been completed. Examples of important investiga-

H. Burr Steinbach

tions at Woods Hole are the early embryological studies made with invertebrate ova, research on the general physiology of membranes, and use of the squid giant axon membrane for research on the nature of nerve impulses.

For any institution primarily dedicated to research to maintain its prestige and influence over a period of more than 70 years is not easy, particularly when it lacks the built-in self-renewal factor of a university. MBL, though it has its peculiar problems, not only seems to have accomplished this but, in some major respects, is stronger now than ever before.

Some people, seeing MBL from afar, suspect that the laboratory is a sort of private club whose members return summer after summer to an attractive "research environment" which includes, besides abundant marine life, plenty of opportunities for swimming, sailing, fishing, and other diversions. This view of MBL is sharply at variance with MBL's self-image, which pictures the laboratory as the scene of remarkably intense work by students and investigators.

If the self-portrait is flattering, it nevertheless stands up surprisingly well under scrutiny. Since World War II, especially, MBL has engaged in some useful introspection. It has undertaken reforms to further its avowed aims of providing first-rate teaching, encouraging high-quality research, and bringing together talented people for mutual stimulation.

That MBL's potential influence on the life sciences is, and has been, great is suggested by the fact that, in 1966, the 287 investigators at the laboratory were from 198 U.S. and foreign institutions. Realizing this potential depends, of course, on seeing that the laboratory does not, in fact, become the private preserve of a favored group of scientists who, regardless of merit, are guaranteed "club privileges."

Traditionally the Board of Trustees has run MBL, and, prior to the war, the board tended to be a self-perpetuating body. This was true even though the trustees were elected by the MBL Corporation, comprised almost exclusively of scientists who at some time or other have done research at Woods Hole (corporation members, now numbering about 600, are chosen by the trustees). Moreover, during the prewar years MBL allocated its research space rather casually, allowing the various subscribing universities to allot space to their faculty members. Also, in some instances MBL courses continued to be headed year after year by the same scientists, sometimes after the freshness of their ideas had faded.

Although in general MBL's elders carried on the traditions which had made the laboratory a success, they had, by allowing the corporation to be dominated by a small group, deviated from the precepts of MBL's first director, C. O. Whitman. In 1893, Whitman wrote: "The whole policy [of MBL] is national in spirit and scope. The laboratory exists in the interest of biology at large, and not to nurse the prestige of any university or the pride of individual pretension. Representative character, devotion to biology at large, independent government—such are the essential elements of a strong and progressive organization."

Indeed, at a meeting of the trustees in 1897, Whitman contrived, apparently by a filibuster and other tactics, to break the dominant influence that the trustees from Boston, as MBL's founders, had over the laboratory. Since that time the corporation's annual meeting, at which trustees are elected, has been held in August at Woods Hole in order that a representative group of members may attend; prior to Whitman's benign coup, such meetings were held in January in Boston and attendance was small. However, the influence of the corporation membership, as a group, in MBL's management was later compromised by the corporation's habit of simply electing the slate of new officers and trustees prepared by the trustees' nominating committee.

The state of affairs existing during

Some early investigators at the Marine Biological Laboratory. MBL's first director, C. O. Whitman, of the University of Chicago, is at front, third from left. Others are (front row, from left) W. M. Wheeler, W. A. Setchell, H. C. Bumpus, S. Watase; (back row) P. A. Fish, J. Loeb, E. O. Jordan, C. L. Bristol and E. G. Conklin.

Campus of the Marine Biological Laboratory, with main building at right, fronts on Great Harbor, off Vineyard Sound. In background are Eel Pond and Buzzards Bay. The U.S. Bureau of Commercial Fisheries Laboratory is at left [U.S. Fish and Wildlife Service Photo by Brigham]

the prewar years appears to have been acceptable under the conditions then prevailing. The community of biologists in the United States was still relatively small and close-knit. Moreover, MBL generally could accommodate any competent scientist seeking research space. Following the war, however, circumstances changed. Research in the life sciences had entered a period of rapid growth and increasing complexity. Biologists were establishing new ties with other branches of science, as indicated, for example, by the fact that a number of universities were setting up groups or departments for research in biophysics.

The pressures and tensions generated by these developments were felt at MBL, as elsewhere. Corporation members, especially some of the younger ones, began demanding a larger voice in MBL's affairs. As H. Burr Steinbach, MBL's current director and president (and chairman of zoology at the University of Chicago), puts it, "The palace revolution that occurred was the result of the growth and the spreading interests of biology."

In the early 1950's the corporation instructed the board of trustees to have its nominating committee thereafter recommend at least 50 percent more candidates than there were positions to be filled. This has encouraged nominations from the floor. Another new rule has limited the period a trustee may serve to two consective terms; he must then drop out for a year before becoming eligible for reelection. Greater turnover on the board has resulted from these changes, although the process has not gone fast enough to suit everyone. "Some trustees, such as the Academy members, carry tremendous weight and prestige, and they often get put back on the board even when they haven't done anything," says one scientist who has served on the board.

Two other important reforms also were adopted during the early postwar years. One was to require a change of the heads of all courses at 5-year intervals. The other was to allocate research space not to universities but to individual investigators, on their merits.

The screening of applications for research space is said to be rigorous. Teru Hayashi, physiologist at the Illinois Institute of Technology and chairman last year of the MBL research space committee, told *Science*: "In my evaluations I try to see who has the bright ideas, good experimental design, and whether the questions asked are of a basic, fundamental nature. We tend to lean over backwards for young promising investigators whose careers are well started."

The space committee looks at lists of publications for evidence of past productiveness, although, inevitably, some exceptions are allowed. For instance, a few years ago an elderly and once highly productive investigator (now deceased) whose professional life had been intimately linked with MBL continued to get laboratory space even though the work produced was no longer significant.

A fourth of the investigators at MBL this past summer did not have space there the previous year, and Steinbach regards this as evidence of a healthy turnover. Nevertheless, many investigators have returned to MBL often enough to have bought summer homes in the vicinity. However, among these veterans are some of MBL's most competent investigators, and, in their annual trek back to Woods Hole, they often bring their best graduate students as research assistants (191 such assistants, from 80 institutions, were at MBL last year).

In the research field MBL plays largely a passive or service role, waiting for investigators to come to Woods Hole to profit from MBL's facilities and the marine forms supplied by its collection boats. But through its courses, and its choice of scientists to head them, the laboratory exerts a positive influence on the life sciences. Currently, there are courses in marine botany, marine ecology, embryology, invertebrate zoology, and physiology, plus a research training program in fertilization and gamete physiology. The courses are for graduate and advanced undergraduate students, and often, as in the high-powered physiology course, postdoctoral students are enrolled. The students number from 18 to 40 to a course. The work, demanding long hours of students and faculty alike, is research-oriented. Heading the physiology course this past summer was Andrew G. Szent-Györgyi of Brandeis, who recruited as his associate instructors five other leading scientists, including two distinguished Britishers,

Hugh E. Huxley and Sidney Brenner, both fellows of the Royal Society.

Increasing federal support over the past 20 years has helped MBL meet the demand by investigators and students for laboratory space and modern research equipment—a demand greatly stimulated in part by the government itself, through its support of students and investigators. Once largely dependent on private philanthropy and fees collected for tuition and research space, MBL now looks to the government for more than half of its annual income (the 1967 budget is $1.75 million) and for much of its development capital. For example, half the funds for the new Whitman Building, where many investigators now have their laboratories, came from the National Science Foundation and the National Institutes of Health.

Since 1953 the number of independent investigators at MBL has increased by about 100, and the number of research assistants has quadrupled. Altogether, the investigators, assistants, and library readers now total about 550 each summer. (Despite a growing demand for admission to MBL courses, the student population has been held to about 125.)

This growth has led necessarily to some loss of the intimacy that has contributed to MBL's success as what Steinbach calls a "supercommunications system." An outsider, however, is struck by the informality of the place. At lunchtime on a fair day, Stony Beach, a favored spot on Buzzards Bay only 2 minutes from the laboratory by bicycle, is likely to be crowded with scientists and their families. At MBL, informality is the rule. Some scientists affect a summer beard, and nobody thinks of wearing a necktie unless it's for the Friday-night lecture by a distinguished visitor. The Capt'n Kidd bar and restaurant on Water Street, a half block up from MBL, is a popular place to down a few and talk science.

The sense of community at MBL was displayed when Vice President Humphrey visited Woods Hole in late July. In a good-humored demonstration, some 200 scientists, students, and others gathered by the sundial in front of the laboratory, their picket signs protesting the Vietnam war and urging "Save the Redwoods." MBL's more conventional spirits held aloof from the demonstration, but many of its best minds, including 74-year-old Albert Szent-Györgyi, a Nobel Prize winner, took part. The camaraderie, free spirit, and lack of pretense that seems to characterize MBL is attributed by some partly to the fact that most of the scientists, at Woods Hole just for the summer, are not rivals for prestige and position and leave most of their ego-building activities behind at their universities.

Nevertheless, those who have passed many summers at MBL say the atmosphere has changed, not for the better. More of the scientists, partly because of earlier marriages, are living off campus, and the mess hall is no longer a place where senior scientists, their junior colleagues, and students mingle. In fact, a petition recently presented to the corporation indicates that, besides being unhappy with the food, the students and

COLLECTION PARTY, CIRCA 1895: Many of the students at the Marine Biological Laboratory in its early years were women, in part because the Woman's Education Association of Boston assisted in establishing MBL.

research assistants are finding the mess hall a neglected student ghetto.

The heavy influx of summer tourists doesn't improve the atmosphere for scientific endeavor. When the Water Street drawbridge across the Eel Pond channel swings up to accommodate an MBL collection vessel or a sailboat, a crudely painted message appears on its underside: "Tourists Please Go Home." This pretty well spells out the attitude of many people at MBL and at Woods Hole's two other research institutions. Steinbach and others are trying to persuade the Martha's Vineyard–Nantucket steamship authority to move its terminal from Woods Hole to Hyannis.

However this turns out, MBL plans to regain some of its lost intimacy and improve its education program by constructing a new training building and putting up an attractive new dormitory-dining hall building. These new facilities, designed for year-round use, also are expected to permit MBL to take advantage of increasingly flexible university schedules by offering courses and attracting more investigators during the academic year. The National Science Foundation, hesitant about making large grants for summer-use facilities, has encouraged MBL to go beyond its present small off-season program (of supporting a few research groups), though no one wants this done at the expense of the traditional summer activities.

Steinbach and other MBL elders are especially solicitous of the good opinion of the federal granting agencies, for they don't know what the future holds for MBL in an era in which federal support is going increasingly to large-scale programmatic research. MBL's brand of research gets few press notices, and its lack of public visibility is one of the laboratory's chief worries. Nonetheless, MBL has much going for it. Many of the country's leading biologists, having had a close association with MBL, are always ready to vouch for the laboratory's long and continuing contribution to biology.

—LUTHER J. CARTER

# Radiation Hazards: Senate Bill Would Provide Federal Regulation

Concern over the lack of regulations governing the growing number of products that emit radiation was expressed during hearings 28 to 30 August on a bill that would protect the public against damages from radiation. Senator E. L. Bartlett (D–Alaska) conducted the hearings for the Senate Commerce Committee on his bill (S. 2067) which would authorize the Secretary of Health, Education, and Welfare to conduct research and set standards applicable to the emission of radiation from electronic products. Hearings on a House companion measure (H.R. 10790) were held on 14 August.

The recent incident involving 114,000 General Electric color television sets which produced x-rays because of defective shunt regulator tubes pointed out the lack of regulations pertaining to potentially hazardous radiation sources. General Electric detected its own problem and corrected the faulty sets. Although the G.E. sets were mentioned several times during the hearings, testimony indicated that radiation from medical and dental x-rays, microwaves, ultraviolet light, infrared, and ultrasonics may present a far greater hazard to the public than defective television sets do.

At the present time, the regulation of radiation-emitting devices is left largely to state and local governments; however, many of the devices which administer the largest quantities of radiation to the public are not regulated at all. Testimony indicated that medical and dental x-rays probably present the greatest potential health hazard of the unregulated devices mentioned during the hearings. A U.S. Public Health Service (PHS) publication indicates that Americans received 232 million medical x-rays in 1964, and 227 million dental x-rays. Witnesses asserted that a vast number of x-rays are administered by persons with insufficient training, and often patients receive 10 to 20 times the amount of radiation necessary to expose the x-ray film adequately. Not only do patients apparently receive more radiation than necessary, but single dental x-rays usually involve substantially more radiation than chest x-rays, a dentist told the committee. The PHS has stated that the average dental x-ray involves exposure to 1138 milliroentgens (mr) of radiation, whereas the average chest x-ray involves 45 mr.

Karl Morgan, director of the Health Physics Division of the Oak Ridge National Laboratory, testified that up to 29,000 Americans may die annually as a result of radiation damage from diagnostic medical exposure. He added that he had not estimated nonlethal damage. Morgan stated that radiation fatalities could vary between 3500 and 29,000. His figures, based on extrapolations from effects at high dose rates to those at low dose rates, were obtained from human rather than animal data, wherever such information was available.

Testimony during the hearings was concerned with two types of radiation damage: somatic damage which directly affects the exposed individual, and genetic damage which affects future generations. Morgan said data indicates that "mortality from leukemia and other forms of cancer is about 40 percent higher among children exposed to diagnostic x-ray study *in utero* than among children not so exposed." He also cited a Harvard School of Public Health study which noted "that there was an increase of 10 to 30 percent of cancer primarily in leukemia and cancer of the central nervous system in children whose mothers were irradiated during pregnancy." He added that studies of mongoloid children have indicated that mothers of such children have been exposed to substantially higher amounts of radiation over a long period prior to pregnancy than the mothers of nonmongoloid children.

Witnesses testifying for the American Dental Association (ADA) argued against Morgan's testimony on deaths caused by radiation. Albert G. Richards, professor of radiology at the