tion. It implies skill gained in repetition. It implies improvement and it implies style.

But of the many kinds of art, fine arts and useful arts, the engineer deals only with those that are useful. Utility is the standard by which his function stands or falls.

And how is utility measured? It is measured by the economic test. In this hot crucible of the economic test all his works are tried. He is an engineer only when he can do with one dollar what any fool can do with two.

It is because his art deals with dollars and economic relations that he is bound into the great business structure of society, and being bound into this structure he must be a man among men. He must be able to make his views prevail, to persuade, to contend, to give blows and to take them.

The scholar in his closet or the scientist in his laboratory does not do these things. To the engineer they are every-day life.

And if his training neglects the great human mirrors of history and languages, particularly his own language, if his mind and his heart are insensible to the great social forces, if he but feebly develops the subtle qualities of character that make for personality, his career as an engineer is limited, no matter how much science he knows.

The realm of economics where he works is a human realm involving organization, leadership and sympathy, to say nothing of passion, ignorance and vanity. Value is its criterion rather than truth.

The business of the engineer is no business for the philosopher. To be trusted with the expenditure of other people's money is no calling for a dreamer. If the key to the scientist is thought, the key to the engineer is action.

Engineering is not related to all of science.

As a body of knowledge science is composed of many sciences. Their practical application gives rise to many arts not all of which are economic or practiced by the engineer.

The science of biology has its art of medicine. The science of anatomy has its art of surgery. The science of astronomy has its art of navigation. The sciences of mathematics, mechanics, physics and chemistry have their art of engineering, which is the art of the economic application of these sciences to the purposes of man.

THE WOODS HOLE OCEANOGRAPHIC INSTITUTION

By Dr. HENRY B. BIGELOW

DIRECTOR

IT is gratifying to report that the study of the present status of oceanography made by the committee of the National Academy on that subject and their recommendations[1] have borne fruit in the incorporation of a new establishment for the study of the sea, the Woods Hole Oceanographic Institution. And it is still more encouraging to students in sea science that the Rockefeller Foundation has appropriated for the new institution funds sufficient to assure it an adequate building program and sufficient operating income.

The purpose of the new institution, as its name implies, is to carry on and to encourage the study of the sea in the broadest sense. Like the Marine Biological Laboratory, it is an independent organization, but similarly assured of informal association with other educational and research institutions through the personnel of its trustees. The initial board is as follows: Dr. Thomas Barbour, Dr. Henry B. Bigelow (director), Dr. William Bowie, Dr. E. G. Conklin, Mr. Newcomb Carlton, Dr. Benjamin M. Duggar, Dr. Frank R. Lillie (president), Dr. John C. Merriam, Mr. Seward D. Prosser, Mr. Lawrason Riggs, Jr. (treasurer), Mr. Elihu Root, Jr., Dr. Harlow Shapley, Dr. T. Wayland Vaughan. The by-laws provide for an increase in the number of trustees up to twenty-four.

The choice of Woods Hole as the site for the headquarters of the new institution was reached only after a careful consideration of other possible situations along the Atlantic Coast of North America. The final decision was based on the combined advantage of close proximity to two world-famed laboratories of marine biology, on the one hand, and, on the other, on the exceptional opportunity for illustrative investigations that is offered by the neighboring waters.

The first of these inducements needs no explanation. The second depends in part upon the ease with which the transition from inshore to offshore waters can be reached from Woods Hole, on the abruptness of that transition and on proximity to the continental slope, and abyss. At the same time the Gulf of Maine, close at hand, with its tributaries, offers a more promising field for intensive investigations into the interaction between the physical-chemical and the biologic aspects of oceanography than any other sector of comparable extent along the coast of America. This follows from the fact that deep troughs, freely open

[1] SCIENCE, 71: 84–89.

to the ocean, enclosed sinks, a varied coast-line, a wide range of depth and offshore banks supporting some of the most productive of sea fisheries can all be reached within a few hours' sail from Woods Hole, while the transition from regions of extreme turbulence to waters more stable can be followed within short distances. The thermal diversity (regional, bathymetric and seasonal) is also wide, with temperatures ranging within a few miles of Woods Hole, and at different seasons, from below the freezing-point of fresh water to values almost tropical. A wide variation in the fertility of the local waters for pelagic plants is reflected by variations in the mass productions of the latter, while the faunal associations (including the planktonic) are equally diverse and abundant.

In short, there is hardly an oceanographic problem but can be hopefully attacked close to Woods Hole, unless primarily associated either with tropical shallows, with Arctic ice or with mid-oceanic conditions. The northeastern coast of the United States with neighboring parts of Canada is the most convenient headquarters for studies in the last two of these fields combined, because of nearness on the one hand to the ice-laden Labrador current (chief discharge of Arctic waters into the Atlantic) and on the other to the open Atlantic basin, with Bermuda in the offing as the possible site of a future substation.

The preceding remarks introduce one of the most important features of the institution's program, namely, that it expects to own and operate a seagoing ship, of moderate size, with convenient living quarters, capable of extended voyages and equipped to carry on investigations at all depths in the various fields of sea science. This is the more desirable because no other American marine laboratory independent of governmental control is at present in condition to do this. To make the most of such facilities, it is planned to keep the laboratory open with resident staff and the ship in commission the year round.

Plans for the laboratory building, docks, etc., are now being prepared and the institution hopes to open its doors by the summer of 1931. Before that time the trustees expect to announce in detail what facilities can be offered and what initial program of research is planned, based on the general purpose of offering every opportunity (compatible with work on shipboard) for participation by visiting oceanographers, whether from America or from abroad. This implies field-investigations in a variety of subjects, for which the offing of Woods Hole is favorable for the reasons just stated. The most essential activities of the institution may be expected to center around the work at sea. In this connection it must, accordingly, be recognized that the technical requirement of oceanography (necessity for obtaining the raw data for the major problems at sea) will confine the projects that can be undertaken at any one time to those that can be provided for simultaneously by the station's fleet. Consequently the activities, not only of the staff but likewise of many of the visitors, must be coordinated parts of a joint program. At the same time the laboratory purposes to offer every hospitality to individual workers who may elect to attack, independently, any problems the data for which can be obtained from the pier or from small boats.

At present few opportunities are open for the student of oceanography to gain experience in the technique of his subject, and the first-hand intimacy with the sea that he requires as a background for his detailed studies. The institution therefore expects to offer to university students instruction in oceanographic methods by participation both in the cruises and in the general work of the laboratory.

To carry out this part of the program, as well as to make the facilities available to qualified investigators, friendly and continuing relations with universities are obviously essential. Equally essential will be a constant endeavor to encourage the coordination of effort between various scientific institutions of this and other countries, that is especially needed in oceanography, where the area to be covered is so vast and where so many fields of science intertwine.

SCIENTIFIC EVENTS

THE DEGREE OF CHEMICAL ENGINEER AT CORNELL UNIVERSITY

IN response to an increasing demand on the part of industry for engineers who have had a specialized training in chemistry, the College of Engineering and the Department of Chemistry of Cornell University have been authorized by the Board of Trustees to offer jointly a curriculum leading to the degree of chemical engineer. This curriculum comprises five years of required and elective work. During the first four of these five years the student who expects ultimately to receive the degree of chemical engineer will be registered in the College of Arts and Sciences as a candidate for the degree of bachelor of chemistry, receiving that degree upon the completion of a definite four-year curriculum, the last two years of which contain a number of fundamental engineering subjects. During the fifth year of residence, the stu-