SCIENTIFIC SURVEY OF FISHING BANKS*

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THE need for increased exploitation of our marine resources has been keenly felt and the recent achievements of the power fishing vessels operating off Bombay and Bengal have proved that there is sufficient scope for increased exploitation. Rao (1948) has pointed out: "The main and immediate problem of Indian marine fisheries is, therefore, one of intensive and extensive exploitation rather than conservation." At the same time he has emphasized that an estimation of our resources and research must precede large scale exploitation.

Many still believe that the resources of the sea are inexhaustible and, therefore, cannot be affected by the activities of man. But this general belief concerning the limitless number of fish in the sea has been shown to be fallacious and due to faulty deductions based on insufficient or erroneous observations. Irrational and unscientific exploitation of fishery resources might lead to over-fishing, rapidly causing sharp and continued reduction in the abundance of fish in a relatively short period and it would then take many years for such fisheries to recover. At present we know almost nothing about the magnitude of our fishery resources. Although experimental trawling operations have been conducted in our waters the results are far from being conclusive. A good deal of exploratory work has to be done for gaining a fair understanding of the problems relating to fish production. Further, it is not enough that fish be produced in a body of water; we are interested principally in using them and in general the yield of fish will depend upon their production and also on the efforts put into their capture. The fact that some fish are taken by us can itself affect their production, and so an examination of the effects of fishing on particular fish stocks is of much importance. It is therefore essential that scientific investigations should be conducted with the double object of opening up hitherto unexploited fisheries and fishing grounds; and understanding the various factors that will enable fishing to be carried out along scientific lines to maintain the maximum sustained yield.

In occidental maritime countries, where fisheries have assumed an important place in the national economy and planning, extensive fishery investigations are being carried out. The biologists investigate the life histories of fish where and when they spawn, factors affecting their hatching, survival and growth, their migrations and conditions determining their number. Investigations have also been directed toward finding out how many fish there are of different kinds, what determines the numbers in each kind, what part of the stock is removed by commercial fishing and how such fishing affects the numbers in the succeeding generations. The study of populations and the dynamics of production are of basic importance to fisheries management as well as research since it is the numbers which determine whether the industry will be successful or not. Fish populations are notorious for their wide fluctuations and the methods used to take census of fish populations, to determine their mortality in successive years and to learn something of its causes are to some extent peculiar to these animals.

Fishery research is the headlight of fishing industry. The industry can plan and develop its activities on scientific lines only with the help of fishery scientists who will be in a position to provide the necessary advice and information. Recently there is a growing interest manifested by maritime countries of the West in investigating and developing their marine fishery resources. An index of this growing interest is the number of research vessels that has been recently built or vessels converted for carrying out fishery research and exploring new fishing grounds. Through the courtesy of the U.S. Fish and Wildlife Service the author was allowed to participate in one of the cruises of *Albatross III*[1] as a collaborator. The following account of the activities of this research vessel is given as an illustration of the type of work that needs to be undertaken in our waters.

The general plan of investigation to be carried out was to collect information necessary to maintain and increase the production of the fisheries of the Northwest Atlantic. The research was directed at problems of immediate and particular values to the fisheries and those which were to receive

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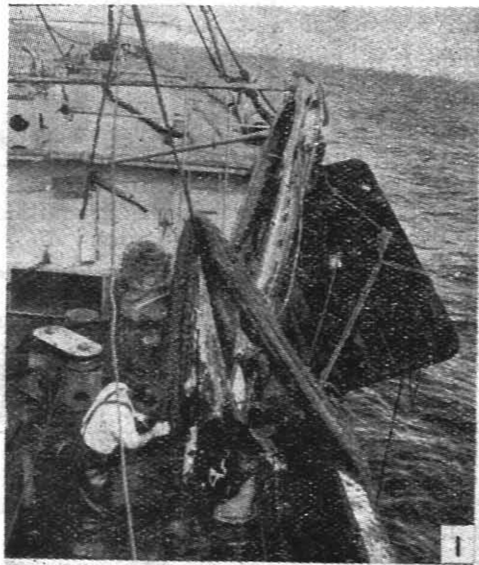
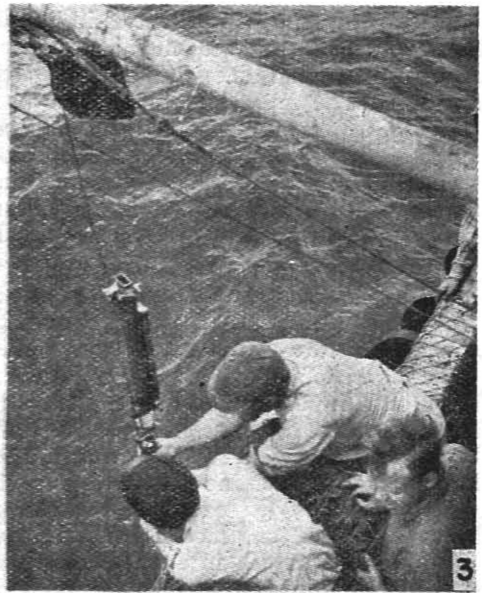
[1]The author wishes to express his sincere thanks to the authorities of the U.S. Fish and Wildlife Service and particularly to Dr. William F. Royce for the privilege of making this cruise on *Albatross III*.

immediate attention included: (1) census of fish populations of the New England banks, (2) examination of the effects of otter trawling on the bottom, (3) improving the fishing gear and (4) improving methods of handling and preserving fish.

ment is about 525 tons. She had on board a complement of seven scientists and three collaborators. There are two laboratories on the main deck, the wet laboratory suitable for handling and examining fish and also used for chemical and hydrological work. The dry





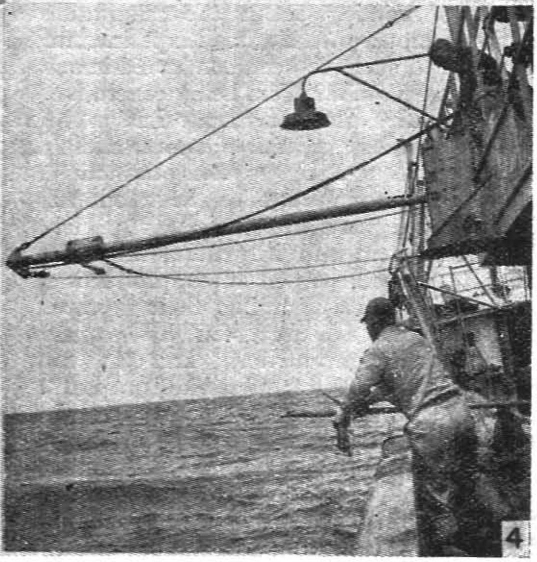


Photo 1. The cod end of the Iceland trawl being hauled up.
„ 2. Scientists working on the fish caught.
„ 3. Getting ready to lower the Nansen reversing water bottle.
„ 4: The bathythermograph being taken in.

Albatross III, powered by a 805 horsepower diesel engine, is 179 feet long, has a beam of 24 feet and draft of 12 feet. Her displace-

laboratory or library is used as an office for scientists for the preliminary study of the data collected at sea. It also contains the essential reference books. The ship provides comfortable living quarters for the operating crew as well as the scientific personnel.

A detailed schedule of the cruise was prepared beforehand and it included tows half-hour long from hook-up to start of haul back at 10 fathoms and in the same direction as the current, when possible, using Iceland trawl with rollers and without V.-D. gear[2] (Photo. 1) Counts or accurate estimates of the numbers of fish of each species in each tow were obtained. Measurements of commercially important[3] and other species, weights and lengths of all species caught and collection of scale samples from selected species (Photo.2) were made. Tagging operations were conducted when lively haddock were caught. These, together with collection of plankton[4] were some of the important activities on board. Position at start and finish of haul, duration of haul, nature of bottom, depth, direction and force of wind and current, weather conditions and speed of the boat were all recorded in Trawl log sheets. In addition to these, certain hydrological data were collected with the aid of such instruments as the Nansen reversing water bottle (Photo. 3) and the bathythermograph (Photo.4). The latter is an ingenious device used to obtain a record of temperature as a function of depth. The temperature sensitive part activates an element that moves a pen resting against a small smoked-glass slide, which in turn is moved by a pressure responsive element. As the instrument is lowered into the water and raised again, the pen traces temperature against pressure (hence depth). This instrument has the great advantage that it can be used at frequent intervals while under way, and thus a detailed picture of the temperature distribution can be rapidly obtained. These readings were taken at or near each trawling station and about every ten miles on run between stations. With the aid of the Nansen reversing water bottles it is possible to collect water samples at required depths and also to ascertain the temperature at that particular depth at the time of collection of water. The bottle is attached to a wire rope by means of two clamps and lowered to the desired depth. When the bottle is lowered it is so constructed that water can pass through it. Then a messenger (it is essentially a weight drilled out so that it will slide down the wire rope) is sent down the rope, it strikes the release and the bottle falls over and turns through 180 degrees (hence called the reversing water bottle). Simultaneously it shuts the valves on either ends by which device about 1200 cc. of water of that particular depth is trapped in the bottle. The sample thus collected is used for the study of its chemical and physical properties. During the reversal the temperature at that depth is registered in a special type of thermometer attached to the bottle. When more than one such bottle is used the first messenger, after reversing the bottle, releases another messenger that will be attached to the lower clamp of the first bottle before lowering. This closes the next lower bottle, releasing a third messenger and so on. The data collected through these sources were entered in the necessary forms and brought back to the shore laboratory for detailed study.

As a result of this cruise for nine days, 42 stations distributed over an area of approximately 20,400 square miles were surveyed and several rich fishing grounds were located. This information was made available to the industry so that commercial fishing vessels might take advantage of it.

Outlined above briefly are some of the aspects of fishing bank investigations as they were done by the U.S. Fish and Wildlife Service in 1948. It may not be possible to adopt *in toto* the various techniques and equipments used in other countries but as the fundamental principles underlying fishery investigations are the same every where, the type of investigation mentioned in this article *mutatis mutandis* should be begun in our waters for a proper understanding of the various problems relating to marine fisheries, exploring new fishing grounds and assessing the magnitude of the resources. While discussing the need for studying normal patterns in fishery biology Walford (1948) has correctly drawn attention to the fact that unfortunately it is the anomalies and not the norms which attract public interest to provide funds for research. He says: "Thus it seems to be generally true that such an understanding as we have about our fishery populations results not so much from research pursued systematically to learn normal patterns as it does from investigations of anomalous

2 This is the Vigneron-Dahl modification of the otter trawl introduced in 1923. In this the bridles or ropes attached to the trawl net are given a wider sweep, so that they herded or scared more fish into the net.

3 All marketable fish were dressed and stored in ice, after the scientists have finished with them, to be brought back to shore for sale.

4 Animals and plants floating more or less passively with the current and hence at the mercy of the prevailing water movements. A study of these organisms is very essential as they constitute directly or indirectly the food upon which all larger marine animal life depends.

or otherwise unsatisfactory conditions needing relief." Any investigation relating to fisheries should be an integrated and continuing programme designed to determine the patterns of normal life production of marine organisms especially those that are of direct interest to fisheries to provide useful and necessary information for the present as well as the distant future. The programme should include biological, hydrological and other related studies for it has been well established that the individual species should not be considered as an entity in itself without considering its relationship to both the animate and inanimate environments. In the beginning work may have to be predominantly biological and largely fundamental, since the requisite basic knowledge has to be acquired before it can be applied. A beginning has already been made in this direction at the Central Marine Fisheries Research Station.

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ROGER BACON AND HIS SEARCH FOR A UNIVERSAL SCIENCE

IN the history of science and of scientific thought, Roger Bacon, the thirteenth century English Franciscan friar, represents a unique character, with hardly any parallel, about whom scholars have held and still hold divergent and conflicting views. In the 16th century, Roger Bacon was usually regarded as a necromancer, black magician and alchemist interested in many secret arts and sciences, of which a familiar example is found in the play 'Robert Green' composed about 1592. According to Thorndike, Gabriel Naudé was perhaps the first to draw attention to the scientific originality of Bacon's writings and thoughts, in 1625. Jebb, in publishing in 1733 the complete edition of *Opus Majus*, Bacon's *magnum opus*, also tried to establish Bacon as a scientist of great genius. Efforts of these early scholars not only succeeded in discovering the scientist in Bacon and restoring him to the world of intellectuals to which he properly belongs, but started an entirely opposite current of thought even depicting him as a harbinger of modern experimental science. The researches of J. S. Brewer, J. H. Bridges and others during the nineteenth century and of Emil Charles, Robert Steele, A. G. Little, Lynn Thorndike, C.B. Vanderwalle and other Baconian students in the present have thrown a flood of light on Bacon, making it possible to form a far more correct estimate of his life and character, his writings and contributions and his place in the history of scientific thought. Even to-day Bacon has remained a controversial figure that he has always been, some historians regarding him as an outstanding modernist and a 'martyr of science' and others holding a more reserved and less enthusiastic view, but all maintaining the exceptional nature of his writings and thoughts which easily single him out from his thirteenth century contemporaries.

That interest in Bacon has by no means abated is evident in Dr. Easton's new study*, in which an attempt has been made to understand the Franciscan friar in the light of latest researches. With the whole corpus of writings on Bacon before him, Dr. Easton has justifiably adopted a cautious and critical attitude, not wanting in sympathy, carefully weighing every evidence, opinion and statement, before forming his own estimate of this puzzling character. He has worked on the assumption that 'he (Bacon) cannot have been unique, and that his originality, as, indeed, all human originality, has rested on his treatment of materials familiar to large numbers of people in his time. As a thinker he may have been original, but he was only unique in the sense that all thinkers are unique'. Moreover, Bacon has to be understood against the intellectual background of the thirteenth century Europe and against the full set-up of the failures and successes of his own personal career as a student, as a teacher and as a friar in the Order he chose. Alive to this necessity, the author has very successfully kept this back-

*Roger Bacon and His Search for a Universal Science—by Dr. Stewart C. Easton. Published by Basil Blackwell, Oxford. pp. 255. Price 25 sh. net.