

THE IMPORTANCE OF EXTENDED SCIENTIFIC INVESTIGATION.

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We meet here as members of a government that within less than three decades has not only revolutionized the methods of fish-culture, but has preserved to its several States, inland as well as seaboard, an industry yielding an annual income of over \$45,000,000; a government which now maintains for the propagation of its fishes a fleet of steam and sailing vessels, more than a score of liberally equipped hatching and breeding stations, and which gratuitously issues to those unable to inspect its work a series of publications of great value to practical fishermen, of vast importance to the fish-culturist, and of sterling worth to the scientific world. The names of Baird, Verrill, Goode, and Ryder are familiar in every college and university, and their well-worn publications are conspicuous in biological laboratories from Italy to Scandinavia, and from Liverpool to Tokyo. Abstracts from reports of the United States Fish Commission form a considerable proportion of the last annual of the British laboratory at Plymouth, England, and other governments have frequently sent commissioners to inspect our hatcheries and acquaint themselves with American methods of work.

We should be careful, however, lest the consciousness of a successful past act as a sedative for the present. The lines of research wisely indicated by the founders, I might rather say founder, of American fish-culture should be assiduously followed, and the bypaths explored. The excellent reports of the one lately in charge of the Division of Fishery Methods and Statistics of the Commission—the secretary of this Congress—give an annual guarantee of the work actually accomplished and prove beyond peradventure that the Commission is not only self-supporting, but that the fisheries under its assistance are of rapidly increasing importance.

The introduction of the shad into the Pacific has yielded an average income of approximately \$20,000, and the shad industry of the Atlantic, an industry yielding \$2,000,000 annually, owes its continuance, if not also its existence, to the efforts of the United States Fish Commission. The planting of cod fry upon the coast of New England has replenished the waters of the east, and it is a fact that the fish were so plentiful in Narragansett Bay during the past autumn that nets could not be drawn, and the neighboring markets became overstocked.

The intelligent propagation of the cod rests upon the scientific work of Professor Ryder. Successful shad raising is largely due to the researches and devices of Commissioner McDonald. The life-history of the oyster was practically unknown until worked out by Professor Brooks. The migrations of the menhaden were unexplained before the researches of Dr. Peck. The work of Professor Libbey bears directly upon the question of distribution of the mackerel, and I venture to predict that successful

sponge-culture will follow upon the continuation of the work begun at Woods Hole by Prof. H. V. Wilson. A continuance of these and similar lines of research is an absolute necessity for the growth and development of the more immediately practical work of propagation and distribution.

The collection and distribution of seeds is not the only function of the Department of Agriculture. This Department maintains a corps of scientific workers at home and abroad, and there is not a State, county, town, or hamlet that is not directly benefited by the results of its organized system of acquiring and diffusing knowledge. The efforts of the United States Fish Commission have been along similar lines and have yielded grand results, but the possibilities of the development of the fish industry have scarcely been indicated.

For some years the starfish have wrought havoc among the oysters of the colder water of our coast. The fishermen have laboriously "mopped" the "beds" with tangles of cotton waste, but have remained quite ignorant of the life habits of their enemy. A brief scientific study of the subject, however, has revealed many facts which point toward a possible, if not a probable, early correction of the evil. It has been found that the young, almost microscopic, gather in a narrow band along the shore, hidden in the eelgrass, where they may be killed off by the thousand with little labor and slight expense. Each oysterman, quite unwittingly, has been actually supporting, immediately around his oyster-bed, a nursery for the propagation of his enemy, the starfish.

In one direction in particular there is crying need of both extended and extensive scientific research. I refer to a matter that received some attention at the Chicago congress, namely, that research which shall result in the *development of the market* for food-fish. I think I do not overstate the fact when I say that there should be three times as much fish consumed as is consumed at the present time. The problem is not alone how shall we produce more fish, but how shall we improve the industry by providing a better and a more stable market for what is already produced. I feel that the fisherman and the fish-dealer are in a measure responsible for the fact that the average American can not endure fish oftener than one day in seven, and were it not for a wise provision of the church perhaps one day in seven would be far too frequent. While the dressing and shipping of meat and poultry has become almost an art, the methods of dressing and handling fish are crude in the extreme.

The abuse of fish as an article of food begins at the moment it is captured and extends to, and often beyond, the kitchen. I need not relate the rough handling on board the smack, the careless packing, and the slovenly condition of our markets; these are all prejudicial to the consumer as well as to the fish; but I wish to emphasize the fact that they are also sources of great loss to the dealer.

The blood that is ordinarily allowed to remain in the fish is the very medium that the bacteriologist uses for the culture of microbes, and its retention in the body of the fish provides the very medium in which the germs of decay delight. Should the fisherman bleed the fish immediately on its capture he would do much toward its reaching the consumer in a healthy condition.

The digestive organs of the fish are very active, and its processes of digestion continue after death; but while before death the contents of the alimentary tract are alone acted upon, after death the digestive ferments attack the surrounding tissues, and they attack these tissues with great energy. A few minutes is often sufficient

for the deterioration of the flesh immediately inclosing the abdominal cavity. It would be a great saving to the dealer if the fish could be disemboweled and thoroughly washed as soon as captured.

Decay is practically an infectious disease. It is the direct result of the activity of certain microscopic organisms. If these organisms have difficulty in entering the tissue of the fish, or if their activity is inhibited through the application of cold or certain chemicals, the process of decay is retarded. Every time a fish is roughly handled, thrown upon the deck or pitched about as so much offal, walked upon or bruised in any way, the continuity of its flesh is broken and decay germs flood into the rupture. The slightest bruise of an apple or pear results in the formation of a center of decay quite visible to the eye. In the fish the center of decay is not so easily detected by the eye, but it is nevertheless present, and its presence is damaging to the dealer and disappointing to the consumer.

Animal tissue absorbs water very readily, but on the absorption of water it changes its structure, loses its flavor, and rapidly deteriorates. Fish should not be allowed to lie in their own slime on wet floors, or in poorly drained barrels and boxes.

The present method of shipping fish by the use of chopped ice is crude, expensive, and often ineffectual. Poultry, meat, or anything but a fish would find no market if shipped in a similar way: The fish arrive at their destination in a thoroughly uninviting condition, they are reeking with slime and filth, ghastly to the sight, offensive to the smell, and disgusting to the touch.

If the retailer, along the coast as well as inland, can be provided with fish that have been properly killed, skillfully cleaned, and carefully handled he will be in a position to present them to his customers in an attractive form, and the consumer will discover that all fish do not taste alike, which is synonymous with saying, all fish are not equally bad.

While urging that all lines of research already undertaken by the Government should be continued, I would suggest that a definite series of experiments be instituted which shall ascertain the best methods of preparing, packing, shipping, storing, and retailing fish, for I am convinced that improvements are possible along all these lines, and that with improvement the demand for food-fish will be very materially increased. Such an investigation, moreover, is eminently appropriate to the United States Fish Commission, since private enterprise can not be expected to experiment unselfishly for the public good.

This opens up another question: When more improved methods have been devised, how shall these, as well as the innumerable improved methods already familiar to the Commission, be brought to the attention of the fisherman?

There is no school, academy, or college, to my knowledge, in the entire United States which gives even one short course in the economics of fish-culture. There are, however, over 1,000,000 men, women, and children dependent upon the fisheries for their existence. The importance of providing instruction in practical fishery has already resulted in the establishment of schools in Norway, Sweden, Germany, and Japan. Dr. J. Lawrence-Hamilton has indicated the scope and outlined the courses for a Fisherfolk's Free Technical School in England, and the late Professor Goode urged the establishment of similar schools in this country. Though the first purpose of such a school should be to instruct, its laboratory would provide opportunities for research, its field equipment would stimulate investigation, and its existence would

guarantee the collection and preservation of scientific data that would be of incalculable value to the fisherman as well as to the dealer.

It is a fact that at present there is not a single institution along our entire coast where one can observe the habits of our marine animals uninterruptedly throughout the year. There is no place where our biologists may go for a few weeks during the winter or early spring, when the ocean is teeming with animal life. The summer months are as the autumn to marine forms, and he who would study ocean life at its best must work in the early spring. The organization or individual that accomplishes the establishment of a permanent institution where instruction in practical fish-culture and fishery economics can be given; where apparatus is provided for the investigation of the lakes, rivers, and sea; where naturalists from our universities and commissioners from our States will be welcome at all times of the year, and where problems of scientific and economic interest can be studied and solved, will obtain what Baird, Goode, and Ryder saw in the distant future, and will combine and control the purely practical and the purely scientific. The need of American biology to-day is the same as the need of successful fish-culture—coordination, cooperation, and the establishment of a station, or the devotion of a station already established, like that at Woods Hole, to instruction and to extended uninterrupted scientific research.

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