



FISHERY TECHNOLOGICAL RESEARCH PROGRAM

Usually, in June of each year, representatives of the fishery and allied industries and personnel of the Technological Section of the Service's Branch of Commercial Fisheries meet in Washington, D. C., to discuss the progress of projects during the past year and to suggest projects for the new fiscal year's program. This year, as a result of program planning for the research initiated under Public Law 466, usually referred to as the Saltonstall-Kennedy Act, the Washington office personnel of the Section and the Chiefs of the four Technological research laboratories met with industry members as the need arose throughout the year to discuss the development of a fishery technological research program for fiscal year 1956. These meetings, together with the continuing contacts with industry at each of the laboratories, supplemented the usual annual meeting and assisted the Service in formulating a sound research program based on national interest.

At the Technological Section Conference of laboratory heads on June 14, 1955, in Washington, D. C., the progress on projects during fiscal year 1955 was reviewed. Then, the technological research program for the fiscal year 1956 was discussed, together with the contracts negotiated as a result of the research conducted under Public Law 466. The basic program thus arrived at, plus the necessary liaison on these research contracts, constitutes the research program for fiscal 1956.

This article consists of:

1. A summary of the progress on technological research projects for fiscal year 1955.
2. A list of reports issued by the Technological Section during the year.
3. A list of the research projects now under contract.
4. The new program for fiscal year 1956.

Technological research is carried out in four field laboratories located in East Boston, Mass., College Park, Md., Seattle, Wash., and Ketchikan, Alaska. The Alaska laboratory is sponsored jointly by the U. S. Fish and Wildlife Service and the Fisheries Experimental Commission of Alaska. University and industrial fellowships are maintained in all laboratories. Limited laboratory facilities are available by contract for university, State, or industry-sponsored projects. Several such projects are now under way at these laboratories. Results of any such research becomes public property and is available to the entire industry.

Part I - Progress on Fishery Research Projects During Fiscal Year 1955^{1/}

NUTRITION:

1. Investigation of the Toughening of Frozen Blue-Crab Meat: There is very little information available to guide the crab-meat packers in proper techniques for the freezing preservation of their products. Attempts to hold blue-crab meat in frozen storage have not been successful except for very short periods. Research on this problem was transferred from the Department of Chemistry to the Department of Zoology at the University of Maryland during the first month of this fiscal year. Two graduate students have been working on the project, spending most of their time investigating the histology of raw, chilled, and frozen crab meat. Since the first student found it necessary to withdraw from the fellowship within a few months, little was accomplished. The second student expects to spend considerable time this summer on the project. Factors he is investigating are the bound and unbound water and normal distribution of minerals and various organic substances of fresh and commercially-processed crab meat.

(College Park)

2. Chemical and Physical Properties of Fish and Shellfish Proteins: Work on a new method for determining cook drip in fresh and frozen fish and shellfish was completed during the year. The method was found to give reproducible results with a good degree of precision.

By the use of this method, it was found that the cook drip from fresh fish increases rapidly with storage time. In the case of frozen fish, it was found that a sharp increase in cook drip takes place immediately after the fish are frozen. The cook-drip values then remain nearly constant when the fish are held in frozen storage.

(Seattle)

3. Determination of Chemical Changes in Fish Protein During Freezing and Storage: Deterioration in quality of frozen fishery products is due, in part, to the fragile nature of meat structural proteins. It has been demonstrated that the major structural protein of fish muscle--actomyosin--is particularly subject to changes generally classified as "denaturation."

In an attempt to gain a better understanding of the adverse effects of freezing and cold storage on the quality of fish protein, resulting changes in the protein structure of the actomyosin fraction of fish muscle are being investigated. A study is in progress of the relationship between viscosity, solubility, and chemical reactivity properties of fish-actomyosin systems that have been subjected to frozen storage. In this manner it is hoped to obtain a clue as to the nature of the change in fish protein resulting from frozen storage.

(Ketchikan)

4. A Comparison of the Nutritive Value of Fish and Meat: During the past several years metabolism trials have been conducted with coeds under a cooperative project with the College of Home Economics at the University of Maryland. A basal diet has been developed containing only ten grams of protein daily. The girls, for a period of 7½ weeks in the fall of 1954, consumed this low protein diet to determine how effectively fish protein compared to beef would replace the protein loss. One group was fed haddock protein in increasing levels. Another group received beef protein at the same levels. Complete collections of excreta and samples of food were taken to determine nitrogen balance. Also, venous blood samples were taken at intervals to determine the relative hematopoietic value of these two protein sources. These results confirm previous reports which indicated no differences in the blood-forming ability of fish protein compared to that of meat.

^{1/}A discussion of the Fishery Technological Research program for fiscal year 1955 (July 1, 1954 to June 30, 1955) appeared in Commercial Fisheries Review, vol. 16, no. 8 (August 1954), pp. 12-26. The city at the end of each project report indicates the Service laboratory that is conducting the work. (The complete address of each laboratory is shown in the Technological Section's Organizational Chart on page 40.)

Analyses of the foods to determine their caloric value are under way at the present time. Information on caloric value is needed to determine the role of calories in the diet on the economy of utilization of protein. This work will be continued.

(College Park)

5. Sulfide Discoloration in Canned Tuna: This is a collaborative project with the Continental Can Company. The experimental work on this project, which was an investigation of the production of iron sulfide discoloration in canned tuna, has been completed. The work will be published in a series of papers, which are now being edited. Work during the past year has shown that: (1) the amount of free sulfide in a can of tuna has no direct relationship to the amount of iron sulfide deposited on the can; (2) the tendency for tuna to cause can discoloration is increased as the length of time that the raw fish are held in cold storage is increased; (3) either free water or free oil must be present in canned tuna before discoloration will take place; and (4) the mechanism whereby elemental iron in the can is converted to the ferrous form is the controlling factor in can discoloration.

(Seattle)

6. Feeding Studies with Gums Extracted from Irish Moss: Gums are being extracted from Irish Moss and derivatives of these could be used in many foods and pharmaceutical preparations. Very little applicable data are available on nutritive value and wholesomeness of these marine-plant products. Such data are required by Federal and state regulatory officials before new products are permitted to be used. Data are also needed to indicate the best use of a natural resource growing in fairly limited areas. The experimental work has been completed, including the histological studies of animals by Dr. John A. Wagner, Medical School, University of Maryland. The first draft of the manuscript has been completed and it should be ready for publication very shortly. A cursory examination of the data indicates that the gums of Irish Moss are wholesome as a food.

(College Park)

REFRIGERATION:

1. Freezing Fish at Sea--New England: Following its annual overhaul, the Service's research trawler Delaware left for its first cruise of the season on June 29. Six cruises were made, during which fish were brine-frozen for studies at the laboratory to determine storage characteristics. Some of the fish were used as raw material for precooked frozen fish sticks in another project. The vessel was transferred to the Exploratory Fishing and Gear Development Section in December. However, since the vessel is still based at the East Boston Fishery Technological Laboratory, it has been possible to obtain various lots of fish, brine-frozen or iced, for continuation of this project. As a result of circumstances in which brine-frozen fish were obtained but no control lots of iced fish of the same species could be prepared, the storage tests that were planned for several varieties of fish were delayed. Only recently have these varieties, such as ocean perch, hake, whiting, and pollock been obtained and placed in frozen storage. It still has been impossible to obtain cod for these tests.

Automatic controls were installed on the absorption refrigeration system aboard the Delaware during the year. Where it was formerly necessary to have an attendant present at nearly all times to operate the system, the automatic controls now make it possible to have the machinery operate for long periods without attention.

(Boston)

2. Quality Standards for Haddock Fillets: A rough draft of proposed voluntary Federal grade standards for frozen haddock fillets was prepared. Further studies on the project were discontinued in favor of work on grade standards for frozen fried fish sticks.

(Boston)

3. Manual on the Refrigeration of Fish: After the assignment of this project to the Boston laboratory, active work on the preparation of this manual was not begun until nearly the middle of the fiscal year. A refrigeration engineer was employed to write certain chapters dealing with

refrigeration machinery, cold-storage plants, freezing operations, etc. The preparation of other chapters has been assigned to certain personnel of the various technological laboratories. Chapters completed in rough draft so far are: 1. Introduction; 2. Historical Background; 3. Cold Storage Design and Equipment; 4. Refrigeration Machinery and Installation; 6. Relation of Physical-Chemical Components to the Refrigeration of Fish; and 7. Spoilage of Fish Prior to Freezing. Due to the press of work on other projects, particularly those initiated with funds resulting from Public Law 466, the remaining chapters are not yet completed. Those portions now in rough draft will be published soon as separate parts of the manual. The remaining chapters will be released as they are completed.

The refrigeration engineer at the Boston laboratory has spent considerable time obtaining background information on the project, conducting tests to obtain technical data on freezing rates for fishery products under various conditions, and other matters pertinent to the project.

(Boston)

4. Cold Storage Life of Fish:

A. STUDIES ON FROZEN PACIFIC OYSTERS: Studies on the freezing characteristics of Pacific oysters are being conducted in cooperation with The Refrigeration Research Foundation.

When using a modification of the AOAC method for determining free liquid in fresh oysters, the following variables showed surprisingly little effect on the amount of drip formed during freezing and thawing: (1) "Cut" or damaged vs. whole oysters, (2) freshness of oysters, (3) blowing time, (4) thawing temperatures, (5) total thawing time. Commercially-frozen oysters were found to have considerably more drip than the experimentally-frozen oysters.

It is believed that the method used may not be measuring the actual free liquid present in the oyster accurately. An attempt is now being made to evolve a more satisfactory method of drip measurement for oysters that have been frozen.

Exploratory work is in progress on the use of antioxidants to preserve the flavor and color of Pacific oysters during frozen storage and to study the problems involved in producing a satisfactory frozen breaded oyster product.

B. COLD STORAGE LIFE OF FRESH-WATER FISH: Studies on the frozen storage life of certain fresh-water fish are being conducted in cooperation with The Refrigeration Research Foundation.

Cold-storage-life tests were completed on 1 batch each of 6 species of fresh-water fish. White bass, yellow perch, and sheepshead after 12 months of storage at 0° F., and crappie after 9 months of storage at the same temperature, showed no significant changes in quality and were rated acceptable to good. Despite initial poor texture and flavor, Utah chub had changed very little during 12 months of storage at 0° F. Lake Michigan chub was found to have received approximately equal protection when frozen covered with water or water solutions of various antioxidants.

Freezer storage studies are continuing on 6 species of fresh-water fish. More extensive work on the frozen storage of lake herring is being outlined for next year.

(Seattle)

PROCESSING AND PRESERVATION:

1. Development and Evaluation of Food Products from Alaska Fish: Progress on this project was limited for the most part to work of an exploratory nature due to the lack of experienced personnel. A home economist, hired for the summer of 1954, prepared and tested several fish recipes to determine their suitability for use as precooked frozen products. Frozen precooked chum salmon pie, chum salmon chowder, clam fritters, clamburgers, crab--Alaska fisherman's style, and crab chow mein were considered worthwhile for additional developmental work. Preliminary trials with precooked halibut steaks indicated that the storage life of such a product would be short and that further developmental work was necessary. Frozen precooked fish sticks prepared from local

cod were found to be of equal or superior quality when compared with commercial sticks prepared from cod from another area. Experimental work was started to determine the canning characteristics

cated that there was a slight, but definite, advantage in the use of the antioxidant.

(Ketchikan)

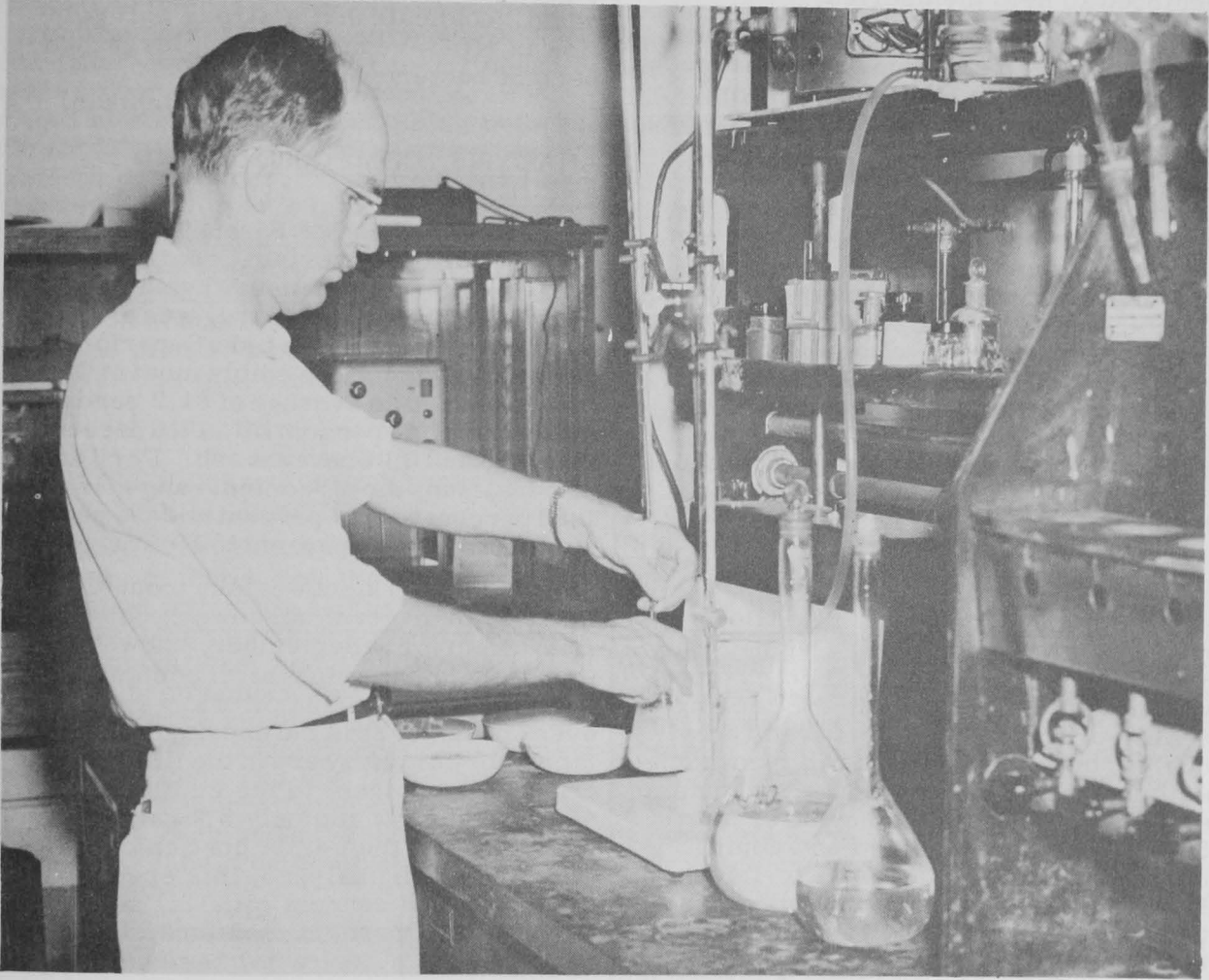


Fig. 1 - Determination of chlorides in a sample of Gulf of Mexico oysters.

of smoked sablefish. No significant differences in over-all quality were found between packs prepared from large (over five pounds) and small (five pounds or under) fish. Further work is planned to improve the soft oily texture of canned smoked sablefish. Storage tests with canned smoked-salmon caviar spread have shown that the spread tends to develop a strong oily flavor. A test series was prepared in which an antioxidant (Sustane 6) was added to the regular spread ingredients as a possible protective agent against the development of the off-flavor. Results of the test indi-

2. Processing Oysters from the Atlantic and Gulf Coasts: Oysters grown along the Gulf and South Atlantic coasts have a distinct, rich, pleasing flavor, but differ considerably in texture and color from those grown on the Northeast Coast. The texture is soft, smooth, and yielding in the fresh state. Because of the soft texture, any manipulation of the oysters on freezing and defrosting tends to disintegrate the meat and increase the drip. These factors have severely restricted the area in which the Southern oyster can be successfully marketed. In spite of the entirely different technological problems

of the Southern oyster industry, there has been almost no study of these problems. The situation is aggravated by the fact that most of the plants are quite small and the operators are less well equipped to help themselves.

Contracts have been negotiated with the University of Florida at Tallahassee; Tulane University, New Orleans; and Louisiana State University, Baton Rouge, La., to conduct work on this project. (See contracts list elsewhere in this article.) Samples of shell stock and shucked oysters have been collected in the South Atlantic and Gulf coasts at monthly intervals since last November. Chemical analyses have been made of these oysters at the College Park laboratory. Preliminary studies indicate a seasonal gain in dried solids, fat, protein, and carbohydrate, confirming a local opinion that the general condition of Southern oysters improved throughout the winter and early spring.

(College Park)

3. Keeping Quality of Chilled Dungeness Crab Meat Packed in Hermetically Sealed Metal Containers: This project was initiated to determine the keeping quality of both fresh and thawed (previously frozen) dungeness crab meat packed in hermetically-sealed metal containers when stored at temperatures above 32° F. The data obtained on keeping quality will provide a basis for formulating government-purchase specifications and for preparing recommendations to the industry.

Organoleptic, bacteriological, and chemical (pH, volatile-reducing substances, and volatile nitrogen) tests have been carried out on crab meat held at 40° F. The experimental work has shown that the storage life of the samples of crab meat which have been studied to date has varied widely among the samples from different plants and even among the samples from the same plant taken on different dates.

To date no determinations, either bacterial or chemical, have indicated imminent spoilage before it is obvious by organoleptic examination.

A short study was made of the effect of the brine-washing procedure, as practiced in a commercial plant, on the bacterial load of the crab meat. Bacterial counts showed that the load was reduced significantly after brining. This would seem to indicate that a strong salt solution is effective in destroying large numbers of bacteria.

(Ketchikan)

ANALYSIS, COMPOSITION AND SPECIFICATIONS:

1. Composition of Fish: The first analyses of the important Great Lakes fish, lake herring (Leucichthys artedi), of which we have any record, was carried out on samples taken in Lake Superior in December 1954. The edible meat of these fish contained an average of 81.2 percent moisture, 1.48 percent oil, 17.0 percent protein, and 0.99 percent ash. For 16 individual fish, the oil content ranged from 0.86 percent to 2.87 percent and the protein content from 15.6 percent to 19.5 percent.

Analyses on siscowet lake trout (Cristivomer namaycush siscowet), caught in Lake Superior in September, showed these fish to contain the highest oil content and the lowest protein content of any species ever encountered in the experience of this laboratory or anywhere in the literature. One fish contained, in the edible portion, 49.3 percent oil and only 5.9 percent protein. For the edible portion of 10 individual fish analyzed, this species averaged 24.9 percent oil, 13.1 percent protein, 62.1 percent moisture, and 0.84 percent ash.

Proximate composition was determined for 16 species of trash fish taken in the Gulf of Mexico as a part of the study of their suitability as fur-animal food.

The study of the variation in chemical composition of fish with the area in which the fish was taken was continued using sheepshead (Aplodinotus grunniens) as the test species. Sheepshead obtained from Midwest lake and river sources are being used for this comparative study. The composition, especially the oil content, showed wide variation, depending upon the source of the fish.

(Seattle)

2. Determination of Oil in Fish Meal:

A series of experiments was started to determine the value of a modified acetone extraction procedure for extracting oil from fish meal. This method, developed previously, involves use of a mixture of acetone and water for the oil extraction. The samples of freshly-prepared cod-fillet-waste meal and herring meal were stored and the oil content determined at storage intervals, using both the modified and the usual acetone extraction procedures. The modified procedure proved to be superior for extraction of oil from both of these meals. The modified procedure will now be tried on a meal prepared from some species of fish which contains a highly unsaturated oil. It is planned to carry out this experiment this fall, using pilchard meal.

(Seattle)

3. Fish Sticks--Storage Characteristics and Quality Standards:

A. STORAGE CHARACTERISTICS:

Only very recently have the producers of the popular fish stick had to worry about storage problems. Under present competitive conditions, some processors now have been reporting a considerable inventory of the product. Studies on the storage life of variously-prepared commercial packs of cod and of haddock fish sticks and of laboratory-prepared fish sticks have been under way for almost a year and should be completed by September 1955.

The studies indicate that only lean fish may be used for sticks if an extended storage life is desired. Pollock, ocean perch, and possibly other intermediately oily fish may be used for the institutional trade that involves a rapid turnover. No significant differences have been discerned in storage life of fish sticks attributable to the various commercial breeding materials tested. The overwhelmingly important factor in determining the storage life and acceptability of fish sticks has been found to be the quality of the fish-fillet block used for preparing the sticks. The quality of the fish-fillet block is determined by: (a) freshness of the fillets used for the block; (b) adequate packaging of the block to protect the quality; and (c) the time the blocks are in frozen storage.

Losses during the processing of fish sticks may be minimized by: (a) rigid and exacting requirements as to the dimensions of the blocks; (b) development of a standardized block which would require the minimum number of cuts to produce the fish sticks; (c) use of a saw blade properly designed to minimize sawdust; (d) or reducing the sawing of fish blocks to an absolute minimum by substituting machines which guillotine or score the fish blocks into fish sticks; (e) use of short cooking times at high oil temperatures; (f) continuous clarification of cooking oil by recirculation through a filtering mechanism; (g) removal of excess batter prior to breading the fish sticks to prevent lump-formation in the breading mechanism; and (h) removal of loose breading from fish sticks to prevent accumulation of charred breading in the hot cooking oil.

B. VOLUNTARY GRADE STANDARDS:

A draft of Proposed Voluntary Standards for grade and Condition of Frozen Fried Fish Sticks was completed and submitted to the fishing industry for review and comment.

C. OBJECTIVE TEST FOR STANDARDS DEVELOPMENT: Chemical methods of determining the amount of breading on frozen fish sticks seem to be ruled out at this time. The chemical composition of the fish and sticks does not seem to suggest any special characteristics of each which could be used as a basis for an analytical method. Further study will be made to apply physical methods of separating the breading and the meat so that a percentage evaluation can be made.

Preliminary tests have been carried out on the possible application of x-rays in the detection of bones and voids in fish blocks and for the detection of bones in fish fillets.

A research contract has been given to the Massachusetts Institute of Technology for studies on the development of new objective tests for quality of fresh and frozen fishery products.

D. PRODUCT STANDARDS: The development of voluntary Federal standards for frozen fish blocks and frozen ocean perch fillets has been assigned to this laboratory. Very preliminary work has been started on the fish-block standards.

(Boston)

4. Preparation and Storage Characteristics: A study was made of the changes that occur during frozen storage at 0° F. in both raw and fried fish sticks experimentally made from orange rockfish (Sebastes pinniger) and commercially made from Pacific halibut (Hippoglossus stenolepis), Atlantic cod (Gadus morhua), and Pacific cod (Gadus macrocephalus). At intervals during the frozen storage tests the raw fish sticks were cooked in deep fat and the fried fish sticks were heated in the oven prior to serving. Organoleptic examinations made over a period of 33 weeks indicated that: (1) orange rockfish sticks acquired an undesirably strong fish flavor after four weeks of storage; and (2) the storage life of the commercial fish sticks mentioned above depended to a large degree on their initial quality. Fish sticks that had high initial quality were still good in quality at the end of 33 weeks of storage at 0° F.

A. VOLUNTARY GRADE STANDARDS: Work was started on April 1, 1955, to study the development and application of voluntary standards of grade and condition in the production and distribution of selected fishery products on the Pacific Coast. Initial studies have included the application of the proposed voluntary standards for fish sticks and specific problems in Pacific Coast production related to differences in the quality of precooked fish sticks. After a survey of the fish-stick production facilities and problems on the Pacific Coast, laboratory work was started on these two phases of fish-stick production and distribution problems: (1) Storage tests, at 0° F., of precooked fish sticks produced from Pacific cod (Gadus macrocephalus); and (2) Study of qualitative changes in the frying oil during production, and the effect of these changes on the quality of the product.

An initial study of tuna at different stages of spoilage is in progress at the Seattle laboratory. A separate study of the reliability of certain objective chemical tests for determining the freshness of fish was started in May 1955, under a research contract with the School of Fisheries, University of Washington, Seattle.

(Seattle)

5. Quality Standards: The Service has been requested by the fishing industry to

investigate the possibility of developing quality standards for certain fishery products. This project is part of the Service program for the development of voluntary Federal standards of grade and condition for fishery products. Standards are needed to facilitate marketing and to improve the general quality of fishery products. A staff member of the College Park laboratory has been studying the requirements for these standards and gathering background on the methods for and needs of an inspection and grading service. Background information essential to the training of graders of fishery products is also being accumulated.

(College Park)

6. Investigations of Canned Maine Sardines: This research study was sponsored by the Maine Sardine Tax Committee through a contract with the Service. The purpose of the project was to carry out research and compile technical data for the development of standards of grade for canned Maine sardines ($\frac{1}{4}$ -oil pack) and for the improvement of inspection methods and packing processes. A set of Proposed Standards of Grades of Canned Maine Sardines was prepared and accepted by the Tax Committee. Data were collected for six packing procedures used by the Industry and used as a basis for the development of the standards. In addition, the data obtained indicated: (a) the optimum fill-in weights of fish and oil; (b) that the salt used by the industry was entirely satisfactory; (c) that under normal conditions sardines handled without refrigerated brine should be packed and processed within 24 to 30 hours after they are landed aboard ship. Tests to determine suitable processing time in retort are in progress. The Service phase of the project was discontinued at the end of the contract period (April 1955). Standards work is being continued by the Maine Sardine Industry at its Research and Quality Control Laboratory in Orono, Maine. During the next fiscal year the standards will be applied on a voluntary basis as a control measure to evaluate the quality of products being produced and to encourage production of high-grade products.

(Boston)

8. Federal Specifications for Fishery Products: Work was carried out on the following specifications as indicated:

PP-S-311 Shrimp, Canned; and PP-S-316a Shrimp, raw and cooked; chilled and frozen. The specifications were developed and issued as Interim Federal specifications.

PP-C-516 Crab Meat, Fresh and Frozen. The proposed revision was prepared and is ready for industry review and consideration for preparation as an Interim specification.

PP-C-651 Crab Meat, Canned. The proposed revision was prepared by the Service and submitted to the Quartermaster Food and Container Institute for incorporation of Armed Forces general and packaging requirements.

PP-S-516 Sardines, Canned. The proposed revision was prepared and submitted to the QMF&CI for incorporation of Armed Forces comments. Copies were distributed to the fishing industry for preliminary review.

PP-O-951 Oysters, Canned. Data are being collected by the Service laboratories for use in developing the Federal specification.

(Boston)

INDUSTRIAL FISHERY PRODUCTS:

1. Vitamin Content and Nutritive Value of Industrial Fishery Products: The mixed feed industry has been concerned about possible variations in nutritive quality since these may be directly related to the performance of their product, which must be guaranteed to the poultry or swine feeder. Research is needed to determine factors affecting the nutritive quality of fishery industrial products, such as fish meal, fish oil, condensed fish solubles, and homogenized condensed fish. A considerable number of bio-assays have been conducted during the past year to determine the relative quantity of unidentified growth factors in fish meals, condensed fish solubles, and dried solubles. The data have not yet been summarized for publication and the work is continuing. A limited number of chick-feeding tests have been completed during the past year to determine whether processing factors may be responsible

for apparent variations in nutritive quality of various lots of fish meal. In addition, contracts have been let to a number of institutions to do research on various phases of this project, particularly feeding studies with chickens and swine, to determine if variability in nutritive quality exists. Chemical evaluation analyses will be made on many samples, either produced in a portable reduction plant under closely-controlled conditions, or taken by staff members from regular production of known history in commercial plants.

(Seattle and College Park)

2. Quality Index of Fish Meals: A literature review on factors that may affect the quality of processed feeds is being compiled. This review was undertaken to obtain information that will aid in the development of methods of analysis that will indicate the nutritive value of fish meal. Resumes of approximately 300 articles have been prepared, and about 100 more will be abstracted later. The following parts have been prepared in preliminary form:

- Part I. Factors that affect the overall nutritive value of a product.
- Part II. Factors that affect the digestibility of a product.
- Part III. Effect of raw material on the quality of the product.
- Part IV. Protein and its relation to the quality of the product.
- Part V. Amino acids and their relation to the biological and nutritive value of the product.
- Part VI. Fats, fatty acids, and their relation to the quality of the product.
- Part VII. Effect of processing methods on the quality of the product.
- Part VIII. Effect of storage on the quality of the product.
- Part IX. Methods applicable to the determination of the nutritive value and quality of a product.

When the literature survey and critical review are completed, the material will be published.

Preliminary work was started on the use of oil extraction of fish meals as a

possible method to indicate the quality of the meal. The question to be answered is whether the decrease in the amount of ether extractives, which occurs during prolonged storage, is an index of a change in the nutritive value of the meal. These determinations are to be continued over a long storage period, and the results correlated with nutritive value as determined by chick tests.

(Seattle)

3. Nutritive Value of Fishery Products for Feeding Fur Animals: Several samples of small fish taken in shrimp trawls and from other sources have been analyzed to determine proximate composition and thiaminase content. Feeding studies with rats have been continued throughout the year to determine the nutritive quality of menhaden press cake. Up to the present time, three generations of rats have been raised on a diet consisting of menhaden press cake, cabbage, and a high calorie diet made up of starch, fat, and cod-liver oil. No difficulty in handling the animals has been experienced with feeding of the frozen press cake. During this summer, the thiaminase content of whole menhaden and menhaden press cake will be determined. Thiaminase, if present, must be in rather small concentrations since cabbage has been the only source of thiamin in the diet consumed. The data from these feeding tests are needed to determine the value of these products for feeding fur-bearing animals, particularly mink. The sources of animal protein for fur-bearing animals have traditionally been horse meat and certain beef organs. These are now in very short supply so the fur farmers are looking for fishery products that can supply their needs.

(College Park)

4. Production of Dried Solubles: For the past three years, research has been undertaken on the production of dried solubles. Dried solubles have been prepared, with and without additives, using for raw materials approximately 30 samples of commercially-prepared condensed menhaden solubles. It was found that none of the dried solubles was entirely satisfactory, since all were hygroscopic and caked during storage. Approximately

one-third of the samples could be processed into dried solubles that had a reasonably good storage life when packed in multi-wall paper bags. A statistical analysis of data is now under way to determine factors affecting the quality of the end products. The experimental work has been completed and the data will be summarized for publication within the next few months.

(College Park)

5. Proximate Composition of Marine and Fishery Products of Alaska: The proximate composition of samples of Alaska shrimp waste, sablefish, herring, cutthroat trout, sealion, whitefish, and of experimental feeding rations from the Experimental Fur Station at Petersburg have been reported. There has been considerable interest this year concerning the possibility of using sea lions for fur-animal feeding purposes. At the request of a large fur-farm operator in Wisconsin, four sea lions were obtained and the proximate composition of samples of meat, liver, and blubber was determined. Analyses for riboflavin, niacin, and vitamin B₁₂ are currently being conducted at the Seattle Technological laboratory on samples of the liver and meat. Mineral constituents such as iron, calcium, phosphorous, and iodine are currently being determined on samples of Alaska shrimp waste and seaweed (Fucus sp.).

6. Study of Pharmaceutical and Other Industrial Products from Salmon Eggs: THE FATTY ACIDS OF SALMON EGG OILS: The component fatty acids in the oil from salmon eggs have been determined. Forty-six percent of the fatty acids are 20 and 22 carbon atoms in length with 3 to 6 double bonds. One-third of the total oil in the egg is present as uncombined oil. It consists primarily of the triglycerides of the fatty acid and contains most of the color. The other two-thirds of the oil is very tightly bound to the protein and is 50 percent phospholipid material, probably mostly lecithin.

Commercial methods of preparing oil and meal from salmon eggs have been investigated. Enzymatic digestion followed by solvent extraction has given promising results in the laboratory. This process will be investigated further during the

next year. Samples of defatted egg meal have been prepared for fish and poultry-feeding studies.

7. Utilization of Waste Materials from Fish Frozen at Sea: A lot of approximately eight tons of frames and viscera from round brine-frozen haddock was processed into fish meal at a commercial plant, using the wet reduction process and hot-air drying. The yield of meal was 18.2 percent. A similar lot of waste was processed commercially, using the dry reduction process and vacuum drying. In this instance the yield of meal was 19.5 percent. No particular problems were encountered in processing these lots of waste from brine-frozen fish over those normally encountered in usual reduction-plant operations. Several lots of meal have been prepared from waste from brine-frozen haddock by a solvent-extraction process. The waste from brine-frozen ocean perch, whiting, and cod has also been processed into meal on a laboratory scale. Statistical analysis of the data from the feeding of these haddock-waste meals to chicks will be completed shortly. The nutritive value of other fish-waste meals similarly tested is being evaluated.

(Boston and College Park)



Fig. 2 - Microbiological assay of fish meal samples for B vitamin.

8. Vitamin Analyses of Fish Meals and Other Fishery Products: Except for preparation of the final report, this project has been completed. During the year analyses of protein, oil, moisture, riboflavin, nicotinic acid, and vitamin B₁₂ have been carried out on 30 samples of herring products, 13 of menhaden, 64 of salmon, 28 of tuna, 8 of mackerel, 6 of crab, and 8 of miscellaneous species.

A comparison was made of the vitamin contents of fish solubles prepared in four different ways. A sample of drum-dried solubles prepared by a non-acidified process and containing the original oil showed no loss of riboflavin or nicotinic acid. When oil was separated from the solubles, the oil contained a high proportion of the nicotinic acid. The drum-dried solubles contained more of the vitamins than did solvent-dried solubles.

(Seattle)

9. New Products from Fish Oils: Work on the separation and purification of fish-oil fatty acids by the urea-fatty-acid-complex procedure is continuing. The procedure has been applied to the separation of poly-unsaturated fatty acids (iodine value 350) from salmon-egg oil and also to the separation of hydrogenated salmon-egg-oil fatty acids. The fatty acids obtained from these separations are being used in the preparation of new chemical products, including long-chain alcohols, halides, and silicone derivatives.

A report on the preparation of silicone derivatives from long-chain fatty acids is being prepared for publication.

(Seattle)

10. New Uses for Fish Oils: This project began in March 1955. The first work carried out concerns the separation of glyceryl ethers present in the unsaponifiable fraction from fish-liver oils, especially dogfish-liver and ratfish-liver oil. The principal glyceryl ethers occurring in liver oils are batyl alcohol, chimyl alcohol, and selachyl alcohol. Recent published reports indicate that the glyceryl ethers, particularly batyl alcohol, may have definite uses as pharmaceuticals.

A new method for obtaining the individual glyceryl ethers has been developed, based upon their ability to form urea complexes. This work is nearing completion, and a report will be prepared in the near future.

(Seattle)

11. Unidentified Growth Factors: The preparation of concentrates of the unidentified growth factors in fishery by-

products was continued during the year. The concentrates were assayed by use of both rats and micro-organisms. Concentrates prepared from menhaden meal gave good microbiological growth response.

Experiments designed to evaluate the growth effects of the inorganic substances present in the unidentified-growth-factor concentrates are being started.

(Seattle)

Part II - Reports by the Technological Section During Fiscal Year 1955

COMMERCIAL FISHERIES REVIEW:

Cold-Storage Life of Fresh-Water Fish-- No. 1, by D. T. Miyauchi, vol. 16, no. 9 (September 1954), pp. 18-20 (Sep. 377).

Vitamin Content of Fishery Byproducts: Part 2 - Vitamin B₁₂ in Pacific Sardine (*Sardinops caerulea*) Organs and Riboflavin, Nicotinic Acid, and Vitamin B₁₂ in Albacore Tuna (*Germo alalunga*) Organs, by Neva L. Karrick, vol. 17, no. 2 (February 1955), pp. 8-11 (Sep. 373).

Freezing and Cold Storage of Pacific Northwest Fish and Shellfish: Part IV - Storage Characteristics of Four Species of Salmonidae, by M. Heerdt and M. E. Stansby, vol. 17, no. 3 (March 1955), pp. 13-17 (Sep. 395).

Determination of Cook Drip in Pacific Ocean Perch (*Sebastes alutus*) and Pacific Oysters (*Ostrea gigas*) by Use of a New Method, by William N. Sumerwell, vol. 17, no. 3 (March 1955), pp. 18-21 (Sep. 396).

Weight Range, Proximate Composition, and Thiaminase Content of Fish Taken in Shallow-Water Trawling on Northern Gulf of Mexico, by Charles F. Lee and William Clegg, Technical Note No. 31, vol. 17, no. 3 (March 1955), pp. 21-23 (Sep. 395).

How to Cook Frozen Fish Without Prethawing: Part I - An Attempt to Determine the Optimum Internal Temperature for Baked Frozen Halibut Steaks, by Kathryn Osterhaug and Marian MacFarlane. (Scheduled for publication in 1955.)

Freezing Gulf of Mexico Shrimp at Sea, by John A. Dassow, vol. 16, no. 7 (July 1954), pp. 1-9 (Sep. 373).

Keeping Quality of Chilled Dungeness Crab Meat Packed in Hermetically-Sealed Containers, by Clarence J.

Carlson, vol. 16, no. 11 (November 1954), pp. 20-21 (Sep. 385).

Chemical Changes in Fish Protein During Freezing and Storage, Harry L. Seagran, vol. 16, no. 12 (December 1954), pp. 13-14 (Sep. 387).

Preparation of a Smoked Salmon Caviar Spread, by Clarence J. Carlson, vol. 17, no. 1 (January 1955), pp. 13-15 (Sep. 391).

Keeping Quality of Chilled Dungeness Crab Meat in Hermetically-Sealed Containers, by Louise A. Carle and Lydiane Kyte, vol. 17, no. 2 (February 1955), pp. 12-13 (Sep. 394).

Study of Pharmaceutical and Other Industrial Products from Salmon Eggs, by Robert M. Kyte, vol. 17, no. 2 (February 1955), pp. 14-15 (Sep. 394).

Proposed Method for Estimating Amount of Solubles Added to Whole Fish Meal, by Charles F. Lee, Technical Note No. 30, vol. 16, no. 9 (September 1954), pp. 21-23 (Sep. 378).

Metabolism Trial to Determine Comparative Nutritive Value of Fish and Meat, by Hugo W. Nilson, vol. 17, no. 2 (February 1955), pp. 16-17 (Sep. 394).

Oyster-Processing Research for Atlantic and Gulf Coasts, by Charles F. Lee, vol. 17, no. 4 (April 1955), pp. 29-30 (Sep. 399).

Weight Range, Proximate Composition, and Thiaminase Content of Fish Taken in Shallow-Water Trawling in Northern Gulf of Mexico, by Charles F. Lee and William Clegg, Technical Note No. 31, vol. 17, no. 3 (March 1955), pp. 21-23 (Sep. 396).

Development of Voluntary Federal Standards of Grade for Fresh and Frozen Fishery Products, by Arthur J. Nolte, vol. 17, no. 6 (June 1955), (Sep. 404).

Freezing Fish at Sea--New England:
Part 8 - Some Factors Affecting the Salt (Sodium Chloride) Content of Haddock During Brine-Freezing and Water-Thawing, by J. Holston and S. R. Pottinger, vol. 16, no. 8 (August 1954), pp. 1-11 (Sep. 375).

Cooperative Fish-Product-Acceptability Project with Quartermaster Food and Container Institute, by Harris W. Magnusson, vol. 16, no. 11 (November 1954), pp. 17-19 (Sep. 384).

A Comparative Study of Fish Meals Made from Haddock Offal, by Joseph N. Carver, vol. 16, no. 12 (December 1954), pp. 14-16 (Sep. 388).

Some Factors Affecting the Color of Fish Sticks, by J. Holston, vol. 17, no. 1 (January 1955), pp. 11-13 (Sep. 391).

Weight Changes During the Cooking of Fish Sticks by J. Holston, vol. 17, no. 4 (April 1955), pp. 30-31 (Sep. 399).

LEAFLETS AND SCIENTIFIC REPORTS:

Planning Your Research Paper, by F. Bruce Sanford, Commercial Fisheries Technical Leaflet No. 5, May 1954, 18 pp.

Off-flavor Development in Frozen Oysters, by Martin Heerdt, Manuscript Report, August 1954, 4 pp.

Triennial Index of Commercial Fisheries Abstracts 1951-1953, by M. E. Stansby and Marjorie Zachow, August 1954, 91 pp.

Bibliography of Unidentified Growth Factors in Fishery Products, by F. Bruce Sanford, Manuscript Report, September 1954, 68 pp.

Check List of the Most Important Points in Organization of Fishery Research Papers, by F. Bruce Sanford, Commercial Fisheries Technical Leaflet No. 7, September 1954, 2 pp.

REPORTS OF THE FISHERIES EXPERIMENTAL COMMISSION OF ALASKA:

Biennial Report, Fisheries Experimental Commission of Alaska, Fishery Products Laboratory, Ketchikan, Alaska, February 1955, 19 pp.

REPORTS IN TRADE OR SCIENTIFIC PERIODICALS AND ADDRESSES:

The Amino Acid Content of Roe at Different Stages of Maturity from the Five Species of Pacific Salmon, by Harry L. Seagran, David E. Morey, and John A. Dassow, Journal of Nutrition, vol. 53, no. 1 (May 1954), pp. 139-150.

Freezing Shrimp at Sea, by John A. Dassow, Southern Fisherman Yearbook vol. 14 (March 31, 1954), p. 103.

Some Factors Affecting the Sodium Chloride Content of Haddock During Brine Freezing and Water Thawing, by J. Holston and S. R. Pottinger, Food Technology, vol. 8, no. 9 (September 1954), pp. 409-411.

Is Salt a Problem in Brine-Frozen Fish?, by J. Holston, Fishing Gazette, vol. 72, no. 1 (January 1955), pp. 62-63.

What are the Effects of Brine Dipping of Haddock Fillets?, S. R. Pottinger, Fishing Gazette, vol. 72, no. 3 (March 1955), pp. 35, 68.

Analytical Determination of Oil in Fish Meal, Compiled by F. Bruce Sanford; based on a report by M. E. Stansby, Fish Meal and Oil Industry, September 1954, pp. 135-136.

Split Fillets, prepared by F. Bruce Sanford; based on a paper of M. E. Stansby, Fishing Gazette, vol. 71, no. 10 (October 1954), pp. 40-41.

Is Fish Flavor Transferred in Refrigerated Lockers, compiled by F. Bruce Sanford; based on a report by Martin Heerdt. To be published in Frozen Food Center.

Preliminary Studies on the Utilization of Freshwater Fishery Resources of Alaska, by J. A. Dassow. Presented at the Fifth Alaska Science Conference, Anchorage, Alaska, September 1954, by J. A. Dassow.

REPORTS IN PREPARATION:

Freezing Fish at Sea--New England:
Part 9 - Improvements in the Brine-Freezing Mechanism on the Trawler Delaware, by C. G. P. Oldershaw.

- Freezing Fish at Sea--New England: Part 10 - Studies of Miscellaneous Handling Problems, by Harris W. Magnusson.
- Freezing Rates and Energy Requirements for Freezing Packaged Fish Fillets and Fish Sticks in a Multi-plate Compression Freezer, Technical Note, by J. W. Slavin.
- The Immediate Effects of Brine Dipping Upon Fillets from Iced and from Brine-Frozen Haddock, by J. Holston and S. R. Pottinger. (This manuscript is still in the revision stage.)
- Reduction of Curd in Canned Salmon Prepared from Frozen Fish: Part I - Use of Acid and Brine Dips, by J. A. Dassow and H. J. Craven. Part II - Effect of pH and Salt Content, by H. L. Seagran.
- Keeping Frozen Alaska Shrimp Tender, by C. J. Carlson and J. A. Dassow.
- Full Utilization of Alaska Salmon Oil, by F. B. Sanford.
- Utilization of Sea Lions in Alaska, by J. A. Dassow.
- Study of Pharmaceutical and Other Industrial Products from Salmon Eggs, by Robert M. Kyte.
- Alaska Whitefish: Proximate Composition and Edibility, by R. G. Landgraf, Jr., and J. A. Dassow.
- Preparation of Canned Smoked Chum Salmon Spreads, by R. G. Landgraf, Jr., and Christine Heller.
- Quality Changes in Frozen Dungeness Crab, Technical Note by C. J. Carlson and J. A. Dassow.
- Canned Smoked Shrimp, Technical Note by R. G. Landgraf, Jr.
- Modified Tenderometer for Measuring Changes in Texture of Fish and Shellfish, Technical Note, by H. J. Craven.
- Component Fatty Acids of Salmon Egg Oil, by Robert M. Kyte.

Part III - Saltonstall-Kennedy Contracts for 1955

Since it is not possible within the limits of the Service's facilities and personnel to conduct extensive research in all phases of technology, a portion of the research was contracted out to universities, State agencies and private laboratories in fiscal year 1955, but the research work is continued in fiscal year 1956. These contracts are under the administrative supervision of the Service's four Fishery Technological Laboratories.

CONTRACTS AND AGREEMENTS FOR 1955:

Seattle--Supervising Laboratory:

1. University of Washington, Seattle, Wash. To develop rapid chemical tests for determining freshness of fish. \$9,785

2. University of Minnesota, Minneapolis, Minn. Determine the nature of the chemical reaction involved and the products formed in the development of undesirable odors during storage of fish oils. \$12,190

3. University of Minnesota, Minneapolis, Minn. To obtain fundamental information on the chemical structure and methods of analyzing unsaturated and saturated acids of fish oils. \$13,300

4. University of Minnesota, Minneapolis, Minn. Investigate chemistry of inclusion type complexes. Prepare and study the nature of altered fatty acids of fish oils. \$13,344

5. University of Minnesota, Minneapolis, Minn. Separating fatty acids from fish oil glycerides, and preparing amines and other derivatives from fatty acids for use in iron, manganese, and other ore flotation experiments. \$14,998

6. University of Southern California, Los Angeles, Calif. Development of a method for bio-assay of growth factors present in fishery byproducts. \$6,820

7. Oregon State College, Corvallis, Ore. Evaluation of fish oils as supplements to swine ration. Nutritional value, study of carcasses to determine advantages or detrimental effects, especially regarding fat quality. \$7,375

8. California Department of Fish and Game, Los Angeles, Calif. Improve methods of handling and freezing skipjack and other tuna at sea and study of quality differences in the canned product. \$10,000

Boston--Supervising Laboratory:

1. Northeastern University, Boston, Mass. Economic analysis of freezing fish at sea in New England fisheries. Joint project with Economics and Cooperative Marketing Section. \$15,000

2. Massachusetts Institute of Technology, Cambridge, Mass. Develop new objective tests for quality of fresh, frozen, and processed fish. Develop rapid analytical methods to determine fresh condition of fish. \$15,900

3. University of Massachusetts, Amherst, Mass. Development of background information for voluntary Federal standard of grade for raw breaded shrimp. \$14,898

4. Arthur D. Little, Inc., Cambridge, Mass. Preparation of new resins from fish oils. \$16,500

College Park--Supervising Laboratory:

1. Tulane University, New Orleans, La. Investigate nature of pigmented areas and the factors involved in the bleeding reactions in the shucked oyster. \$7,600

2. Louisiana State University, Baton Rouge, La. Development of a quality test for fresh and frozen oysters and the study of the changes in frozen storage. \$10,000

3. Florida State University, Tallahassee, Fla. Investigate fat content and its effect on quality during frozen storage, and study variation in composition and nutritive value. Develop new oyster products. \$12,367

4. Maryland State College, Princess Anne, Md. Determine partition of Kjeldahl nitrogen in fish meal and origin of protein to physiological tissues. \$5,800

5. Texas A. and M. Research Foundation, College Station, Tex. Development of a method of Chromatographic analyses of the constituents of marine oils. \$5,900

6. Florida Southern College, Lakeland, Fla. Use of modified or fortified fish oils as insecticides and fungicides in the citrus industry. \$5,240

7. North Carolina State College, Raleigh, N. C. Determining the differences in physical-chemical characteristics of fish body oils with season, with geographical areas of production, and species. \$9,700

8. University of Delaware, Newark, Del. To determine the nature and properties of the non-glyceride fractions of fish oils; literature survey on fish oil chemistry. \$29,690

9. University of Cincinnati, Cincinnati, Ohio. The use of fish oils in the lubrication of leather. \$16,000

10. University of Delaware, Newark, Del. Assay of fish meals for feeding quality in chick diets. \$15,000

11. Reedville Oil and Guano Co., Reedville, Va. Pilot and commercial meal and oil production studies; to supply equipment, facilities, and services. \$6,500

12. Storrs Agricultural Experimental Station, University of Connecticut, Storrs, Conn. Research with fish oil in poultry feeds. \$8,000

13. University of Florida, Gainesville, Fla. Development of background information for a voluntary Federal standards of grade and condition for natural sponges. \$6,000

Part IV - Research Program for Fiscal Year 1956

The Fishery technological research program for fiscal year 1956 (July 1, 1955, to June 30, 1956) was developed after recommendations were received from members of the fishing and allied industries. Assignment of projects was

made after taking into consideration the location, facilities, and personnel at each of the Service's four Fishery Technological Laboratories and the funds available. Projects are listed by area and laboratory.

NORTH ATLANTIC
(EAST BOSTON, MASS.):

1. Freezing Fish at Sea--New England:

The project has been virtually completed, but will be continued only to obtain storage data on those varieties of roundfish frozen in brine at sea, which were not sufficiently studied previously. The initial taste-test series for fillets of brine-frozen pollock, whiting, ocean perch, and hake, is under way. Additional information on the use of these products as raw material for frozen fish sticks is continuing. Brine-frozen cod will be obtained for storage tests as soon as possible.

An economic analysis of the brine-freezing of fish at sea as compared to the present commercial practices of icing fish on vessels will be made in cooperation with Northeastern University on a contract financed jointly with the Service's Economics and Cooperative Marketing Section.

2. Composition of Fish: Numerous requests are received for information on the proximate composition of the various species of fish that are caught in the New England area. Since information of this type is generally lacking, a study of the proximate composition of these species will be made to include the effect of season, size of fish, and other factors that may be of importance. The composition of fillets removed from the fish and the remaining waste will be determined separately. By calculation, the composition of the whole fish will then be available, as well. This investigation is being conducted in collaboration with the Service laboratories at College Park, Seattle, and Ketchikan.

This project has been extended and will include studies on the utilization of waste materials from fish frozen at sea. The search for new commercial-scale products from fish viscera will be continued. Included in this study is the separation of heparin, an anticoagulant, from fish viscera. The proximate analyses and preparation of fish wastes and trash fish into conventional fish meals will be continued. Animal feeding studies to determine the nutritive value of haddock frames and pollock scales are in progress.

3. Voluntary Federal Standards for Grade and Condition of Fishery Products:

(1) VOLUNTARY QUALITY STANDARDS FOR HADDOCK FILLETS: Background studies have already been made and the standards are in the process of preparation. They will be reviewed and sent to industry for comments when completed.

(2) FISH STICKS--VOLUNTARY QUALITY STANDARDS AND STORAGE CHARACTERISTICS (ATLANTIC COAST): The fish stick industry readily realized the desirability for developing voluntary quality grade standards if they were to maintain or even improve the quality of fish sticks. The Service, at the suggestion of the fishing industry, implemented a research program for the development of quality standards. The program on voluntary standards for fishery products will be carried out in two phases: (1) development of standards, and (2) research on product evaluation. The work on standards will include the preparation of voluntary Federal standards for grade and condition of fishery products as may be desired by the industry. Standards for fish sticks, fish blocks, and ocean perch fillets are in the process of preparation.

The research phase will include such background studies as the possibilities of using varieties of fish not now used extensively in the preparation of fish sticks, storage tests on fish blocks and fish sticks, objective tests for freshness and quality, and such other related problems as may be found necessary for the actual preparation of voluntary Federal standards of grade.

(3) VOLUNTARY QUALITY STANDARDS FOR BREADED SHRIMP: Background information on voluntary Federal standards of grade for raw breaded shrimp is being developed by the University of Massachusetts. The Service will develop the standards from the data supplied, in part, by the University.

The over-all purpose of the project will encompass: (1) specific product work as assigned to one of the four laboratories; (2) supplementation of the work of the other laboratories on their

assigned product standards; (3) the development of material for graders' training manuals; and (4) research on improvements in tests and measurements for factors significant in standards program. The standards program is being conducted in collaboration with the Service's laboratories at Seattle and College Park.

4. Flavor Evaluation in Fish: Very little information is available regarding the nature of flavor components in fish. This project will involve the identification of flavor and odor components of fish; development of a method for assay of these components; and correlation of the content of flavor components with quality or freshness of the products.

5. Preservation of Fish on Fishing Vessels: The present methods for preserving the freshness of fish aboard the fishing vessel are being reevaluated. Small-scale tests will be made to determine the effect on quality of fish pre-chilled in refrigerated sea water prior to placing in ice in the hold. Another approach to the problem of prolonging the quality of the fish aboard the vessel is to investigate the use of antibiotic ice. Preliminary reports indicate that small amounts of certain antibiotics have retarded the growth of many species of bacteria. The required antibiotic concentrations and method of preparing the ice will be among the objectives of the study. The experimental use of antibiotic solutions by the menhaden boats are being followed as industry tests progress to augment information being obtained by the Service.

6. Federal Specifications for Fishery Products: Specifications for fishery products will be developed in order of priority indicated by other Federal agencies. Work is first to be completed on the following specification:

PP-0-951 - Oysters, Canned. A proposed revision will be prepared for industry review and consideration for preparation as an Interim Specification.

7. Manual on the Refrigeration of Fish: Several sections of this manual assigned to personnel of the various technological laboratories have been completed and

will be released as parts of a series. The remaining sections will be released as they are completed. After completion and publication of the manual the project as such will be discontinued. Revision of dated sections will be assigned to individuals, as information requiring such action is accumulated.

8. Freezing and Storage of Fishery Products: Data will be obtained on the rate of freezing of various types of packaged fishery products by different freezing methods to determine the most efficient method for the particular product. A method of freezing that is suitable for packaged fillets containing no air spaces may be found to be inefficient when used for packaged fish sticks, which may contain appreciable air space. Data on the storage of fish in a jacketed-type frozen-storage room will also be obtained to determine the advantages of this type of storage over the conventional types. Some information to be developed on this project would be for revision of sections of the Refrigeration Manual as data become available.

MIDDLE AND SOUTH ATLANTIC (COLLEGE PARK, MARYLAND)

1. Vitamin Content and Nutritive Value of Industrial Fishery Products: Work on this project will continue on a limited scale. Feeding tests at experimental and practical ration levels are being conducted on contracts financed from Public Law 466 funds as follows: The use of fish oil in high-energy poultry rations at the University of Connecticut; Chick assays of fish meal for nutritive quality of the protein at the practical ration level by the University of Delaware; Development of a bio-assay procedure to accurately determine the growth response attributable to the unknown growth factors in fish meals by the University of Southern California; The evaluation of fish oils as supplements to swine rations by Oregon State College; Bio-assay procedure for evaluating any changes in the protein quality of the raw fish, and as cooked fish, press cake, dried scrap, and fish meal during the processing cycle by the University of California; Determination of effects of raw material and processing variables on the amounts of unknown growth factors in fish meals by the University of Wisconsin.

2. Study of Nutritive Value of Fish Meal, Condensed Fish Solubles, Fish Body Oils, and Homogenized Condensed Fish: The project was expanded to include pilot-scale studies of the above-mentioned industrial fishery products and analyses of menhaden at all stages from raw fish to meal and oil. Service personnel will have available for experimental purposes a pilot plant at Reedville, Va. Through the preparation of fish meals of known history they will determine the effects, if any, attributable

contractors on the meal and oil research program in the Middle and South Atlantic Gulf areas will be carried on at this laboratory. The Seattle laboratory will maintain close liaison with the several meal and oil research contractors located on the Pacific Coast and Northwest area.

3. Voluntary Federal Standards for Grade and Condition of Fishery Products: This project is a part of the Service's program for the development of standards of grade and condition for fishery products.

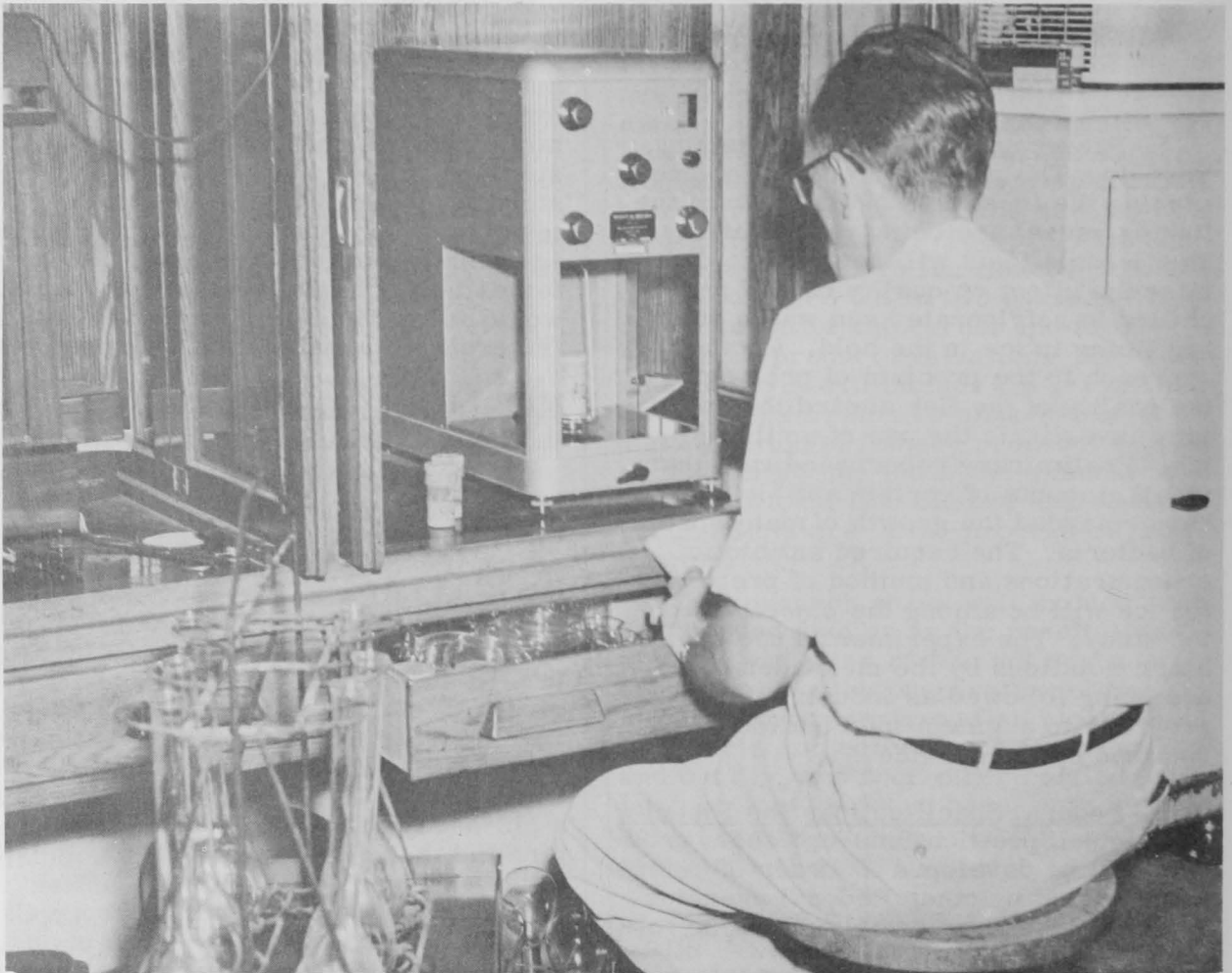


Fig. 3 - Weighing samples of oysters for determination of total protein. This is a new balance indicating the smaller weight of one and one-tenth milligram by optical means.

to condition of raw materials, and to processing and storage procedures on the nutritive value. Service studies, in addition to sample preparation and distribution, will cover in-plant observations of processing variables on a commercial scale. In addition to a limited amount of analytical work, evaluation of the research results from close liaison with the several

Data obtained through research will be used to draft standards of grade and condition for fishery products. The investigation will include the development of microbiological and chemical objective tests. As a grade standard for a fish product is developed, a handbook will be prepared for use in the training of workers to carry out the grading service. At

present, the preparation of a voluntary grade standard for breaded shrimp is the product assignment for this laboratory. This project is being conducted in collaboration with the Service laboratories at Boston and Seattle, and with the University of Massachusetts, a contractor assigned to supply background information on raw breaded shrimp products now marketed.

4. Comparison of Nutritive Value of Fish and Meat (Cooperative Project with the University of Maryland): A preliminary examination of the data indicates that in human nutrition protein loss can be as effectively replaced with fish protein as with beef in the diet. A more detailed report will be made upon completion and evaluation of the statistical data. The project will continue, with emphasis on the comparative calorific values supplied by fish and beef in the diets used.

frozen meat through physical or chemical means is also being explored.

Histochemical studies for the determination of the normal distribution of minerals and various organic substances in frozen crab meat are continuing, and sections of muscles were processed in preparation for enzyme digestion studies. These determinations may indicate variations in the amount of one or more constituent that cause changes in the texture of crab meat due to freezing. The University plans to complete a substantial portion of these investigations by fall.

6. Nutritive Value of Fishery Products for Feeding Fur Animals: The project will be continued to supply fur farmers with data necessary for the preparation of properly-balanced rations. Fresh-water fish, including sheephead, will be assayed for thiaminase.



Fig. 4 - On the left are Chesapeake Bay oysters with the free liquor drained off into the adjacent evaporating dish. The right hand pair of dishes contain a similar amount of Gulf of Mexico oysters and liquor.

5. Changes in Texture of Frozen Blue-Crab Meat (Cooperative Project Sponsored by the Refrigeration Research Foundation): Continuing studies on homogenates of fresh and frozen crab meat appear to indicate a water loss in frozen meat as compared to fresh meat. There was no apparent change in pH with freezing. Further refinements in the quantitative aspects of this phenomenon, particularly in relation to duration of storage, are being presently undertaken. The quantitative determination of bound to unbound water in fresh and frozen crab meat is planned. The possibility of increasing the bound-water fraction in

7. Atlantic and Gulf Coast Research--Processing Oysters: The Southern oyster differs from that of the Northeast in being softer, having a lower solids content, and often having a brown color. These differences in texture make it necessary to handle Southern oysters in a different manner. They have not been successfully frozen for storage. Project will continue with some analytical work, product evaluation, and contract liaison at the laboratory. Contracts awarded include: Tulane University--investigation of the nature of pigmented areas and the physiological factors involved in the bleeding reactions in the shucked oyster;

Louisiana State University--development of a quality test for fresh and frozen oysters and of microbiological studies of oysters as harvested, handled, and processed for freezing and during frozen storage; Florida State University--investigation of fat content and its effect on quality during frozen storage and study of variations in composition and nutritive value.

PACIFIC COAST

(SEATTLE, WASHINGTON):

1. Quality Index of Fish Meals: To trace any variations in the nutritive quality of fish meal, a rapid chemical or physical test appears desirable. Before this can be accomplished, more will have to be learned about the cause of variation in the nutritive value of different lots of fish meals. A literature survey on the nutritive value of fish meals and allied feedstuffs will be carried out. Abstracts from the literature search will be critically reviewed and the compilation published. Then it is planned to investigate two possible bases for a quality index. One of these is the amount of dye absorbed in fish meals; the other is the comparative solubility of the fat in fish meals in different solvents.

2. Chemical Evaluation of Fish Oils and Investigation of New Uses: Separation and purification of fish oil fatty acids of specific chain length by urea complexing will be continued with emphasis on development of a technique for sharper separation of the constituent fatty acids. The fatty acids are being used in the preparation of new chemical products, including silicones, halides, and long-chain alcohol derivatives. Other products will be developed involving addition of groups at double bonds.

The program has been expanded and will include the following studies: (1) Development of new compounds by altering the fatty acids at various points in the structure; (2) Separation and utilization of the non-glyceride constituents of fish oils, such as glyceryl ethers. These compounds may have definite uses as pharmaceuticals. The work will be closely correlated with contract research on fish oils. Contracts awarded include: (1) Development of a procedure for separating fatty acids from fish oils for industrial

or pharmaceutical use--by the University of Minnesota; (2) Development of analytical techniques for following oxidation of fish oils in fish flesh, fish meal, and processed fish oil and to find methods of preventing these processes--by the University of California. Development of pilot-scale continuous extraction equipment and procedures based on the urea complex approach will be undertaken.

3. Cold-Storage Life of Fish (Cooperative Project Sponsored by the Refrigeration Research Foundation): Work will be continued on the study of freezing and frozen storage of Pacific oysters. Principal subjects for investigation will include: (1) Development of a satisfactory method for estimating drip; (2) the use of antioxidants to preserve flavor and color during frozen stage; and (3) the preparation of a satisfactory frozen breaded oyster product. Studies of the response of the fresh-water fish of the Great Lakes and Midwest rivers to freezing and frozen storage will be expanded. A survey of the technological problems of the industry in this area is a part of the work contemplated.

4. Determination of Oil in Fish Meal (Cooperative Project with the Association of Official Agricultural Chemists): A simplified method for extracting oil from fish meal with a mixture of acetone and water as solvents was developed. Experiments are under way to determine whether this procedure can replace the more complicated two-stage extraction method of AOAC.

5. Study of Chemical Compounds Forming During Spoilage of Fish: Fish of different species, and even of the same species, when handled under varying conditions, may spoil in a variety of ways. A huge number of chemical compounds may result from these different types of spoilage. A knowledge of the types of compounds forming under different handling conditions would be of considerable value. For example, it would provide basic information needed in developing freshness tests. Once the mechanism of spoilage is known, measures to protect fish quality can more logically be developed. There might also be provided clues to the causes for differences in nutritive value of fish meals prepared from raw materials of varying degrees of quality.

The work will be carried out to determine not only the nature and types of chemical compounds forming during spoilage, but also the reasons why different types of spoilage occur under various handling conditions.

6. Voluntary Federal Standards for Grade and Condition of Fishery Products: This project is part of the over-all Service program on the development of standards of grade for fishery products approved under the Saltonstall-Kennedy program. The work will include assistance to other Service laboratories in the preparation, review, testing, and revision of voluntary standards for specific fishery products in relation to application of such standards to Pacific Coast fisheries. At present, fish sticks produced from Pacific cod and related breaded fishery products are under study for preparation of voluntary standards. When standards for products produced largely in the Pacific Northwest are to be developed, this laboratory will have primary responsibility for them. The Standards program is being conducted in collaboration with the Service laboratories at Boston and College Park.

7. Composition of Fish: Most data in the literature on composition of fish is either so old as to be of minor value, or on too small batches of fish, or even a single fish, and not applicable to fish in general. Information on composition of fish is fundamental to the solution of almost every technological problem, since it is necessary to know the makeup of the fish before applying any methods of preservation or attempting to utilize it for byproducts.

A careful sampling of each species from the Pacific Coast, Gulf of Mexico, and fresh-water fish from the Great Lakes and Mississippi River, including seasonal and geographical variation, will be carried out. This project is integrated with similar studies at each of the other laboratories.

ALASKA (KETCHIKAN):

1. Proximate Composition of Marine Mammals and Fishery Products of Alaska: Information on the proximate composition of fish and marine mammals of Alaska is generally lacking. These studies will include the effect of season, size

of fish, and other factors that may be of importance.

2. Development and Evaluation of Food Products from Alaska Fish: Studies on the use of antioxidants in fish spreads is continuing. Small packs of canned smoked herring niblets, canned smoked butter clams, and canned smoked pink shrimp were prepared and evaluated by taste-panel tests. The canning characteristics of smoked sablefish are being studied. Studies of the storage qualities of these specialty products and the preparation of other such products is in progress.

3. Study of Pharmaceutical and Other Industrial Products from Salmon Eggs and Fish Wastes: Previous studies on this project have shown that salmon eggs contain an oil which is highly unsaturated. In addition, they contain high-quality protein and certain growth factors for fish and poultry. Studies of the enzymatic digestion method for the separation of the oil from the protein constituents are continuing. The development of solvent dehydration-extraction methods and pilot-plant scale preparation of meal are contemplated.

4. Determination of Chemical Changes in Fish Protein During Freezing and Storage: In an attempt to gain a better understanding of the adverse effects of freezing and cold storage on the quality of the meat of fish, changes in properties of the actomyosin fraction of fish muscle that has been subjected to frozen storage are being studied. Tests are being devised to determine the rate and extent of these changes in fish protein. The results of the studies will be applied toward methods of improving the quality of frozen fishery products.

5. Keeping Quality of Hermetically-Sealed Chilled Dungeness-Crab Meat: Studies on the keeping quality of hermetically-sealed non-heat processed dungeness-crab meat stored at 40° F. continue. Representative cultures will also be isolated from fresh and frozen crab meat. The effect on the quality of crab meat of certain of the individual types of organisms isolated will be investigated.

DEPARTMENTAL (WASHINGTON, D. C.):

1. Federal Specifications for Fishery Products: This project has been assigned to the field laboratories, with primary responsibility at Boston. Information concerning specifications is discussed under the appropriate laboratory section.

2. Review of Publication Methods: Improvements were made in the methods of issuing progress reports and research

reports on technological projects. More information was disseminated to the industry. The program is being considerably expanded to keep the industry informed on progress being made on all Saltonstall-Kennedy investigations, in addition to our regular activities. Current information on all projects will appear in the section "Research in Service Laboratories" in Commercial Fisheries Review.

TECHNOLOGICAL SECTION ORGANIZATION CHART

Branch of Commercial Fisheries, U. S. Fish and Wildlife Service
U. S. Department of the Interior
Washington 25, D. C.

Washington, D. C.

<u>Name</u>	<u>Title</u>	<u>Room Number</u>	<u>Interior Building</u> <u>Telephone</u>
Charles Butler	Chief, Technological Section	3024	REpublic 7-1820
Elliott A. Pachtman	Asst. Chief, " "	3024	Ext. 4745

Field Laboratories

<u>Activity</u>	<u>Location</u>	<u>In Charge</u>	<u>Telephone</u>
North Atlantic Technological Research	61 Sumner St. East Boston, Mass.	Samuel R. Pottinger	East Boston 7-6880
Middle & South Atlantic Technological Research	P. O. Box 128 College Park, Md.	Hugo W. Nilson	Warfield 7-5800
Pacific Coast Technological Research	2725 Montlake Blvd. Seattle, Wash.	Maurice E. Stansby	East 0586
Alaska <u>Technological Research*</u>	622 Mission St. Ketchikan, Alaska	Clarence J. Carlson	3425

* Sponsored jointly by the U. S. Fish and Wildlife Service and the Fisheries Experimental Commission of Alaska (E. C. Phillips, Chairman; Clarence J. Carlson, Secretary.)

FISH MEAL AND OIL PROJECT

The Service's College Park laboratory reports encouraging progress on the fish oil and meal project during July, with the collection, analysis, and distribution to two contractors engaged in the chick-feeding tests of 23 samples of fish meal of known history. A number of bulk samples of oil were also obtained, including one special sample which was saturated with high purity nitrogen immediately after processing. Lots of this oil are being sent to the University of Minnesota and to the Service's Seattle Fishery Technological Laboratory, while other samples have been distributed to contractors in Florida, Connecticut, Massachusetts, and Delaware.

A pilot-scale fish-meal plant is now in operation at Reedville, Va. This equipment will enable the staff to start the important in-plant phase of the project in the very near future.

These studies are being carried out with funds provided by the Saltonstall-Kennedy Act (68 Stat. 376).



SOME FACTORS AFFECTING SAWDUST LOSSES IN CUTTING FISH STICKS

On the basis of preliminary studies, the major factors determining sawdust loss during the cutting of fish sticks with a bandsaw were found to be (1) gauge (thickness of the bandsaw blade); (2) gullet shape (space between teeth); and (3) the "set" of the blade (the slight bending of alternate teeth to the left and right perpendicular to the body of the blade). Other less important factors were number of teeth per inch and width of the blade.

During this investigation a blade was chosen so as to eliminate as much as possible all of these factors. The chosen blade was a scalloped edge (serrated) band knife. This blade minimized the effect of gullet shape, gauge, and set. The blade had the following characteristics: $\frac{1}{2}$ -inch width, 2 teeth per inch, no set, and 0.020-inch gauge. The sawdust loss incurred by such a blade was less than half the sawdust loss observed by the more or less standard types of blades. This blade, however, has its disadvantages in that it does not cut as quickly as a standard blade, and tends to bend a trifle under pressure when cutting fish sticks, resulting in misshapen sticks. A study is now being made to attempt to correct these faults.

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Branch of Commercial Fisheries,
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CORRECTIONS FOR AUGUST 1955 ISSUE OF COMMERCIAL FISHERIES REVIEW

Table 1 on page 63 should be corrected as follows:

Tariff Par. 721 (e) Oysters, oyster juice, etc., the rates listed in the first two columns ("Rate of Duty") should read: "8¢ lb. 3/" under the "January 1, 1955" column and "6¢ lb. 3/" under the "Geneva 1955 Agreement" column.

Tariff Par. 923, Stat. Class (1954) 3230.640, in column 3 ("Negotiating Country") footnote "2/" besides "Benelux" should be deleted.

At the bottom of the table the following footnote should be added: 3/ Including weight of immediate container.

On page 78, the legend for the sketch should be: "Model of an otter trawler."

In Chart 3, page 68, the Legend should read:

"———1955
———1954"