



FISHERY TECHNOLOGICAL RESEARCH PROGRAM

Fishery technological research is developed from recommendations received from members of the fishery and allied industries. Generally in June of each year members of the Branch of Commercial Fisheries, the chiefs of the Branch's technological research laboratories, and representatives of the fishery and allied industries meet in Washington, D. C., to discuss the progress on projects carried out during the preceding fiscal year and to help develop a program for the next fiscal year (beginning July 1). Such meetings assist the Service in formulating a sound research program by providing information on the projects of greatest importance to the industry and by offering an opportunity for the mutual exchange of ideas.

This year the Technological Section - Industry Conference was held on June 9, 1954, in Washington, D. C.^{1/} Industry participation and response was extremely gratifying. A complete review was made of the progress on projects during Fiscal Year 1954. Then, discussions were held regarding the program for the next fiscal year (1955).

This article contains:

1. A summary of the progress on fishery technological research projects for Fiscal Year 1954.
2. A list of reports issued by the Technological Section during the year.
3. The new program for Fiscal Year 1955 developed from the recommendations of the Technological Section - Industry Conference as far as funds and Service limitations permit.

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 industrial-sponsored projects. Results of any such research becomes public property and is available to the entire industry.

PROGRESS ON FISCAL YEAR 1954 FISHERY RESEARCH PROJECTS

A discussion of the Fishery Technological Research Program for Fiscal Year 1954 (July 1, 1953, to June 30, 1954) appeared in Commercial Fisheries Review vol. 15, no. 10 (October 1953), pp. 25-28 (also reprinted as Separatè 360). The city

at the end of each project report indicates the Service laboratory that is conducting the work for the project. (The complete address of each laboratory is shown in the Technological Section's Organizational Chart on page 26.)

^{1/}Minutes of this meeting are available from the Branch of Commercial Fisheries, Fish and Wildlife Service, U. S. Department of the Interior, Washington 25, D. C.

NUTRITION:

1. Toughening of Frozen Blue-Crab Meat: Practically no work was done on the project because a competent research fellowship student could not be obtained.

(College Park)

2. Chemical and Physical Properties of Fish and Shellfish Proteins: Work, which has dealt with drip in frozen fish, has indicated that drip may be of minor practical importance if the frozen fish is cooked without thawing. Under such conditions the total drip formed during cooking bears less relationship to the period of time which the fish had been in frozen storage than does drip which forms when fish is first thawed before cooking. The amount of drip in fish which has never been frozen at all is considerable after the fish is cooked. Thus, drip caused by prolonged storage may not increase the total amount of cook drip by any great amount. When the fish are cooked without thawing, nothing is discarded and drip is then of minor significance.

(Seattle)

3. Chemical Changes in Fish Protein during Freezing and Storage: Deterioration in the quality of frozen fish products is due in part to changes occurring in the protein fraction generally classified as "denaturation." It has been shown by physical methods that, of fish proteins, the actomyosin fraction is the most subject to these changes. Since little is known of the nature and rate of these changes, the resulting properties of thawed fish proteins are being studied and compared with "native" fish proteins. Such properties include resulting chemical activity, molecular size and shape, solubility, and the state and power of hydration of fish proteins.

(Ketchikan)

4. Comparison of Nutritive Value of Fish and Meat: In the fall of 1952, 10 girls at the College of Home Economics of the University of Maryland consumed a low-protein basal diet for a period of 54 days. Five of the girls received in addition a serving of baked haddock fillets and five received a similar allotment

of roasted beef. Quantitative samples were taken of all food eaten and all feces and urine that was voided. Since then fellowship students have been analyzing the samples to determine the retention of protein from the two sources and the composition of the blood samples taken at two-week intervals. The data summarized in a Master of Science thesis indicates no significant difference in results between the diets containing the two animal proteins.

Another fellowship student is now determining the caloric content of randomly-selected samples of the diet by proximate analyses and direct calorimetry to determine the effect of caloric intake on the economy of protein utilization. Preparation is also being made to continue these comparative studies with girls consuming diets containing less protein in the basal diet and different allowances of fish and beef. In this way it is hoped to determine the minimum levels of each which will give a positive balance of protein and satisfactory blood composition.

(College Park)

5. Canned Tuna Discoloration: This is a collaborative project with Continental Can Company. It has been determined that the extent to which the fish is pre-cooked is not a significant factor in causing sulfide discoloration. Spoilage of tuna is a minor factor in causing such discoloration. It has been determined that the principal source of sulfide sulfur is the intact fish proteins, rather than breakdown products of smaller molecular weight. Investigation of other factors which may be the cause of discoloration of canned tuna is continuing. In particular, attention is being given to the effect of different types of feed in the tuna stomachs when caught upon sulfide discoloration of the canned product.

(Seattle)

6. Feeding Studies with Irish Moss Gums: Gums are being extracted commercially from Irish moss, and derivations of these are being used in foods and pharmaceutical preparations. Rats and mice have been allotted to 5 comparable groups and are fed a balanced ration to which has been added 0-, 1-, 5-, 15-,

and 25-percent gum. All of the animals died, and preserved tissues of the important organs of practically all individuals are being studied by a cooperating pathologist to determine the effect of diet on tissue structure. Weekly data on the weight and food and water intake for the individual rats are being summarized for publication. The data so far analyzed indicate that the product is wholesome.

(College Park)

REFRIGERATION:

1. Freezing Fish at Sea, Defrosting, Filleting, and Refreezing the Fillets:
OVERHAUL OF THE "DELAWARE" AND FISHING OPERATIONS: The Delaware was drydocked and given its annual overhauling preparatory to fishing operations. Changes were made in the absorption refrigeration system to increase output. Alterations in the brine freezer were completed, which not only made possible an increase in freezing capacity but also permitted loading and unloading of the freezer at deck level.

Several successful cruises were made during the summer and fall of 1953. Following minor changes in the brine-freezing mechanism, very satisfactory results were obtained. Experimental lots of fish were supplied for studies in the laboratory and pilot plant. Fish frozen in-the-round at sea were landed at the Boston Fish Pier and sold to producers for processing into fillets. Cruises were made with a full complement of men to permit round-the-clock fishing operations. A preliminary economics study was made under these conditions in order to obtain cost figures for freezing fish at sea.



The Service's research trawler Delaware at the East Boston Laboratory dock.

A serious fire occurred aboard the Delaware near the close of the fishing season. Although there was no damage to refrigeration machinery and freezing equipment, the after part of the vessel was damaged considerably. Plans for restoration of the vessel proceeded satisfactorily, and the vessel was ready for fishing at the end of the fiscal year.

UNLOADING, STORING, AND PROCESSING ASHORE: Data were collected on rates of handling and storage-volume requirements of brine-frozen fish both aboard the vessel and ashore. Satisfactory procedures for transferring the frozen fish from a vessel into cold storage were evolved. Boxes holding about 400 pounds of brine-frozen fish proved efficient as both transfer and storage containers. Brine-frozen fish stored in such boxes, or otherwise treated to minimize desiccation (e.g. spray-glazing), were stored satisfactorily for well over six months. After the stored fish were thawed they were of excellent appearance and filleted well.

In commercial-scale studies the time required to scale and fillet thawed round haddock and the yields of fillets therefrom compared very favorably with similar data for iced eviscerated haddock. Data were secured on the rates of thawing in circulating water at various temperatures. In water warmer than 75° F. danger of adverse effects on the quality of the thawed fish was noted.

LABORATORY TESTS: Studies on the frozen-storage life, prior to filleting, of round fish frozen at sea have been made with the assistance of a large consumer taste panel composed of residents in the Boston area. Results obtained to date strongly suggest that round-frozen fish may be held in storage for at least six months prior to filleting. Studies performed to date indicate that the quality of fillets prepared from round brine-frozen haddock is equally as good as that for fillets from iced gutted fish.

During immersion-freezing of fish, penetration of salt becomes excessive only when high brine temperatures and/or excessively long immersion periods are used. Salt analyses of random samples of water-thawed haddock which had been

brine-frozen at sea under semicommercial conditions indicate that penetrated salt is leached during the thawing process. Adequate thawing was shown to reduce the salt content in the first quarter-inch of meat to below 0.5 percent, which is not objectionable to the taste.

Studies on the immediate effects of brine-dipping on the physical, chemical, and organoleptic characteristics of haddock fillets were completed. Studies were performed on fillets from both iced and brine-frozen fish. Results indicate that fillets from frozen fish absorb slightly more salt than do those from iced fish. Other than salt absorption, no significant differences were noted between fillets of iced and of brine-frozen fish after dipping in tap water or in one of six concentrations of brine.

Studies made with various types of immersion-freezing media indicate that requirements posed by costs and by the equipment presently available on the Delaware limit the possibilities to the use of inorganic media. The effects of such media on flavor during extended cold storage are being investigated.

(Boston)

2. Quality Standards for Haddock Fillets: A set of standards for evaluating the quality of packaged frozen haddock fillets was prepared. These standards should assist in comparing fillets from brine-frozen haddock and fillets from iced haddock. As a first step towards evaluating precooked fillets and "sticks," factors effecting their quality have been investigated.

(Boston)

3. Manual on the Refrigeration of Fish: Completion of this manual has been delayed by necessary shifts in personnel. Considerable information has been compiled from periodicals, domestic and foreign governmental sources, etc. Surveys have been carried out at fishing ports, freezing plants, and at wholesale and retail cold-storage warehouse outlets to obtain the latest information on practices in the frozen fish industry.

(Washington, D. C.)

4. Cold-Storage Life of Fish: Cold-storage life tests on 1 batch each of 12 species of fresh-water fish were completed. Lake whitefish, sheepshead, carp and bullhead have average cold-storage life (i. e. they keep in marketable condition for about 9 months at 0° F. though some deterioration takes place). Lake smelt, eulachon, lake trout, buffalofish, and lake chub have less than average cold-storage life. Yellow pike, yellow perch, and blue pike have exceptionally long cold-storage life. Cold-storage life estimation is continuing on six species of fresh-water fish and on several marine species. Improved handling methods (such as use of antioxidants) are being sought for prolonging the storage life of those species which are difficult to store.

(Seattle)

5. Cause of Texture Change of Canned Salmon Prepared from Frozen Fish:

Large amounts of proteinaceous curd are formed on the surface of canned salmon prepared from frozen fish. Dipping thawed salmon steaks in a five-percent solution of tartaric acid before canning effectively reduced curd formation. Salmon steaks treated with tartaric acid solutions did not stick to the can after processing as did untreated and brined steaks. Visual examination indicated that the surface protein is coagulated by the action of the acid. Brining thawed salmon steaks before canning resulted in some reduction in curd formation but was not as effective as the acid dips.

The retention of extra-cellular fluids or drip is caused by muscle proteins swelling and imbibing free liquid. This liquid-binding power of muscle proteins is influenced by salt content and pH, and exhibits a zone of minimum effect corresponding to the "isoelectric zone" of fish-muscle proteins. The retention of fluid on processing, with corresponding curd reduction, was shown to depend upon the liquid-binding power of the proteins above about pH 6.5 occasioned by the presence of about 2- to 5-percent salt in the meat. The reduction of curd by dissolving surface-soluble proteins using a strong brine was of questionable value. This project was completed on July 16, 1953.

(Ketchikan)

6. Preparation and Storage Tests of Frozen Fish Sticks: In this new project attempts are being made to adapt Pacific rockfish for making fish sticks. Such sticks are being prepared from whole rockfish fillets and from the dark and light meat of this species, and storage tests are being carried on to determine the keeping quality of the frozen products.

(Seattle)

PROCESSING AND PRESERVATION:

1. Specialty Food Products from Alaska Fish and Edible Fish Trimmings: Development work was continued on a canned smoked shrimp product and processing times were determined for $\frac{1}{4}$ -pound and $\frac{1}{2}$ -pound cans. A final report was received from the National Canners Association Laboratory, Berkeley, California, on the storage tests with inoculated packs of smoked salmon-egg spread. This product had sufficient salt (sodium chloride) incorporated so that there was



Ketchikan, Alaska, Laboratory (center) and boat harbor.

a salt content in the spread greater than eight percent which should protect the product from the dangers of botulism even though the product was stored at room temperature. The National Canners Association Laboratory concluded that this smoked salmon-egg spread product presented no hazard of botulism. Work was continued on the preparation of a canned smoked salmon spread from frozen chum salmon and a good product has been developed. Several specialty products were prepared and served as appetizers at the sea-food banquet of the Fourth Alaska Science Conference sponsored by the American Association for the Advancement of Science in Juneau, Alaska.

(Ketchikan)

ANALYSIS, COMPOSITION, AND SPECIFICATIONS:

1. Composition of Fish: Determination of the proximate composition of several species of fresh-water fish continued. Effect of the area in which the fish is caught and the season of catching is being investigated using sheepshead (a species caught commercially in a wide variety of waters, including the Great Lakes, small lakes, and rivers) as a test species. Work is also being carried out on the proximate composition of marine fish, including various soles, rockfish, and halibut.

(Seattle)

2. Determination of Oil in Fish Meal: No work was carried out on this project.

(Seattle)

3. Federal Specifications for Fishery Products: Only intermittent part-time work was carried out on this project. Revision of the specification for canned salmon, PP-S-31b, was completed. The revision of the specification for fresh (chilled) and frozen fish, PP-F-381c, was approved by the Provisions Technical Committee in February and the specification was prepared for publication. Data were obtained for revision of specifications for canned shrimp, PP-S-311a, and fresh (chilled) and frozen shrimp, PP-S-316a. The first draft of the former was submitted for informal coordination with the Armed Services and for incorporation of military requirements. The first draft of the latter was prepared by the Fisheries Subcommittee of the Provisions Technical Committee in preparation for informal coordination with the Armed Forces. Next in line for consideration are specifications for canned sardines, PP-S-51b, and fresh crab meat, PP-C-656.

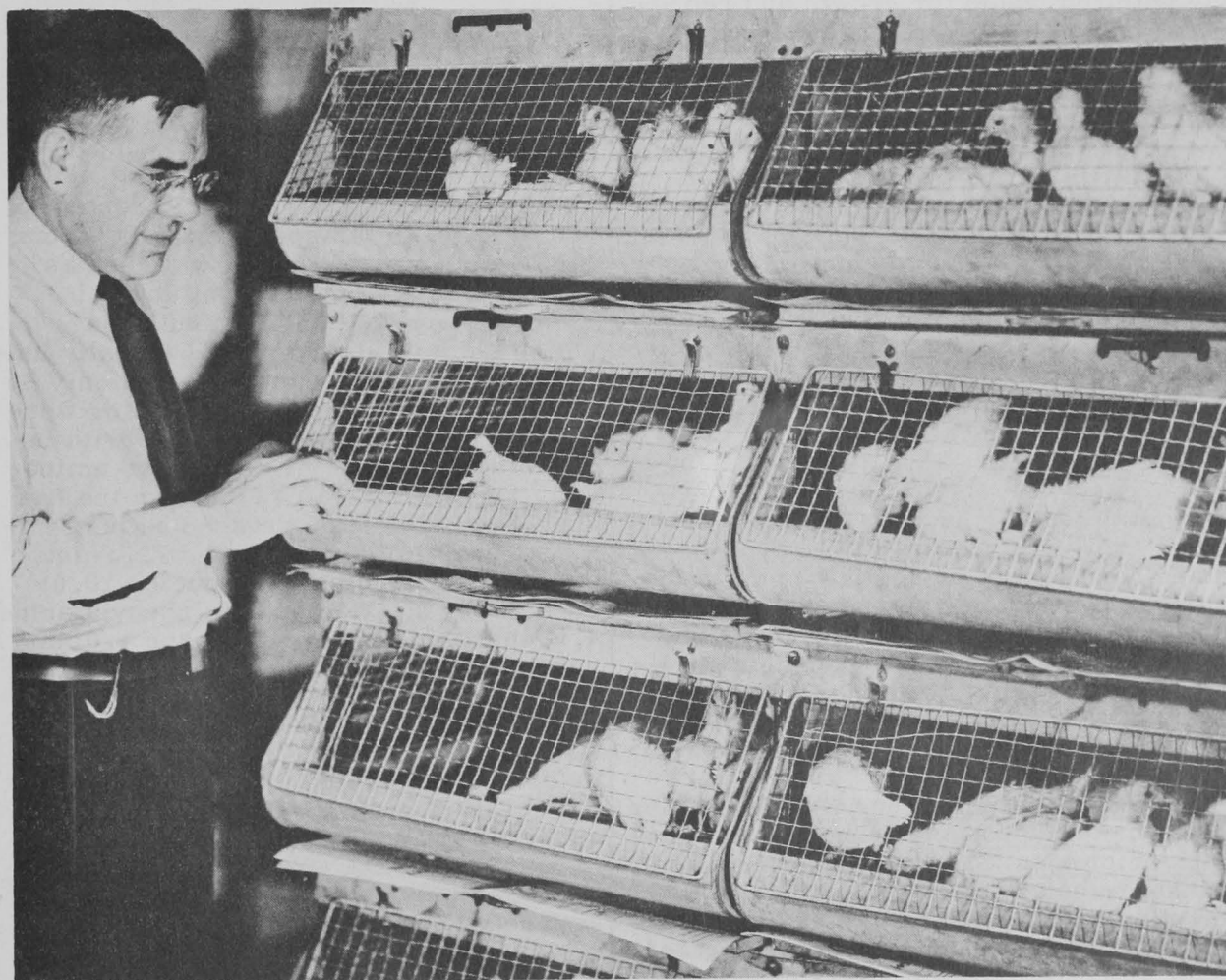
(Washington, D. C.)

BYPRODUCTS:

1. Vitamin Content and Nutritive Value of Fishery Byproducts--Biological Studies: FEEDING STUDIES WITH MENHADEN OIL: Twenty-four groups of broilers in battery cages were fed from 7 to 12 weeks

a practical broiler diet which contained from 0- to 8-percent menhaden or corn oil. It was found that none of the broilers showed any evidence of disease due to the oil in their feed even though no precautions were taken to feed fresh oil only. All birds, except those receiving the 8-percent level of menhaden oil, grew satisfactorily. The broilers receiving this high level of oil did not consume quite as much feed as the rest. The meat of the birds receiving about 1½ percent menhaden oil or less in the diet had an excellent flavor, but that of birds receiving more than this had an off- or very fishy flavor.

was taken to use fresh oil or use freshly-mixed feed. Those receiving the diets containing 0-, 1-, and 2-percent levels of oil started laying within the normal age range and all of the eggs had desirable color and an excellent flavor. Pullets receiving the 8-percent level of oil did not start laying until alpha tocopherol was added to the diet. These birds then started to lay and all eggs had a satisfactory color and most of them had an excellent flavor. Apparently alpha tocopherol acting as vitamin E or as an antioxidant was the only nutrient that the diet of natural feeds did not supply in sufficient quantity to permit laying when the



Battery of chicks used in evaluating unknown growth factors in fishery byproducts.

Individual pullets in indoor cages were fed growing or laying diets containing 0-, 1-, 2-, and 8-percent menhaden oil for a period of about 10 months. It was found that all pullets remained healthy and free from disease, although no effort

high levels of menhaden oil were fed.

FEEDING EXPERIMENTS TO DETERMINE NUTRITIVE QUALITY OF THE PROTEIN OF FISHERY BYPRODUCTS:
Battery-caged chicks were fed a low-pro-

tein diet for a 2- or 3-week depletion period. Comparable groups were then fed the same diet except that 3 percent additional protein from fish meals, condensed solubles, or dried solubles replaced an equal weight of carbohydrate. The increase of live weight over a period of three weeks was used as an index of protein quality. The object was to determine the reason for the apparent variability in the nutritive quality of protein. The data have not yet been analyzed so no conclusions can be made.

Some preliminary feeding tests with rats are being conducted to determine the nutritive value for growth and reproduction of fish-meal press cake and certain canned pet foods. The experiments have not been conducted long enough to formulate conclusions.

BIOASSAYS OF UNIDENTIFIED GROWTH FACTORS IN FISHERY BY-PRODUCTS: Numerous assays were conducted with rats and with micro-organisms to determine the content of unidentified growth factors in fishery by-products. Perfect correlation in results has not been attained and this is probably due to different requirements of the rat and micro-organisms for growth factors. No generalizations can yet be made as to what fishery byproducts are excellent or poor sources of the unidentified growth factors and what processing steps concentrate or destroy them in the various byproducts. It is not yet certain how many growth factors are needed by animals, but fishery byproducts apparently contain more than one factor.

(College Park)

2. Vitamin Content and Nutritive Value of Fishery Byproducts--Chemical and Microbiological Studies: Determination of the range of protein, moisture, oil, riboflavin, niacin, and vitamin B₁₂ content of samples, each representing a carload lot of the following fish-meal samples, have been completed: 13 of tuna meal, 8 of mackerel meal, 1 of anchovy meal, and 23 of pilchard meal. Similar work on samples of Alaska herring meal is under way as are analyses of a large number of samples representing smaller lots of menhaden and crab meals. Tuna meals have a somewhat higher content of

riboflavin, niacin, and vitamin B₁₂ than do meals prepared from the other species of fish.

(Seattle)

3. Utilization of Viscera from Round (Whole) Fish: Due to a shortage of laboratory personnel, work did not get under way until about the middle of the fiscal year. A literature survey was made prior to beginning actual laboratory work. Proximate analyses of total viscera and of sorted parts are now being conducted.

(Boston)

4. Study of Pharmaceutical and Other Industrial Products from Salmon Eggs:
PART I. AMINO ACID CONTENT OF SALMON EGG PROTEIN: This phase was completed May 16, 1953.

The "essential" amino acid content of roe at different stages of maturity from the five species of Pacific salmon has been determined by microbiological assay methods. The distribution of amino acids in the roe was generally uniform, being significantly altered only by maturity. Most of the amino acids were present in increasing quantities with increasing maturity. The average amino acid content of mature roe from the five species of salmon expressed as percentage of protein was: arginine 7.1; histidine 2.8; isoleucine 7.3; leucine 10.0; lysine 8.8; methionine 2.9; phenylalanine 4.9; threonine 5.9; tryptophane 1.0; and valine 7.3.

PART II. THE FATTY ACIDS OF SALMON EGG OILS: The long chain unsaturated fatty acids present in salmon-egg oil have considerable promise for specialized applications but basic information is lacking. A study of the fatty acid distribution in salmon-egg oils is currently in progress.

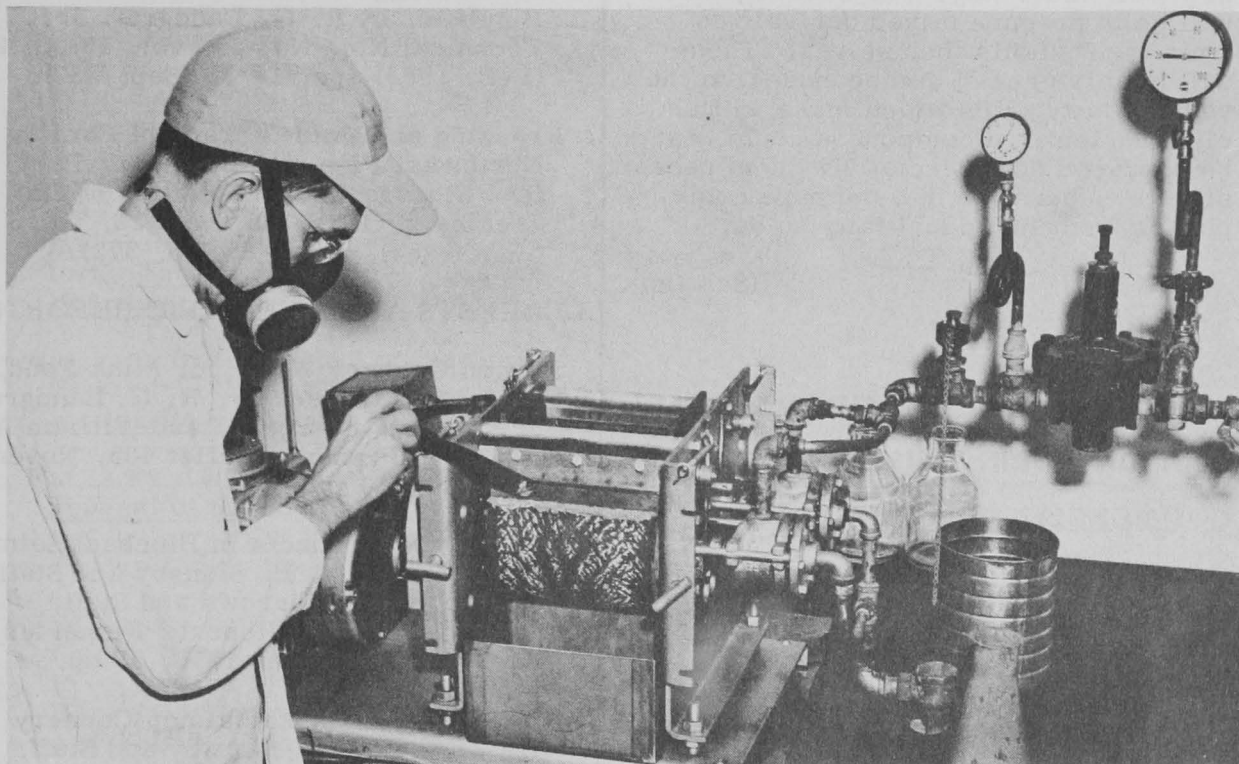
(Ketchikan)

5. A Dried Product from Condensed Menhaden Solubles or Stickwater: Production of condensed menhaden solubles for the 1953 season was at a record high level, and new plants in construction should result in further increases in production. This rapid increase in produc-

tion has stimulated the interest in dry solubles as the development with the greatest promise for expanding the market potential for condensed solubles. Samples of condensed solubles from most of the plants on the Atlantic and Gulf Coasts have been collected, and the chemical and physical characteristics determined. These samples have been dried

will be through the use of one or more additives. However, chemical and physical characteristics of individual lots of condensed solubles must be considered if difficulties in drying the condensed solubles and then grinding the dry product are to be avoided.

(College Park)



Preparing dried menhaden solubles using the experimental drum drier.

on a small-drum dryer and graded numerically for physical characteristics and behaviors during the drying process. This "drying suitability" grade is now being correlated to the analytical data on the corresponding samples of condensed solubles as well as to the behavior of the dry product when exposed to controlled relative humidities in the range of 30 to 65 percent. Small lots are also being packaged in protective multiwall kraft paper bags to study storage characteristics. Selected lots of condensed solubles are also being dried after mixing with additives. Both chemically-active and inert additives and combinations are being tried for their effect on the properties of the dry product. Preliminary indications are that the practical elimination of excessive hygroscopicity of dry solubles

6. Chemical Evaluation of Fish Oils and Investigation of New Uses: A method for separation of fatty acids into saturated and unsaturated fractions has been adapted to fish oils. The procedure involves crystallizing urea fatty-acid complex compounds from solvents at different temperatures. Employing this technic, five different fish oils have been fractionated into saturated and unsaturated components. These include menhaden, herring, tuna, salmon head and viscera, and salmon-egg oil. In the case of salmon-egg oil, more than half the oil has been separated as a highly unsaturated (iodine value about 300) fraction of potentially much greater value than the original oil.

Work is now under way on preparation from fish oils of such compounds as alkyl

halides, amines, quaternary ammonium compounds, and silicone derivatives. This work must proceed in two stages. First, compounds of known structures are prepared from pure fatty acids which occur in fish oils. Many of these compounds, derived from long-chain fatty acids, have never been reported in the literature. This phase of the work is now well under way. The second phase will be to prepare mixed derivatives from the fish oils themselves. These will be mixtures of compounds from the various fatty acids which make up fish oils. Such mixed compounds could best be produced commercially without necessity for separation into the pure compounds from individual fatty acids.

(Seattle)

REPORTS BY THE TECHNOLOGICAL SECTION DURING FISCAL YEAR 1954

COMMERCIAL FISHERIES REVIEW:

Glazing Brine-Frozen Salmon, by D. T. Miyauchi, Technical Note No. 26, vol. 15, no. 5 (May 1953), pp. 24-25 (Sep. 350).

Alaska Pollock: Proximate Composition; Amino Acid, Thiamine, and Riboflavin Content; Use as Mink Feed; by R. G. Landgraf, Jr., Technical Note No. 27, vol. 15, no. 7 (July 1953), pp. 20-22 (Sep. 354).

Freezing Fish at Sea--New England. Part 7 - Pictorial Story of Operations at Sea and Ashore, by the Technical Staff of the Boston Laboratory, vol. 15, no. 12 (December 1953), pp. 1-12 (Sep. 362).

Possibilities for the Production of Fishery Specialty Products in Alaska, by R. G. Landgraf, Jr., Technical Note No. 28, vol. 15, no. 12 (December 1953), pp. 18-19.

Salt Content of Salmon Canned from Brine-Frozen Fish, by D. T. Miyauchi and M. Heerdt, vol. 16, no. 1 (January 1954), pp. 8-10 (Sep. 364).

Vitamin Content of Fishery Byproducts: I - Effect of Processing Methods on the Riboflavin, Nicotinic Acid, and Vitamin B₁₂ Content of Solubles and Meal, by Neva L. Karrick and M. E. Stansby, vol. 16, no. 2 (Feb. 1954), pp. 7-10 (Sep. 366).

Effect of Salt on the Storage Life of Salmon Eggs Preserved with Sodium Bisulfite, by R. G. Landgraf, Jr., Technical Note No. 29, vol. 16 no. 2 (Feb. 1954), pp. 13-15 (Sep. 367).

Freezing and Cold-Storage of Pacific Northwest Fish and Shellfish: Part III - Storage Characteristics of Six Species of Oily Fish, vol. 16, no. 6 (June 1954), pp. 1-8 (Sep. 372).

LEAFLETS AND SCIENTIFIC REPORTS:

Salmon Cannery Waste for Mink Feed, by James R. Leekley, R. G. Landgraf, Jr., Jeanne E. Bjork, and William A. Hagevig, Fishery Leaflet 405, November 1952, 31 pp.

Use of Fish Products in Blueback Salmon Diets, by M. E. Stansby and Staff and Roger W. Burrows and Staff. Special Scientific Report: Fisheries No. 106, November 1953, 59 pp.

Utilization of Alaska Salmon Cannery Waste, by M. E. Stansby and Staff, Special Scientific Report: Fisheries No. 109, September 1953, 107 pp.

REPORTS OF THE FISHERIES EXPERIMENTAL COMMISSION OF ALASKA:

Home Canning Alaska Fish and Shellfish, by R. G. Landgraf, Jr., Christine Heller, and John A. Dassow, Technical Report No. 4, Fisheries Experimental Commission of Alaska, Fishery Products Laboratory, Ketchikan, Alaska, July 1953, 12 pp.

Proximate Composition and Vitamin Content of Rations, and Fish Components Fed at the Experimental Fur Station, Petersburg, During 1949, 1950, and 1951, by R. G. Landgraf, Jr., Technical Report No. 5, Fisheries Experimental Commission of Alaska, Fishery Products Laboratory, Ketchikan, Alaska, May 1953, 11 pp.

Specialty Products from Alaska Herring by R. G. Landgraf, Jr., and H. J. Craven, Technical Report No. 6, Fisheries Experimental Commission of Alaska, Fishery Products Laboratory, Ketchikan, Alaska, July 1953, 6 pp.

REPORTS IN TRADE OR SCIENTIFIC PERIODICALS, AND ADDRESSES:

Recent Progress in Fishery Byproducts Research, by F. Bruce Sanford, Fifth California Animal Industry Conference Proceedings, 1952 (1953).

Recent Progress in Fishery Byproducts Research of Interest to the Animal Feed Industry, by F. Bruce Sanford, National Fisheries Institute Yearbook, 1953, pp. 99-105.

Alaska Salmon Waste Potential, by Howard J. Craven, National Fisheries Institute Yearbook, 1953, p. 107.

Fat in Fish Meal by M. E. Stansby, Journal of the Association of Official Agricultural Chemists, vol. 36, no. 2 (May 1953), pp. 202-211.

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. 1-11.

Freezing Fish at Sea, by J. F. Puncochar and S. R. Pottinger, Food Technology, vol. 7, no. 10 (October 1953), pp. 408-411.

Fishery Byproducts, by F. Bruce Sanford, Fishing Gazette Annual Review Number 1953, pp. 208-216. (1953).

Freezing Fish at Sea--New England: Studies of Miscellaneous Handling Problems, by Harris W. Magnusson. Presented at the International Fish Symposium, Swedish Institute for Food Preservation Research, Gothenburg, Sweden, November 18, 1953.

Some Factors Affecting the Salt (Sodium Chloride) Content of Haddock During Brine-Freezing and Water Thawing, by J. A. Holston and S. R. Pottinger. Presented at Annual Convention of American Association for the Advancement of Science, Boston, Mass., December 29, 1953.

Freezing Shrimp at Sea, by John A. Dassow, read at the Gulf and Caribbean Fisheries Institute Meeting, Miami, Florida, November 1953. Published in Southern Fisherman 1954 Yearbook, vol. 14, p. 103 (1954).

The Experimental Freezing Trawler Delaware, by C. P. G. Oldershaw. Presented at the Gulf and Caribbean Fisheries Institute Meeting, Miami, Florida, November 1953.

Composition of Certain Species of Freshwater Fish. I - Introduction: The Determination of the Variation of Composition of Fish, by M. E. Stansby. Read at June 1953 meeting of Institute of Food Technologists in Boston. Published in Food Research, vol. 19, no. 2 (1954).

Feeding Menhaden Oil to Growing and Laying Pullets, by Hugo W. Nilson, Accepted for publication in Southern Fisherman.

REPORTS IN PREPARATION:

Freezing Fish at Sea--New England:

Some Economic Aspects, by Morton Garfield.

Immediate Effects of Brine Dipping Upon Fillets from Iced and from Brine-Frozen Fish, by John Holston and S. R. Pottinger.

Water Soluble Protein as an Indicator of Added Solubles in Whole Fish Meal, by Charles F. Lee.

Composition of Cooked Fish Dishes, by Charles F. Lee (being prepared for printing).

RESEARCH PROGRAM FOR FISCAL YEAR 1955

Fishery technological research program for Fiscal Year 1955 (July 1, 1954, to June 30, 1955) was developed from recommendations 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 four 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: Information will be secured on freezing, cold-storage, and acceptability characteristics of species other than haddock, such as ocean perch, whiting, pollock, red hake, and others. Particular emphasis will be placed on determining if these fish, when frozen aboard vessel, can be thawed later and used as raw material for precooked frozen fish sticks, uncooked portion-size frozen fish squares, and other ready-to-serve fish products.

2. Utilization of Waste Materials from Fish Frozen at Sea: Work on this project begun the middle of Fiscal Year 1954 will be continued. Proximate analyses of total viscera and of sorted parts will be conducted preliminary to manufacture of the viscera and frames into conventional fish meals, fish solubles, and solvent-extracted meals. Samples of commercial-scale products from frozen-at-sea waste materials will be compared for B₁₂ content and other growth factors with products from waste of fish refrigerated by icing. New uses for fresh viscera will be sought.

3. Voluntary Quality Standards for Haddock Fillets: Tentative standards for evaluating the quality of packaged frozen haddock fillets have been prepared to assist in comparing the quality of fillets from haddock brine-frozen at sea with fillets from iced haddock. The suggested standards now require further Service and industry review.

4. Fish Sticks--Voluntary Quality Standards and Storage Characteristics (Atlantic Coast): Standards for fish sticks and the block fillets from which they are prepared will be developed in cooperation

with industry to eliminate the production and marketing of poor-quality products. Background information will be obtained from Federal agencies establishing standards for similar food products. Procedures and problems in fish-stick production will be studied through visits to fish-stick plants in the New England area. Research initiated on the cold-storage life of fish sticks during the latter part of the last fiscal year will be continued. Samples of fish sticks prepared from various kinds of raw material in the laboratory and in commercial processing plants will be stored in commercial cold storage to obtain information on both storage life and quality.

5. Investigation of Canned Maine Sardines: This cooperative project with the Maine Sardine Packers Association was started toward the end of last fiscal year. The ultimate goal is to develop tentative grade standards for Maine sardines shortly after the end of this calendar year. Results of plant surveys, experimental packs, and consumer surveys will be used as criteria for establishing tentative grade standards. At the same time practice recommendations for the industry will be developed. Field headquarters for the project are in Boothbay Harbor, Maine.

6. Manual on the Refrigeration of Fish: The North Atlantic Technological Research unit has been assigned the task of completing this manual. Some information on certain parts of the manual is completed in rough draft. A refrigeration engineer will be employed to write those sections of the manual dealing with specialized refrigeration machinery, cold-storage warehouse layouts, efficiency in plant operation, etc., while other sections of the manual will be assigned to various Technological Section personnel.

MIDDLE AND SOUTH ATLANTIC (COLLEGE PARK, MD.):

1. Development of a Dried Product from Condensed Menhaden Solubles or Stickwater: Experimental work should be concluded in about 3 months and the general results should be ready for publication in about 4 months. Satisfactory straight drum-dried products have been made from about one-third of the samples

of condensed menhaden solubles which have been collected. The other dried products were too hygroscopic to be satisfactory.

Certain chemical additives have been tried but none was satisfactory. A final test will utilize inert additives with high absorption qualities to produce concentrates containing a high proportion of condensed solubles. An extensive statistical analysis will be made of data on physical and chemical qualities of the solubles in order to determine what changes in processing can be recommended to produce solubles which can be dried easily.

2. Nutritive Value of Fishery Products--Biological and Chemical Studies: Concern has been expressed by both producers and consumers as to apparent differences in the nutritive value of the protein of fishery byproducts. These differences may not be important under practical feeding conditions, but the reasons for the apparent differences should be determined as soon as possible. Feeding studies with chicks, using experimental low protein and practical broiler diets, have been and will continue to be carried out. Preliminary investigations at College Park and in cooperation with the staff of the Seattle laboratory will be made to develop simple chemical indexes of nutritive quality of fishery byproducts if variability exists to any important degree.

Work will be continued to determine the nutritive value of fish flours prepared for human consumption, and certain processed or prepared byproducts, such as fish-meal press cake and pet foods.

Bioassays with rats and chicks will be continued to determine the amount of unknown growth factor or factors in samples of fish meals, condensed solubles, and concentrates. This work is carried out in cooperation with the Seattle laboratory staff. The results should indicate what processing factors are important in insuring the high nutritive quality of fishery byproducts.

3. Comparison of Nutritive Value of Fish and Meat (Cooperative Project with the University of Maryland): A series of

metabolism studies have been conducted with the cooperation of the College of Home Economics, University of Maryland, in which two comparable groups of girls have eaten a basal diet low in protein and have eaten either fish or beef as supplemental animal protein. The studies have included analyzing all food consumed, metabolic products which have been excreted, and samples of venous blood collected at regular intervals. The data indicate no difference in the nutritive value of the two animal proteins.

A new test will be started this fall in which the diets will contain much lower levels of protein in order to determine if either animal protein is more efficient when consumed at levels just permitting a positive nitrogen balance. A nontechnical article will be prepared by early fall to summarize the more important data collected to date.

4. Changes in Texture of Frozen Blue-Crab Meat (Cooperative Project Sponsored by the Refrigeration Research Foundation): A graduate student in the Department of Chemistry of the University of Maryland studied this problem several years ago and found certain indications that enzymes may be active in frozen crab meat. Very little work was done this past year since there was no fellowship student available for the project. The project has now been transferred to the Department of Zoology and a graduate student will begin a study this fall on the comparative histology and physiology of meat taken from freshly-killed crabs, cooked crabs, and meat that has been stored frozen for various periods of time. The results should indicate what changes are taking place in the meat and probable reasons for the changes.

5. Feeding Studies with Irish Moss Gums: Animal-feeding studies have been completed. Data on the histological studies of the test animals are being collected on a contract basis by the University of Maryland. As soon as the results of the histological work become available a manuscript will be prepared for publication.

PACIFIC COAST (SEATTLE, WASH.):

1. Nutritive Value of Fishery Products--

Chemical and Microbiological Studies: Emphasis on this project will be shifted during the year to a study of the chemical changes responsible for the wide variation in the nutritive value of different batches of fish meal. With variation in nutritive value of different meals of as much as three times, or more, it is important to have available a quick laboratory test to appraise the nutritive value. The first step in development of such a test is a study of the chemical or other changes occurring which cause such differences in nutritive value. Work on this portion of the project will get under way during the winter.

Tests on the vitamin content of fish meals will be completed shortly and reports will be prepared. Work will also be carried out on unidentified growth factors in fish meals, with particular emphasis on determination of the content of such factors in different meals and correlation of a microbiological test with animal-feeding tests. This latter phase of the project is being conducted in collaboration with the Service laboratory at College Park.

2. Chemical Evaluation of Fish Oils and Investigation of New Uses: Improvement in marketing fish oils depends upon development of new uses which will take advantage of their special chemical characteristics. Work which is being carried out on menhaden oil will be continued in two phases. In the initial phase, reactions involving the pure chemical fatty-acid constituents of fish oils are being studied to find out how such reactions can be controlled, and to study the chemical characteristics of the resulting compounds. As this preliminary information is assembled on each type of reaction of the pure components making up the oil, the work is then translated to similar reactions using the fish oil as a starting material in place of the pure chemical compounds.

3. Cold-storage Life of Fish (Cooperative Project Sponsored by The Refrigeration Research Foundation): Include studies on cold-storage life of Pacific oysters and methods of improving the storage life of certain species of fresh-water fish. Both of these studies are financed in part from funds provided by The Refrigeration

Research Foundation. Work on the Pacific-Coast-oyster phase of the project will include a determination of the effect of season at which the oysters are taken on storage characteristics, including drip formation. Excessive drip formation is a serious problem in marketing frozen Pacific oysters. Previous work carried out by the Service has shown that frozen chub and sheepshead have poor storage life when handled by conventional methods. An attempt will be made to find improved methods of storing these species.

4. Composition of Fish: Work will be carried out largely on the proximate composition of Pacific oysters and fresh-water fish, on which data are quite meager. Such data are needed for background information in connection with processing these species both for food and for by-products. The data are also of value to nutritionists. Work during the coming year will be limited largely to samples being obtained in connection with the project on cold-storage life of fish.

5. Fish Sticks--Voluntary Quality Standards and Storage Characteristics (Pacific Coast): Information required for setting up voluntary quality standards for fish sticks will be assembled. Work will be carried out to adapt rockfish for use in the production of fish sticks. This species is at present considered less desirable than cod or similar species because of the layer of dark meat occurring just beneath the skin. Storage tests to determine the cold-storage life of fish sticks prepared from various species of Pacific Coast fish will be carried out.

6. Canned Tuna Discoloration (Cooperative Project Sponsored by the Continental Can Co.): Work will be continued to elucidate the mechanism of the reaction between sulfur in tuna and iron in the can, which sometimes causes severe economic losses owing to the formation of black iron sulfide in the canned product. Work during the past year has shown that the source of the sulfur entering into this reaction is high-molecular-weight proteins rather than spoilage-breakdown compounds. Work will be carried out on the mechanism whereby, in some cases even when considerable sulfide is available, it does not react with iron from the can to form the discoloration.

7. Determination of Oil in Fish Meal (Cooperative Project with the Association of Official Agricultural Chemists): Work will be continued on efforts to improve upon the accuracy and simplicity of the official AOAC procedure for the determination of the oil content of fish meal.

ALASKA (KETCHIKAN):

1. Cause of Texture Change of Canned Salmon Prepared from Frozen Fish: Experimental work was completed. Final reports covering (1) the use of acid and brine dips for the reduction of curd in canned salmon prepared from frozen salmon, and (2) the effect of pH and salt content on curd formation are being prepared for publication.

2. Food Products from Alaska Fish: Studies to assist in the development of "off-season" fishery industries in Alaska will be continued. Several reports covering previous experimental work with new products will be completed and released for industry use. In the planned experimental work more emphasis will be given the problems of quality loss and spoilage during the preparation and storage of fishery products. Initially, smoked salmon products and canned king- and dungeness-crab meat will be studied.

3. Pharmaceutical and other Industrial Products from Salmon Eggs--Part II--The Fatty Acids of Salmon-Egg Oil: Previous research has shown that salmon eggs have considerable promise for the development of valuable byproducts from both the protein and oil components. Further work will continue on the composition of the salmon-egg oil in order to separate and identify more completely the long-chain unsaturated fatty acids. The findings are being correlated with the latest developments in vegetable and animal oils and will provide the basis for additional research and application in other fish oils.

4. Determination of Chemical Changes in Fish Protein during Freezing and Storage: Chemical changes occurring in the protein of fish during freezing and storage are evidently related to the gradual development of undesirable flavor and texture characteristics. Methods of ob-

jectively measuring the rate and extent of these changes are needed in order to better study the effect of variables in fish handling, freezing, and storage. Such findings could then be applied to the development of improved processing procedures and would be of great value in establishing objective quality standards for frozen fish.

Present research will continue on the relationship between the solubility and viscosity properties of isolated fish actomyosin systems (comprising about 75 percent of the total fish protein) that have been subjected to frozen storage. Attention will be given to the application of newer biochemical techniques for separating and measuring the active protein components.

5. Processing and Evaluation of Crab Meat Packed in Hermetically-Sealed Containers: High-quality standards are of greatest importance in the preparation and storage of refrigerated hermetically-sealed food products. The most desirable characteristics of fresh crab meat are best preserved by such preparation. Previous studies have shown the best procedures for freezing, packaging, and storing the crab meat. Additional study is desirable on the relation of processing problems and the effect of transition storage temperatures above 32° F. to the quality of the final product at the consumer level.

The bacteriological and chemical factors causing this quality loss, as well as the effect of handling procedures, will be studied.

DEPARTMENTAL (WASHINGTON, D. C.):

1. Federal Specification for Fishery Products: Proposed revisions for Federal Specification PP-S-311a (Shrimp; Canned) and PP-S-316a (Shrimp, Raw and Cooked: Chilled and Frozen) were scheduled to be resolved with Industry in July. Initial drafts on the specifications PP-C-651 (Crabmeat; Canned) and PP-C-656 (Crabmeat: Fresh) will be completed. The next project will involve revision of the specification PP-S-51b (Sardines: Canned).

2. Review of Publication Methods:

Reevaluation will be made of current methods of issuing progress reports and research reports on technological projects in order that the information may be more readily available to the industry.

Initial consideration will be given to expanding the section "Research in Service Laboratories" in Commercial Fisheries Review to provide currently more detailed information on the progress on research projects.

TECHNOLOGICAL SECTION ORGANIZATION CHART

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Field Laboratories

<u>Activity</u>	<u>Location</u>	<u>In Charge</u>	<u>Telephone</u>
North Atlantic Technological Research	61 Summer St. East Boston, Mass.	Joseph F. Puncochar	East Boston 7-4307
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 Technological Research*	622 Mission St. Ketchikan, Alaska	John A. Dassow	540

* Sponsored jointly by the U. S. Fish and Wildlife Service and the Fisheries Experimental Commission of Alaska (J. W. Mendenhall, Chairman; John A. Dassow, Secretary).



THAWING FROZEN WHALE MEAT

Whale meat gives an excessive amount of drip on thawing. Frozen whale meat brought to Japan from the Antarctic Ocean was defrosted by the following methods: in air, in water, by Joule's heat, and by dielectric heating. Dielectric heating appeared to be the best method since the quality of the defrosted product most nearly resembled that of the original raw meat. Defrosting in still air has some practical value.

--Food Science Abstracts, May 1953.