United States Department of the Interior, J. A. Krug, Secretary
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BIBLIOGRAPHY OF THE PRESERVATION OF FISHERY PRODUCTS BY FREEZING

Part I - Period to January 1945

Part II - Period of January 1945 to December 1947, inclusive

PART I

By Dorris Bucher[1], Martin Heerdt, Jr.[2], and Kathryn Osterhaug[3]

Fishery products were preserved commercially by freezing for a decade before this method of preservation was commonly used for other foods. The first artificial freezing of fish is supposed to have taken place in about 1861 or 1862. For this reason the literature on the subject is both extensive and scattered. The following bibliography contains some references as far back as 1898 and covers the ground quite thoroughly from about 1920 to January 1945. Articles from 33 journals and many books are included. In the majority of cases the original article was procured and read by one of the authors; to make the bibliography more valuable, a brief summary of each article is included. Obviously, not every reference was considered of sufficient importance to warrant inclusion. Because of the numerous references on the subject of freezing fish, it was found necessary to devise a system of classification to prevent the bibliography from becoming too cumbersome. The 755 references are classified under 16 main headings. It can be seen from an examination of the bibliography that the preservation of fishery products by freezing is a broad subject and one which has received considerable attention.

1/ Chemist, formerly with the Branch of Commercial Fisheries
2/ Chemist, Branch of Commercial Fisheries
3/ Home Economist, Branch of Commercial Fisheries

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10. *Digest of Literature on Quick Frozen Foods. C. R. Fellers. Q.F.F. 1, No. 3, 32-33, 1938.

11. Refrigerating Engineers Hear of Frozen Food. Anon. F.I. 2, No. 6, 285, 1930.

Fish freezing problems are explained by Dr. D. B. Finn.

12. Recent U. S. Patents for Quick Freezing Systems (A Summary.) F.I. 2, 344, 1930.

Patents are listed by number, date, owner and operation.

13. Freezing and Merchandising Meat. E. T. Gibson. Q.F.F. 2, No. 1, 18-19, 39, 1939.

Problems in operation and production are outlined together with a discussion of the importance of research, and an estimate is given as to the developments expected in the future.

14. Quick Frozen Industry. E. T. Gibson. I.&R. 101, 131-5, 1941. Proceeding, American Institute of Refrigeration, 1941, 45-57.

Methods of freezing and distribution are discussed, taking pea operation as a typical example. The necessity of maintaining rigid requirements as to quality is shown to be a prerequisite for success in this field.

15. Some Problems in Preparation, Processing and Distribution of Frozen Food Products. W. E. Guest. I.&R. 96, 339-41, 1939.

Methods are given for the preparation and freezing of fruits and vegetables as well as poultry and meats with the product under quality control. The economic side is considered in the cost of plants and operations.

* Original article not available.

16. Cold Storage Operation. J. A. Hawkins. I. & R. 90, 81-82, 1936.

The general practices and theories involved in the preservation of perishables are discussed together with the temperature requirements and the facilities needed for this work.

17. State and National Experimental Investigation. L. A. Hawkins. I.&R. 76, 498-501, 1929.

Research conducted on refrigeration of fish in research laboratory of Atlantic Coast Fisheries Company is mentioned.

18. The Cold Storage of Eggs and Poultry. T. W. Weitz. U. S. Dept. Agr. Cir. 73, Rev. 1940. 55 pages.

Methods are given for the preparation of eggs and poultry for freezing, storing, and shipping. The results of an investigation on the palatability of cold stored eggs and poultry is reported.

19. A Great Future for Frozen Fish. A. G. Huntsman. F.C. 44, No. 8, 9, 10, 1927.

Following a discussion of causes of fish spoilage, quick freezing is concluded to be one of the best ways of preserving the freshness of fish. Iced salt water is used for precooling prior to rapid freezing.

20. *The Processing and Handling of Frozen Fish as Exemplified by Ice Fillets. A. G. Huntsman. B.B.C. Bull. 20. 1931.

21. General Applications of Refrigeration. Foodstuffs, Preservation of Perishable Produce. Anon. I.E.R. 12, No. 4, 765-771, 1931.

The quick freezing of fish and crustacea as practiced in current world industry is briefly described.

22. The Chemistry and Technology of Food and Food Products, Two Volumes. M. B. Jacobs. Interscience Publishers, Incorporated, New York, N. Y., 1944. Vol. I, Part II, Chapter XIV, 501-504. Handling frozen fish. Vol. II, Part V, Chapter X, pp. 324-329. Freezing preservation of fish and shell fish.

23. Fish Refrigeration. J. M. Lemon. The Refrigerating Data Book and Catalog, 1940 Edition, 37-46. Bureau of Fisheries, Sp. 2436C. The three primary types of spoilage are bacterial action, oxidation and enzymatic action. Freezing methods are classified and explained.

24. *Quick Freezing Packaged Products. R. P. Melhart. I.&C.S. 42, No. 497, 185-6, 1939.
Materials and design used in packaging affect the rate of freezing. The article discusses the design of a small plant using immersion methods.

25. Allen's Commercial Organic Analysis. Fifth Edition, C. A. Mitchell. 9, 371-381.
General principles are given for the preservation of meat by low temperatures.

26. The Science of Meat Freezing. T. Moran. R.E. 12, 343-344, 1926.
Several factors determine the changes produced: (1) The prefreezing treatment, (2) the lowest temperature and temperature changes in the frozen state, (3) the rate of freezing, (4) the mode of thawing.

27. *Frozen Foods in Japan. T. Murayama. I.&C.S. 39, No. 460, 97-8, 1936.
Brine and convection systems of quick freezing are used in Japan.

28. Ueber den Einfluss der Gefriergeschwindigkeit, etc. O. Notevarp and E. Heen. Z.G.K.I. 47, No. 8 and 9, 122-6, 140-2, 1940.
Results of experiments carried out at Bergen, Norway, show that fish must be absolutely fresh and that storage temperature is very important, but that the rate of freezing is of less importance.

29. River Barges Aid Freezing Experiments. W. Ogden. Q.F.F. Sept., 33, 1944.
Two barges equipped with T. V. A. developed freezing equipment are being used to process foodstuffs in Tennessee.

30. Quality Control in Refrigeration Industries. M. E. Pennington. R.E. 38, No. 2, 75-6, 99, 1939.
Progress in refrigeration and cold storage is outlined; Specific suggestion are given for determining the rate of freezing, the prevention of dessication, and the optimum temperature of storage.

31. The Future of Frozen Fillets. P. W. Petersen, F.G. 47, No. 5, 17.
A superior product results when packaging is employed. Processing skinning fillets, and choice of a freezing system are factors to be considered by the future industry.

32. *New Studies on the Preservation of Flesh and Fish by the Freezing Process. R. Plank. Z.G.K.I. 32, 142-147, 1925.

33. *Neue Untersuchungen uber die Konservierung von Fleisch und Fischen durch das Gefrierververfahren. R. Plank and E. Kallert. Z.G.K.I. 31, 77, 1924.

34. *The Preservation of Fish by Freezing. R. Plank, E. Ehrenbaum and K. Reuter. Abhandlungen den Volksernahrung, herausgegeben von der Zentral-Einkaufsgellschaft 5, 248, 1916. Z.G.K.I. 23, 37-41, 45-52.

35. Development of Rapid Freeze Processes Affecting Public Cold Storage Warehouses. G. Poole, I.&R. 79, 45-49, 1930.
Fishing fleet management, freezing processes, packages, storage, and distribution of quick frozen fish is covered.

36. Quick Freezing. G. Poole. F.G. 52, No. 7, 84-87, 1955.
History of various methods of quick freezing, theoretical studies, packaging, and transportation of frozen products are discussed.

37. Recent Progress in Quick Freezing. G. Poole. R. E. 29, No. 2, 67-73, 1935. I.&.C.S. 38, No. 446, 116-8, 1935. I.B.R. 1935, 155.
Methods of freezing, packaging, and transportation are reviewed.

38. Freezing and Cold Storage of Fish. G. A. Reay. M. R. 43, No. 508, 142-4, 1940.
The need for fish freshness, application of freezing principles, and proper storage conditions are emphasized.

39. Preliminary Investigations of Methods for Freezing and Storing Fillets of Some Pacific Northwest Fish. M. E. Stansby and R. W. Harrison. U. S. Fish and Wildlife Service Spec. Scientific Rept. 15, 1942.
Changes in color, flavor, and drip became evident after 6 to 9 months of storage for most species. Brine treatment, low storage temperatures, and moisture-vapor-proof wrappers increased storage life.

40. The Preservation of Fishery Products for Food. C. H. Stevenson. U. S. Fish Comm. Bull. 18, 335-576, 1898; M.S. 94.
This bulletin presents a description of freezers and the process of freezing and cold storage of fish as practised in the late nineteenth century.

41. Freezing Fish in Europe. C. H. Stevenson. F.G. 21, 1, 1904; January.
From U. S. Fish Commission Bulletin for 1898.
European facilities for freezing fish at the turn of the century are discussed.

42. Refrigeration of Fish. H. F. Taylor. U. S. Bureau of Fisheries Document No. 1016, 501-633, 1927.
Scientific principles, changes that take place when fish are frozen and stored and their prevention, design and construction of fish freezers, practical freezing methods, transportation, defrosting and cooking are discussed.

43. Sea Food. H. F. Taylor. F.I. 1, 155-156, 1929.
Low temperature is the most nearly ideal preservative we have for fish.

44. Marine Products of Commerce. D. K. Tressler. Reinhold Publishing Corporation, New York, 1923. 280-306.
Refrigeration and cold storage of fish are described.

45. *Influence of Packaging, Rate of Freezing, and Temperature of Storage on Quality of Frozen Meat. Proceedings Second Frozen Food Locker Operators Conference. Apr. 30-May 1, 1940. Wisconsin College of Agriculture, Madison, Wisc.

46. The Freezing Preservation of Foods. D. K. Tressler and C. F. Evers. The Avi Publishing Company, Incorporated. 1943. 789 pp.
Review--R.E. 46, No. 3, 170, 1943.
This is a complete general reference covering most phases of the frozen food industry including refrigeration of fish.

47. Outlines of Food Technology (Chapter on Preservation of Food by Freezing). H. W. Von Loesecke. 459-483, 1942. Reinhold Publishing Corporation, New York.
This chapter covers methods of processing fish for freezing, methods of freezing, and changes occurring during cold storage.

48. The New Low Temperature Research Laboratory and Projected Refrigeration Research. P.R.P.S. 8, 3-5, 1931. O. C. Young.
A description of a refrigeration installation and a discussion of problems in low temperature research are included.

49. The Quality of Fresh, Frozen and Stored Halibut as Determined by a Tasting Panel. O. C. Young. P.R.P.S. 37, 12-16, 1938.

50. World-wide Development of Quick Freezing. M. T. Zarotschenzeff, Q.F.F. Dec., 1938.
A summary of quick freezing abroad includes trends and problems of the industry.

51. Between Two Oceans. M. T. Zarotschenzeff. The Cold Storage and Produce Review. 1930.
This 157-page booklet gives much information on frozen fish, both of a theoretical and practical nature. Data on freezing times for fish and percentage of water frozen at various temperatures are included, as well as a very thorough discussion of all phases of commercial methods.

52. Four Years in Quick Freezing. G. Poole and M. T. Zarotschenzeff. I.&R. 91, 215-7, 300-3, 388-90, 1930.
The following topics are discussed: growth of industry, control of enzymes; effect of freezing on bacteria; modern freezing systems; economies of the "Z" process; effect of freezing on vitamins.

53. Frosted Foods Today. M. T. Zarotschenzeff, F.G. 56, No. 2, 24-25, 1939.
The status of quick-freezing abroad is summarized.

DEVELOPMENT OF FREEZING

54. Pioneers in the Freezing of Fish. I. M. Atwood. F.G. 35, 962, 1918.

A brief history on frozen fish is given. Fish should be thawed in a cool place, without the aid of water.

55. History and Present Importance of Quick-Freezing. C. Birdseye and G. A. Fitzgerald. J.I.E.C. 24, 676, 1932.

The industry developed slowly and concerned itself wholly with fish until 1929 when it began to include fruits, vegetables, and shellfish.

56. Quick-Freezing Fillets. C. Birdseye. F.G. 52, No. 11, 7, 1935.

The history of commercial fish freezing is traced.

57. Modern Practice in Fish Preservation by Cold. L. Berube. F.R. 3, 69-74, 1938.

Theory and methods, past and present, are given.

58. Freezing Salmon; Pacific Salmon Fisheries. J. N. Cobb. Rept. Comm. Fisheries, 136-138, 1921. M.S. 29.

The history of Pacific Coast salmon freezing is given.

59. Development of the Frozen Foods Industry. Brief history. I.& R.78, 543-547, 1930.

Historical data on fish freezing are given.

60. Selling Frozen Fish in New York 53 Years Ago. J. B. Jessop. F.G. 43, No. 1, 20-21, 1926.

Pan frozen whitefish competed with fresh fish in New York in the 1870's.

61. Shipping Frozen Fish to Europe in 1874. J. B. Jessop. F.G. 43, No. 4, 14-15, 1926.

The first shipment of frozen fish sent to England, using ice and salt as a refrigerant, arrived in good condition, but landing was refused by market managers.

62. How Foods Are Frozen in the Northwest. F. W. Knowles. F.I. 12, No. 4, 54-56; No. 5, 50-52; No. 6, 59-61, 1940.

The birth and development to the present status of the industry is traced. Practical operating information given includes data and drawings on methods and equipment.

63. Fifty Years of Refrigeration in Our Industry. M. E. Pennington. U. S. Egg-Poultry Mag. 47, 554-556, 566, 568, 570-571; I. & R. 101, 45-48, 1941

The use of refrigeration by the poultry industry has gained in importance during the past fifty years.

64. Methods of Freezing Fish. P. W. Peterson. R.E. 9, 7-9, 15, 1922.

A discussion of the history of frozen fish is presented.

65. Food Freezing Temperatures. P. W. Peterson. R.E. 21, 422-423, 1931.

Historical summary and theory of quick freezing are discussed.

66. The Growth and Future of the Frozen Fish Industry. H. F. Taylor. F.G. Review Number, 1929, 100-109.

History of refrigeration of fish is outlined. The problems of quick freezing round fish and fillets, storage, and transportation are discussed.

67. Fishing Industry Grows with Refrigeration. H. F. Taylor. R.E. 25, 321-323, 1933.

The history of the freezing of fish is outlined.

68. Thermal Properties of Meat. J. H. Awbery and E. Griffiths. J. S. C. I. 52. 326-328T, 1933.

The thermal constants of specific heat, conductivity, and diffusivity have been determined for fresh beef.

69. Storage Temperature & Freezing Rates. D. B. Finn. P. R. P. S. 11. 9, 1931; I. B. R. 1933, 582.

Future research on effect of rate of freezing and storage temperature fluctuations upon size of ice crystals in frozen fish is outlined.

70. Production and Distribution of Quick Frozen Perishable Foods in U. S. C. Birdseye. I. and R. 83. 223-227, 1932.

Processing and distribution of quick-frozen foods involves a consideration of the biological and chemical aspects as they affect freezing, packaging, storage, and transportation.

71. Quick Frozen Foods. Kolbe and Zarotschenzeff processes. S. C. Bloom. R. E. 18, 165-170, 1929.

The theory of dehydration of frozen foods is correlated with methods and rates of freezing.

72. The Freezing of Muscle. J. Brooks. R. F. I. B. 1933, 25, 1934.

So much "free" water is unfrozen at -20° C. that measurement of per cent water frozen from meat at that temperature is of no value in estimating the amount of bound water.

73. Variations in the Physiochemical Properties of Meat During Freezing and Storage. S. P. Bystrov. Myasnaya Ind. 9. No. 7, 32-3, 1938. Chimie & Industrie 41, 264; C. A. 33, 3473, 1939.

Freezing meat and storing it at low temperatures increases its electrical and conductivity, viscosity and density of the extracts, and decreases the surface tension.

74. The Velocity of Ice Crystallization through Super-cooled Gelatin Gels E. H. Callow. R.F.I.B. 1924, 12-14, 1925.

Separation of ice irreversibly alters the structure of the gel. Velocity of crystallization is influenced by per cent gelatin content, pH, NaCl content and hydrolysis.

75. The Behaviour of Frozen Pork-Muscle in Salt Solutions at 0° C. E. H. Callow. R.F.I.B. 1931, 147, 1932.

Frozen muscle tissue apparently takes up more water than unfrozen, when immersed for 12 days in 20, 25 and 30 per cent salt solutions.

76. Meat, The Freezing of Tissues. R. Chambers. R.F.I.B. 1931, 28-30, 1932.

Experiments were made by means of the micromanipulative technique to observe microscopically the process of intracellular freezing.

77. The Formation of Ice in Protoplasm. R. Chambers and H. P. Hale. P.R.S. B110, 336-352, 1932.

Ice formation and effect of supercooling and freezing on frog muscle fibre, amoeba, and epidermal cells of onion bulb scale are described.

78. Preservation of Fish. II. J. T. Clark and J. M. Philipson. F.T. 1, 224-225, 1932; C.A. 26, 5671, 1932.

Codfish juices from fresh fish, freshly frozen and thawed fish press juices, and drip-liquor from thawed fillets had identical values of 1.028 for density and 1.3740 for refractive index.

79. Colloid Aspects of Food Chemistry and Technology. Wm. Clayton. 1932. P. Blakiston's and Son, Inc., Philadelphia, Chapter XII. The Freez ng and Thawing of Colloid Systems.

Included is a discussion of freezing in general; freezing of fish and meats; bound water, living muscle; and rigor mortis.

80. Latent Heats of Common Foods. A. H. Cooper. R.E 20, 107, 1930.

A formula is given for calculating latent heat.

81. A Physiological View of Freezing Preservation J.I.E.C. 24, 661-665, 1932. H. C. Diehl.

A review of the literature of the past century which deals with the reaction of plant tissues to low temperature and ice formation is an aid to the technology of freezing preservation.

82. Advances in Knowledge of Freezing. II. D. B. Finn. P.R.P.S. 17, 5-7, 1933.

Fish should be cooled and frozen from 41° to 23° F. in 48 minutes, further chilled to -4° F. and stored at this temperature. Considerable detailed discussion of the critical rate of freezing and denaturation in cold storage is given.

83. Effect of Frozen Mass Formation of Freezing Rate of Foods. W. J. Finnegan. R.E. 42, 233-237, 260-261, 1941; I.&R. 101, 403-409, 1941.

Experiments using fresh fillets indicate a relationship between the solidification point and rate of freezing.

84. The Theory of Freezing of Tissues. R.F.I.B. 1922, 8, 1923.

The most efficient preservation depends upon the rate of cooling falling within certain limits. When these are observed, the changes which take place on freezing are reversed on thawing.

85. Theory of Freezing. R.F.I B 1923, 9, 1924.

It is probable with eggs that some irreversible change of the nature of coagulation occurs at temperatures between -6° C. and some unknown lower limit, but does not occur if this cri ical interval is hurried over with sufficient rapidity.

86. The State of Water in Colloidal and Living Systems. R. A. Gortner. Transactions of the Faraday Society, No. 115, 26, Part 12, 1930.

Bound and free water may exist in lyophylic hydrosols and hydrogels.

87. Some Recent Developments in Low Temperature Research. W. Hardy. C.&.I. 52, No. 3, 45, 1933.

The effect of cold upon the complicated catalytic cycles of metabolism is given.

88. Heat Transfer in Foods. Temperature Changes in Fruit, Vegetable, Meat and Fish Products during Freezing and Thawing. M. A. Joslyn and G. L. Marsh. R.E. 24, 81-88, 1932.

The article gives curves for temperature changes of oysters and shrimps during freezing and thawing.

89. Freezing of Gelatin. K. Kinoshita. F.I. 3, 81, 1931. Bull. Chem. Soc. Japan 5, 261-266, 1930.

Water of hydration is very loosely combined in gels when the gelatin concentration is below 15 per cent, but is more strongly held at 20 per cent, as shown by behavior on freezing.

90. Why Quick Freeze? C. F. Kolbe. F.I. 2, 165-168, 1930.

The theory of crystal formation, heat conduction, equipment for packaging, freezing, and distribution refrigeration are discussed.

91. Great Possibilities in Rapidly Frozen Fillets. C. F. Kolbe. F.G. 45, No. 3, 11, 55, 1928.

Freezing theory and possible market development is presented.

92. A Method for Studying the Histological Structure of Frozen Product. I. Poultry. F.R. 4, 117-128, 1939.

An inexpensive apparatus is described that adequately dehydrates frozen tissues and fixes them. On microscopic examination, previous location of ice formations can be identified.

93. Fast Freezing of Meat. Kuprianoff. Z.G.K.I. 39, 213-214, 1932; C.A. 27, 1683.

The freezing time varies with the thickness of meat and with the nature of refrigerant.

94. *On the Rate of Freezing in Fish Muscle. G. O. Langstroth. Proc. and Trans. Nova Scotian Inst. of Sci. 17, 206-212, 1930.

95. *On the Rate of Freezing of Fish Muscle. II. G. O. Langstroth. Biological Board of Canada, Atlantic Station Manuscript Report No. 26.

96. The Frozen State in Mammalian Muscle. T. Moran. P.R.S. 107B, 182, 1930.

Measurements made on the amount of ice present in muscle when frozen to equilibrium at different temperatures in the range -1.5° to -20° C. indicate that there is less than 6% "bound water" in the muscle.

97. Meat, Rapid Freezing. T. Moran. R.F.I.B. 1931, 14-21, 1932.

Two aspects of rapid freezing have been investigated, namely, the critical cooling rate and the effects of the temperature of storage. Numerous cooling curves and photomicrographs are included.

98. Rapid Freezing. Critical Rate of Cooling. T. Moran. J.S.C.I. 51, 16-20T, 1932; C.A. 26, 2252, 1932.

The limiting cooling rate is fixed by the conditions such that the time to cool and freeze semitendinosus muscle from +5 to -5° C. should be in the range 32-48 minutes.

99. Water Frozen in Muscle. T. Moran. R.F.I.B. 1933, 25-26, 1934.

A new method is described for measuring the amount of ice in muscle at different temperatures.

100. The Effect of Rate of Cooling and Thawing upon the Final Rate of Distribution of Water in a Gelatin Gel. T. Moran and H. P. Hale. R.F.I.B. 1924, 5-12, 1925.

On freezing a mass of colloid, ice forms slowly on external surface if rate is slow, and slowly within the mass if rate is fast.

101. The Freezing of Tissue. T. Moran and J. R. Vickery. R.F.I.B. 1927, 10-12, 1928.

An analogy is shown between freezing and dessication.

102. Aim toward Rapid Freezing without Excessively Low Temperatures. R. L. Perry. I.&R. 99, No. 1, 25-26, 1940; Power Plant Engineering 45, No. 5, 70-72, 1941.

Low temperature is undesirable because the outside layers of product are overfrozen, and expensive because of the reduced capacity of compressors.

103. Quick Freezing Terminology. P. W. Peterson. F.I. 8, 371, 1930.

C. Birdseye defines quick freezing of meats, fruits and vegetables.

104. *Theories concerning the Changes Taking Place in the Cell Membranes of Animal Flesh during the Process of Refrigeration. R. Plank. I.&.C.S. 28, 234-235, 261-263, 1925.

105. The True Freezing of Fish Flesh. Anon. P.R.P.S. 59, 19, 1944.

By method A, 9% of the liquids of fish muscle can be separated, unfrozen, at 14° F.; and by method B, 11% halibut muscle remains unfrozen at -7° F.

106. The Temperature at Which Unbound Water is Completely Frozen in a Biocolloid. J. L. St. John. J.A.C.S. 53, 4014, 4019, 1931.

It is shown that a temperature of -12.5° C. is sufficient to freeze all of the fill water in a hydrophilic biocolloid but the bound water remains unfrozen at temperatures ranging from -12.5 to -35° C.

107. Low Temperatures and Their Applications. H. Sloan. I.&R. 79, No. 4, 299, 1930.

Application of low temperatures to meat freezing is described; cooling curves are included.

108. Preservation of Food by Freezing with Special Reference to Fish and Meat. A Study in General Physiology. W. Stiles. Dept. Scientific Research, Food Investigation Board, Special Rept., No. 7, 186, 1922.

The physics and chemistry of the freezing process, different freezing methods, storage and thawing are discussed.

109. The Freezing of Colloids. J. R. Vickery. R.F.I.B. 1928, 23-24, 1928.

The concentration of electrolytes is of importance in determining the degree of reversibility and the critical temperatures in the freezing of complex colloidal systems.

110. Latent Heats of Foodstuffs--New Determination and Résume of Theory Applicable to Freezing of Foods. W. R. Woolrich. R.E. 22, 21-24, 1931.

All experiments to date indicate that the latent heat of fusion is directly proportional to the moisture content.

111. Cooling and Freezing Curves for Fish, I and II. O. C. Young. P.R.P.S. 22, 11-14, 1934; 26 12-16, 1935; I.&C.S. 39, No. 458, 106-107, 1936; I.B.R. 1935, 156; 1936, 45; Cold Storage and Produce Review 38, 7-8, 1936.

Typical cooling and freezing curves are given for halibut steaks and round halibut and salmon. The time lapse in the zone of crystal formation is shown to be critical.

112. Dry and Wet Freezing in the Meat Industry. M. T. Zarotschenzeff. I.&R. 82, 133-128, 1932.

The article discusses extraction of latent heat, freezing curves, freezing methods, and quick freezing tests.

113. Keeping Quality of Frozen Fish. Willis H. Baldwin. I.&R. 94, No. 2, 98, 1938.

Live fish are frozen, stored and defrosted, after which they develop rigor mortis and proceed through the acid-alkaline cycle.

114. The Freezing and Cold Storage of Live Clams and Oysters. M. H. Friedman. B.B.C., Ann. Rep. 23-24, 1932.

Experiments were performed to determine the proper condition for keeping clams and oysters alive in cold storage.

115. Frozen Oysters Survive unless Jarred. M. H. Friedman, P.R.A.S., 10, 34, 1934; F.G. 51, 3, 1934.

Oysters frozen at 24° F. survive seven weeks storage at that temperature without apparent injury providing they are not jarred.

116. *Anabiosis of Fish. Anon. I.B.R., 238, 1936.

117. Some Experiments on the Freezing and Thawing of Live Fish. W. H. Martin, C.B., Sup. to the 47th Ann. Rep. of the Dept. of Marine and Fisheries, Fisheries Branch (1915), 73-75.

Fish will not survive for any length of time at a temperature of -1° C. or lower.

118. The Critical Freezing Temperature for Living Muscle. T. Moran. R.F.I.B. 1928, 19-19, 1929.

When muscle is frozen to -2° C., less than 40% of the water freezes, and upon thawing, the muscle resumes its normal state, all freezing changes being completely reversible. As the per cent water frozen increases above 40 per cent (by using freezing temperatures lower than -2° C.), freezing changes become increasingly less reversible.

119. Critical Temperature of Freezing--Living Muscle. T. Moran. P.R.S.B105, 177-197, 1930.

In freezing or drying living amphibian muscle three zones may be distinguished. 1. Up to 40% removal of water gives complete recovery upon restoring water. 2. At 40 to 78%, physiological activity progressively diminishes. 3. Beyond 78%, muscle immediately dies.

120. The Freezing of Living Tissues. E. C. Smith, R.F.I.B. 1930, 17, 1931.

Frozen and thawed frog's cardiac muscles and nervous tissue are measured for oxygen uptake, respiration and lactic acid.

121. The Oxygen Uptake of Frozen and Thawed Muscles. E. C. Smith. P.R.S. 108B, Memo. 162, 553-559, 1931.

Muscles frozen 24 hours at a temperature not lower than -2.4° C. recover their initial ability for oxygen uptake on thawing. Below -3° C., the oxygen uptake on thawing is reduced to less than 10% of the resting uptake.

122. Meat, the Freezing of Tissues. E. C. Smith. R.F.I.B. 1931, 30-32, 1932.

The breakdown and resynthesis of phosphagen in frozen and thawed living muscles is discussed. Liberation of water as a result of freezing muscle-globulin suspensions has little analogy to drip in thawed muscles.

123. Meat: the Freezing of Mammalian Muscle. J. R. Vickery. R.F.I.B. 1929, 18-21, 1930.

The effect of freezing before and after the onset of rigor and lactic acid production are discussed.

124. The State of Anabiosis. M. T. Zarotzschenzeff. I.&C.S. 33, 1930.

Fish will revive if frozen to any temperature between -1.5° and -10° C.

125. The Role of Supercooling in the Process of Rapid Freezing. E. Y. Bardakh. Kholodil'naya Prom. 15, No. 5, 19-26, 1937; Chem. Zentr. II, 735, 1938; C.A. 34, 4163, 1940.
Fine crystals can be obtained even by slow freezing if foods are given proper preliminary treatment.

126. Sodium Chloride as a Preventative of Drip in Frozen Fish. S. A. Beatty. B.B.C. Annual Report, 40-41, 1930.
Drip loss was reduced from 16 to 6% by use of 20% brine dip for 1 minute.

127 Effect of Time before Freezing on Quality of Frozen Halibut. H. N. Brocklesby and W. A. Riddell, Fisheries Research Board of Canada, Annual Report 1937, 58.
Halibut held longer than 5 days in ice prior to freezing undergo abnormal changes during storage in the frozen state.

128. Effect of Time before Freezing on Quality of Frozen Halibut. H. N. Brocklesby and W. A. Riddell. Fisheries Research Board of Canada, Annual Report 1938, 48.
Halibut held longer than 6 to 7 days in ice prior to freezing undergo extensive deleterious changes during cold storage.

129. Freezing Meat and Poultry Products for Home Use. Bureau of Animal Industry, U. S. Department of Agriculture. A.W.I.-75, 1944.
Steps in preparation of fish, poultry and eggs for freezing are illustrated.

130. The Commercial Freezing and Storing of Fish. E. D. Clark, L. H. Almy and M. E. Pennington. Bureau of Chemistry, U. S. Department of Agriculture. Bulletin 635, 1918; M.S. 91.
A discussion of preparation, cleaning, freezing, glazing, cold storage, packaging, reglazing, length of storage, and food values of fish is presented.

131. Frozen Fish Fillets Used Successfully in Benzoated Brine Dip Experiments. C. R. Fellers and E. W. Harvey. F.G. 57, No. 6, 36, 44, 1940; C.A. 35, 218, 1941.
The use of 5% salt brine containing 0.3% sodium benzoate was found useful in effectively prolonging the storage life of haddock and other fillets.

132. Quality Control of Frozen Food Products. G. A. Fitzgerald. R.E. 37, 306-309, 1939.
General requisites of quality control, raw material, sanitation, and protection in distribution are described.

133. A Massachusetts Revolution. F.G. Review No., 17, 1928.
This article describes in detail methods of filleting, wrapping, and packing fillets.

134. Automatic Fillet Machine Developed by Atlantic Coast Fisheries Company at Boston. Anon. F.G. 56, No. 2, 25, 1939.
A capacity of 100 fillets per minute and 17% increase in yield is obtained with the new equipment described.

135. Sanitation and Quality Control in the Fishery Industries. G. A. Fitzgerald and W. S. Conway. Am.J.Pub.Health 27, 1094-1101, 1937.
Freshness test, sanitary aspects of production at sea, prior to filleting precautions, bacteriological standards and significance are considered. Use of bacterial counts and the Stansby-Lemon electronic freshness test are recommended.

136. Quick Freezing Quality in Poultry. Anon. F.I. 9, 578-579, 1937.
Close control and careful processing produce a standard product of high quality.

137. Standards for Refrigeration of Fish. Anon. I.&R. 80, 351, 1931.
A system should be devised which would grade the fish of each species into classes according to size and which would eliminate from the freezing process all fish which are not strictly fresh.

138. Public Health Aspects of Frozen Foods. C. R. Fellers. I.&R. 98, 493, 1940; Mass. Agri. Exp. Sta. Contrib. No. 136, 1932; Am. J. Pub. Health 22, No. 6, 1932.
Frozen food factories are clean; modern methods of sanitation are used.

139. Lactic Acids as an Index of Keeping Quality of Frozen Fish. J. M. Lemon. Proceedings, American Institute of Refrigeration 1941, 58-62.
Fish which were frozen alive are likely to remain in good condition over a considerably longer period of cold storage than those which were frozen after several days storage at room temperature.

140. Meat, By-products. T. Moran. R.F.I.B. 1931, 21-22, 1932.
Improvement in the grading and preparation, packing, and freezing of edible offal is necessary.

141. Health Problems in Packing Crustacean Products. J. T. R. Nickerson, G. A. Fitzgerald and R. Messer. Am.J.Pub. Health 29, 619-627, 1939.
Chlorine is of value in the control of contamination in packing operations.

142. Refrigerating and Preserving Fish, Meat, or Other Foods. P. W. Peterson. U.S. 1,681,009, August 14; C. A. 22, 3713, 1928.
Fish are washed in a solution containing sodium hypochlorite, frozen with the solution remaining on the surface, and then coated with ice.

143. Some Comments on the Future of Frozen Fillets. P. W. Peterson. F.G. 47, No. 5, 17, 1930.
This article discusses quality, processing, skinning, and method of freezing fish fillets.

144. Relationship between Time of Freezing Beef after Slaughter and Amount of Drip. J. M. Ramsbottom and C. H. Koonz. F.R. 5, 423-429, 1940.
An increase in the period of storage was found to lessen the rate of increase of drip, to increase ice crystal size, and to cause pH to remain unchanged.

145. Relation of pH to Drip Formation in Meat. L. Sair and W. H. Cook. C.J.R. 16D, 255-267, 1938; C.A. 33, 250, 1939.
The quantity of drip is affected by the period between slaughter and freezing and by the pH of the tissue.

146. Pacteriology and Sanitation of Quick Frozen Foods. N. H. Sanderson, Jr. R.E. 42, 228-232, 1941.

Automatic methods of self cleaning of machinery are important; plant personnel should be selected and trained with emphasis on habits of personal cleanliness. Spoilage in quick frozen foods is discussed.

147. Methods of Preparing Sea Foods for Locker Plant Storage. M. E. Stansby. F.G. 58, No. 1, 27, 1941.

Fish must be fresh. Preparation for storage including brine dip for fillets and steaks, sharp freezing, and storage life are discussed.

148. Judging the Quality and Freshness of Fish by Organoleptic Methods. M. E Stansby. U. S. Department of Interior, Fish and Wildlife Service Fishery Leaflet 94, October, 1944.

Factors of fundamental importance to consumers of fish are palatability, good appearance and odor during preparation for the table, and satisfactory keeping quality between time of purchase and consumption. Useful accesory tests for predicting these primary qualities are described for fish and shellfish, and they include such well known organcleptic observation as odor of surface of fish or gills, appearance of eyes and gills, etc. Federal specifications for purchase of fish are included.

149. The Preservation of Fillets. H. L. A. Tarr. P.R.P.S. 43, 10-13, 1940.

The effect of citric acid on fillet drip is compared with the effect of brine.

150. Formation of Drip in Fish Muscle and Its Control in Defrosted Fish. H. L. A. Tarr. P.R.P.S. 47, 5-9, 1941.

Drip from frozen fish flesh and defrosted fish can be controlled by use of brine dips after freezing and after thawing. Effect of brine concentration and the mechanism by which salt prevents drip is explained.

151. Quick Frozen Fish Fillets. The Role of Preservatives in Enhancing Keeping Quality. H. L. A. Tarr and P. A. Sunderland. I.&C.S. 42, No. 495, 91-92, 1939; C.A. 34, 184, 1940.

The preservative actions of Na benzoate, benzoic acid, potassium nitrite, hydrogen peroxide, chloroform, boric acid, HCl, sulfur dioxide, and p-hydroxybenzoic acid ethel ester for fresh flounder and frozen halibut are compared.

152. Brining Fillets in Order to Enhance Keeping Quality and Prevent "Drip". H. L. A. Tarr and P. A. Sunderland. P.F.P.S. 44, 12-14, 1940.

Plaice and halibut fillets, immersed for five minutes in 52° salinometer brine containing 0.2% sodium nitrite, received the maximum enhancement of keeping quality and prevention of loss of weight by drip.

153. Drip in Unfrozen and Frozen Fillets Controlled by Brining. H. L. A. Tarr and P. A. Sunderland. P.F.P.S. 45, 19-20, 1940.

A dip of one minute in 60° Salinometer brine at 32 to 35° F. will reduce drip in fillets of most species of fish.

154. Improvements in Methods of Merchandizing Fish. H. F. Taylor. Booklet, The Patterson Parchment Paper Company, Passaic, New Jersey, 1925.
Methods of preparing fish for freezing are described.

155. Refrigeration in the Preservation of Foods. H. F. Taylor. R.E. 19, 134-137, 1930.
Methods of preparation of fish for freezing, effect of freezing on fish, and other problems are discussed.

156. Frozen Fish. H. F. Taylor. F.I. 1, 597-598, 1929; M.S. 309.
Cleanliness is a means of abating odor and pollution nuisances in fish freezing plants.

157. Preserving Fish, etc. for Food. H. F. Taylor. U.S. 1,920,222, August 1, 1933.
By adjusting the pH of the fish to 7 before freezing, the thawed fish has less drip.

158. Sanitation in a Modern Fish Filleting and Freezing Plant. D. K. Tressler. Municipal Sanitation 1, 190-193, 1930.
Methods of handling, filleting and freezing fish in a Gloucester plant are illustrated.

159. Quality Control Vital to Success in Frozen Foods Industry. D. K. Tressler. F.I. 10, 330-333 & 357-359, 1938.
A high quality frozen product can only be attained by means of adequate control which starts with the selection of the variety and extends through all steps of raw material production, preparation, freezing, storage, transportation, wholesaling and retailing.

160. Freezing and Storage of Foods in Freezing Cabinets and Locker Plants. D. K. Tressler and C. W. DuBois. N.Y.S. Agr. Exp. Sta. Bull. 690, 1940.
General directions are given for cutting, packing, and freezing of fish and shellfish.

161. How Brining with Pure Salt Improves Fillets. D. K. Tressler and W. T. Murray F.G. 49, No. 2, 24-26, 1932.
The use of a pure salt in place of solar sea salts lengthens the permissible period of cold storage of haddock fillets by three months.

162. Experiments on the Preparation of Shrimps for Freezing. O. C. Young. P.R.P.S. 43, 3-5, 1940.
A method for preparation of shrimp is described.

METHODS OF FREEZING

General

163. Modern Practice in Preservation of Fish by Cold. L. Berube. R. E. 34, 305-307, 313, 1937.

An abstract of a paper on freezing methods and theory read at the M. I. T. conference is presented.

164. Modern Practice in Preservation of Fish by Cold. L. Berube. F. I. 9. 645, 1937.

Brine freezing should be avoided in favor of cold blast freezing.

165. Factors to be Considered in the Evaluation of Food Freezing Methods. W. J. Finnegan. Q. F. F. 1, No. 10. 14-18, 1939.

To determine adaptability of any food freezing method to commercial practice, it is necessary to understand a few basic factors and to ascertain their practical value.

166. Food Freezing. W. J. Finnegan. I. and R. 98, 457-458, 1940.

Different foods require different treatment to obtain the best frozen product. The basic principles of heat exchange should be applied in the design and selection of suitable equipment.

167. Three Years of Progress in Food Freezing Methods. Anon. F. I. 12, No. 12. 63-65, 1940.

Sharp, air blast, tunnel, single and double contact, spray or fog, block ice, immersion and other freezing methods are discussed.

168. New Type Quick Freezer Designed. F. W. Knowles. F. G. 57, No. 1. 24, 1940.

This freezer permits straight-line package freezing; it has possibilities for commercial fisheries.

169. Developments in Refrigeration of Fish in the U. S. J. M. Lemon. U. S. Bureau of Fisheries, Invest. Rept. 16, 1932.

Methods of freezing and transporting frozen fish are discussed. A bibliography with 311 references is included.

170. *Quick Freezing Systems in the United States of North America. J. M. Lemon. Proc.Am.Inst.Ref. 1933, 164-170.

171. Sea Food Refrigeration Comes of Age. J. M. Lemon. F.G. 55, No. 10, 80-82, 1938.

Fish quick-freezing practices within the industry are discussed.

172. The Quick Freezing of Perishable Foodstuffs. J. W. Martin. R.E. 19, 131-132, 1930.

This article is a general discussion of quick freezing methods.

173. *Symposium of Papers on "Quick Freezing". British Assn. of Refrig'n. Proc. 35, No. 2, 5-25 & 26-35 (discussion), 1938-1939. Low Temperature Conduction Freezing for Perishable Foods. W. T. Murray; Quick Freezing, W. S. Josephson; Commercial Development of Quick Freezing in Great Britain and Empire. W. H. Peak; "Z" Process of Quick Freezing. W. G. Brettell.

174. Exceptional Care in Fish Freezing. Anon. P.F. 33, No. 10, 43, 1935.

A description of methods of freezing large size fish is given.

175. A Modern Fish Freezing Plant. P. W. Peterson. R.E. 10, 425-431, 1924; C. A. 19, 548; I.&R. 67, 103-108; 4th Int. Cong. of Refrig'n., 1181-1198.

$CaCl_2$ brine is used indirectly in two fish freezing methods.

176. Principal Quick Freezing Methods. Anon. Q. F. F. 4, No. 10, 12-14, 1942.

A brief outline description (with pictures) of various methods now being used for quick freezing foods is given.

177. *Food Freezing Methods. O. C. Young. M. R. 43, 225 and 228, 1940.

Recent advances have been made in methods of freezing and in handling facilities for fish.

178. Fish Freezing Advances in Newfoundland. M. T. Zarotschenzeff. F. G. 51, No. 8, 11-12, 1934.

Of the three principal commercial fish freezers in operation, two use direct contact brine freezing similar to the Ottsen system, and one uses indirect contact brine freezing similar to the Petersen system.

Comparison of Methods

179. Preservation of Foods by Freezing. H. R. Beard. P.F. 28, No. 12, 25-26, 1930.

A description of methods for quick and sharp freezing fish is given.

180. Histological Investigation of Frozen and Stored Hake Muscles. D. J. Bowie. B.B.C., Ann. Rept. 1932, 21.

Brine frozen fish showed small ice-crystal space; similar tissue allowed to thaw before fixing showed little evidence of crystal spaces. Crystal spaces in brine frozen fish are comparatively small in contrast to air frozen samples.

181. A Chemical and Nutritional Study of Frozen Haddock Muscle. G. C. Crooks, Ph. D. Thesis, Mass. State College, 1937.

The chemical and nutritive value of haddock muscle frozen in various ways and stored for one year at various temperatures was studied.

182. Seasonal Variation in Chemical Composition of Common Haddock. G. C. Crooks and W. S. Ritchie. F.R. 4, 159-72, 1939; C.A. 33, 5533, 1939.

No significant differences were found in the composition of samples frozen by various methods.

183. Evaluating Food Freezing Methods. W. J. Finnegan. R.E. 37, 381-383, 1939.

Speed of freezing, and fixed vs. flexible freezing facilities are discussed.

184. Factors to Be Considered in Evaluation of Food Freezing Methods. W. J. Finnegan. I.&R. 96, No. 5, 429-432, 1939; R.E. 37, 381-383 & 399, 1939.

A discussion is given on direct and indirect contact and conduction freezing; test vs. commercial freezing; fixed vs. flexible freezing.

185. Methods of Freezing Fish. I., So. African J. Industries 4, 629-637, 1921; C.A. 15, 3879.

The freezing and handling of large quantities of common fish such as herring is discussed.

186. Interim Report on Methods of Freezing Fish, with Special Reference to the Handling of Large Quantities in Gluts. Great Britain, Food Investigation Board, Dept. of Sci. and Ind. Research, Special Rept. 4, 1920.

Common fish such as herring or sprat may be preserved during a glut if the proper procedure is followed.

187. Palatability of Rapidly Frozen Meat. Lampitt & Moran. J.S.C.I. 52, 143-146, 1933.

The palatability of rapidly frozen meat is compared with similar meat frozen more slowly.

188. Freezing and Cold Storage of Herrings. I. H. Green. "Report of Experiments Carried out at North Shields". Dept. of Sci. and Ind. Res., Food Investigation Board, Memoir 11, London, 1920; J. Hyg. 19, No. 1, 1920.

Brine freezing is more satisfactory than air freezing at 18° F., keeping properties of ungutted frozen fish are superior to gutted.

189. Quick Freezing of Poultry. Van R. H. Greene. R.E. 36, 97-99, 1938; Q.F.F. 1, No. 2, 31 & 57, 1939.

Poultry may be quick frozen to advantage by the air blast, Birdseye or "Z" process.

190. Physics of Food Storage and Transport. E. Griffiths. J.Sci.Instr. London, 17, No. 12, 269-273, 1940.

Fish freezing, disadvantages of slow freezing, plate froster method for packaged fillets, and railway transportation are described very briefly.

191. Experiments of Refrigeration Requirements and the Amounts of Frozen-out Water with Fast and Slow Freezing of Foodstuffs. R. Heiss. Z.G.K.I. 40, 97-104, 122-128 & 144-146; C.A. 27, 5829, 1933.

Foodstuffs require the same amount of refrigeration to lower their temperature by any given amount, regardless of the rate of cooling.

192. The Quantities of Water Frozen-out in the Freezing of Foodstuffs. R. Heiss. Biochem. Z. 267, 438-451; C.A. 28, 2073, 1934.

The quantity of water frozen at any temperature is independent of the rate of freezing.

193. Quick Freezing of Dressed Poultry as Compared to Slow Freezing. T. W. Heitz and T. L. Swenson. U.S. Egg Poultry Mag. 39, No. 11, 36-37, 1933.

Experiments were conducted with ducks and poultry to determine dessication, bacterial count, fat rancidity, and eating quality.

194. Freezing Makes Rapid Progress. H. J. Humphrey. F.I. 8, 612-613, 1936.

Relative merits of fast vs. slow freezing are discussed and varieties good for freezing, and problems affecting quality are outlined.

195. The Freezing of Fish - Failure and Success. F. S. Jackson. C.B. 1, No. 15, 297-302, 1923.

The quality of fish frozen by different methods is compared.

196. Frozen Shrimp. J. R. Kelley. I.&R. 93, 273-274, 1937.

Methods of packaging and freezing are recommended, and the advantages of frozen shrimp are pointed out.

197. Meat; Rapid Freezing. T. Moran. R.F.I.R. 1932, 22-23, 1933.

No difference in palatability could be detected between rapidly frozen and slowly frozen samples of loin chop of lamb, sheep's liver and semitendinosus muscle.

198. Rapid Freezing of Meat. T. Moran. R.F.I.B. 1933, 28, 1934.

Experiments on the palatability of rapidly and slowly frozen samples of meat suggested that the former possessed no advantages.

199. Brine Freezing of Fish. H. F. Taylor. U. S. Bureau of Fisheries Econ. Circ. 53, 1921; M.S. 88, 1929.

Air frozen fish are compared with brine frozen.

200. Theory and Practice of Rapid Freezing in Fish Industry. H. F. Taylor. I.&R. 79, 111-121, 1930.

A discussion is given on preparation, packaging and freezing of quick and slow frozen haddock fillets, and on the relative amounts of drip formed in fish frozen by each method.

201. Solving the Problems of Rapid Freezing. H. F. Taylor. F.I. 2, 146-152, 1930.

A discussion is given of such problems of the fish freezing industry as methods of quick freezing, packaging, and storage; transportation of frozen fish; determination of and retarding drip in fish fillets.

202. Freezing Methods Evaluated. J. G. Woodroof. F.I. 10, 618-621 & 659, 19[illegible]

Basic research on the effects of different rates and methods of freezing is described. Photomicrographs are shown.

203. Quick and Flash Freezing of Foods. W. R. Woolrich and L. H. Bartlett. Mechanical Engineering 64, 647-653, 1942.

A general discussion is given of such diverse fields as supercooling phenomenon, rates of freezing, effect of freezing on quality of product, and commercial freezing equipment. It is pointed out that quick freezing does not give a superior product for all foods.

204. Frozen Fish Products. O. C. Young. Fisheries Research Board of Canada, Annual Report, 1939, 33.

Effects of methods of freezing and of cold storage temperatures on fish are discussed.

205. Freezer Studies. O. C. Young. P.R.P.S. 32, 9-12, 1937.

Arguments are presented in favor of more rapid freezing as well as methods for increasing the rate of freezing in sharp freezers with a minimum of effort.

Blast Freezing

206. Quick Freezing System Using Air. Victor Buhr. F.G. 50, 19, 1933; U.S. ~~Patent No.~~ 1,930,414.

Air blows over, under, and along sides and ends of products while they are traveling through a freezing chamber on a perforated belt.

207. Food Freezing - Engineered for Quality and Economy. W. J. Finnegan. I.&R. 95, 355-361, 1938.

Finnegan multi-stage freezer operation on peas is extensively discussed.

208. Acceleration of Low Temperature Heat Exchange. W. J. Finnegan. I.&R. 98, 409-410, 1940.

Multiple exchange of heat in air blast food freezer illustrates efficient heat transfer; other factors also control the efficiency of freezing.

209. Modern Food Freezing Accompanies Ice Making. W. J. Finnegan. I.&R. 99, 419-423, 1940.

Operational description is given of "Finnegan" equipment installed at Atlantic Ice Manufacturing Company for custom freezing of fish, seafood, and other products.

210. Quick Freezing of Poultry. W. J. Finnegan. R.E. 41, 91-93, 175-178, 1941.

Theory and practice of quick freezing poultry, describing a multi-stage freezing process is given.

211. Columbia River Packers' Association Install New Type Freezing System. Anon. F.G. 57, No. 3, 34, 1940.

A Niagara "No Frost" cold air blast recirculating unit is used in freezing 14 tons of tuna on truck racks in 20 hours in a room 12 by 44 by 12 feet. Five such rooms are in operation.

212. The New Frick Blizzard Freezer. Anon. F.G. 58, No. 6, 38 & 44, 1941.

This truck and pan system is well adapted to freezing fish fillets and panned fish; it employs high velocity and low air temperature in a tunnel.

213. Freezing Foods or the Like such as Fish, Fruit Juices, etc. B. J. Foss. U.S. 1,952,666, March 27; C.A. 28, 3496, 1934.

The material is subjected to the direct action of a gas such as air at a temperature of -40° C. and a velocity of 1000 feet per minute.

214. Grayson Method of Quick Freezing by Multi-stage Intense Refrigeration. R. V. Grayson. F.G. 57, No. 2, 33, 1940.

This method utilizes a sub-zero air blast, basket in tunnel system of freezing.

215. New Method of Quick Freezing. I.&R. 91, 457-458, 1936; R.E. 33, 95, 1937.

A Murphy method freezer is installed in the Deerfield Packing Corporation, Bridgeton, New Jersey. The unit consists of a series of refrigerated shelves for placement of product to be frozen, combined with air blast freezing.

216. New Refrigerator Apparatus Adapted for Freezing Fish. I.&R. 91, 135, 1936; I.B.R. 1936, 319.

Carl Sundback's apparatus (illustrated) provides for tunnel circulation of refrigerated air.

217. New Quick Freezing Unit Developed (Blizzard). I.&R. 101, 127-128, 1941.

The Frick "Blizzard" or blast freezer handles fillets in five pound pans at the rate of 1,000 pounds every two hours.

218. Moderne Luftfrysning Paa Gaspekysten. M. Jul. Kemoteknik Nr. 7, Ingeniøren Nr. 45; 65-66, 1940 (July 6).

An establishment for fish on the Gaspe Coast uses a modern blast freezing method.

219. *Ueber einige Sonderanwendungsgebiete Kuenstlicher Kaelte. K. Linge. Z.G.K.I. 47, No. 7, 98-102, 1940.

In the German Heckermann process, the foods are spread out and frozen by an air blast.

220. Efficient Method of Quick Freezing. T. Mitchell. R.E. 41, No. 2, 101-102, 1941.

Frick blast freezing system is described.

221. Blast Freezing Plants. E. D. Pollock. R.E. 48, No. 1, 16-19, 1944.

High velocity air blast freezing is discussed and compared with low velocity freezing of fish fillets and other products.

222. The Case for Blast Freezing of Poultry and Other Shrinkable Food Products. J. E. Watkins. I.&R. 105, No. 3, 93-97, 1943.

Tests of freezing turkeys show that shrimkage due to desiccation is reduced as freezing temperature is lowered; power requirements go up. Blast freezing gives satisfactory results.

223. Freezing and Thawing of Fish. O. C. Young. Fisheries Research Board of Canada, Annual Report 1940, 34-35.

Fish freezing methods with modified forced air circulation are studied. It is important to have a low storage temperature and a proper method of thawing.

224. Fans in Freezing. O. C. Young. P.F. 35, No. 9, 69-71, 1937.

Advantages of circulation outweigh the single drawback of drying.

225. Apparatus and Procedure for Freezing and Packaging Food Products such as Fish and Meat. C. Birdseye. U.S. 1,773,079, 1,773,080, 1,773,081; C.A. P24: 5084, 1930.

Birdseye patents a belt froster.

226. Bringing Quick Freezing to Seasonal Crops. C. Birdseye. F.I. 3, 490-491, 1931.

This is the first illustrated description of the multiplate freezer.

227. Portable Quick Freezing Apparatus. C. Birdseye. I.&R. 82, 375-377, 1932.

Birdseye multiplate freezer emerges as a portable unit.

228. The Gravity Froster. C. Birdseye. R.E. 40, 281-285, 1940; U.S. 2,228,998, 2,228,999, 2,229,000, January 14, 1941.

This efficient bulk quick freezing process and apparatus handles 1,200 pounds of green shrimp tails per hour.

229. Quick Freezing of Meat by New Low Cost Method. J. E. Bryan. I.&R. 94, No. 4, 297-298, 1938; F.I. 10, 12-13.

A method for use of dry ice developed for packaged products results in handling 1,000 pounds per hour at a cost of one-half cent per pound.

230. How Fillets Are Frozen by the Cooke Method. L. V. Burton. F.I. 2, 152-155, 1930.

The Cooke method of freezing fish fillets is described with illustrations.

231. Birdseye Demonstrates New 20-Plate Froster. L. V. Burton. F.I. 13, No. 11, 46-47, 1941.

The high capacity, continuous freezer controls the rate of feed to attain constant predetermined temperature of frozen product. It has a conveyor feed and discharge, and it fits into the production line.

232. A Kolbe Installation at the Gorton-Pew Plant. T. J. Carrol. F.I. 2, 169-172, 1930.

The fillet freezing operation is explained in detail along with a description of the Kolbe equipment.

233. Apparatus for Freezing Foods such as Fish. A. H. Cooke. U.S. 1,795,330; C.A. P25, 2494, 1931.

Heat conducting elements attached to an endless-belt carrier serve as heat transfer means between the cooling agent and articles to be frozen.

234. New System of Quick Freezing Has Many Advantages for Sea Foods. A. R. Fisher. F.G. 56, No. 9, 16, 21, 1939.

The apparatus consists of a series of flat rubber bag shelves arranged one above the other and refrigerated with brine. The shelf has the advantage of fitting the conformity of the product being frozen.

235. Quick Freezing Equipment Available Now for Large or Small Freezers. Anon. F.G. 45, No. 8, 15, 1928.

Kolbe floating pan system is installed at Quincy, Massachusetts for custom freezing.

236. New Type Freezing Unit Developed by Kolbe. R. E. Kolbe. F.G. 46, No. 10, 16-17, 1929, U.S. 1,777,094.

A compact cabinet freezer has been developed from the "diving bell" method of block freezing. The brine is circulated around enclosed pans of fish on shelves.

237. An Introductory Freezer. Anon. F.G. 47, No. 5, 28, 1930.

Fillets are frozen on aluminum plates resting on dry-ice cubes.

238. New Quick-freezing System Incorporates Several Novel and Striking Features. Anon. F.G. 47, No. 12, 22-23, 1930.

The product is frozen in molds under pressure while being automatical conveyed through a brine-filled flume.

239. Frick Company Develops New Type of Freezer for Boston Concern. Anon. F.G. 48, No. 8, 13, 1931.

Covered pans of fish are frozen in troughs of brine.

240. Booth Fisheries Company Announces Quick-freezer. Anon. F.G. 48, No. 9, 26, 1931.

Calcium chloride brine is sprayed on tops and bottoms of pans in an insulated cabinet.

241. The Birdseye Portable Quick Freezer. Anon. F.G. 49, No. 4, 43, 1932.

Six stage plate froster, on wheels, requires only water and electrical connections for operation.

242. The Jackstone Roto-froster. Anon. F.G. 58, No. 3, 24-25, 1941.

The Roto-froster is used for the custom freezing of fish.

243. Frozen Food Plant Installs New Freezing and Handling Equipment (Finnegan). Anon. I.&R. 98, 73-75, 1940.

A multistage tubular freezer is installed for the rapid freezing of fish, soft shell crabs, crab meat, and oysters.

244. Method of Freezing and Packaging Foods. R. P. Fletcher. U.S. 2,235,209, March 18, 1941.

Food placed in a sectionalized mold is squeezed between refrigerated plates for quick freezing.

245. Where the Petersen Rapid-freezing Systems Stand Today. F.I. 2, 173-175, 1930.

Evolutional history of Petersen systems and a description of their operation is given.

246. Continuous Quick Freezer Developed by Birdseye. Anon. F.I. 12, No. 9, 44-45, 1940.

This freezer has automatic feed and discharges, takes little floor space, is portable, and freezes products without dehydration.

247. Pressure Freezer. J. Goreg to Booth Fisheries Corporation. U.S. 2,232,383, February 18, 1941.

The freezer consists of a number of superimposed plates with a means for exerting force to lift the plates in succession to compress the product.

248. "Wet Process" Solves Problems in Packing and Transporting Frozen Foods. A. B. Haslacher. F.I. 8, 438-439, 1936.

Using a wet method, freezing is accomplished in six hours in small containers, and in 24 hours in larger ones.

249. Ice Fillets. A. G. Huntsman. C.F. 16, No. 4, 17, 1929.

A method somewhat similar to that of Birdseye is described except that refrigeration is applied by means of an ice salt brine, and that a higher temperature is used.

250. Brine Freezer, Using Ice and Salt. A. G. Huntsman. P.R.A.S. 2, 406, 1931.

This compact ice and salt brine freezer handles up to 150 pounds of fish per hour.

251. Birdseye Method of Freezing Fish. Anon. I.& R. 76, 321-324, 1929.

A method (illustrated) of preparing and preserving frozen fish uses a quick freezing machine consisting of flexible metal belts sprayed with calcium chloride brine. A fillet-skinning machine is also pictured.

252. *The Petersen Rapid Freezing System. Anon. I.&C.S. 34, 19-20, 1931.

253. Kolbe Floating Pan Instant Freezing System. I.&R. 77, No. 3, 153-154, 1929.

This method of preserving and preparing frozen fish comprises a floating pan rapid freezing system.

254. Going Fishing as a Business. Anon. I.&R. 81, No. 4, 239-241, 1931.

The "Hendron" quick freezing equipment at Booth Fisheries is pictured and described.

255. Freezing Poultry from the Inside. Anon. I.&.R. 92, 431-433, 1937.

Dressed poultry in aluminum forms are indirectly frozen by brine flowing through paraffin tubes extending through the fowl.

256. Method of and Apparatus for Freezing Materials. R. E. Kolbe. U.S. 1,527,562. February 24, 1925.

The diving bell system of immersion freezing in brine uses pans with air entrapping covers.

257. Freezing Method. R. E. Kolbe. U.S. 1,641,441, September 6, 1927.

The equipment consists of a floating pan in a labyrinth.

258. Method of and Apparatus for Freezing Materials. R. E. Kolbe. U.S. 1,835,881, December 8, 1931.

Covered pans with bottoms only submerged in a liquid medium move through and prevent contact of the product with the medium.

259. Direct Expansion Quick Freezing Machine. H. G. Miller. I.&R. 79, 128-129, 1930.

Food to be rapidly frozen is held against the side of a drum containing the primary refrigerant.

260. Super-frozen Packaged Fish from Florida. J. E. Munson. I.&R. 81, No. 4 242-244, 1931. F. G. 48, No. 9, 18-20, 1931.

Products are arranged on the bottom of an upturned pan. A cover is fitted over to provide a double metal contact as well as to protect the fish from the brine spray in the freezer.

261. Booth Invents New Freezer. Anon. P.F. 29, No. 11, 30-31, 1931.

Booth has invented a quick freezing apparatus which works on the indirect-contact principle through a system of covered trays or pans sprayed with calcium chloride brine.

262. Plate Type of Evaporator as Used in Locker Plants. A. F. Sawyer. R.E. 44, No. 1, 17-18, 1942.

The evaporator is used in banks for room cooling and as shelves for freezing.

263. Quick Freezing of Filleted Fish. L. H. Sherrill. F.I. 1, 33-35, 1928; C.A. 23, 449.

Calcium chloride brine with its low freezing point is used to freeze fish very rapidly and thereby prevent distortion and formation of large ice crystals.

264. The Jackstone Roto Froster. A. J. Stone. Q.F.F. 2, No. 7, 16, 32, 1940.

The Jackstone Roto Froster, illustrated and described, can be used to freeze fish fillets.

265. The Practical Side of Freezing. A. J. Stone. R. E. 41, 252, 1941.

A study of plate freezing is presented.

266. Methods of Freezing and Cold Storage. O. C. Young. Fisheries Research Board of Canada, Annual Report 1938, 49.

Experiments on storage of fish frozen in a modified plate freezer show that best storage life is obtained at 0° F. or lower.

267. Full Drawn Poultry Quick Frozen in "Flexible Froster". M.T. Zarotschenzeff. I.&R. 98, 329, 1940.

Product to be frozen is placed between flat rubber bags through which a liquid at a very low temperature is circulated. The elastic rubber surface adapts itself to the contour of the product.

268. New Quick Freezing System. L. H. Bartlett and H. E. Brown. R.E. 42, 83-87, 1941; M. R. 44, No. 523, 147-148, 1941.

An improved immersion "polyphase" freezer is used for shrimp.

269. Polyphase Freezing Process Developed; Low Cost Unit Built. L. H. Bartlett and W. R. Woolrich. F. I. 13, No. 12, 60-62, 103, 1941, 14, No. 1, 62-64, 1942.

Articles of food to be frozen (shrimp) are brought into direct contact with the polyphase freezing medium which is slowly agitated in the continuous freezer. The apparatus is compact enough to be mounted aboard a fishin g boat and to operate upon the fishing grounds.

270. Preserving Perishable Foodstuffs by Rapid Freezing. F. O. S. Bland. U.S. 2, 102,506, December 14, 1937, C.A. P32, 1350, 1938.

Fish are immersed in a liquid at -30° C., containing pure glycerol 20 to 40%, ethyl alcohol 20 to 40%, and water 25 to 45%, to effect rapid freezing.

271. Brine Spray Refrigerating Systems. S. C. Bloom. I.&R. 66, 560-562, 1924.

General considerations, types of brine systems, and shrinkage of meat are discussed.

272. New Rapid-freezing System Uses a Blizzard of Snow. C.F. 16, No. 2, 16, 1929.

An apparatus is described which will freeze any kind or shape fish in a blizzard of carbon dioxide snow.

273. New Quick Freezing Machinery. R. H. Coffin. I.&R. 94, 217-219, 1938.

Fish and shrimp traveling on belts of the Smith individual quick freezing machine are frozen by chilled spray from nozzles suspended above.

274. Freezing of Fish and Other Articles of Food. N. Dahl. U. S. 1,367,024, February 1, 1921.

Fish are subjected to a preparatory freezing by the introduction of the freezing liquid directly into the interior of the package. Freezing is completed by supplying the freezing liquid at the top of the package.

275. Fish Freezing in Brine. H. M. Dunkerley. Fishing Trades Gazette, March 20, 1918, 19; M.S. 87.

Experimental data indicates that the time necessary to freeze fish of different sizes and shapes depends upon brine temperature, brine velocity, and thickness of the fish.

276. Southern Sea Foods Frozen by New Quick Freezing System. Anon. F.G. 58, No. 7, 37, 1941.

Immersion freezer using direct contact with medium is suitable for shrimp.

277. The Freezing and Cold Storage of Fish. Anon. M.S. 61; Fishing Trades Gazette 35, No. 1, 39-43, 1917.

The Ottesen method is discussed.

278. Fresh-N-Ice, a New Quick Freeze Process. A. B. Haslacher, I.&R. 81, 475-476, 1931.

Immersion freezing in liquid medium is conducted in tanks submerged in calcium chloride brine.

279. The Quick Freezing of Dressed Poultry. T. W. Heitz and T. L. Swenson. I.&R. 85, 163-165, 1933.

The use of the fog method of freezing reduces bacterial count and fat acidity of the product and improves the eating quality.

280. Rapid Freezing of Fish in England. I.&R. 79, No. 2, 127, 1930.

"Z" system of freezing fish uses a brine fog.

281. Quick Freezing. W. S. Josephson. I.&C.S. 42, No. 491, 22, 1939; C.A. 33, 5521, 1939.

Products to be frozen are exposed to an atmosphere of liquid and gaseous carbon dioxide.

282. Compartment Ice and Salt Freezer. A. S. McFarlane. P.R.A.S. 13, 7-9, 1934.

This apparatus uses chopped ice and salt for brine immersion freezing of herring for bait.

283. Brine Fog Quick Freezes without Extreme Temperature. H. Merriman. F.I. 4, 396-398, 1932.

The "Z" process is explained and experimental work is reviewed.

284. Quick Freezing with Portable Units. H. A. Noyes. F.I. 10, 678-679, 1938.

The portable "Z" pack unit gives flexible and efficient service.

285. *Freezing of Fish in Salt Brine. A. J. A. Ottesen. Norsk Fiskeritidende 13, 111-115, 1913.

286. *Neue Untersuchungen ueber die Konservierung von Fleisch durch Ottesen-Gefrierverfahren. E. Oestert. Beihefte zur Zeitschrift Für die gesamte Kalte-Industrie, 1927, Reihe 3, Heft 1.

287. Essais de "Quick Freezing" Applique aux Grosses Pieces de Viande. M. Piettre. F.R. 3, 167-174, 1938.

Cooling and freezing curves are given for brine frozen quarters of beef in latex bags.

288. Tests on Quick Freezing Applied to Large Cuts of Meat. F.I. 9, 646, 1937. M. Piettre.

The Hoveman process consists of freezing beef quarters in latex bags by brine spray.

289. Quick Freezing Applied to Meat Carcasses and Crystallization and Desiccation of Certain Proteins at Low Temperatures. M. Piettre. R.E. 34, 305-307, 313, 1937.

Hoveman's patent on brine freezing of beef quarters in vacuumized latex bags is discussed.

290. The Quick Freezing of Poultry. W. J. Price. I.&R. 85, 203-206, 1933.

Duck freezing operations by the "Z" process are explained and pictured.

No. 2

291. Glycerine in Quick Freezing. Anon. Q.F.F. 6/ 29, 1943.

It has been found that immersion in 50% glycerine solution, food can be frozen quickly at high temperatures.

292. New Methods of Brine Freezing for Fish. H. F. Taylor. F.G. 41, 19-22, 1924; M.S. 258.

History and purpose of brine freezing, apparatus, speed of freezing, appearance and quality of the fish are described.

293. Freezing by Immersion, Methods, and Media. J. G. Woodroof. R.E. 37, 384-387, 1939.

Agitation speeds the rate of freezing. Requirements for medium are specified.

294. The Romance and Engineering of Food Preservation. W. R. Woolrich. Science 99, 107-114, 1944.

A new method of quick freezing uses a polyphase medium of dextrose, sucrose and water.

295. Preserving Foods such as Fish or Meat. M. T. Zarotschenzeff. Brit.339,172, February 16, 1929; C.A. P25, 2494.

Air saturated with highly atomized liquid such as fresh or sea water or brine in the form of fog at -22° C. to -25° C. is used for freezing.

296. Rapid Freezing with Atomized Brine. M. T. Zarotschenzeff. I.&R. 79, 389-390, 1930.

The temperature rise phenomenon and the effect of freezing on animal tissues and juices are explained.

297. The "Z" Process in America. M. T. Zarotschenzeff. I.&R. 83, 67-70,1932.

Amount of free water in frozen mammalian muscle is dependent upon temperature.

298. Old Problems in the Fishing Industry and New Ways of Solving Them. M. T. Zarotschenzeff. I.&R. 87, 181-184, 1934.

Details are given for the construction of the "Z" process equipment and for the cycle of operation.

299. The Quick Freezing and Marketing of Ducks. M. T. Zarotschenzeff and C. J. Coon. I.&R. 91, 51-57, 1936.

In order to produce good quality quick-frozen ducks the following requirements are necessary: (1) proper breeding, feeding and preparing methods; (2) quick chilling at the farm; (3) immediate delivery to the quick-freezing and packing plant; (4) correct freezing, packaging and storing conditions.

300. Concentrating Clam Nectar by Freezing. N. M. Carter. P.R.P.S. 55, 13-15, 1943.

Four methods of freezing clams were used and the concentrated nectar was spearated by suction filtration.

301. Quick Freezing and Packaging Enter Red Snapper Industry of the South. Anon. F.G. 56, No. 7, 9, 26, 1939.

Red snapper, snapper steaks, and peeled green shrimp are quick frozen and packaged in small units for institutional trade.

302. Filleting and Freezing Fresh Water Herring. Anon. F.G. 60, No. 11, 42, 1943.

New Wisconsin and Michigan plants which package frozen lake herring are briefly described.

303. *Quick Freezing of Oysters. R. V. Grayson. Q.F.F. 1, No. 9, 14, 36, 1939.

304. The Story of Deveined Shrimp. R. V. Grayson. Q.F.F. 3, No. 9, 18-19, 33-39, 1941.

Shrimp is quick-frozen, packaged and stored.

305. Rapid Freezing of Canadian Mackerel. E. Hess. I.&R. 81, No. 1, 47, 1931.

Rapid or brine frozen mackerel and scallops after two months storage are equal to the fresh product.

306. Quick Freezing Texas Shrimp. E. Hickman. R.E. 43, 212, 245, 1942.

Shrimps are deveined and frozen with shells on.

307. Quick Freezing of Bottom Fish. Anon. I.&R. 101, 126, 1941.

A symposium.

308. Shrimp Industry of the South Atlantic and Gulf States. F. F. Johnson and M. J. Lindner. U. S. Bureau of Fisheries, Investigational Report 21, 1934, 83 pp.

The authors present a complete story of the industry including frozen headless packaged shrimp.

309. Stabilizing the Erratic Prawn Industry. J. E. Munson. F.G. 47, No. 1. 21, 1930.

The article is devoted to the application of Kolbe system of freezing packaged fresh prawns for the market.

310. Pack Brine Frozen Lobster. A. E. Nickerson, Ltd., C.F. 17, No. 7. 20, 1930.

Fresh boiled lobsters are placed in cans lined with parchment and frozen in brine, then sealed and held at a temperature not above 30° F.

311. Quick Freezing of Florida Shrimp. H. L. Pace. I.&R. 86, 119, 1934.

Pace describes the procedure used to pack shrimp.

312. Steelheads--Frozen Fish de Luxe. Anon. P.F. 29, No. 10, 50-51, 1931.

The process of preservation is comprised of the following steps: removal of slime and blood by washing, sharp freezing of the whole round fish, heavy ice glazing, and wrapping parchment.

313. Salmon Steaks Frozen by Birdseye Process. Anon. P.F. 35, No. 13. 57, 1937.

Cellophane packaged salmon steaks and fillets were placed in cartons and frozen in the plate freezer to 0° F. in three hours.

314. Mexican Frozen Shrimp Industry. Anon. P.F. 39, No. 10. 71, 1941.

Methods of handling shrimp before and after freezing are discussed.

315. *Freezing of Oysters. L. Radcliffe. Oyster Institute of America, Buyers' Bulletin 8, 1-2, 1937.

316. *The Freezing Preservation of Oysters. D. K. Tressler. A.F. 18, No. 6. 8-9, 1937.

317. Production of Z-pack Swordfish in Japan. W. M. Zarotschenzeff. I.&R. 96, No. 3, 239-241, 1939.

Diagrams of the production line and steps in the preparation and freezing of swordfish give a picture of the first packaging and quick freezing plant in Japan.

318. Freezing Fish for France. Anon. C.F. 16, No. 6, 21, 1929.
French fishing vessel will freeze fish at Grand Banks and carry them to port.

319. V. D. Limited Brings Out Simple Brine Freezing Plant for Trawlers. Anon. F.G. 45, No. 2, 51, 53, 1928.
A brine freezing system of three-fourth ton capacity freezes hake in one and a half hours.

320. Brine Freezing on Trawlers. Anon. F.G. 46, No. 8, 14, 1929.
The French vessel, the Zazpiakbat, is freezing fish caught on the Grand Banks by the "Z" system.

321. Refrigeration on Tuna Boats. Anon. F.G. 53, No. 7, 28, 29, 1936.
The development of the West Coast tuna fisheries is outlined, and argument against actual freezing in favor of cooling is presented.

322. New Way of Freezing Fish Developed in Canada. Anon. F.I. 1, 675, 1929.
Fillets are wrapped in parchment and frozen in 0° F. brine on board ship.

323. Refrigeration of Tuna on Fishing Vessels. H. C. Godsil. Conclusion and summary of detailed Progress Report No. 2 on the refrigeration of tuna. California Division of Fish and Game, Mimeo. Rept. July 15, 1940; I.&R. 100, No. 6, 406-407, 1941; P.F. 38, No. 12, 43-44, 1940; F.G. 57, No. 9, 24,31, and No. 12, 15, 1940; Proceedings, American Institute of Refrigeration, 29-40, 1941.
No difference was noted in the quality of tuna fish frozen and held in brine under the following conditions: (a) 30° F. for __days, (b)25° F for 31 days, (c) 20° F. for 41 days.

324. New Fish Freezing Process. Anon. I. and R. 78, No. 3. 266, 1929.
Sterilizing and freezing equipment is used on board fishing boats in England (details).

325. Norwegian Vessel Fitted out for Quick Freezing Fish. Anon. I. and R. 81, 115, 1931.
The mother ship to a fleet of motor dories freezes by brine immersion, then glazes and stores on board.

326. Fish Freezing in France. Anon. I. and R. 82, 306, 1932.
Two trawlers freeze fish at sea by "Sacip" system, a combination of cold air and brine.

327. Fish Freezing and Transport in France. Anon. I. and R. 87, 320, 1934.
Fish freezing aboard sailing vessels uses a brine spray.

328. Brine-freezing and Cold-storage in Long-distant Trawlers. A. Lumley and J. Pique. R. F. I. B. 1932, 187, 1933.
A very short discussion of plant design for brine freezing aboard trawlers is given.

329. The Handling and Storage of White Fish at Sea. A. Lumley, J. Pique, and G. A. Reay. R. F. I. B. Special Rept. No. 37, 74 pp., 1929.
Deterioration of fresh fish aboard both the short and long distance trawlers is mainly due to bacteria; and can be arrested by the use of ice. By the use of cleanlier and more careful methods, the duration of freshness will be extended from 6-7 days to 10-12 days. Long distance trawlers require some method of freezing preservation because their trips exceed the time limit of fresh storage.

330. Fish: Handling and Storage of Fish in Trawlers. A. Lumley, J. Pique, G. A. Reay. R. F. I. B. 1928, 67-70, 1929.

Cod, haddock and hake were brine frozen on voyages in excess of 14 days at sea.

331. Refrigeration Equipment in Common Usage. R. E. Manns. P. F. 39, No. 3. 23-25, 1941.

Equipment installed on various tuna clippers for freezing fish is reviewed.

332. Recent Developments in Floating Freezer Operation (Halibut and Tuna). Anon. P. F., Refrigeration No., 26, 51, 1928.

Freezing equipment and storage accommodations for freezing bait herring and halibut have been installed on the "Donna Lane".

333. "American Voyager's" One Hundred and Seventeen Day Trip is Refrigeration Epic. Anon. P. F. 39, No. 8. 21-22, 1941.

Tuna are brine frozen on board, then stored in dry wells at -14° F.

334. Should Boston Operators Freeze Their Fish at Sea. C. E. Pellissier. F. G. 48, No. 4. 26, 1931.

This survey shows vessel owners unconvinced of the need or value of installing refrigerating equipment for landing the catch in a frozen condition.

335. Discussions of Refrigeration on Board Trawlers. (Pro and Con). H. F. Taylor. and R. E. Kolbe. F. G. 45, 19-21, 1928.

The suitability of refrigerating machinery to many types of vessels is debated.

336. A British Problem, Experiments with Refrigeration on Trawlers Explained. W.C.F., December, 38, 1929.

Fish are sorted as they come out of the net, placed into boxes and immediately frozen on board.

337. Freezing Experiments for Boats. Anon. W.C.F., February, 36, 1930.

Fish frozen in brine on board ship may be kept for 12 months or more.

338. Shin Shibata's Shrimp Freezer. Anon. W.C.F. 4, Annual Reference No. 25, 34, 1932.

Shrimp are frozen on board boat and stored at -10° F. until landed.

339. Preservation of Fresh-caught Fish. M. T. Zarotschenzeff. P.F. 28, No. 11, 21, 1930.

Recommendations are given for brine freezing aboard the trawler.

340. Fish from Trawl to Table. M. T. Zarotschenzeff. I.&R. 79, No. 4, 292, 1930.

Advantages of mechanical refrigeration over crushed ice storage are given with procedure for handling fish after catching.

341. The "Z" Process in Norway. W.M. Zarotschenzeff. I.&R. 81, No. 2, 113-114, 1931.

New steamer operated by Norwegian firm has a complete quick freezing plant for preparing fish at sea.

342. Rapid Freezing and Chilling of Fish and Meats in Atomized Brine. M. T. Zarotschenzeff. I.&R. 77, No. 3, 155-156, 1929.

This illustrated article describes the "Z" method as used on the fishing vessel "Naiada".

343. Preserving Foods such as Fish and Other Seafoods. H. Beard and C. Hedreen. U. S. 2,151,967; March 28, 1939.

An ice glazing solution, tenacious and crack-resistant has been developed for frozen foods.

344. Frozen Flesh Foods such as Fish. R. H. Bedford. U. S. 2,093,069; September 14, 1937. C.A. P31, 8060, 1937.

Fish are provided with a non-cracking ice glaze formed of an eutectic solution of water with boric acid, sodium sulfate or disodium hydrogen phosphate.

345. New Ice Glaze for Frozen Fish. R.H. Bedford. I.&F. 90, 217-218, 1936; C.A. 30, 8415, 1936; I.F.R. 1936, 180.

A new type of glaze gives good results with halibut.

346. Ice-glazing Foods such as Fish forStorage or Transportation. R. H. Bedford. U. S. 2,194,684, March 26,1940; C.A. 34, 4830, 1940.

A transparent ice glaze on fish is formed of water containing HCl at pH of 1 which gives a non-cracking character to the ice.

347. Frozen Foods such as Fish. R. H. Bedford U.S. 2,175,680, October 10, 1939; C.A. 34, 827, 1940.

Foods such as fish are provided with a transparent non-cracking ice glaze formed from an aqueous solution of a polyhydric alcohol, ketonic alcohol or aldehydic alcohol.

348. Frozen Foods such as Fish. R. H. Bedford. U. S. 2, 214, 398, September 10, 1940; C. A. 35, 827, 1941.

Frozen foods such as fish are provided with a transparent ice glaze formed of an aqueous solution having a pH of about 5.5 and containing sufficient hydrogen peroxide to give the glaze a non-cracking character.

349. Glazes for Frozen Fish. R. H. Bedford and O. C. Young. B. B. C. Annual Rept., 37-38, 1936.

Harmless salts overcome the tendency of a glaze to crack; the addition of a harmless organic substance increases the transparency.

350. Process of Preserving Frozen Food Products. D. W. Davis. U. S. 709, 751, September 23, 1902.

Frozen flesh is dipped in water at 32° F. to form an ice glaze, and the product is stored below 32° F.

351 Loss of Weight of Fish in Cold Storage. -- 2. Checking Evaporation. By "Frigor". Fishing Trades Gazette, March 6, 1920, P. 49; and May 20, 1920, P. 45; M. S. 137, 149, 1929.

This article discusses "life" of ice glazes and application of glaze to different species of fish.

352. Reducing the Shrinkage of Frozen Fish in Storage. J. M. Lemon. U. S. Dept. of Commerce, Bureau of Fisheries Investigational Rept. No. 9, 1-2, 1932; C. A. 26, 4387, 1932.

Unhydrogenated cottonseed oil proved superior to hydrogenated cottonseed, corn or peanut oils or an ice glaze in the freezing of fish.

353. Desirable Properties of a Glaze for Frozen Fish. O. C. Young. I.B.R. 1935, 338; P.R.P.S. 24, 18-20, 1935.

A glaze should be non-cracking, strong, have low water vapor pressure and latent heat of fusion but high melting point, as well as good appearance and antiseptic properties.

354. Dehydration of Fish in Cold Storage. O. C. Young. P.R.P.S. 14, 12, 1932; I.B.R. 333, 1933.

Oil-treated fish show discoloration.

355. Packaging Frozen Foods. M. Babbitt. F.I. 9, 130-131, 1937.

Packers have spent years of research and sales tests to learn the kind of protection necessary, size and style of package that will sell, and how to word directions.

356. Packaging Frozen Foods. R. M. Bergstein. R.E. 36, 300-302, 318, 1938; I.&R. 96, 77-79, 1939.

Important factors in packaging are moisture resistance, liquid tightness, and characteristics of liners.

357. The Importance of Flexibility in Protective Coatings for Frozen Foods. R. M. Bergstein. R.E. 37, 352, 356, 1939; I.&R. 96, 242, 1939.

A high degree of moisture-vapor transmission resistance in the packaging of frozen foods is important. The wrapper should be flexible.

358. Packaging--1940. R. M. Bergstein. Q.F.F. 2, No. 7, 24, 29, 1940.

Improvements in fabrication, synthetic resins, and locker packaging are considered.

359. Packaging Quick Frozen Foods. C. Birdseye. F.I. 2, 156-158, 1930.

Frozen fish storage problems are minimized by the choice of proper packaging materials and shipping cases.

360. Corrugated Fibreboard Shipping Containers. C. Birdseye. R.E. 19, No. 3, 75-79, 1930.

This is a discussion of packaging, based on freezing and thawing curves for different sized packages.

361. Packaging Perishables for Quick Freeze. C. Birdseye. Canning Age 11, No. 5, 329, 1930.

Packages should be of such a material as to offer maximum resistance to desiccation, oxidation, and the absorption of odors.

362. Permeability of Membranes to Water Vapor, with Special Reference to Packaging Materials. F. T. Carson. National Bureau of Standards, Miscellaneous Publication M 127, 1937.

Data is given on the comparison of testing methods leading to the presentation of a standard method. The measurement of water vapor permeability has many variables dependent upon the mechanism of the passage of moisture through a membrane.

363. Passage of Moisture through Packaging Materials. F. T. Carson. F.I. 10, 14-16, 1938.

Ten factors influence the loss or gain of moisture in packaged foods.

364. Testing Packaging Materials for Permeability to Moisture. F. T. Carson. F.I. 10, 130-132, 170, 1938.

The permeability of various packaging materials to water vapor is tabulated.

365. Custom Tailored Packaging. T. F. Cass, Jr. Q.F.F. 4, No. 1, 16-17, 31, 32, 1941.

Cartons and carton board stock of suitable qualities, as well as set-up styles and liners are covered.

366. Benzoate-coated Wrappers for Fish Fillets. H. E. Crowther. Q.F.F. 3, No. 3, 14-15, 23, 34, 1941.

A coated wrapper has been developed to improve the quality of frozen fillets eliminating the need for brining.

367. Packaging of Frozen Foods under War Conditions. H. C. Diehl and W. Rabak. P.I.F.T. 1942, 117-120.

Films, overwraps, ice glazes and plastic dips are considered and criticized.

368. Moisture-vapor Proofness of Wrapping Materials Used in Frozen Foods. C. W. DuBois and D. K. Tressler. I.&R. 97, 449-451, 1939.

Results including extensive tabulations are given for moisture-vapor proofness of different types of wrappers.

369. *Glassine Papers. DuPont Cellophane Company, 2 Park Avenue, New York City, New York.

370. Trade in Fresh and Frozen Package Fishery Products. R. H. Fiedler. Bureau of Fisheries, Economic Circular No. 63, 12 pp., 1928.

This report covers preparation, packaging, freezing and storage, and distribution of fish.

371. The Sea Food Package. Anon. F.G. 57, No. 11, 72-74, 79, 82, 1940.

Cryovac, pliofilm and cellophane usage is described for frozen fishery products.

372. Quick Freezing. Anon. F.G. 57, No. 11, 97, 1940.

Quick-frozen fish is packaged as the housewife would desire it.

373. A Modern Seafood Package Wins All-American Competition. Anon. F.G. 59, No. 7, 33-40, 1942.

The Atlantic Coast Fisheries Company's frozen fillet line is described in detail from fish to package.

374. Refrigerated Foods Call for Specific Containers. Anon. F.I. 3, 221-222, 1931.

Transparent moisture-proof wrappers cardboard boxes, and fiberboard shipping cases for fish are described briefly.

375. Packages and Packaging Materials Used by the Frozen Foods Industry. Anon. F.I. 11, 128-142, 1939.

Barrels, bulk tin containers, wooden boxes, prefabricated fiber containers, folding boxes, liners, outside carton wrap, other wraps, tin cans, tin and fiber cans, use of color, informative labels, package accessories, shipping containers and packaging by machinery are topics discussed in brief.

376. Latex Rubber as a Frozen Food Container Anon. F.I. 11, 250-251, 1939.

An illustrated article describes the use of "Cryovac" bags and lists the advantages.

377. Manufacture and Properties of Regenerated Cellulose Films. W. L. Hyden. I.E.C. 21, 405-410, 1929.

The article discusses the history, manufacture, physical, chemical and physiological properties and application of regenerated cellulose films.

378. Cryo-Vac. (Latex Rubber Balloon as Wrap). Anon. Ind. and Eng. Chem., I. E. C. News Edition, 17, No 8 293, 1939.

Packaging of poultry with latex is illustrated.

379. Transparent Cellulose Bags for Packaging Quick Frozen Foods. T. W. Koch. Q.F.F. 2, No. 7, 22-23, 1940.

Work on the use of transparent cellulose bags for packaging is reviewed and experiments were performed involving the use of a transparent rubber-derivative film.

380. Packaging Quick Frozen Foods. . F. Kolbe. I.&R. 79, No. 2, 122-125, 1930.

Refrigeration requirements shipping containers, loose package and block frozen package, oxidation desiccation and shipping containers are factors to be considered by the industry.

381. Packaging Quick Frozen Foods. R. E. Lowey. Q.F.F. 1, No. 2, 16-18, 1938.

Problems are encountered in the carton packaging of frozen food. Frozen fish cartons are pictured.

382. Investigations with Frozen Fish. R. A. McKenzie. B.B.C. Annual Rept. 1930, 20.

Drying and rate of defrosting ice fillets can be controlled by various methods.

383. New Developments in Folding Boxes. J. D. Malcolmson. F.I. 2, 18-19, 1930.

Folding boxes are using in shipping fresh frozen fish.

384. Paperboard Containers for Frozen Foods. J. D. Malcolmson. F.I. 2, 155, 1930.

Insulating property of paperboard containers and their application to industry are described.

385. The Storage of Frozen Poultry. T. Moran. R. F. I. B. 1936, 43-44, 1937.
Birds packed in: (1) grease-proof paper-lined boxes suffered excessive desiccation, (2) boxes lined with two layers of aluminum-foil grease-proof paper exhibited no desiccation, (3) boxes lined with (2) plus individual wrapping of each bird in aluminum foil showed no desiccation.

386. New Outer Wrap for Consumer Use in Freezing, Storing of Fish. Anon. Packaging Parade, October, 1944, p. 67.
"Frostinette Tubing" holds any moisture-proof wrapped product, regardless of shape.

387. Frozen Seafoods -- New Consumer Acceptance is Fostered by Packaging and Quality Product. C. E. Pellissier I. and R. 99, 66-68, 1940.
Packaged frozen fish fillet production exceeds fresh fillets.

388. Metal Containers for Freezer Storage. M. E. Pennington. R. E. 41, 163-166, 1941.
Fish are better preserved if contact with air is reduced to a minimum and desiccation is avoided. These ends can be accomplished by using metal containers.

389. Packaging and Transportation of Quick Frozen Foods Important. Anon. F. G. 55, No. 7. 10, 11, 32, 1938.
Packaging is discussed from the standpoint of wrapping materials, cartons or boxes, and shipping cases for frozen fish.

390. Some Observations on the Materials Used in Packaging Frozen Foods. W. Rabak. Paper Trade Journal 111, No. 9, 80-82, 1940.
Experimental data show that the amount of moisture lost depends upon the resistance to water-vapor permeability of the wrapping or lining materials and upon the efficiency of the sealing.

391. Some Observations on the Materials Employed in Packaging Frozen Foods. W. Rabak. P.I.F.T. 1940, 193-198.
Moisture-proof cartons are experimentally compared with outer wrapping materials.

392. The Protective Packaging of Frozen Foods. W. Rabak. R.E. 48, No. 5, Sec 2 (Application Data 34), 1944.
Factors of importance in packaging frozen foods include moisture permeability, choice of type of wrapper, etc.

393. Wrapping Materials for Frozen Foods such as Frozen Fruits, Berries, Meats, Vegetables, Fowls or Fish. F. H. Reichel and R. T. K. Cornwell. U.S. 2,281,513, April 28, 1942; C.A. P36, 5578, 1942.
A flexible wrapper formed of non-fibrous cellulose material is used. It does not adhere to the food and protects it from desiccation or freezer burn.

394. Some Methods of Protecting Stored Frozen Poultry. H. J. Reynolds. P.I.F.T. 1940, 189-192.
Poultry box liners, individual wrappers and latex bags are protective coverings which may be used at proper storage temperatures.

395. Latex Container and Its Application to Frozen Meats and Poultry. M. T. Rogers. Q.F.F. 2, No. 1, 17, 31, 1939.

Consideration is given to the precautions required and costs involved when using latex.

396. Rubber Latex Sack Introduced for Protection of Frozen Sea Foods. M. T. Rogers. F.G. 56, No. 8, 19, 1939.

Directions are given for using Cry-O-Vac bags.

397. Current Trends in Food Packaging. C. A. Southwick, Jr. P.I.F.T. 1941, 57-60.

Transparent sheetings, treated papers and board are discussed from the standpoint of moisture-vapor, grease, flavor and water proofness.

398. Where Carton Packaging of Foods Stands Today. E. S. Stateler. F.I. 5, 94-99, 1933.

Outside wrappers, tight wrappers, adhesives, and packaging machines are considered from an economic standpoint.

399. What Cellophane Offers Foodstuffs. L. B. Steele. F.I. 2, 13-14, 1930.

Early mention is made of the use of moisture-proof cellophane for quick frozen foods including fish fillets.

400. Theory and Practice of Rapid Freezing in the Fish Industry. H. F. Taylor. I.&R. 79, No. 1, 36, 1930.

Fillets are packaged in a continuous roll for slicing into 7/8 inch thickness before freezing.

401. Storing Frozen Comestibles. Taylor and Cooke. U. S. 2,011,426; C.A. 29, 6664, 1935.

Paperboard containers which have been impregnated with steam saturated air are used to prevent the drying of frozen meats and fish during storage.

402. The Latest Developments in Paper and Fiberboard for Packaging Food. E. A. Throckmorton. P.I.F.T. 1942, 121-125.

Present day food packaging employs coatings, laminations, bags, wraps, cartons, dips and fiber cans.

403. Packages and Packaging Materials for Quick Frozen Foods. D. K. Tressler. Q.F.F. 2, No. 7, 17, 42, 1940.

The certain qualities which all cartons and packaging materials must posses are: moisture-vapor proofness, moisture and water proofness, liquid tightness, inability to impart odors or flavors, attractiveness, strength and lack of brittleness.

404. The Technique of Determining Moisture-vapor Transmission through Papers and Boards. D. K. Tressler and C. F. Evers. Paper Trade Journal 101, No. 10, 33-35, 1935.

A method for determining moisture-vapor transmission gives data from which rates of transmission are calculated.

405. Cellophane for Food Conservation under War Needs. A. F. Wendler. P.I.F.T. 1942, 144-147.

Characteristics of cellophane contribute to its utility in food packaging industries.

406. Frozen Food Containers and Container Materials. J. G. Woodroof and W. DuPree. F.E. 45, No. 2, 75-81, 117, 1943.

The results of tests on 100 kinds of packaging materials indicate that the use of one water impervious film is a must for every package.

407. Cellophane as a Means of Preventing Dehydration. O. C. Young. B.B.C. Annual Report 1932, 112.

Moisture-vapor proof cellophane is effective in decreasing dehydration while plain cellophane is comparatively useless.

408. Preserving Frozen Shellfish. O. C. Young. Fisheries Research Board of Canada, Annual Report 1942, 26-27.

The lack of moisture-vapor proofness of a container may be overcome by flooding packed shellfish meats with water.

EFFECT OF FREEZING

General

409. Biochemical Studies on the Effect of Cooling upon Muscle. I. The Biochemistry of Frozen Fish. H. Akatsuka. J. Biochemistry (Japan) 7, 27-39 (1927); C. A. 21, 2283, 1927.

Practically no change was found in the amount of total and residual nitrogen in the muscles of cold storage carp frozen at -1° C. to -3° C., or at -10° C. to -13° C.; but the creatine content decreased 19 per cent by freezing at -24° C. for 20 minutes.

410. The Preservation of Fish Frozen in Chilled Brine. L. H. Almy and E. Field. I. The Penetration of Salt. J. I. E. C. 13, 927-929, 1921; II. The Keeping Quality of Fish. Ibid., 14, 203-206, 1922.

Weakfish, flounders, herring and whiting were frozen in chilled brine under different conditions to determine the various factors which influence the penetration of salt into the outer tissues of the fish.

411. The Effect of Freezing on the Autolysis of Meat. A. K. Balls and M. W. Kies. Proceedings of the American Institute of Refrigeration 1941, 106-113.

Muscle tissues of beef, chicken and pork did not show any greater tendency to autolyze after freezing and subsequent thawing than when not frozen, but glandular tissue did.

412. Effect of Freezing Rate of Quality of Broiled Steaks. D. E. Brady, P. Frei, and C. W. Hickman. F. R. 7, 388-393, 1942.

Experiments on quick and slow frozen pork, lamb and beef reveal that the slow frozen product has a higher evaporation rate in storage and larger cooking loss (drip and evaporation) than the quick frozen one.

413. Changes in the Physical and Morphological Character of Meat, Fish, Milk and Other Food Stuffs by Cold. Butzler. Deutsche Schlact und Viehhof Zeitung, 10, 623-624, 639-641; C.A. 5, 2502, 1911.
Experimental and general data on the effects of cold storage on food products are included in this paper.

414. Studies on the Refrigeration of Meat. Investigations into the Refrigeration of Beef. G. A. Cook, E. F. J. Love, J. R. Vickery and W. J. Young. Australian Journal of Experimental Biology and Medical Science 5, 15-31, 1926.
Increasing the latent period of freezing increases the changes in the beef as determined by (1) the quantity of drip, (2) the net nitrogen loss on thawing, and (3) the microscopic appearance in the frozen condition.

415. Relation between Cold Storage and Canning of Fish D. B. Dill and L. H. Almy. F.C. 38, 40-41, 1921; C.A. 15, 4031, 1921.
When tuna is frozen slowly in air to -6° F. and is subsequently canned the product has a characteristic pitted appearance similar to the honeycomb appearance of spoiled tuna after canning.

416. Biochemical Changes in Muscle Tissue on Freezing. S. S. Drozdov and N. S. Drozdov. Ukrainian Biochemical Journal 13, 405-423, 1938; C.A. 33, 9333, 1939.
In beef muscle frozen at -23° C. there was a shift in pH to the acid side, an increase in lactic acid, glucose and acid-soluble and inorganic phosphorus.

417. Biochemical Changes in Muscle Tissue during Freezing. S. S. Drozdov and N. S. Drozdov. Ukrainian Biochemical Journal 14, 241-259, 260, 1939; C.A. 34, 5474, 1940.
During freezing of muscle tissue, glycolysis is increased, especially if the tissue is slow frozen.

418. Influence of Rate of Freezing and Temperature of Storage on Quality of Frozen Meat. C. W. DuBois, D. K. Tressler and F. Fenton. P.I.F.T. 1940, 167-179.
Tests indicated that the all around quality of frozen meat increased with the rapidity of freezing. However, the palatability of roasts frozen at slowest rates was good when cooked.

419. The Effect of Rate of Freezing and Temperature of Storage on Quality of Frozen Poultry. C. W. DuBois, D. K. Tressler, and F. Fenton. R.E. 44, 93-99, 1942.
Birds frozen most rapidly were rated higher than those frozen slowly. Photomicrographs of tissue cross sections are shown.

420. A Preliminary Study of the Effect of Cold Storage upon Beef and Poultry. A. D. Emmett and H. S. Grindley. J.A.C.S. 27, 658-678, 1905; 28, 25-63, 1906.
Freezing caused practically no change in nutritive value of drawn or undrawn fowl.

421. Studies on the Refrigeration of Meat. Conditions Determining the Amount of "Drip" from Frozen and Thawed Muscles. W.A. Empey. J.S.C.I. 52, 230-236 T, 1933.
Drip is considered from the standpoint of: exact nature, reasons for its appearance in muscle and factors influencing its formation.

422. Freezing and Storage of Fish. D. B. Finn. R. E. 32, No. 3, 141-143, 158, 1936.

The rate, degree of freezing and temperature during storage has a definite effect on the fish tissue.

423. The Denaturation of Fish Proteins by Freezing. D. B. Finn. B.B.C. Annual Report, 1932, 110.

Denaturation is most marked between -2°C. and -4°C.

424. Denaturation of Proteins in Muscle Juice by Freezing. D. B. Finn. P.R.S. B111, 396, 1932.

The extent and rate of denaturation varies with the temperature in the frozen state and the hydrogen ion and salt concentration of frozen muscle juice.

425. Advances in Knowledge of Freezing. D. B. Finn. P.F.P.S. 14, 3, 1932; I.B.R. 1933, 582.

Per cent of water frozen in fish at various temperatures is used to point out denaturation changes and a possible critical temperature zone.

426. Denaturation of Fish Muscle Proteins by Freezing. D. B. Finn. C.B.F. 8, 313-320, 1934; C.A. 28, 4795, 1934.

The extent of denaturation is greatest at -2°C.; denaturation rate diminishes greatly at -20°C.

427. The Ice Phase in Frozen Muscle Tissue. D. B. Finn and P. E. Bailey. B.B.C., Annual Report 1932, 110-111.

Halibut muscle juice at -2°C. has 52.5 per cent water frozen; at -3° C., 68 per cent water frozen, and at -6°C., 82.7 per cent water frozen.

428. Test Frozen Fish as Food. Anon. F. G. 37, No. 6, 24, 1920.

The chemical analysis of food value of frozen fish indicates no change due to freezing.

429. Cell Structure and Freezing. V. R. Gardner. R. E. 39, No. 4, 233, 1940.

Freezing has a definite effect on cell structure of fruits and vegetables.

430. Effect of Freezing on the Available Iron Content of Foods. W. H. Hastings, C. R. Fellers, and G. A. Fitzgerald. Proceedings, American Institute of Refrigeration, 1941, 21-26; Contribution No. 407, Massachusetts Agricultural Experiment Station.

The availability of iron as determined by chemical and bioassay methods is at a maximum in frozen food, including haddock.

431. *Beitrag zur Theorie der Gefrierveraenderungen von Lebensmittelm. R. Heiss Z. G. K. I. 42, No. 8, 155-156, 1935.

Title translation - "Additions to the Theory of Changes in Foods Caused by Freezing".

432. *Untersuchungen ueber das Gefrieren von Lebensmittelm. R. Heiss. Angewandte Chemie 49, 17-21, 1936.

Title translation - "Researches on the Freezing of Foodstuffs".

433. Quick Freezing of Foodstuffs. Anon. I. and R. 93, No. 2, 125-127, 1937.

The Food Preservation Conference at the University of Texas considers problems of quick freezing reactions involved in freezing animal tissue, and the quick freezing of shrimps.

434. Susceptibility of Frozen Defrosted Poultry Meat to Drip. C. H. Koonz and J. M. Ramsbottom. F.R. 4, 485-492, 1939.

There was no difference in the amount of cooking shrinkage for poultry frozen at various temperatures.

435. The Breakdown and Resynthesis of Phosphagen in Frozen and Thawed Muscles. E. Kreps. P.R.S. 108B, 545, 1931.

Muscles frozen for 24 hours at temperatures not lower than -1.5° C. recover their initial phosphagen content on thawing, when frozen below -2.5° C. there is no recovery.

436. Freezing of Water in Fish Muscle and in Gelatin. J. H. Mennie. C.J.R. 7, 178-186, 1932; C.A. 26, 5476, 1932.

The unfrozen water in gels at temperatures down to -20° C. is estimated by the colorimetric method and compared with results obtained by other methods.

437. The Factor of Quality in the Freezing of Meat. T. Moran and E. C. Smith. R.F.I.B. 1929, 12-13, 1930.

Prime home-killed beef is compared with experimentally frozen, Argentine chilled, and Australian frozen products.

438. Meat, the Freezing of Tissues. T. Moran and J. R. Vickery. R.F.I.B. 1927, 10-12.

The removal of water beyond a critical point by either freezing or desiccation causes the muscle to exhibit all the properties of a dead muscle.

439. Refrigeration. J. A. Moyer and R. U. Fittz. McGraw-Hill Book Company, Incorporated, New York, 1932, pages 431-433, 434.

Colloidal and mechanical changes take place when flesh is frozen and stored.

440. Relations between Low-temperature Research and Colloid Chemistry. F.F. Nord. Naturwissenschaften 24, 481-486, 1936; C.A. 31, 19, 1937.

A review of the effects of freezing on colloid structure (particularly proteins), with many references.

441. The Histological Changes in Frozen Fish and the Alterations in the Taste and Physiological Properties. G. H. F. Nuttall and J. S. Gardner. Journal of Hygiene 17, 56-62, 1918.

Title is indicative of contents.

442. Tryptic Hydrolysis of Fresh and Frozen Fish Muscle. J. R. Panton. B.B.C. Annual Report 1930, 39-40.

Freezing and storing at -20° C. have little effect on tryptic digestion of fish muscle.

443. Effect of Freezing and Thawing Beef Muscle upon Press Fluid, Losses and Tenderness. P. Paul and A. M. Child. F.R. 2, 339-347, 1937.

Total moisture, drip, and tenderness of cooked beef are unaffected by freezing or by different thawing temperatures.

444. *On the Influence of Rate of Freezing upon the Histological Changes in Animal Tissues. R. Plank. Z. Allgem. Physiol. 17, 221-238, 1917; Z.G.K.I. 24, 9-11, 17-21, 1917.

445. *Refrigeration's Effect on Membranes. R. Plank. Refrig. World 61, 15, 1926.

446. Freezing Temperature as Related to Drip of Frozen-Defrosted Beef. J. M. Ramsbottom and C. H. Koonz. F.R. 4, 425-431, 1939.
Irrespective of the freezing temperature, there was little drip in large rib cuts where the area of cut surface was small in relation to the volume of meat. Photomicrographs show that the freezing temperature materially affects the structural appearance of the frozen muscle tissue.

447. Influence of Freezing Temperature on Haddock Muscle, I. G. A. Reay. J.S.C.I. 52, 265-270T, 1933; C.A. 27, 5834, 1933.
The globulin and albumin of haddock muscle became denatured when it was frozen.

448. The Influence of Temperature on Haddock Muscle, II. G. A. Reay. J.S.C.I. 53, 413-416T, 1934; C.A. 29, 3061, 1935.
The maximum formation of drip occurs between -1 and -3°C.

449. The Freezing and Cold Storage of Fish. G. A. Reay. R.F.I.B. 1938, 96-98, 1939.
"Critical" rate of freezing is determined for haddock; however, they may be frozen at a considerably slower rate without loosing commercial quality even after six months.

450. Effect of Precooling and Rate of Freezing on the Quality of Dressed Poultry. L. Sair and W. H. Cook. C.J.R. D16, 139-152, 1938.
The rate at which poultry is frozen has no effect on the number of bacteria present, and little on the extent of surface desiccation.

451. Fish: Glycogenolysis. J. G. Sharp. R.F.I.B. 1934, 96-98, 1935.
Between -1.6°C and -2°C a "critical" temperature of freezing must exist; muscle frozen below this temperature is irretrievably altered in so far as the mechanism for removal of accumulated lactic acid is concerned.

452. Change of Glycogen in Fish Muscle. J. G. Sharp. P.R.S. 1934, 114B, 506.
Lowering of the temperature to -10°C. reduces the rates of breakdown and accumulation of lactic acid to a point at which almost no change occurs.

453. Glycogenolysis in Fish Liver at Low Temperatures. Sharp. Biochem. J. 29, 854-59, 1935; Postmortem breakdown of glycogen and accumulation of lactic acid in fish muscle at low temperatures. Biochem. J. 29, 850-853, 1935. In fish muscle in the frozen state the maximum rate of glycogenolysis occurs in the interval -3.2° to -3.7°C.

454. The Production of Lactic Acid in Muscle in the Frozen State. E. C. Smith. R.F.I.B. 1928, 19-23, 1929.
The rate of production of lactic acid in amphibian muscle is given at different freezing temperatures.

455. The Formation of Lactic Acid in Muscles in the Frozen State. E. C. Smith. P.R.S. 105B, 198-207, 1929.
The accumulation of lactic acid in the frozen state, extra lactic acid of freezing, muscle behavior on thawing, and the nature of irreversible change at the critical point are considered.

456. The Quick-Freezing of Meat. E. C. Bate-Smith. M.R. 47, No. 560, 267-269, 1944.

The article is a review of scientific aspects of freezing, e. g. analogy of gelatine gels, to meat, drip as affected by rate of freezing and other factors, quick freezing principle applied to meat, subsequent treatment, and palability.

457. The Formation of Lactic Acid in Desiccated amphibian muscle. E. C. Smith and T. Moran. R.F.I.B. 1929, 15-18.

That lactic acid production can be brought about by drying proves definitely that the effect of freezing may be attributed to desiccation.

458. Effect of Freezing on the Swelling of Tissue. I. A. Smorodintsev and S. P. Bystrov. Compt. Rend. 14, 369-72, 1937. C.A. 31, 6266, 1937.

Swelling is dependent on the pH of the medium with a minimum effect occurring at pH 4.2.

459. Influence of Freezing on the Acid-Base Coefficient of Meat. I.A. Smorodintsev and S. P. Bystrov. Bull. Soc. sci. hyg. aliment. 25, 361-9, 1937. C.A. 32, 3499, 1938.

The pH of meat decreases progressively during freezing, storage at -8° to -18°C., and thawing.

460. Effect of Low Temperatures on the Physiochemical Properties of Meat. L. A. Smorodintsev and S. P. Bystrov. Kholodil'naya Prom. 16, No. 3, 20-22; Chimie and Industrie 41, 264; C.A. 33, 3474, 1939.

The least swelling in water and salt solutions is obtained with meat that has been frozen at -25°C.

461. Effect of the Rate of Freezing on the Physiochemical Properties of Meat. I. A. Smorodintsev and S. P. Bystrov. Kholodil'naya Prom. 16, No. 4, 36-7. 1938; Chimie and Industrie 41, 901; C. A. 33, 8840, 1939.

The rate of freezing has a marked influence on the swelling of meat but does not greatly affect the solubility of myogen and of myosin.

462. On the Cause of Cold Death of Plants. W. Stiles. Protoplasma, 9, 459-468, 1930.

Death is caused by the formation of ice crystals in the protoplasm which brings about a disturbance in the colloidal system.

463. What happens during quick freezing. H. F. Taylor. F. I. 3, No. 5, 205-206, 1931.

A true explanation will be found in the province of colloid chemistry rather than mechanics.

464. New Method of Quick Freezing. R. B. Taylor, F. I. 9, 701-4, 1937.

Direct contact freezing is conducted in six minutes on a regular production basis in a sugar solution at a temperature of 3 to 5° F.

On Organisms

465. Effects of low temperatures upon encysted Trichinella spiralis. D. L. Augustine. Am. J. Hyg. 17, 697-710, 1933.
Complete destruction of trichinella larvae occurred when the product was frozen rapidly to -18° C. and held for 24 hours.

466. Quick Freezing of Pork. D. L. Augustine. N. P. Jan. 21, 1933; F. I. 5, 177, 1933.
Quick freezing of fresh pork at -30° F. with one day storage at 0° F. destroyed all encysted trichinella larvae.

467. Public Health Aspects of Frozen Foods. C. R. Fellers. Amer. J. Public Health, 22, 601-611, 1932; Mass. Agric. Exper. Sta. Contr. No. 136, 1932.
Fish are well preserved by freezing. Freezing reduces the number of microbes present and prevents their multiplication.

468. Bacterial Content of Frosted Hamburg Steak. L. P. Geer, W. T. Murray and E. Smith. Am. J. Pub. Health 23, 673-676, 1933.
The quick freezing process causes a material reduction in the numbers of bacteria. The overall average reduction due to freezing plus storage for 1 month is 84.1%.

469. Quality of Meat as Affected by Freezing Temperatures. O. C. Hankins and R. L. Hiner. R. E. 41, 185-189, 1941.
Freezing has an effect on trichinae, bacteria molds, juiciness, and nutritive value. Storage effects flavor.

470. The Effects of Freezing on Marine Bacteria. I. Quantitative Studies. E. Hess, B. B. C. I, No. 2, 95-108, 1934.
When marine bacteria were exposed to moderate freezing temperatures (-16°C.), sea water offered greater protection than broth media or distilled water.

471. Cultural Characteristics of Marine Bacteria in Relation to Low temperatures and Freezing. E. Hess. C. B. F. 8, 32, 461-74, 1933.
Growth of Pseudomonas fluorescens and Flavobacterium deciduosum was observed at 0°C., -3°C., and -6.5°C.; they were found to remain motile and to retain their normal cultural characteristics at these temperatures.

471. Cultural Characteristics of Marine Bacteria in Relation to Low Temperatures and Freezing. E. Hess. C. B. F. 8, 32, 461-74, 1933.

Growth of Pseudomonas fluorescens and Flavobacterium deciduosum was observed at 0°C., -3°C., and -6.5°C.; they were found to remain motile and to retain their normal cultural characteristics at these temperatures.

472. The Germicidal Action of Freezing Temperatures on Bacteria. C. M. Hilliard, C. Torossian and R. P. Stone. J. Bact. 3, 423-31, 1918.

Intermittent freezing of bacteria exerts a more effective germicidal action than continuous freezing. The degree of cold below freezing is not a very important factor in the destruction of bacteria.

473. Tests show Quick-Freezing fails to Kill Spores of Poisonous Germs. L. H. James. I. and R. 82, 140, 1932.

"Quick freezing" of fruits and vegetables does not kill botulinus spores.

474. Does Freezing Kill Clostridium botulinum spore. L. H. James. J. Bact. 23, 47, 48, 1932.

Examinations of samples one day after being frozen and periodically to 11 weeks showed that there was neither a reduction in the total number of living spores nor was toxin liberated.

475. Effects of freezing on the Spores and Toxin of Clostridium botulinum. L. H. James. J. Infectious Diseases 52, 236-41, 1933. Am. J. Public Health 23, 740, 1933.

Botulinus toxin frozen and defrosted 15 times was not reduced in strength.

476. Effect of fast freezing on bacterial flora of mackerel. J. S. Kiser and T. D. Beckwith. F. P. 7, 255-9, 1942; C. A. 36, 6255, 1942.

Bacterial counts were greatly reduced in fish flesh frozen at -28° to -20°C.

477. Observations on Death Rates for Bacterial Flora of Frozen Egg Products. F. A. Nielson and G. F. Garnatz. P. I. F. T. 1940, 289-294.

A reduction in bacteria count of eggs was effected by the addition of salt and below freezing storage temperatures.

General

478. Precautions necessary when storing frozen foods. J. J. Antun. F. I. 10, 319 1938 .

The correct methods of stacking cases requires dunnage on the floor and space between the stack and the wall.

479. The Cold Storage of Smoked Fish. A. Banks and G. A. Reay. R. F. I. B. 1936, 104-7, 1937.

Lowering the temperature of storage below the customary level brings about a definite improvement in quality of smoke-cured codling and kippers.

480. The Freezing and Cold Storage of Smoked and Cured Fish. A. Banks and G. A. Reay. R. F. I. B. 1937, 81-84, 1938.

A better kipper is ultimately obtained by smoking herring after cold storage rather than before.

481. The determination of Storage Conditions -- Meat refrigeration, its Literature and Methods of Analysis. P. K. Bates and M. E. Highlands, R. E. 27, 299, 1934.

New methods are given for determining the actual behavior of meat under various conditions.

482. The Cause and the Prevention of Drip in Frozen Fish. S. A. Beatty. P. R. A. S 2, 12, 1931.

Ice crystal size and protein denaturation influence drip in frozen fish.

483. A chemical Study of Frozen Fish in Storage for Short and Long Periods. F. D. Clark and L. H. Almy. J. I. E. C. 12, 656-663, 1920.

Very little chemical change took place in two species of salt water fish frozen by an air process, stored at 15°F., and examined chemically and organoleptically over a 27.5 month period. Different kinds of wrappers were used.

484. The Cold Storage of Fish. J. T. Clark and J. M. Philipson, F. T. 1, 153-4, 1931; C. A. 26, 4387, 1932.

The time during which fish can be stored at or about -10°C. is limited only by desiccation and discoloration due to oxidation of the fats.

485. Air Conditioning and Food Preservation. The importance of temperature, humidity and air composition. W. H. Cook, I. and C. S. 42, 8-10 (1939); C. A. 33, 4683 (1939).

Humidity, ozone, carbon dioxide, and oxygen have specific effects in the cold storage of fruits and meat.

486. Frozen Storage of Poultry. IV. Further observations on surface drying and Peroxide Oxygen Formation. W. H. Cook and W. H. White, C. J. R. 18D, 363-370, 1940.

The ability of moisture resistant packages to prevent surface drying is demonstrated. Delays between slaughter and freezing accelerate the development of rancidity in the fat during subsequent frozen storage.

487. The Cooling and Freezing of Fish. W. Cursiefen. Z. G. K. I. 47, 43-8, 1940; C. A. 36, 3862, 1942.

Data (with diagrams) are given on the course of autolysis, the bacterial content, the course of the cooling process, the loss of juices, the rate of thawing, peroxide nos. of the oil, etc.

488. A Preliminary Study of the Effect of Cold Storage on Beef and Poultry. A. D. Emmett and H. S. Grindley. J. I. E. C. 1, 413-436, 580-597, 1908.

The chemical composition of fresh and cold stored flesh are compared.

489. The Quick Freezing and Storage of Poultry. W. J. Finnegan. I. and R. 100, 69-76, 1941.

Ice formation, surface drying, causes of desiccation, and deterioration are factors in good storage practices for poultry.

490. Refrigeration and its relation to the Fishing Industry. D. B. Finn. P. R. P. S. 5, 7-10, 1930.

The article is a general discussion of crystal formation, oil oozing, autolysis, bacterial action, shrinkage and rusting.

491. Changes in the hydrogen ion concentration of muscle and beef juice in the frozen state. D. B. Finn. R. F. I. B. 1931, 32-34, 1932.

Changes in hydrogen ion concentration in the frozen state are negligible.

492. *Structural changes in fish after freezing. H. Fox. I. and C. S. 33, 41-42, 48, 1930.

493. Changes occurring in Frozen Perch or Bass Fillets upon Storage. A. Gettkandt. Deut. Fischerei-Rundschau 63, 167-8, 1940; C. A. 36, 5910, 1942.

The Autolytic changes occur after 8 months of storage at -22°C.

494. Modification undergone during storage by meat frozen by various processes. N. Golovkin. Myasnaya Ind. S. S. S. R. 10, No. 2, 29-34, 1939; Chimie and Industrie, 42, 654; C. A. 34, 2944, 1940.

The formation of lactic acid during storage is smaller in meat frozen rapidly than in meat frozen by the standard process.

495. The Freezing Storage and Transport of New Zealand lamb. E. Griffiths, J. R. Vickery, and N. B. Holmes. R. F. I. B., Special Report 41, 1932. 178 pages.

A scientific survey of the New Zealand frozen lamb industry shows that there is no need for radical alterations of technique although improvements at each stage of the chain of treatment are possible.

496. *Advancement in Freezing and Storage of Packaged Fish. Haase. I. R. R. 241, 1936.

497. Some scientific aspects of Cold Storage. J. S. Hepburn. Hahnemannian Monthly 55, 708-13, 1920; C. A. 15, 127, 1921.

This is a resume of the biochemical changes occurring in cold stored fish.

498. The Denaturing of Fish Muscle on Storage. W. W. Johnston. B. F. C., Annual Rept. 41-42, 1930.

In early periods of storage, denaturation occurs principally in the albumen fraction of the protein.

499. Factors influencing keeping qualities of Frozen Foods. M. A. Joslyn. I. and R. 99, 63-5, 1940.

Changes during frozen storage, growth of ice crystals, temperature equilibrium, and chemical changes are discussed.

500. Preventing decolorization of brine frozen meat. D. A. Khristodulo. Myasnaya Ind. U. S. S. R. 9, No. 5, 27-30; Chimie and Industrie 40, 1093; C. A. 33, 2602, 1939.

Good results are obtained by adding 0.05 -0.1% sodium nitrite to the solium chloride brine used for freezing. The original color is restored progressively, from month to month.

501. Odor attributable to the Process of Cold Storage. A. Labrie. R. F. I. B. 1934, 101, 1935.

Odor develops in the fatty layer beneath the skin and spreads rapidly through the product at the higher cold storage temperatures and in the presence of oxygen and sodium chloride.

502. *Suggestions for storing frozen fish. J. M. Lemon. Q. F. F. 1, No. 9, 15, 30, 1939.

503. Recent advances in the low temperature preservation of foodstuffs. T. Moran. J. S. C. I. 48, 245-251T, 1929.

The extent and chemistry of thechanges occurring during storage were determined, and a survey of actual commercial conditions was made.

504. Quick Freezing not always necessary. Olav Notevarp and Erik Heen. R. E. 40, 95; Z. G. K. I. Feb., 1939; I. P. F., Jan. 1940, No. 52.

The technique has been described for measuring the quality of frozen fish after storage.

505. A Further Study of the Chemical Composition and Nutritive Value of Fish Subjected to Prolonged Periods of Cold Storage. W. A. Perlzweig and W. J. Gies. Biochem. Bull. 3, 69-71, 1913.

Fresh fish, similar to flounders, may be preserved frozen by best cold storage processes for two years without undergoing chemical or nutritional changes.

506. Quick-freezing Seafoods. N. J. Placanica, I. and R. 100, 387-8, 1941; C. A. 35, 6342, 1941.

Problems of autolysis, drip, enzyme action, and oxidation are involved in the freezing of seafoods.

507. Refrigeration as Applied to Fisheries. G. Poole. F. G. 35, 1754, 1918.

The freezing and storing of fish at proper temperatures causes no appreciable chemical change in those constituents upon which food values are calculated.

508. Freezer Storage Temperature as Related to Drip and to Color in Frozen-Defrosted Beef. J. M. Ramsbottom and C. H. Koonz. F. R. 6, 571-580, 1941.

Temperature of freezer storage did not appear to be important in regulating the amount of drip but a darker color developed in lean beef tissues at 10°F. than occurred at -30°F.

509. Cold Storage of Fish. G. A. Reay. Fish Trades Gazette, Sept. 12, p. 24, 1931.

Storage at very low temperature guards against bacterial spoilage, "rusting", and structural changes.

510. Fish: Freezing and Cold Storage. G. A. Reay. R. F. I. B. 1933, 167-173, 1934.

Drip in haddock muscle is influenced by temperature and duration of storage, and rate of freezing and thawing. Protein denaturation was followed in different species of white fish frozen in brine at -20°C., and stored at -21°C., -12°C., and -6°C., for periods of 4, 6, 8 and 12 weeks.

511. The Keeping Quality of Thawed Haddock. G. A. Reay and M. M. Stewart. R. F. I. B. 1933, 173-178, 1934.
In most cases the color of the gills, blood and flesh of the thawed brine frozen fish will be browner than before freezing.

512. Cold-storage of Herring. G. A. Reay. R. F. I. B. 1934, 83-84, 1935.
A criterion for successful freezing of herring is perfect freshness after thawing and conversion to a kipper of good quality.

513. The Preservation of Fresh and Thawed Fish in Ice. G. A. Reay. J. S. C. I. 54, 96-8T. 1935; C. A. 29, 4092, 1935.
Storage of fish at -21°C. induces slow changes in quality.

514. Freezing and Cold Storage of Fish. G. A. Reay. R. F. I. B. 1931, 202, 1932.
The denaturation of the globulin fraction is one of the most striking factors of the alteration of fish muscle.

515. Freezing and Cold Storage of Herring. G. A. Reay. F. R. 3, 205-9, 1938; C. A. 32, 5947, 1938.
If herring are frozen rapidly and glazed they will store successfully for 6 months at -23°C.; brining decreases storage life by 2 months.

516. The deterioration and Commercial Preservation of Flesh Foods. W. D. Richardson, and E. Scherubel. J. A. C. S. 30, 1515-1564. 1908.
Chemical, histological, and bacteriological results indicate that cold storage is an adequate and satisfactory method for the preservation of beef for 554 days.

517. Frozen Fish Research. Chemical and Biochemical Studies of Halibut. W. A. Riddell, H. N. Brocklesby and L. I. Pugsley. I. and C. S. 40, 189, 1937; C. A. 32, 3500, 1938.
When halibut muscle juice became denatured during cold storage, a certain fraction of the globulin protein decreased in proportion to the denaturation.

518. Post Mortem Changes in the Haddock. J. G. Sharp. R. F. I. B. 1933, 190-2, 1934.
Maximal glycogenolysis and accumulation of lactic acid occurred in muscles stored at -2.5° to -3.5°C. Other changes occurred in the liver when stored at low temperatures.

519. *The Chemical, Histological and Palatability Changes in Pork during Freezing and Storage in the Frozen State. C. L. Shrewsbury, L. W. Horne, W. I. Brann, R. Jordan, O. Milligan, C. M. Vestal, and N. E. Weitkanp. Purdue Agr. Expt. Sta. Bull. 472. 1942.

520. Light-bending properties of "Drip" from Stored Halibut. E. P. Sidaway. P. R. P. B. 49, 3-5, 1941.
The index of refraction of the drip of halibut muscle is not a measure of freshness, probably because of variations in the amount of protein in the juices.

521. A Study of the Influence of Cold Storage Temperatures upon the Chemical Composition and Nutritive Value of Fish. Biochem. Bull. 3, 54-68, 1913. C. S. Smith.
The percentage of water, ash, nitrogenous constituents, and muscle lipin acidity did not change during nine months of commercial storage.

522. The Production of Lactic Acid in Muscle in the Frozen State. E. C. Smith. R. F. I. B. 1928, 19-23, 1929.

With increasing severity of freezing, the production of lactic acid rises rapidly to a point representing approximately the removal of 80% of the water.

523. Meat, By-Products. E. C. Smith. Ibid, 1931, 22, 1932.

Animal tissues imported for the preparation of medicinal products can be transported quite satisfactorily in a hard frozen or des cated condition.

524. Optimum Conditions for Frozen Foods in Refrigerated Storage. A. E. Stevens. I. and R. 101, 207-11, 1941; Proc. 2nd Food Conf. Inst. Food. Tech. 2, 61-68.

Desiccation, oxidation and autolysis tend to lower the quality of most frozen products.

525. The Scientific Principle of Cold Storage. W. Stiles. J. S. C. I. 40, 112-57, 1921. C. A. 15, 3338, 1921.

This is a discussion of preservation of food by cold storage above and below the freezing point and the problems involved in improving storage conditions.

526. Loss of free liquid on heating brined and unbrined, unfrozen and defrosted fillets. H. L. A. Tarr. P. R. P. S. 48, 19-20, 1941.

Denaturation which proceeds in the muscle of frozen fish is different from that effected by heat.

527. Advances in the Preservation of Fish by Freezing. H. F. Taylor. J. I. E. C. 24, 679-82, 1932; C. A. 26, 4108, 1932.

The juice of drip from frozen meat of fish is not due to laceration of cell membranes by ice crystals but to a colloidal phenomenon.

528. Chemical Problems of the Quick Freezing Industry. D. K. Tressler, J. I. E. C. 24, 682, 1932.

Researches have had to be carried out in order to solve the problems of desiccation, oxidation, drip, off-flavors, odors, and enzyme action.

529. Changes which may occur in frozen foods during cold storage. D. K. Tressler, F. I. 5, 346-347, 1940.

Problems pertaining to freezer burn, enzymes, oxidation, hydrolysis, and coagulation are discussed.

530. Preventing Changes in Stored Frozen Foods. D. K. Tressler. F. I. 5, 410, 432, 1933; C. A. 28, 217, 1934.

Enzymatic changes in fish are objectionable in that they produce offensive odors and may increase drip.

531. Freezing Studies on Alaskan Fish with Particular Reference to the Pink Salmon. J. A. Dassow and M. E. Stansby. U. S. Fishery Products Laboratory, Ketchikan, Alaska. Published date unknown.

Pink salmon steaks can be stored successfully for short periods of time if protected by an ice glaze.

532. Frost Zone Psychrometry. D. D. Wile, N. P. July 29, 25, 1944.

Errors in psychrometry result from failure to use finely graduated thermometers, failure to either wet the wick with super cooled water or to discard the wick and use an ice coated bulb, depending upon temperature, and failure to avoid radiation from the observer's body.

533. Psychrometry in the Frost Zone. D. D. Wile. R. E. 48, No. 4, 291, 1944.

Instructions are given for using the wet bulb psychrometer at temperatures below freezing. The adiabatic saturation theory, Arnold theory, impact effect, Dalton factor, and thermometer stem correction all have an influence upon psychrometry. (52 References).

534. Cooling Coils. O. C. Young. B. B. C. Annual Rept., 111, 1932.

The effect of increasing the number of coil banks from 1 to 4 is to decrease the difference between brine and room temperatures from 23°F. to 7.2°F.

535. *Size of Ice Crystals in Frozen Fish In Relation to Rate of Freezing, Duration, and Temperature of Storage. O. C. Young. Proceedings Royal Society of Canada, 1942, p. 143.

536. The Cold Storage of Smoked Fish. A. Banks, C. L. Cutting, and G. A. Reay. R. F. I. B. 1938, 98-102, 1939.

Smoked haddock stored 112 days at varying temperatures was judged as follows:

slight rancidity but no freezer burn at -30°C.

rancidity and slight " " -20°C.

marked rancidity and " " -10°C.

537. Quality of Frozen poultry as affected by Storage and Other Conditions. H. M. Harsaw, W. S. Hall, T. L. Swenson, L. M. Alexander, and R. R. Slocum. U. S. Dept. Agr. Tech. Bull. 768, 1941.

The quality of quick frozen drawn and undrawn birds is compared after storage of one, two, and three years at 0°F. and -20°F.

538. Cold Storage Changes in Frozen Fish. I. and R. 81, 318, 1931.

Experiments are reported on the effect of different storage temperatures on frozen fish.

539. Frozen Foods. R. Ireland. Canning Age 11, 397, 1930.

It is necessary to store frozen food at less that 15°F. in order to avoid undesirable changes during storage.

540. Cold Storage Changes in Frozen Fish. A. H. Leim. P. R. A. S. 2, 7-8, 1931.

Progressive changes in frozen fish as affected by temperature of storage are measured by edibility.

541. Frozen Fish. A. Lumley, J. Pique, and G. A. Reay. R. F. I. B. 1929, 98-99, 1930.

Haddocks, brine frozen to equilibrium at 0° to -5°F. and stored at -10°F. are most likely to be properly preserved during long distant voyages.

542. Rapid Freezing. Temperature of Storage. T. Moran and H. P. Hale. J. S. C. I. 51, 20-23T, 1932; C. A. 26, 2252, 1932.

For best results, rapidly frozen foodstuffs should be stored at about -20°C.

543. Cold Storage Experiments. J. M. Morton. B. B. C., Annual Rept., 23, 1930.

Frozen fish placed in a location within a cold storage room where considerable fluctuation in temperature took place were in no worse condition after two months than those held at constant temperature.

544. Low Temperature Preservation of the Haddock. G. A. Reay. R. F. I. B. 1930, 128-34, 1931.

After storage at -2° or -23°C., and thawing, the fish muscle was translucent and in good condition; storage at intermediate temperatures, however, produced opacity and poor quality.

545. Fish: Freezing and Cold Storage. G. A. Reay. R. F. I. B. 1932, 181-7, 1933.

Eight storage temperatures controlled to ± 0.1°C. were used and data obtained for the storage of haddock at temperatures just below the freezing point of the muscle.

546. The Freezing and Storage of White Fish. G. A. Reay. R. F. I. B. 1936, 100, 1937.

Less irreversible alteration is sustained by fish the lower the temperature and the shorter the frozen storage period.

547. Cold Storage of Different Species of White Fish. G. A. Reay. R. F. I. B. 1933, 171, 1934.

Cold Storage at -21°C. and -12°C. was conducted for subsequent smoking; denaturation of the proteins during cold storage was measured.

548. The Freezing and Cold-Storage of Fish. G. A. Reay. R. F. I. B. 1935, 67-70, 1936.

To preserve herring for kippering after six months the temperature of storage must be at least -28°C.

549. Freezing and Cold Storage of Herrings. G. A. Reay. I. and R. 92, 127-8, 1937.

Herring, frozen at -4°F. and stored at ± 14°F., -4°F., and -18°F. were examined after six months storage.

550. Refrigeration and Herring Industry. G. A. Reay. M. R. 47, 216, 1944.

Freshly caught herring 8 hours without ice or 18 hours with ice, if frozen in 2 hours overall, and well glazed, will, when thawed out after storage for six months at -20°F., be practically as good as when put in storage.

551. *Store-burn in frozen meat products. C. R. Barnicoat. N. Z. J. Science Tech. 15, 248-54, 1934.

552. Keeping Moisture in Storage Fish. Anon. C. F. 16, No. 4, 20, 1929.
Cold storage rooms are lined with false walls enclosing the pipes, and air is circulated by means of a fan.

553. Humidification of Freezers. W. H. Cook. R. E. 38, 229-33, 1939.
Relative humidity of 95 percent is necessary to prevent drying of the unprotected product.

554. Surface-Drying of Frozen Poultry During Storage. W. H. Cook. F. R. 4, 407-18, 1939; C. A. 33, 8840, 1939.
The rate of evaporation from poultry varies directly with the temperature and inversely with the relative humidity of the storage room.

555. Dehydration of Fish During Cold Storage. C. L. Cutting and J. K. Hardy. British Assn. Refrig. Proc. 37, 51-8, 1940-41.
Typical problems involved in the cold storage of fish such as rancidity and desiccation are discussed, and preventive measures are outlined including humidification of air, glazing of fish, and use of adequate packaging materials.

556. Desiccation of Foodstuffs. W. J. Finnegan. I. and R. 97, No. 2, 111-3, 1939; R. E. 38, No. 4, 223-5, 1938.
The cause of desiccation in frozen foods is discussed and the effect of storage temperature is pointed out. Factors minimizing desiccation such as design of cold storage and use of suitable packaging are described.

557. Drying of Foods by Freezing. W. J. Finnegan. I. and R. 106, 49-53, 1944.
Factors controlling dehydration of frozen foods and the relative merits of multi stage and single stage freezing are pointed out.

558. Humidifiaction of Freezers. Van R. H. Greene. I. and R. 98, 321-2, 1940; R. E. 39, 300-6, 1940.
Automatic control is shown to be simple and satisfactory.

559. Humidity in Refrigeration. M. Kalischer. R. E. 38, No. 5, Refrig. Eng. Application Data -- Section 7, 1939.
As the humidity is lowered the rate of evaporation from the surface of products stored becomes greater and greater ultimately leading to drying.

560. Influence of Temperature on the Drying of Fish in Cold Store. C. C. Kuchel. R. F. I. B. 1936, 100-101, 1937.
Lowering the temperature of storage diminishes the rate of drying.

561. Prevention of Drying in Cold Storage. A. H. Leim. P. R. A. S. 1, 78, 1931; F. G. 48, No. 3, 23, 26.
The advantages of a "jacketed" cold storage room in preventing "freezer burn" are emphasized.

562. Humidity and its Control (In Cold Storage Rooms). W. H. Martin. I. and R. 96, 515-16, 1939; C. A. 33, 9055, 1939.
High humidities may be maintained by use of liberal coil surface or cold brine spray systems.

563. Meat: Store-burn in Frozen Offal. T. Moran. R. F. I. B. 1936.

Store-burn is due to excessive evaporation of water and can be prevented by using suitable wraps.

564. *Halting Moisture Loss in Quick Frozen Foods. Anon. N. P. 85, No. 24, 29, 1931.

565. The Histological Changes in Frozen Fish and the Alterations in Taste and Physiological Properties of their Flesh. K. Reuter. J. Hygiene 17, 56-62, 1918.

In very rapid freezing the water of the muscle albumin freezes in a molecular state. The alterations, in the taste of frozen versus fresh fish are indistinguishable. Prolonged air storage of frozen fish is accompanied by oil oxidation and an eventual rancid flavor.

566. Changes which may occur in frozen foods during cold storage. D. K. Tresslar. F. I. 5, 346-7, 1933; C. A. 28, 218, 1934.

Desiccation of fish, unless controlled, is the cause of serious losses.

567. Freezerburn on refrigerated poultry. D. K. Tressler. U. S. Egg Poultry Mag. 41, No. 9, 33-36, 38, 40, 42, 44, 46. No. 10, 38-41, 1935.

The literature on freezer-burn of poultry is critically reviewed and a plan of research to determine the best means of its prevention is outlined.

568. Weight losses in cold storage. M. Tuchschneid. I. and R. 89, 375, 1935; C. A. 30, 2653, 1936.

Fish loses weight during chilling, freezing, and storing.

569. *The desiccation of Frozen Foods in Freezer Locker Stores. J. G. Woodroof, Q. F. F. 3, No. 11, 12-14, 36-37, 1941.

570. Desiccation of Products Stored at Low Temperatures. J. G. Woodroof. R. E. 42, 383-7, 1941.

The dehydrating effect of different methods of freezing was studied. Glazing was offered as one method of diminishing desiccation.

571. The effect of Baffle Boards upon Dehydration of Fish in Cold Storage. O. C. Young. B. B. C., Annual Report, 112, 1932.

Experimental results indicate that baffles of some kind would decrease evaporation.

572. A Jacketed Cold Storage Room. O. C. Young. C. B. F. 7, 495-504, 1933.

Dehydration depends principally upon displacement of air from the outside.

573. The Relation between Coil area, Temperature of Cooling Medium and Dehydration in a Cold Storage Room. O. C. Young. C. B. F. 8, 477-487, 1934.

In studies with a small scale cold storage room the dehydrating effect was found to decrease as the cooling coil area increased, and as the evaporating area of stored material was increased the dehydration per unit area decreased slightly.

574. Molds in Cold Storage. T. D. Beckwith. I. and R. 90, 159-60, 1936.
The effect of temperature on molds most frequently present in cold stored material is investigated.

575. Marine Bacteria of the North Pacific Ocean. The Temperature Range of Growth. R. H. Bedford. C. B. F. 34, 433, 1933.
The temperature of storage, from a bacteriological aspect, must be determined by minimum temperature of a bacterial growth, e. g. -7.5°C.

576. How Freezing Affects Microbial Growth. J. A. Berry. F. I. June, 205, 1932.
A diminution in numbers of micro-organisms of from 90 to 99% had occurred during a year's storage at 15°F.

577. Bacterial Flora of Frozen Fillets. N. E. Gibbons. B. B. C., Annual Report, 42, 1930.
Fish received for freezing had very low bacterial counts (fish sometimes almost sterile) yet by the time the fish were filleted and ready for freezing contamination during handling had raised counts to hundreds of thousands. Freezing and storage at -18°C. for 6 weeks caused considerable drop in counts although storage at -5°C. resulted in little or no change. Some tests are reported on incubation of plates at 25°C., 10°C., and 3°C.

578. Bacteria Count in Frozen Fillets and Temperature Conditions in Freight Refrigerator Cars. N. E. Gibbons. Ibid. 44, 1932.
Bacterial counts of fish fillets in transit in refrigerated cars where the temperature averaged -5°C. showed a measurable increase.

579. *The Growth of Micro-organisms on chilled and frozen Meat. R. B. Haines. J. S. C. I. 50, 223-227T, 1931.

580. Growth of Bacteria at Low Temperature on Mackerel. J. S. Kiser, F. R. 9, 257-267, 1944.
A fairly comprehensive study, including graphs and tables, of the growth of bacteria isolated from Pacific mackerel is presented with special emphasis on the growth at low temperatures.

581. Numbers of bacteria in frozen food stored at several temperatures. S. C. Prescott, P. K. Bates, and M. Highlands. Am. J. Pub. Health 22, 257-262, 1932.
Frozen food if carefully prepared and stored can be merchandized with low microorganism count. Fluctuations were noted at all storage temperatures studied. Haddock was used in the experiment.

582. The Effect of Discontinuous Refrigeration on Bacteria in Foods. J. Bact., 21, 25-26, 1931. S. C. Prescott, P. K. Bates and H. C. Needle.
Foods refrigerated discontinuously showed increases in bacterial growth and spoilage occurred much more quickly. In some cases, growth increased rapidly even at relatively low temperatures.

583. Food Poisoning Organisms under Refrigeration Conditions. Prescott and Geer. R. E. 32, 211, 1936.
Cl. botulinum does not develop toxin in properly prepared foods at temperatures below 50°F.; Salmonella group growth is suppressed by temperatures below 39°F.

584. Effects of Refrigeration upon Larvae of Trichinella spiralis. J. Agr. Research 5, 819-854, 1916.
No infestation has been produced by trichinous meat exposed to a temperature of about 10°F. for 20 days or longer.

585. Bacteria and Other Biological Factors in Relation to Frozen Foods. J. Q. Sealey. R. E. 37, 310-2, 1939.

Biologists express their opinions on questions relating to effects of low temperature on various common organisms associated with spoilage.

586. Rate of Growth of Micro-organisms on Fish's Muscle Stored at Low Temp. M. M. Stewart. R. F. I. B. 1933, 180-187, 1934.

There is a rapid drop in the number of organisms after freezing and storage of fillets at -12°C. and -6°C; a rapid growth takes place at -2°C. after a lag phase of 6-9 days.

587. The keeping Quality of Haddock from Cold Storage. M. M. Stewart. J. S. C. I. 54, 92-6T, 1935; C. A. 29, 4092, 1935.

During a period of 15 days storage (holding in melting ice) there is no difference in the rate of bacterial growth of frozen and thawed fish, compared with fresh fish.

588. Further studies on Development of Clostridium botulinum in Refrigerated Foods. F. W. Tanner, P. R. Beamer, and C. J. Rickher. F. R. 5, 323-333, 1940.

Clostridium botulinum may sometimes develop and produce toxin in frozen foods which have been allowed to thaw and have been stored at temperatures 10°C. and above.

589. The effect of Freezing on Eb. Typhi. S. Thomas and W. A. Kreidler. Abst. Bact. 9, 8, 1925, Abstract No. 25.

Eb. typhi when frozen were completely killed in 8 days. Typhoid organisms inoculated into sterile feces were destroyed by freezing in 20 days.

590. Microbiology of Frozen Foods. V. The Behavior of Colostridium botulinum in Frozen Fruits and Vegetables. G. I. Wallace and S. E. Park. J. Infectious Diseases 52, 150, 1933; Am. J. Public Health 23, 742-3, 1933; I. and R. 85, 75-6, 1933.

The spores of Colostridium botulinum are resistant to freezing. If foods containing these spores are allowed to thaw and stand at room temperature for several days they may become very dangerous.

591. Changes in Fat of Cold-Stored Herring. A. Banks. R. F. I. B. 1935, 77-79, 1936; C. A. 31; 7134, 1937.

Brine-frozen, unglazed herring kept at -20°C. showed definite rancidity after 3 months, while air-frozen, unglazed herring were free from rancidity after 6 months.

592. Rancidity. A. Banks. R. F. I. B. 1936, 98-9, 1937; C. A. 32: 5649, 1938.

The prooxidative action of sodium chloride in the storage of brine-frozen herring appeared to be due chiefly to muscle enzymes activated by salt.

593. Changes in the Fat of Cold Stored Herring. A. Banks. R. F. I. B. 1936, 101-3, 1937.

Brine freezing is recommended over air freezing but brine must be washed off. Herring cannot be stored with success more than 24 hours out of the water.

594. Rancidity in Fats. I. Effect of Low Temperatures, Sodium Chloride and Fish Muscle on the Oxidation of Herring Oil. A. Banks. J. S. C. I. 56, 13-15T, 1937; C. A. 31: 2457, 1937.

The atmospheric oxidation of herring oil at -5°C. is fairly rapid but at -20° and -28° it is very slow. Sodium chloride has no effect on the oxidation of the oil. Herring muscle seems to catalyze the oxidation of herring oil.

595. Changes in the Fat of Cold Stored Fish. A. Banks. R. F. I. B. 1937, 74-5, 1938; C. A. 33: 252, 1939.

Brine-freezing has some slightly adverse effect on the fat of lemon soles during storage though the effect is not so pronounced as it is with herring.

596. Cold Storage of Herring. A. Banks. Ibid. 1938, 95-6, 1939; C. A. 34, 2944, 1940.

The peroxide values of the fish stored at -30°C. ranged from 0.2 to 1.0 millimeters per kg. of oil.

597. Storage of Fish, with Special Reference to the Onset of Rancidity. I. Cold Storage of Herring. A. Banks. J. S. C. I. 57, 124-8, 1938; C. A. 32: 5518, 1938.

Unless special precautions are taken, brine freezing adversely affects the keeping qualities of herring.

598. Rancidity in Fats. A. Banks. R. F. I. B. 1938, 106-12, 1939; C. A. 34, 2942, 1940.

Herring contains an enzyme which catalyzes the development of rancidity of the oil. An exhaustive experimental study is reported in which the change in potency of this enzyme is measured by extracting the enzyme from stored frozen fish and measuring its activity toward catalyzing the rancidity of pure herring oil. Prolonged storage of herring decreases the activity of the enzyme.

599. The Red Discoloration or Rusting of Frozen Fish in Cold Storage. R. H. Bedford, P. R. P. S. 18, 7; I. B. R. p. 27, 1934; C. F. 21, No. 1, 9, 1934.

The evidence thus far gathered indicates that bacteria may be one of the primary causes of "rusting".

600. Some Discolorations of Stored Fresh and Frozen Fish and Their Control. R. H. Bedford. P. R. P. S. 27, 11-14, 1936; I. B. R. p. 179, 1936.

Yellowing and rusting caused by bacteria and oxidation may be controlled by freezing fresh fish, thoroughly glazing, then eliminating ammonia gas from the room, and by storing the fish at -4°F. or lower.

601. Meat, Research on Pork, Ham and Bacon. E. H. Callow. R. F. I. B. 1927, 17-20, 1928.

Proper freezing and storage temperatures permit the water shipment of pork products.

602. The Freezing and Storage of Pork and Mild-cured Bacon. E. H. Callow. R. F. I. B. 1930, 71-74, 1931.

Rapid freezing at -35°C. followed by storage at -10°C. is satisfactory for lean bacon but not for fat.

603. The Freezing and Storage of Pork and Mild-Cured Bacon. E. H. Callow. Ibid. 1931, 134-135, 1932.

Frozen mild cured bacon cannot be transported great distances at -10°C. without danger of discoloration and rancidification.

604. The Storage of Frozen Legs of Pork for the Subsequent Manufacture of Hams. E. H. Callow. Ibid. 1937, 68, 1938.

When frozen pork legs are stored at -10°C. for several months, there is a risk of freezer burn. Three methods for improvement, special bags, chip ice, and an atmosphere of carbon dioxide were tried.

605. Effect of Temperature and Humidity on Colour of Lean and Development of Rancidity in the Fat of Pork During Frozen Storage. W. H. Cook and W. H. White. C. J. R. 19, D, 53-60, 1941.

The development of discoloration and rancidity was followed in pork stored at various humidities and temperatures.

606. Frozen storage of poultry. III. Peroxide-oxygen and free fatty acid formation. W. H. Cook and W. H. White. F. R. 4, 433-40, 1939; C. A. 34, 1762, 1940.

The free fatty-acid content of poultry fat is usually low and shows no relation to storage conditions at freezing temperatures. The storage temperature is important in peroxide-oxygen formation.

607. Seasonings, Their Effect on Maintenance of Quality in Storage of Frozen Ground Pork and Beef. C. W. DuBois and D. K. Tressler. P. I. F. T. 1943, 202-207.

Pepper, sage, mace and ginger have an antioxidant effect upon pork while salt promotes oxidation.

608. Changes in the Fat of Meats. N. P. Ellis and P. R. Howe, I. and E. 100, 459-60, 1941; Proc. Am. Inst. of Refrigeration 1941, 73-78.

Changes in the fat are concerned primarily with rancidity development. Antioxidants were tried.

609. *The Yellowing of the Abdominal Fat of Frozen Rabbits. J. R. Vickery. R. F. I. B., Sp. Rept. No. 42, 1932.

610. Experiments on the keeping quality of beef fat tissues and pork fat tissues at low temperatures. F. Kiermeir and P. Heiss. Z. G. K. I. 46, 91-5, 111-118, 1939; C. A. 33, 9469, 1939.

After periods of storage of 4-5 months at a temperature of -8°C. fat tissues become greasy and rancid.

611. Meat: Rancidity. C. H. Lea. R. F. I. B. 1928, 30, 1929.

Any combination of the factors: molds and bacteria, atmospheric oxidation, and tissue enzymes, may be productive of the general condition known as rancidity.

612. The Chemical Changes in the Fat of Frozen Mutton and Lamb. C. H. Lea. Ibid, 1930, 32-33, 1931.

Oxidation development of free acidity, sweating and growth of micro-organisms were observed in the storage of mutton fat at -5°, -10° and -20°C.

613. *Chemical Changes in the fat of frozen and chilled meat. C. H. Lea. Part I. Frozen Mutton and Lamb. J. S. C. I. 50, 207-213T. Part II. Chilled beef. Ibid 50, 215-220T. Part III. Frozen beef. Ibid 50, 343-349T, 1931.

614. *A Note on the Changes in the Fat of Frozen Mutton. C. H. Lea. Ibid. 50, 409T, 1931.

615. Meat, Changes in Fats During Storage. C. H. Lea. P. F. I. B. 1931, 45-46, 1932.

The superficial fat of bacon, in contrast to that of fresh beef and mutton oxidized comperatively rapidly during storage at -10°C.

616. Chemical Changes in the Fat of Bacon During Storage. C. H. Lea. Ibid. 139-143.

The mild cured sides of bacon were frozen at -30°C. and removed from frozen storage at intervals for subsequent storage at above freezing temperature and for analysis of free acidity and active oxygen.

617. Rancidity in Edible Fats. C. H. Lea. Dept. of Sci. and Ind. Res. Food Invest. Special Report No. 46, 230 pages, 1938.

The mechanism and methods for determining rancidity in edible oils is discussed very thoroughly.

618. Oxidation of Herring Oil. C. H. Lea. R. F. I. B. 1935, 79-81, 1936; C. A. 31, 7134, 1937.

The use of very low temperature is recommended for the storage of herring. The rate of oxidation at 0° is 2.55 times that at -10°C..

619. The Effect of Oat Flour as an Antioxidant in Frozen Fatty Fish Fillets. J. M. Lemon and E. E. Swift. I. and R. 95, 212, 1938; C. A. 32, 1936.

Chemical tests indicated that fish fillets treated with oat flour were less changed during storage for 7 months by oxidative and enzymic decomposition than fillets not so treated.

620. Quantitative indexes of the chemical changes taking place in red fish during cold storage. N. V. Malin. Voprosy Pitaniya 7, No. 4-5, 148-55, 1938; C. A. 34, 1762, 1940.

Fish oils contain considerable amounts of easily oxidized unsaturated fats.

621. Freezing and Cold Storage of Herring. T. Moran and G. A. Reay. R. E. 34, 305-7, 1937.

Freezing and cold storage can be successfully conducted to combat rancidity.

622. Modification of Fat in Frozen Pork Meat After Prolonged Storage. I. I. Novikova. Kholodil'naya Prom. 16, No. 4, 30-5; Chimie and Industrie 41, 901, 1938; C. A. 33, 8841, 1939.

If meat is kept at -18°C., there is no change in pork fat over a period of one year.

623. Fish in Cold Storage. G. A. Reay. I. and C. S. 41, 93-4, 1938; C. A. 32, 7592, 1938.

Herring will keep satisfactorily for 6 months at -30°C..

624. The Yellowing of the Abdominal Fat in Australian Frozen Muscles. J. R. Vickery. R. F. I. B. 1927, 13-14, 1928, 1928, 24-29, 1929.

The higher the temperature and the longer the period of pre-freezing storage, the greater is the development of yellowness.

625. Frozen Salt. A. Adams. "Inco" 12, No. 2, 14-15; Dept. of Commerce, Bureau of Fisheries, Spec. Memo 2414-11, 1934.

Fish shipped with an eutectic salt maintained a temperature of approx. 4°F. for a 70 hour run.

626. An Express Fish Service from Canada to England. C. F. 16, No. 1, 14, 1929.

Diesel-engined, cold-storage ships, capable of an Atlantic crossing in a week are in use. Diagrams of the ships are included.

627. Quick Frozen Foods and Refrigeration. H. Carlton. R. E. 41, 328-9, 358, 360, 1941.

Rapid growth of the locker plant industry needs the cooperation of refrigerating engineers in solving speed of freezing, precooling, maintenance of low storage temperature transportation, and packaging problems.

628. New Shipping Container Valuable to Fisheries. E. Church. F. G. 56, No. 1, 17, 28, 1939.

The Railway Express Agency offers a 10 cubic foot insulated shipping container, dry-ice-refrigerated, for less than carload shipments of frozen food to any point in the U. S.

629. Salt-Ice Frozen Eutectic -- a Neglected Refrigerant. R. E. Cornish. I. and R. 77, 452, 1929.

A frozen eutectic mixture of salt and water gives more B. T. U. per pound than the most favorable mechanical mixture and gives a much lower temperature on a small scale or when nearly metted.

630. The Transportation of Quick-Frozen Food Products in Refrigerator Cars. S. M. Davison. I. and R. 83, 297-299, 1932.

Problems in refrigerated car design are the necessity for air circulation, control of conditions affecting load temperature, and temperature recording and indicating instruments.

631. Frozen Sea Food Shipments Aided by Broquinda (Dry Ice) Refrigeration. Anon. F. G. 57, No. 3, 21, 1940.

A secondary liquid refrigerant cooled by dry ice in an insulated bunker circulates by gravity through exterior coils to cool the desired space.

632. New Aspects of the Shrimp Industry. R. V. Grayson. F. G. 57, No. 8, 40, 50, 1940.

The shipment of frozen shrimp is discussed.

633. Modern Transportation Methods for Frozen Sea Foods. J. T. Sheehan. F. G. 57, No. 11, 98, 100, 1940.

Packaging and transportation are so closely allied that one depends and to a certain extent governs the growth of the other.

634. Mechanical system proves efficient for refrigerating trucks. Anon. F. I. 14, No. 1, 70-71, 1942.

Uniform temperature and reduction in cost is attained by equipping frozen food trucks with finned coils and compressor units.

635. Frosted Meats. I. and R. 78, No. 3, 250, 1930.

Experience of shipping and retailing frozen fish fillets was presented by Dr. H. F. Taylor.

636. New Refrigerated Container Service is Announced. Anon. I. and R. 96, 75-76, 1939.

Dimensions and servicing are given for the Church container.

637. Development of the Refrigerator car. Anon. I. and R. 101, 158, 1941.

The history of refrigerator car development is traced from 1857 to the present time.

638. Shipping Frozen Whiting 1600 miles by Truck. J. C. Johnson. F. G. 50, No. 6, 15, 16, 1933.

Uninsulated vans used 100 pounds of dry ice on a 72 hour run during cold weather.

639. Successful Shipment of Frozen Fish. A. L. Leim. P. R. A. S. 5, 10-11, 1932.

Haddock, halibut, lobster, scallops and clams were quick frozen, stored for about a month at 0°F., and shipped by express (protected by dry ice) to two hotels. All products were in excellent condition when served.

640. Temperature Conditions in Refrigerator Cars. A. H. Leim. B. B. C. Annual Report 1932, 61.

A recording thermometer was used in refrigerator cars enroute; temperature variation ran from 18 to 28°F. at the top and 13 to 18°F. at the bottom.

641. Keeping Quality as Related to the Distribution Problem. C. A. Magoon. I. and R. 80, 39-41, 1931.

The article discusses alteration in color and flavor, micro-organisms, and handling methods.

642. Transportation of Quick Frozen Foods. J. W. Martin. Q. F. F. 2, No. 1, 15-16, 25, 29, 1939.

The Broquinda system refrigerates railway cars with dry ice.

643. Transporting Frozen Foods. I. C. Miller. F. I. 10, 385-386, 417, 1938.

Railroads and trucks divide the larger bulk shipments, but problems arise in handling less-than-car load lots.

644. The Transportation of Frozen Fishes (Le Transport du Poissons Congeles). E. Mir and J. Audige. Bureau of Fisheries, Memo S-291, 1930. Bulletin de la Societe Centrale d'Agriculture et de Peche, Paris, 1913.

Frozen live fish were transported to markets in block ice.

645. *The Preservation and Transport of Frozen and Chilled Beef. T. Moran and J. R. Vickery. Proc. 5th Int. Cong. Refrig. 54, 1928.

646. Frozen Fish Trucked with CO_2 Refrigeration. P. F. 29, No. 1, 28, 1931.

"Dry ice" is used for the shipment of frozen fish.

647. North American Develops Mechanical Refrigerator Car. Railway Age 87, 1155-1157, 1929.

An axle-driven ammonia system employs brine tanks with a capacity for 72 hours standing time.

648. Transporting Quick Frozen Foods Across Canada. P. Standard. Q. F. F. 3, No. 3, 17, 33, 1941.

Some of the advantages of overhead or roof tank type, bunker, refrigerator cars for shipment of frozen produce are lower, more uniform temperatures.

649. Refrigerated Trucks. H. F. Taylor. F. G. 46, No. 3, 18-23, 1929.

Dry ice, frozen brine, mechanically refrigerated ice and salt, as well as silica gel refrigerated insulated truck bodies are used for shipment of frozen and fresh fish.

650. Report on Refrigerated Transportation in Canada. O. C. Walker. Proceedings, American Society of Refrigeration. 1941, 155-162.

Roof tank refrigerator cars are superior and meet general requirements in an economical way for shippers and railways alike. Illustrations are included.

651. The Transportation of Quick Frozen Foods. H. T. Whyte. R. E. 38, 274-276, 1939.

Research and investigational work determine the type of refrigerator car which is necessary in the transport of quick frozen foods at low temperatures.

652. Temperature Control in Railway Transportation. H. M. Wigney. F. I. 2, 182-184, 1930.

Silica-gel refrigerated cars have been used in the shipment of frozen fish.

653. The roof tank refrigerator car. O. C. Young. P. R. P. S. 17, 1933.

Transportation of frozen fish requires uniform low temperatures which are more easily maintained in roof bunker cars.

654. Refrigerator Car Tests II. O. C. Young. P. R. P. S. 29, 3-7, 1936.

Tests were made with overhead cooled refrigerator cars. Temperatures were recorded at bottom, center, and top and at each end and in the middle of the car in the course of shipment of frozen salmon and halibut from Vancouver to Winnepeg.

655. Refrigerator Car Tests III. O. C. Young. P. R. P. S. 34, 18-22, 1937.

Fish were shipped in a refrigerator car and the temperature was studied en-route.

656. Comparative Studies of the Over-head Tankkand End-Tank Methods of Cooling Refrigerator Cars. O. C. Young. Proceedings Sixth Pacific Science Congress, 3, 473-478, 1939.

657. Refrigeration of Fish in 1943. F. G. Annual Review Number, 132, 1943. M. T. Zarotschenzeff.

Quick freezing in the stratosphere, refrigerated transportation, and pre-cooked frozen fish dishes are considered.

658. Quick Freezing Offers Wartime Economies. F. App. F. I. 14, No. 8, 48-9, 108, 1942; M. R. 45, No. 535, 174-5, 1942.

Data from the experience of a large company indicate that labor of distribution and critical materials needed are less for frozen foods.

659. Locker Plants can Increase the Availability of Frozen Fish. Anon. A. F. 21, No. 3, 6, 1940.

A locker plant is a potential cold storage warehouse and the operator is a potential wholesaler and retailer of frozen foods.

660. Probable influence of Quick Freezing on the Shellfish Industries. C. Birdseye. Trans. Am. Fisheries Soc. 62, 80-83, 1932.

High quality and increased availability of quick frozen foods make them an attractive outlet for the shellfish industry.

661. Frozen Foods in War Economy. C. Birdseye. P. I. F. T. 1943, 34-46.

The war effect on frozen foods and war benefits from quick freezing are discussed.

662. Distribution Hurdles - In Quick Frozen Foods. F. W. Bryce. F. I., June, 1930.

The Atlantic Coast Fisheries Co. explains their frozen fillet distribution system.

663. Some Commercial Aspects of the Frozen Food Industry. H. Carlton. R. E. 36, 291-4, 1938.

Superior quick frozen foods are necessary. Possible sources for distribution are presented.

664. The Influence of Modern Refrigeration of Marketing Perishable Goods. T. E. A. Classen, I. and R. 80, 261-2, 355-59, 1931.

Fish freezing is accomplished by a variety of methods. Very low temperatures are as detrimental to the tissues as slow freezing.

665. This Trend towards Frozen Fish. R. H. Fiedler. F. G. 47, No. 7, 53-62, 1930.

Fresh fillets have stimulated the frozen trade in general and growth of freezing and warehouse facilities.

666. Quick Freezing Foods -- Economic Status as Applied to Freezing Methods and Apparatus Design. W. J. Finnegan. I. and R. 94, 45-8, 1938.

The frozen food industry has now reached a size proportion from the standpoint of volume which substantiates the use of more efficient economical and adequate facilities.

667. Refrigerated Display Cases Increase Sea Food Acceptance. A. R. Fisher. F. G. 56, No. 1, 18-19, 1939.

The author claims that the range of temperature which is required in retail display cabinets for fresh and frozen fish is approximately between 34 and 36°F.

668. How the Filleting Boom is Sweeping Lake Erie's Fishing Ports. W. B. Fiske, F. G. 49, No. 5, 12-17, 1932.

Methods and costs for freezing fillets of fresh water fish are presented together with statistics as to volume produced.

669. Fish and Seafood Sales Fit into Locker Plant Growth. Anon. F. G. 61, June, 80, 112, 1944.

There is an opportunity for the fishing industry to extend distribution of their products through the use of lockers and by preparing fish for locker storage.

670. The Relation of Refrigerated Lockers to Conservation of Fishery Products. R. W. Harrison and M. E. Stansby. Trans. Amer. Fish. Soc., 70, 260-3, 1941.

Use of locker facilities for storage of frozen fish can be of benefit to the sports fisherman, the housewife and the commercial fishery. Detailed instructions are given for preparing fish for the refrigerated locker.

671. Frozen Swordfish -- A study of the costs of production of frozen swordfish in the U. S. and Competing Countries as Reported by the U. S. Tariff Commission. Anon. I. and R. 91, No. 5, 385, 1936.

Domestic swordfish is described and compared with the imported frozen product.

672. Frozen Whiting Fillets -- now popular in New England. Anon. I. and R. April, 1943.

The popularity of frozen whiting fillets was stimulated by their use in mid-west fish and chip houses.

673. The place of Cold Storage in the Marketing of Fish. O. C. Mackay. I. and R. 79, 17, 1930.

Refrigeration is the only method of preservation that keeps fish in essentially its original condition for long periods and during transportatioh over long distances.

674. Estimated Cost of Freezing Herring using Ice and Salt. A. S. McFarlane. P. R. A. S. 13, 9-10, 1934.

The total operating cost of freezing 3,000 pounds of herring was $12.00 when using ice costing $2.00 per ton and salt costing $10.00 per ton.

675. Canada experiments with "ice fillets". R. A. McKenzie and J. W. R. Harkness. F. I. 2, 176-78, 1930.

A production process is outlined and pictured. Marketing of packaged quick frozen fillets is explained.

676. Cold Storage a Vital Economic Factor. W. F. Morgan. F. G. 37, No. 6, 15-18, 1930, M. S. -155.

Fish can be economically custom frozen and cold stored.

677. Cold Versus Heat in Food Preservation. P. F. 28, No. 8, 25, 1930.

Recent discoveries are opening a new field of refrigeration in the fishing industry. Diversion of large quantities of salmon from canneries to freezers is probable.

678. Quick Freezing Builds Greater Sea Food Sales. C. E. Pellisier. I. and R. 94, 454-456, 1938.

Frozen oysters can be held for several months at -10°F. or lower.

679. Quick Frozen Fishery Products pay big Dividends to locker Operators. M. E. Stansby. Q. F. F. 3, No. 9, 22-23, 37-38, 1942.

Frozen fish has a place in the locker; and if fresh, when packed in moisture-vapor-proof containers they should have no disagreeable odor.

680. Economics of Locker Plant Operation. S. T. Warrington. R. E. 42, 309-12, 1941.

Investment and operating costs are given for a centralized processing plant with branch locker rooms which are advocated for small communities.

681. Why Not sell more Fish. E. F. Wright. F. G. 55, No. 10, 53-54, 60, 1938.

Quick freezing in small packages is encouraged.

682. Quantitative Chemical Determination on Frozen Fish for the Purpose of Determining the best Method of Thawing this Product. U. Bagnolesi. Ann. Hygiene 50, 461-9, 1940; C. A. 36, 7166, 1942.

Samples of previously frozen fish which had been thawed in different ways were analyzed for protein, fat, ash, and water content.

683. Effect of Thawing and Cooking Frozen Pork and Beef. A. M. Child and P. Paul. Minn. Agr. Expt. Sta. Tech. Bull. 125, 1937.

Freezing and varied thawing temperatures have an effect on palatability thawing and cooking losses, drip, press fluid, total moisture and tenderness.

684. The State of Preservation and the Tendency to Decompose of Defrozen Fish, in Comparison with Fresh. D. Costa and C. Cannella. Ann. Chim. Applicata 30, 402-12, 1940; C. A. 35, 1530, 1941.

Several comparative experiments were made, determining acidity, alkalinity, pH, volatile N-containing bases, hydrogen sulfide, etc., on fresh, slowly thawed, and rapidly thawed fishes.

685. *The thawing of frozen fish. C. L. Cutting. M. R. 18, 198-199, 206, 1940.

686. The Cooking of Frozen Foods. Faith Fenton. N. Y. State College of Home Economics, Cornell Ext. Bull. 628, 32 pp. 1943.

Directions are given for minimizing changes during thawing and cooking frozen foods, (meats, fish, poultry, etc.).

687. Birdseye Cook Book. Frosted Foods Sales Corp., N. Y. 64 pp. 1941.

This booklet contains directions for thawing frozen seafoods and recipes for preparing a number of seafood dishes.

688. Defrosting Frozen Foods. L. E. Howlett. I. and R. 87, 184, 1934.

Produce must never be stored in an atmosphere in which the dewpoint is higher than the temperature of the commodity concerned.

689. *Nature of the Modifications Produced in the Muscular tissue of Frozen Meat During Thawing. E. Kallert, Z. G. K. I. 30, No. 7, 77-81, 1923.

690. Slow Thawing Advised as Means of Saving Frozen Fish Quality. Anon. P. F. 37, No. 3, 60, 1939.

Thawing must take place slowly; no portion of the fish should be allowed to rise above 50°F.

691. The Keeping quality of Thawed Haddock. G. A. Reay and M. M. Stewart. R. F. I. B. 1933, 173, 1934.

Thawed fish resemble fresh unfrozen fish in most respects and do not spoil at a more rapid rate. In some instances the gills of frozen, thawed fish are browner than gills of corresponding fresh fish; other slight differences are described.

692. Effect of Method of Thawing upon Losses, Shear and Press Fluid of Frozen Beefsteaks and Pork Roasts. G. E. Vail, M. Jeffery, H. Forney, and C. Wiley. F. R. 8, No. 4, 337-342, 1943.

The least press fluid exudes when meat is thawed at room temperature; highest per cent total loss occurs in roasts.

693. Thawing of Fish. I. O. C. Young. P. R. P. S. No. 47, 3-5, 1941.

The primary object of these experiments is to determine the relationship between the amount of drip and the rate of thawing for commercially frozen salmon and halibut.

694. Thawing of Fish II. O. C. Young. P. R. P. S. 50, 16-20, 1941.

The quantity of free drip from unfrozen fish varies with the part of the fish from which the sample came. Rate of freezing influences drip.

695. Freezing and Thawing Procedures. O. C. Young. Fisheries Research Board of Canada, Annual Report, 1941, 1933.

Two part-glass models of flooded ammonia refrigerator systems have been constructed to allow visual observation of the refrigerant. The rate of thawing appeared to have the least effect on the quantity of drip as compared with the effects of freshness and rate of freezing.

696. Quality Control from Sea to Consumer. J. L. Alphen. F. G. 54, No. 10, 24-26, 1937.

General Seafoods describes their frozen fillet operation.

697. Quick freezing and marketing of Ducks. Anon. Q. F. F. 1, No. 1, 22-24, 49, 1938.

The plant and process of a Long Island duck packing establishment which uses the Z process for freezing is pictured and described.

698. Perfecting the Frozen Fillet. R. G. Chute. F. G. 43, No. 13, 55, 79, 1926.

A New York producer who specializes in the inland market trade, has solved the technological problems of fast freezing, drip and yellowing of the frozen fillet.

699. Science and Engineering Build a Big Fish Business. Fishing Gazette, Review Number, 1928, p. 83.

The Atlantic Coast Fisheries Company has developed through the application of recent scientific and engineering knowledge.

700. A Little Journey Through a Modern Oyster Plant, the Bluepoints Company of West Sayville, Long Island, New York. Anon. F. G. 55, No. 1, 12-15, 17, 1938.

Plate quick freezing equipment is installed in a fresh opening oyster plant.

701. Quick Freezing goes South. Anon. F. G. 55, No. 8, 18A-18B, 1938.

A combination brine spray and air blast quick freeze unit for fish and shrimp is installed on Alabama State Docks at Mobile.

702. Gloucester's New Fish Freezer. Anon. F. G. 56, No. 4, 15, 36, 1939; I. and R. 96, 511-13, 1939.

Features of a large freezing and cold storage plant are described.

703. Frozen Foods Directory. F. I. 10, No. 4, 239-249, 1938; 12, No. 12, 6 6-86, 1940; 14, No. 5, 51-68, 1942; 15, No. 11, 78-98, 1943.

The directory lists the products, package sizes, systems, and quantities produced by companies engaged in freezing.

704. Large Fish Freezing Plant at Halifax, N. S., Anon. I. and R. 75, 487, 1928.

Fish are processed and filleted in a plant having a freezing capacity of 1000 pounds/ hour or two Birdseye belt frosters.

705. Canada Develops Trade in Frozen Fish. Anon. I. and R. 77, No. 4, 199, 1929.

The facilities of a large Canadian trading company include plant installations for brine freezing of salmon, cod, halibut steaks, and lobsters.

706. Quick Freezing of Wholesale Cuts of Meats. Anon. I. and R., 79, 53-4, 1930.

Large cuts of meat are sharp frozen in 24 hours, glazed, and stored for subsequent shipment. After defrosting they are sold as small retail cuts.

707. Modern Refrigerating Plant Stores Huge Supply of Perishable Foods. Anon. I. and R. 99, 267-268, 1940.

Fish freezing and glazing operations of the Western Refrigerating Company, Chicago are pictured and described.

708. Freezing West Coast Fish. F. W. Jones, Q. F. F. 7, No. 4, 38, 1944.

Santa Cruz Processors outline their fillet freezing operation.

709. Fish Kept Fresh 1500 Miles from the Sea. R. E. Martin. Popular Science Monthly 115, No. 4, 57, 1929.

This is a popular article describing the operations of the Atlantic Coast Fisheries Company.

710. Existing Cold Storage Facilities for Quick Frozen Foods. I. C. Miller. F. I. 10, 438-439, 469, 501, 504, 523, 1938.

The cold storage space available in public, private and meat packing establishments is listed.

711. Gorton-Pew Fisheries Co. Enters Quick-Frozen Fillet Field. J. E. Munson. F. G. 47, No. 4, 17, 20, 24, 1930.

The Gorton-Pew fillet operation is completely mechanized and uses the floating pan system of freezing.

712. "Z" Rapid Freezer Installed in New York. J. E. Munson. F. G. 48, No. 12 20, 21, 1931.

First brine fog freezer in United States is installed at Brooklyn Bridge Freezing and Cold Storage Company.

713. Canadian Discoveries - In Fish Refrigeration-Huntsman Process. P. F. 28, No. 5, 24, 1930.

Frozen fish fillets, "ice fillets" and methods for their production, storage and sale has been experimentally developed.

714. Freezing Pacific Oysters. P. F. 35, No. 6, 33-34, 1937.

Willapa harbor oysters are blast frozen in waxed cups.

715. Crab Meat frozen on Birdseye Machine at Hillsboro, Oregon. Anon. P. F. 35, No. 12, 68, 1937.

Eviscerated crabs are cooked, picked, blanched, packed into 10 ounce cartons and plate frozen.

716. Quick Freezing Units Installed by New England Fish Company. Anon. P. F. 39, No. 8, 59, 1941.

This article describes a method of quick freezing petrale sole fillets.

717. Santa Cruz Firm Specializes on "Bagged" quick-frozen Fish. Anon. P. F. 40, No. 8, 37, 1942.

Blast frozen blocks of fish are placed in Cryo-vac bags for storage.

718. Freezing Fish by the Birdseye System. E. S. Pattison, F. I. 2, 159-161, 1930.

This is a description of preparatory operations, filleting, packaging, and the freezing of fish in a Gloucester plant.

719. New Freezing Service by Brooklyn Bridge Freezing and Cold Storage Company. C. E. Pellissier. I. and R. 93, 451-3, 1937.

Fillets and shrimp are custom frozen.

720. Frozen Fish Loaf. Anon. Q. F. F. August, 19, 1943.

The Seapack Company in Astoria has developed a cooked fish loaf which is frozen in one and ten pound packages.

721. Fish from Trawler to Freezer. Q. F. F., August, 31, 1944.

Pictures of processes are given.

722. Fish steaks -- a standardized product in a standardized package. H. F. Taylor. F. I. 2, 545-547, 1930.

The production of frozen fillet steaks by an Atlantic Coast firm is explained in detail.

723. Santa Cruz Fillet Freezers. E. W. Williams. Q. F. F., Sept., 31, 1944.

The company has a complete line of cellophane wrapped retail and institutional packages.

724. Farm Freezer Analysis. C. W. DuBois. A. E. 24, 343-4, 346, 1943.

Studies of farm freezers and their use were made in New York State.

725. Freezing Plates for Locker Plant Freezing and Farm Freezer and Storage Compartments. C. W. DuBois and D. K. Tressler. R. E. 46, 25-30, 68, 1943.

Curves were made from experimental data on plate freezing with and without air circulation.

726. Locker Plants and Seafoods. F. G. 61, 80, 112, July 1944.

Locker plants can be used for storing fish.

727. Trends in the Refrigeration of Foods. G. A. Fitzgerald. I. and R. 106, 103-5, 1944; R. E. 47, 102-4, 1944.

The trend is toward the freezing and packaging of an increasing variety of foods for storage in farm freezers and locker plants.

728. Storage Locker Business. W. E. Guest. R. E. 36, 236-8, 1938.

Errors in construction of the cold storage, and in the operation of the business may prevent economic success in locker plant management.

729. Essentials of Farm Type Frozen Food Cabinet. E. C. Meyer. A. E. 24, No. 3, 84-5, 1943.

Specifications for a 20 cubic foot home freezer are set forth.

730. Equipment for Freezing and Storing Foods on Farms. P. T. Montfort. R. E. 42, 168-72, 192, 1941.

The present facilities for processing and freezing foods on the farm are both handy and cumbersome. The cost of freezing and storing 1500 pounds for a family of five varies with the different types of equipment available.

731. Freezing and Storing Food on Farms. P. T. Montfort. A. E. 23, No. 3, 88-90, 1942; J. Arch. Eng. and Indust. 4, No. 3, 16-20, 1942.

Further research is needed to increase the acceptance of existing equipment, methods and information.

732. The Relation Between Compressor Size, Insulation Thickness, and Eutectic Values in Farm Freezer Cabinets. P. T. Montfort. A. E. 24, 429-30, 432, 1943.

An analysis is made of the heat loss and cost of operation of boxes using different amounts of insulation, as well as the amount of refrigeration required in certain loading with and without the use of eutectic tanks.

733. Performance of Domestic Frozen Food Cabinets. J. E. Nicholas. A. E. 23, No. 7, 232, 1942.

The performance of domestic units under "home use" conditions shows a power consumption of 56, 65, and 123 kw. hours per month for 3, 6, and 15 cubic foot models respectively.

734. Seasonal Loading and Freezing Rates of Domestic Frozen Food Cabinets. J. E. Nicholas and G. Olson. A. E. 25, No. 5, 169-72, 1944.

Topics discussed include: method and time of preparation, freezing rates of pork, fruits, and vegetables, tables, charts and a summary. Tables and charts are based on method, time for preparation, and freezing rates of pork, fruits, and vegetables have been prepared.

735. Freezing Foods on the Farm. D. K. Tressler. R. E. 40, No. 1, 30-1, 1940.

The purchase of a farm freezer to supplement locker storage requires a thorough consideration of the available types.

736. Problems involved in Mechanical Construction of Refrigerated Locker Plants. H. G. Venemann. I. and R. 98, 501-2, 1940.

The selection of equipment, controls, and compressors of correct capacities and ratings, is considered for locker plant construction.

737. Refrigeration of Locker Plants. American Soc. Ref. Eng. Refrig. Eng. Application Data Section 1, R. E. 37, No. 4, (Sec. 2), 8 pp., 1939.

The design and processes used are given for the refrigeration of locker plants along with operating costs and sample load calculations.

738. Fisheries enlist Chemical Engineering to Rationalize an Ancient Industry. C. Birdseye. Chem. and Met. Eng. 38, 320-324, 1931.

The preservation of fishing gear, salt preservation of fish, refrigeration, quick freezing, and sanitation are discussed.

739. Press Fluid from Heated Beef Muscle. A. M. Child and M. Baldelli. J. Agri. Research 48, 1127-1134, 1934.

An apparatus adaptable to the measuring of drip in fish is described.

740. Frozen Precooked Fishery Products. Fishery Market News 6, No. 1, 17, 1944.

Tests on adaptability of fish for preparation of precooked frozen "dishes" have been started.

741. How Fast is Quick. F. I. 2, No. 6, 242, 1930.

Quick is a relative term dependent upon the type of product being frozen.

742. *Some Problems of the Freezing of Beef Presented to a Biochemist. D. L. Foster. Proc. 4th Int. Cong. Refrig., 247-250, 1924.

743. *Rapid Freezing Research. R. Heiss. I. and C. S. 36, 195, 208, 1933.

744. Refrigeration - A great Development in the Fishing Industry. J. M. Lemon. I. and R. 94, No. 2, 98, 1938.

Fish, properly frozen and handled is just as good as fresh, unfrozen fish.

745. *Refrigeration in the Fish Industry. A. Lumley. Proc. Brit. Assoc. of Refrig. 32, 1935; I. B. R. 44, 1936; I. and C. S. 39, 11-12.

746. The Development of Silica Gel Refrigeration. E. B. Miller. R. E. 17, 103-108, 1929.

Types of cycles, actual units, applications and low temperatures are discussed.

747. Again "Why Not Frozen Fish". H. F. Moore, F. G. 37, No. 6, 19-20, 1920.

Arguments are given for fish freezing.

748. *Data on Meat-Freezing Phenomena. T. Moran. I. and C. S. 36, 75-77, 1933.

749. Hygienic results of Refrigeration in the Conservation of fish and muscles. H. D. Pease. Am. J. Public Health 2, 849-54; C. A. 7, 2976, 1913.

The problems in the freezer storage of fish and oysters relate to the conditions under which they were caught, prepared for refrigeration and handled after removing from refrigeration.

750. Refrigeration load calculations. II. Temperatures below 32°F. S. C. Segal. R. E. 39, No. 4, Refrig. Eng. Application Data Section 12, 1940.

Load calculations are made for wall losses, air changes, and product load for fish and other foods. Values of insulating materials are compared.

751. On the Coagulation of muscle plasma. E. C. Smith. P. R. S. B 105, Memo. 129, 579, 599, 1930.

Muscle plasma is prepared which indicates a relation between gelation and rigor mortis; a change in acidity occurs during gelation.

752. Measuring Moisture Protection. J. F. Stone. R. E. 41, 326-327, 335, 1941.

Methods are presented for determining the adequacy of insulation specifications.

753. The Place of Sea Foods in the Quick-Frozen Food Industry. H. F. Taylor. F. G. 55, No. 10, 72, 73, 76, 77, 79, 1938.

Quick freezing has arrived but its position is not secure nor its future assured unless quality of products is kept at a high standard and researches are continued in all directions.

754. Basic Facts and Formulas for Meat Refrigeration. H. R. Toombs. N. P. July 22, 15, 1944.

B. T. U., Sp. Heat, Latent Heat, Horsepower and other terms are defined for the layman.

755. Refrigeration of Sea Foods. W. M. Zarotschenzeff, F. G. 59, No. 11, 118, 120, 124, 1942.

World production of frozen sea foods is outlined for the future.