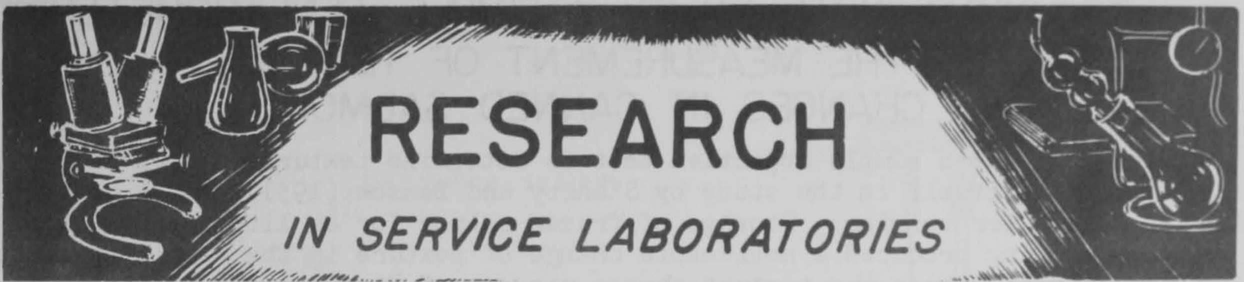

December 1951

REFRIGERATION: Storage Condtions on Quality of Frozen Fish: During a survey trip it was noted that quantities of whole frozen fish were being stored in cold-storage rooms designed primarily for storage of packaged foods and in which air circulation is provided by blowers. This practice results in a very rapid desiccation of the whole glazed fish. The purpose of this project is to determine what simple protective means can be taken to prevent the rapid loss of ice glaze and desiccation of the product.

Preliminary results have been obtained on the effect of different methods of protecting frozen fish against loss of ice glaze. The results are based upon 53 days storage of fish in the laboratory cold-storage room, refrigerated by means of a blower unit providing relatively rapid air circulation. The results indicate that relative high protection against loss of ice glaze may be produced by several simple means of cutting down direct contact of the flowing air, with the surface of the fish. Samples of glazed frozen fish merely wrapped in ordinary kraft paper showed only 20 percent of the loss of glaze which took place in completely unprotected samples. Placing of the glazed fish in wooden boxes without a paper liner but with the lid nailed tightly in place reduced the loss of glaze to less than 5 percent of that occurring with unprotected fish. Samples wrapped in heavy waxed paper or those placed in polyethylene bags showed practically no loss whatever after almost two months storage. These preliminary results indicate that the problem of protection of glazed fish against moisture loss on a laboratory basis is a very simple one; however, costs involved in the application of the procedures on a commercial scale may be prohibitive. Methods of practical application will be considered. (Seattle).

* * * * *

COMPOSITION: Composition and Cold-storage Life of Fresh-Water Fish: Data on the composition of the first six samples of yellow perch and whitefish are presented in the following table:

Composition of First Six Samples Analyzed for Each of Two Species of Lake Erie Fish

Species of Fish	Sample Number	Length	Weight	Fillet Yield	Moisture	Fat	Protein	Ash
		Centimeters	Grams	Percent	Percent	Percent	Percent	Percent
Yellow perch	1	26.5	285	41.0	79.3	0.80	20.1	1.43
(*Percha*	2	24.0	252	38.9	79.8	0.90	19.3	1.14
flavescens)	3	23.5	232	37.5	78.7	0.95	19.2	1.24
	4	23.0	202	39.6	78.5	0.95	19.9	1.20
	5	24.5	235	36.2	79.4	0.84	19.9	1.36
	6	24.5	252	42.8	78.7	0.81	20.3	1.29
Whitefish	1	50	1390	51	66.6	17.1	17.6	1.05
(*Coregonus*	2	45	1080	41	72.5	8.0	19.7	1.09
clupeaformis)	3	45	975	45	71.2	10.7	18.8	1.19
	4	41	845	44	73.9	8.70	18.8	1.05
	5	41	835	39	72.7	8.37	18.9	1.15
	6	38	625	55	75.9	5.68	18.3	1.04

(Seattle).

TECHNICAL NOTE NO. 16--A SIMPLE PENETROMETER FOR THE MEASUREMENT OF TEXTURE CHANGES IN CANNED SALMON

The need for a simple objective test to determine texture changes in canned fish presented itself in the study by Stansby and Dassow (1951) on the use of frozen salmon for canning. Storage of frozen salmon for as little as one week prior to canning produced a noticeable change of texture in the resulting canned product. In all cases the texture change was one of firming or toughening. In some instances the change was a desirable one, but for the greater part it was undesirable. Increasing the storage time of the frozen salmon prior to thawing and canning appeared to increase the undesirable texture change. It was thought that use of a penetrometer similar to that described by Charnley and Bolton (1938) could be used to correlate taste-panel texture ratings with penetration depth of a "needle" into the canned fish. Inasmuch as the Charnley instrument was found to be available only on special order from an instrument maker, it was decided to design a simplified-type penetrometer (figure 1) which could be constructed without difficulty in the average laboratory shop.

The primary use of penetrometers is in the road-building industry for testing materials such as tar and asphalt, which are homogeneous in regard to texture. Tests made on difficult portions of these samples should give nearly identical results. Penetrometers are also used in the food industries, for example in the canning or freezing of peas (Anon. 1951) to determine the optimum texture for processing and in the manufacture of cheese to determine the toughness of the product (Jacobs 1944).

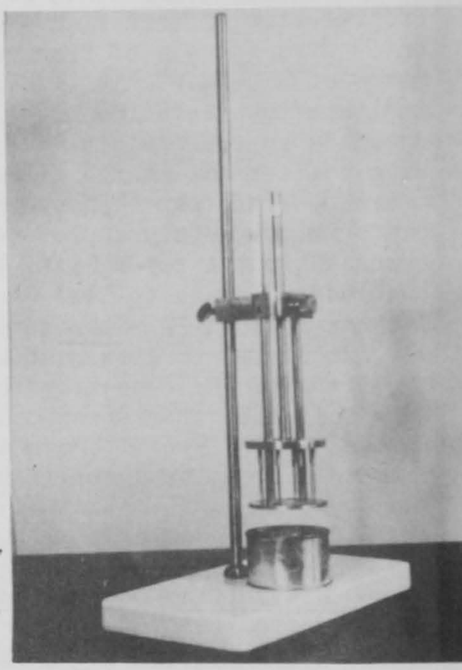

FIG. 1 - PENETROMETER DESIGNED AND USED BY THE FISHERY PRODUCTS LABORATORY, KETCHIKAN, ALASKA.

Canned fish differs in respect to tar and asphalt in that it is non-homogeneous in texture. To provide an average penetration value many readings must be taken over the surface of the sample. In order to minimize the number of readings required, penetrometers for application to food products are often of the multineedle type, such as the Charnley penetrometer.

Ten, Roberts No. 2, standard penetrometer needles were used in this instrument. Adaptation of the instrument for use with products other than canned salmon could be made by varying the number of needles employed. Approximate dimensions of the needles were 1.5 inches long and 0.04 inches in diameter. The needle point is described geometrically as the frustum of a cone approximately 0.25 inches in length. The needles were arranged symmetrically in a disc of stainless iron and shrink fitted into place (figure 2). The arrangement of the needles in the disc was such that contact of the needles with the backbone could be avoided when making a test. The disc, which shall be referred to as the penetrometer head, is approximately 3.2 inches in diameter and 0.3 inches thick. The total weight of the penetrometer head, needles, and shaft is 500 grams. Although the head of the instrument described was designed to fit 1/2-pound flat cans, the measurements of the instrument could be reduced proportionately to allow its use with 1-pound tall cans. In order to allow the head to move up or down with a minimum of friction, the monel shaft (which is

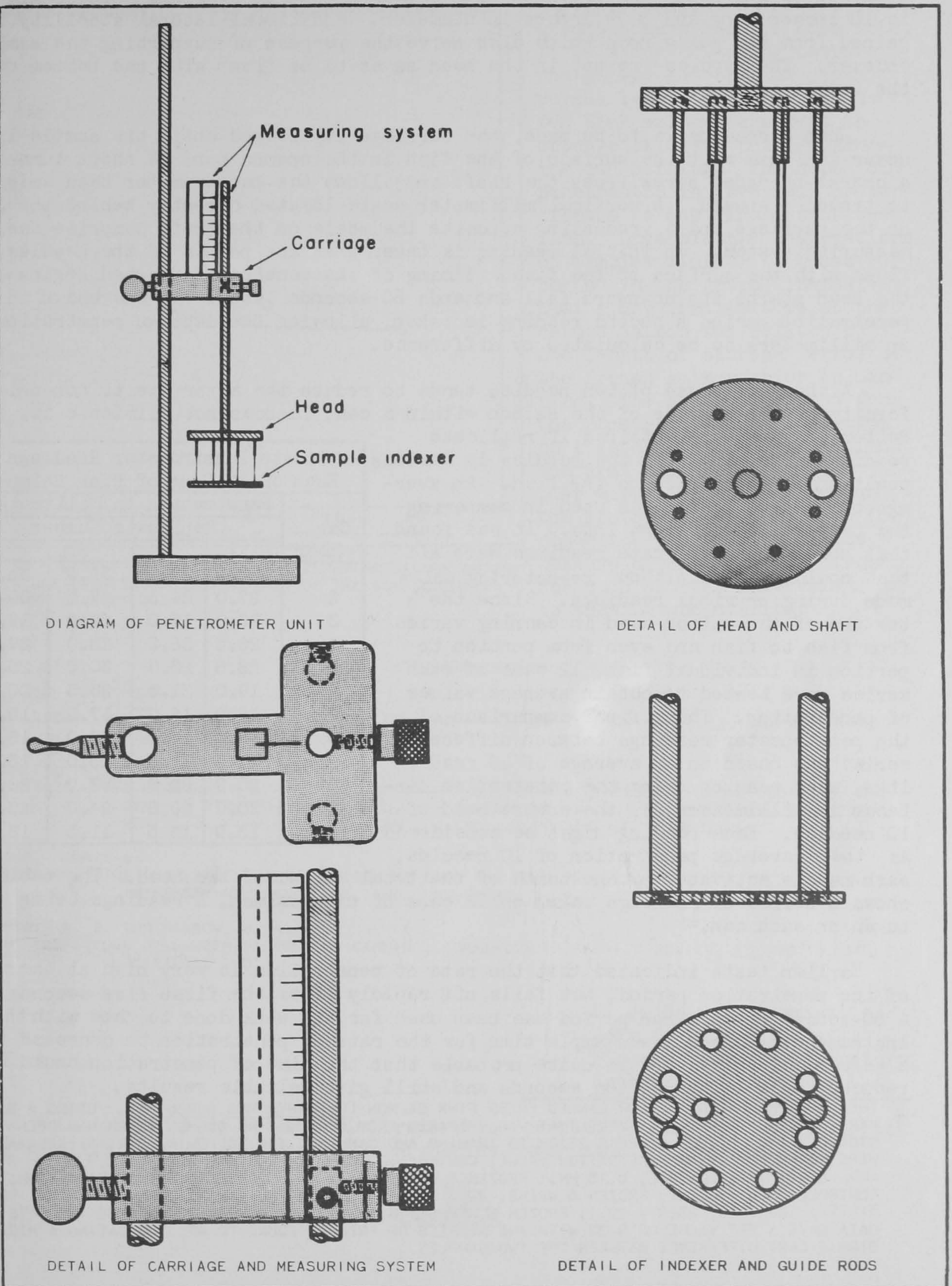

FIG. 2 - DRAWINGS OF THE PENETROMETER. (DETAIL SECTIONS ARE APPROXIMATELY HALF SIZE.)

attached to the head) was provided with a poured babbitt bearing. The shaft is 10 inches long and 0.39 inches in diameter. Additional lateral stability is gained from two guide rods which also serve the purpose of supporting the sample indexer. The needles are set in the head so as to be flush with the bottom of the sample indexer.

When a reading is to be made, the carriage is lowered until the sample indexer is flush with the surface of the fish in the opened can. A short turn of a coarse-threaded screw frees the shaft and allows the penetrometer head and shaft to travel downward. A vertical millimeter scale located directly behind the shaft on the carriage and a graduation opposite the scale on the shaft comprise the measuring system. An initial reading is taken when the points of the needles are flush with the surface of the fish. Timing of the penetration period begins when the head starts its downward fall and ends 60 seconds later. At the end of the penetration period a second reading is taken, allowing the depth of penetration in millimeters to be calculated by difference.

Although the use of ten needles tends to reduce the error due to non-uniformity of the texture of the salmon within a can, it does not eliminate it. Better results were obtained if replicate readings were made with the needles in various positions with respect to the fish. An average of the replicates was used in comparing the texture of different lots. It was found that about four replicate readings were all that could be made without re-entering holes made during previous readings. Since the texture of the salmon used in canning varies from fish to fish and even from portion to portion in individual fish, 12 cans of each series were tested to obtain average values of penetration. Thus, final comparison of the penetrometer readings between different series was based on an average of 48 readings, each reading being the penetration distance in millimeters for the entire head of 10 needles. Each reading might be considered as the average penetration of 10 needles, each needle activated by one-tenth of the total weight of the head. The table shows a series of readings taken on 12 cans of pink salmon, 4 readings being taken on each can.[1/]

Replicate Penetrometer Readings of Each of 12 Cans of Pink Salmon

Can Number	Penetration in Millimeters – Replicate Number 1	2	3	4
1	32.5	27.0	31.0	34.0
2	27.0	29.5	27.5	30.5
3	23.0	17.0	22.0	19.0
4	26.5	26.0	28.0	29.5
5	28.5	23.5	30.0	25.0
6	19.0	21.5	20.5	20.0
7	16.0	16.0	17.5	15.0
8	19.0	14.0	23.0	16.5
9	11.5	11.5	13.0	13.5
10	20.0	22.0	23.0	20.0
11	23.0	20.0	24.0	23.0
12	13.0	13.5	11.5	13.5

Earlier tests indicated that the rate of penetration is very high at the start of the penetration period, but falls off rapidly after the first five seconds. A 60-second penetration period has been used for all work done to date with this instrument. This allowed ample time for the rate of penetration to decrease to a very small value. It is quite probable that the time of penetration could be reduced to as little as ten seconds and still give reliable results.

1/ THE DATA PRESENTED ARE FOR CANNED FRESH PINK SALMON (*ONCORHYNCHUS GORBUSHA*). USING A SIMILAR SET OF DATA FROM A SAMPLE THAT WAS PREPARED FROM FROZEN PINK SALMON WHICH HAD BEEN IN STORAGE AT 0° F. FOR 6 WEEKS PRIOR TO THAWING AND CANNING, THE FOLLOWING STATISTICAL VALUES WERE COMPUTED: MEAN PENETRATION VALUE, CONTROL, 21.5 MM.; FROZEN 6 WEEKS, 12.7 MM.: STANDARD DEVIATION, CONTROL, 6.15 MM.; FROZEN 6 WEEKS, 3.49 MM.: COEFFICIENT OF VARIATION, CONTROL, 28.6 PERCENT; FROZEN 6 WEEKS, 27.3 PERCENT. FIDUCIAL LIMITS USING 1 PERCENT PROBABILITY, CONTROL, 23.9 - .19.1; FROZEN 6 WEEKS, 14.1 - 11.4. COMPARISON OF THE TWO SETS OF DATA GAVE A "T" VALUE OF 8.57 WITH THE DEGREES OF FREEDOM EQUAL TO 47, INDICATING A HIGHLY SIGNIFICANT DIFFERENCE BETWEEN THE TWO SAMPLES.

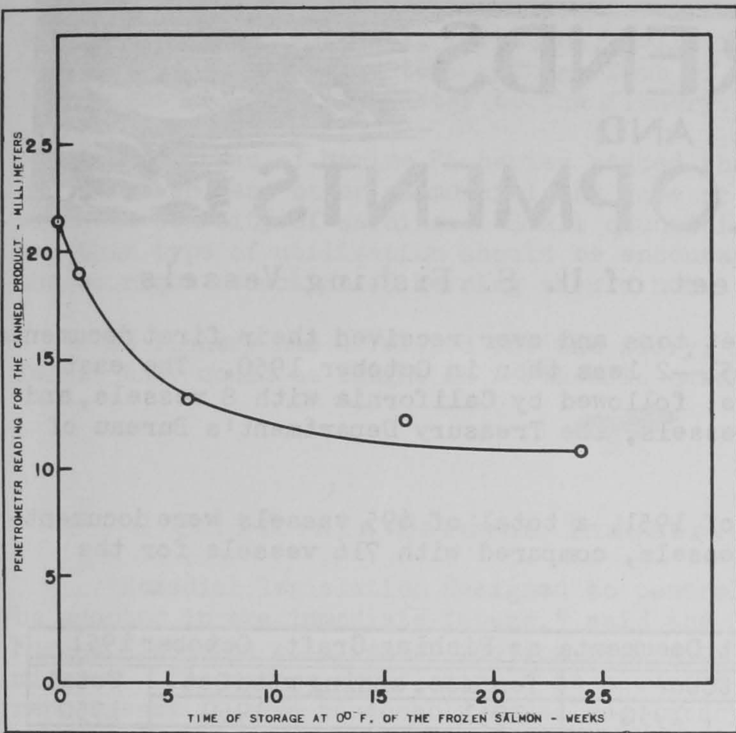

FIG. 3 - EFFECT OF STORAGE OF FROZEN PINK SALMON ON THE TEXTURE (PENETROMETER READING) OF THE SUBSEQUENTLY CANNED PRODUCT.

Figure 3 illustrates the current application of the instrument described in this note. It is a curve showing texture change (by penetration depth) versus length of time that frozen pink salmon were kept in storage at 0° F. prior to thawing and canning. The depth of penetration is inversely proportionate to the firmness of the fish. Organoleptic observations of samples similar to those reported in the graph, indicated that a dry firm texture of the canned salmon was related to the length of storage period of the frozen salmon prior to canning. The graph, prepared from the penetrometer readings made on 4 lots of canned pink salmon, confirms this relationship. Further work is planned in which the instrument will be used for objective comparisons of the texture of canned salmon frozen for much shorter intervals prior to thawing and canning.

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