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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF CHEMISTRY—BULLETIN No. 151.

H. W. WILEY, Chief of Bureau.

THE CANNING OF FOODS;

A DESCRIPTION OF THE METHODS FOLLOWED IN COMMERCIAL CANNING.

BY

A. W. BITTING,

Food Technologist, Bureau of Chemistry.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., December 6, 1911.

Sir: I have the honor to submit for your approval a bulletin on the canning of foods, prepared by A. W. Bitting, food technologist of this bureau, who has conducted quite extensive investigations along these lines, both in the field and in the laboratory. The preserving of foods by heat in sealed containers has become a most important industry, not only from a commercial standpoint, but also from that of good living. The principles involved in the work are not particularly new, but some of them are not generally understood. Many of those engaged in the work of canning follow certain steps according to a prescribed formula rather than from a knowledge of why they are necessary. The consumer often accepts the contents of a can in lieu of the fresh article as a matter of necessity but with misgiving as to its wholesomeness.

The object of this bulletin is to give, in a rather popular form, a description of the conditions in the better type of factories and the methods followed, so as to indicate to manufacturers what is expected in a modern plant; to give to teachers of domestic science more nearly accurate information upon this line of work than is now available; and to inform the consumer what goes into a can and what he may reasonably expect. The description is general and there are many variations due to local conditions which it is not possible to detail. Some of the trade practices are not wholly approved by this bureau and their presentation here does not mean an indorsement. There are changes going on, particularly with regard to grading and labeling, which in time will make it possible for the purchaser to know just what he is buying. The purely technical investigations on the composition of the products, the physical and chemical changes which they undergo in canning, the effect of the container upon the food, the bacteriology of spoilage, etc., have been withheld for future consideration.

I recommend the publication of this manuscript as Bulletin No. 151 of the Bureau of Chemistry.

Respectfully,

R. E. Doolittle,
Acting Chief.

Hon. James Wilson,
Secretary of Agriculture.

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THE CANNING OF FOODS.

A DESCRIPTION OF THE METHODS FOLLOWED IN COMMERCIAL CANNING.

HISTORICAL NOTE.

Canning is the art of preserving a food product in a hermetically sealed container, the preservation being accomplished through sterilization by means of heat. In its highest sense the object is to retain the food in as nearly a fresh condition as possible as to appearance, palatability, and nutritive quality or in the condition in which it is usually consumed. It affords the means of having wholesome succulent vegetables or other products at all times and in places where otherwise the cost or the labor of preparation would be prohibitive. The art was evidently of slow development and the result of various dissociated experiments. The real foundation was laid by Spallanzani, who in 1765 made experiments which disproved the then popular theory of spontaneous generation. These consisted in placing various nutritive liquids in tubes, sealing them, and then boiling in a water bath for an hour. He showed that the liquids remained unchanged as long as the seal was unbroken and free from external air. He therefore concluded that the "eggs" which cause spoilage are somehow carried in the air. This was canning on a very small scale. The experiments also demonstrated that there was a difference in the effect of moist and of dry heat; that whereas life was destroyed by water at a temperature of 45° C., in the dry state 80° C. was necessary.

The first practical application of this discovery was made by Scheele, a Swedish chemist and apothecary, who preserved vinegar by boiling it in jars or bottles and sealing it at once. This was in 1782, and at that time the keeping of good vinegar for extracts and other pharmaceutical processes was of much greater importance than can be realized now. There is no record, however, that Scheele carried his work further than the preservation of the pharmaceutical product.

In 1795 Nicholas Appert, a Frenchman of exceptional training in experimental work and of large practical experience in confectioneries, kitchens, breweries, and distilleries, began work on food preservation. His work was stimulated by offers of reward on the part of the Government for better methods of preparing foods for the army and navy. According to Appert's own story he was unsuccessful until 1804. At that time he learned the secret of preserving by heat in a sealed container, then continued his experiments until 1810, when he published his methods in detail. According to the records he succeeded with many products and produced results which it would be difficult to improve upon at this time. The essential points in the method described by him are that the food to be preserved is placed in glass bottles with water and corked carefully, after which the bottle is placed in a water bath and heated for a period dependent upon the nature of the food used. At the end of the heating period the bottles are removed from the bath and cooled. By this method the temperature attained was from 190° to 200° F., the maximum being 212° F. He says, "I chose glass as the matter most impenetrable by air and have not ventured to experiment with vessels of any other substance." Appert's publication won for him the prize of 12,000 francs offered by the French Government and general recognition as the founder of the art of canning.

In 1807 a Mr. Saddington presented a paper before the English Society of Arts, entitled "A method of preserving fruits without sugar for house or sea stores." Mr. Saddington did not claim the discovery of the method, and being a traveler it is supposed that he learned the general facts abroad, though he may have made some modifications. His method was essentially as follows: The fruit was placed in bottles and loosely corked. The bottles were placed in cold water up to the neck, heat applied gradually until 75° C. was reached, and then kept at that temperature for an hour. After this, the bottles were filled with boiling water, corked lightly, and laid on their sides to swell the cork. Later the corks were cemented.

Peter Durand, early recognizing the possibilities of preserved foods, took out an English patent in 1810, covering both the preserving of "animal, vegetable, and other perishable foods," and also the container, covering "vessels made of glass, pottery, tin, or any metal, or fit materials." The essential feature of the preservation was that the food be heated and hermetically sealed in the container. This is the first record of using the tin can as a container; therefore its invention is attributed to Mr. Durand. It is known, however, that even previous to 1800 the Dutch put up fish in tin, though their methods were not those now generally recognized for canning. The fish, on being caught, were dressed at once, boiled for a short time in salt brine, and smoked for two days, after which they were put in the cans, covered with hot butter or olive oil, and sealed. The tin can was practically coincident with the art of canning.

The first improvement in the tin can, adapting it especially to canning purposes, was made in 1823 by Pierre Antoine Angilbert, a Frenchman. His improvement consisted in first putting the fruit and water in the can and covering it with a lid having a hole in it. The cans were set in a water bath and boiled for some time, after which the hole was closed with a drop of solder. The first patent on a tin can to be issued in this country was in favor of Mr. Thomas Kensett in 1825.

All the early tin cans were made by what was known as the plumb joint; that is, the edges along the sides were butted together and soldered, as were also the two ends. The entire work was done with a pair of scissors and a soldering iron. Only a few cans could be made in a day, 100 being considered a very large number for one workman. It was not until 1847 that Mr. Allen Taylor invented the stamped can with the extension edges. In 1849 the pressed top was added as an improvement.

From the beginning, bottles were too costly and broke too easily to be used for the cheaper articles of food. The earthenware jars were heavy and not sufficiently well glazed. The tin can lent itself to commercial purposes best, but it was expensive and the evolution of its manufacture was slow. At present it is manufactured by automatic machinery at low cost and in enormous quantities.

At first the temperature employed in canning was from 190° to 212° F., but this was found to be insufficient for many products. A higher temperature was secured by adding salt to the water in the bath, and later this was gradually supplanted by calcium chlorid. With the latter it was possible to secure a temperature of 240° F., thus shortening the period of cooking and also making it possible to process some products which could not be sterilized by boiling alone. It was not until 1874 that Mr. A. R. Shriver, of Baltimore, invented the closed-process kettle for cooking with superheated water. About the same time, Mr. John Fisher, of the same city, patented a kettle in which live steam could be used. These same methods, boiling in water in the open, in a bath of calcium chlorid (now being superseded by oil), in superheated water, and with steam in closed kettles, are still in common use, the only difference being in certain modifications for doing the work easily. The most recent addition to the equipment for heating is an agitator, which has the effect of stirring the contents inside the cans so that all parts are heated uniformly and rapidly, and is advantageous for certain products.

Shortly after Appert's method had been published and the tin can found to be suitable as a container, small canneries were established in Aberdeen, Scotland, in Sligo, Ireland, and in European fishing ports. In 1845 the canning of sardines was begun in France; in fact, the early products were nearly all sea foods.

The first canner in this country was Ezra Daggett, who learned the trade abroad. He and Thomas Kensett packed a few salmon, lobsters, and oysters in New York in 1819. The next year William Underwood and Charles Mitchell began operations and a factory was opened in Baltimore. In 1839 Isaac Winslow began experimenting with the canning of corn in Portland, Me. His early efforts were mostly failures, but he had a persistence worthy of any cause, and by continuous work he felt warranted in 1852 in asking for a patent. So skeptical was the Patent Office that letters were not granted until 1862. In 1841 the first real fish cannery was established at Eastport, Me., the product being lobsters and mackerel, and by 1860 there were a number of canneries on the coast, handling both fish and vegetables. The first cannery in the Central States seems to have been established in the early sixties in Cincinnati, closely followed by one at Indianapolis. Canning was begun at San Francisco in 1856 and in the Alaskan waters in 1878.

The Civil War gave the first great impetus to canning in this country. That event showed the enormous advantage of having canned foods and emphasized their general superiority over the dried foods in palatability. The more recent extension of the industry has been due largely to a better knowledge of the wholesome character of canned products and the economy in their use.

EARLY THEORIES ON PRESERVATION BY CANNING.

From the beginning there were numerous theories explaining the preservation of foods by canning. The first was that of the exclusion of outside air. This theory was recognized in part by Appert in his description of the preservative process.

> It is obvious that this new method of preserving animal and vegetable substances proceeds from the simple principle of applying heat in a due degree to the several substances, after having deprived them as much as possible of all contact with the external air. It might, on the first view of the subject, be thought that a substance, either raw or previously acted upon by fire, and afterwards put in hot bottles, and they completely corked, [would] be preserved equally well with the application of heat in the water bath. This would be in error, for all the trials I have made convince me that the absolute privation of the external air (the internal air being rendered of no effect by the action of the heat) and the application of heat by means of a water bath, are both indispensable to the complete preservation of alimentary substances.

Appert did not know what was in the air to cause spoilage, but did recognize that it was the external and not the internal air. At this time some foods and wines were being preserved by excluding the air, the method being to cover the surface of the food or wine with hot oil. The experimenters, following Appert, laid special stress on excluding air, and when tin cans were first used care was taken to heat the contents well before sealing; later the cans were heated, then vented, and again heated. Sometimes a second venting was given. The belief was general that every trace of air must be removed. This theory was held until recently, particularly for meat and fish products, corn, and others difficult to process, as there was no recognition of the more resistive varieties of bacteria found on some substances. The theory of exclusion of air has had followers in the practical operations up to the present time.

The next theory advanced was that it was the vacuum which protected the food substances. This was believed by the workmen almost from the beginning, as they found that heating and then sealing the can resulted in more or less of a vacuum. This theory was closely associated with that of excluding the air, and those believing in it developed mechanical methods for producing the vacuum; these, however, are not of as much practical importance in canning as expected. The cold vacuum is useful in preserving meat and fish products which have been cured by salting, drying, or smoking, for fruits which have been partly cured by drying, sugaring, etc., and for jams, jellies, preserves, etc. The vacuum aids in preserving where the organisms causing spoilage require oxygen for growth.

In factory practice more or less of a vacuum is secured by passing the cans through an exhaust box which will heat them to 180° or more, or by adding hot brine or sirup before the can is sealed. To some products, particularly meat and fish, heat is applied, and the can vented to drive out the air; essentially the same result is accomplished in home canning in that the caps are not tightened until the contents are thoroughly heated. A recent procedure is to cap the cans and seal the vent in a strong vacuum chamber, instead of heating and later venting. The tin can with a good vacuum always shows the ends drawn in when cooled. Cans packed and sealed cold will have the ends flush or upon becoming warm they may spring out, producing so-called "flippers" or "springers," and while not spoiled, they have the appearance of swells and may not be merchantable. While the rôle of the vacuum as an aid in preserving is not to be underestimated, it has not the importance in canning that was attributed to it.

The theory of the arrest of chemical activity was early advanced as being effected by hermetic closure. The French Government appointed Gay-Lussac to investigate the cause of the preservation as introduced by Appert. Gay-Lussac reported that decomposition was a series of oxidation changes in a substance, and that driving out the air and preventing its ingress prevented these changes from taking place. This explanation was satisfactory until microorganisms were discovered and their relation to spoilage proved.

STERILIZATION.

HISTORICAL NOTE.

The present status of our knowledge of canning is based on the modern science of bacteriology. The invention of the compound microscope and its many improvements has revealed the presence of minute vegetable organisms in the air, in water, and on everything with which we come in contact. These organisms are bacteria, yeasts, and molds, and are present either in their vegetative or spore state, being the "eggs" which Spallanzani thought were in the air.

Bacteria and germs were first seen in 1683 by Leeuwenhoek, who constructed a crude compound microscope. He knew nothing of their character nor of their relation to higher organisms, but as many of them were motile he regarded them as animals, and from their habitat named them "infusoria." Almost nothing further was discovered until 1786, when O. F. Müller described some of the structural characters. Another lapse occurred until 1838, when Ehrenberg published a work upon the so-called infusoria, in which he added to and systematized the information to date, some of his names being still used. Dujardin, Perty, Cohn, and Nägeli added much to the knowledge of the structure and life habits of micro-organisms, but none of these associated the organisms with any economic problem.

Pasteur, about 1860, was the first to discover that these organisms were the cause of the changes known as fermentation; also the cause of the supposed spontaneous generation. He recognized that they had a definite relationship to economic activities and later he applied the knowledge gained in the laboratory in a practical way to many industries. He discovered that by heating certain food products to a certain degree and for a certain period the time of keeping might be prolonged. The principle had a practical application to many substances on which boiling would have an objectionable effect and is taken advantage of on a large scale in wine and beer making and in dairying. He found further that by heating and cooling at intervals, as on successive days, sterilization might be accomplished; also that the organisms on different substances had varying resistant powers to heat and that in intermittent heating different temperatures must be employed, according to the predominating organism. All of the fundamental principles that Pasteur discovered have an important relation to canning.

In 1876 Dr. Robert Koch discovered the relation of specific germs to diseases, and a few years later elaborated methods for separating germs into pure cultures. Since that time progress has been rapid and the relation of various organisms to the different industries has become fully established.

The first direct application of bacteriological methods to spoilage problems in canning in this country seems to have been made by H. L. Russell, of Wisconsin, in 1895.[1] He investigated the cause of swells in peas and found it to be due to bacteria as a result of insufficient processing. The Wisconsin packers were processing the peas at 230° F. for from 10 to 11 minutes, and were having heavy losses. He advised, as a result of his experiments, that the temperature be raised to 242° F. and maintained for 15 minutes, which caused a cessation of the trouble.

In 1896 Prescott and Underwood [2] began the study of swelled and soured corn, and later turned their attention to soured peas. Their first results were published in 1898. In that year they gave the first of a series of addresses before the National Canners' Association, which had a most marked effect in establishing canning on a scientific basis. They identified the bacteria causing spoilage in corn and peas, determined the thermal death points, the degree of heat attained in the center of cans, and the time required to attain it.

In 1897 the Canadian Government caused work to be done on spoilage in canned lobster, or black lobster, as it was called. It was determined that it was due to bacteria.

In 1903 Harding and Nicholson,[3] of the New York Experiment Station, studied the swelling of peas; they gave additional descriptions of the organisms, and, as a result of their experiments, recommended that the process be changed to 240° F. for 30 minutes.

Since 1900 there have been numerous contributions on the organisms causing spoilage. These usually deal with one particular product or some special phase of bacterial activity. There has been no systematic effort made to classify the organisms, to determine their relation to different products, the kind of spoilage produced, nor the exact methods of dealing with each. Several large packers employ experts to work out their own problems, but hold the results secret. It is evident that in the preparation of food there is a rich field for scientific research, with great possibilities for valuable and practical results.

MODERN METHODS OF STERILIZATION.

Sterilization may be accomplished by heat below, at, or above the boiling temperature, depending upon the length of time the heat is applied and the number of applications made. It is not practicable to sterilize all foods in the same way because of injury to quality or prohibitive expense. Sterilizing below the boiling point is feasible only for a few products, principally fruits, and then is advisable

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[1] Wisconsin Agr. Exper. Sta. Report, 1895, pp. 227–231.
[2] Technological Quarterly, 1898, pp. 6–11.
[3] New York Agr. Exper. Sta., Geneva, 1903, Bul. 249.

only when it is desired to preserve a very fine appearance. This may be accomplished above 180° F. by maintaining the temperature for a longer time than when boiling, or by repeating the operation on two or more successive days. The object is to prevent breaking the tissue and loss of juices from the fruits by excessive heat. This method of sterilization has been applied experimentally and in private canning with gratifying results, but it involves so much time and labor that it is not used commercially except in a limited way. Sufficient work has not been done to say definitely what products can best be treated in this way nor what temperatures are best suited for different foods. It has been used chiefly with goods in glass, though equally satisfactory results are obtained with foods in tin.

Cooking at boiling temperature is practiced with nearly all fruits, as the germs present are easily destroyed. Most of the fruits are processed for from 12 to 25 minutes. The tomato is the most important vegetable processed at boiling temperature, which is usually maintained for 50 minutes.

Cooking at a temperature above the boiling point is necessary or advantageous for most vegetables, fish, milk, and meats. It is accomplished in retorts where steam is admitted under pressure, in retorts where water can be superheated, on the open calcium chlorid or oil bath.

Among the vegetables requiring a high temperature in processing are corn, peas, beans, both green and dry, pumpkin, beets, and sweet potatoes. Corn is one of the difficult products to can, requiring a temperature of from 245° to 250° F. for from 75 to 80 minutes, depending to a considerable extent upon how dry it is packed. If very dry, the heat will penetrate to the center of the can very slowly, the actual time required to raise the center to the temperature of the bath being from 55 to 65 minutes. In a can of peas this is accomplished in 6 or 7 minutes, the difference being due to the fact that heat currents are set up in the liquid portion of the peas while they are absent in the corn. The necessity for a high temperature is therefore dependent upon the ease with which the heat can penetrate the product, as well as the resistance of the organisms. Some products which were formerly processed by boiling for a long time are now given a higher temperature for a few minutes, as the product has a much better appearance when it is not overcooked.

Meat products, as a rule, contain highly resistant organisms, besides which the majority of these foods are of such a consistency that the heat penetrates them very slowly. As a class they require the heaviest process. Milk also contains very resistive germs, but being liquid it heats rapidly; in order to keep it smooth and prevent the portion in contact with the tin from scorching, the cans are turned or agitated almost continuously during the cooking.

DETERMINATION OF TEMPERATURE AND TIME OF PROCESSING.

In sterilizing, the heat must be applied equally to all cans, and it is therefore necessary to deliver steam at the bottom of the kettle, whether open or in a retort, to insure a circulation of the heat. In retorts, whether steam or hot water is used, there must always be a vent open to give off steam in order to hold the heat uniform at all points. The thermometer is the all-important tester, for if it does not show the proper degree of temperature, spoilage will follow. To test the uniformity of temperature in a retort, self-registering thermometers are sealed in a number of cans when placed in the crates, the cans are marked, and when the cooking is completed the thermometers are examined and compared, so that the heat may be adjusted until all give like readings. In a similar manner the time required for the heat to reach the center of the can is obtained, experimental lots being run for varying periods, and the temperature noted. The calcium chlorid or oil bath acts in the same way as the open water bath.

The writer employs two methods of determining the temperature in the center of a can and the rate of penetration. First, a thermometer is placed in a packing joint which is soldered into the can so that the bulb will just reach the center. By placing a collar an inch above the gasket the can may be submerged in oil and heat applied until a certain temperature is reached. The length of time necessary for the thermometer inside the can to reach the same point as that on the outside, or within from 2° to 5° of it, as experience demonstrates may be sufficient, must be allowed in the retort and the heating then continued for such an interval as may be found necessary for sterilization. For example, if the spores of certain organisms are killed at 230° F. in 12 minutes, and it should take 20 minutes to cause the content of the can to become heated, it would require 32 minutes as a minimum for processing, and as a margin of safety the recommendation would be for a longer time, probably for 40 minutes.

The second method of determining temperature in different parts of the retort and in the center of cans is to seal a thermocouple in the can and connect it with a recording apparatus. Thus a time and temperature curve is obtained directly. One of the important points learned from the latter apparatus was the effect of stirring or agitating the contents of cans which ordinarily required long cooking. A can of corn in a retort requiring 65 minutes to reach 245° F. requires only 30 minutes when rolled back and forth. The effect of the agitation was a shorter cooking, a brighter color of the corn, and a bright can on the inside. The principle is good, but some mechanical difficulties in successful operation have yet to be overcome.

The varying temperatures and methods used in canning produce a certain amount of strain on the cans. These strains also vary with the temperature at which the tipping is done. The contents of a can expand with heat and contract upon cooling. If a can of corn is tipped at 190° and placed in the retort to process, it is at once subjected to an external pressure of from 10 to 13 pounds per square inch, and the expansion of the contents will increase until the internal pressure equals or slightly exceeds the external, or it rises to from 12 to 14 pounds per square inch. During a part of the cooking process the strains become equalized, or nearly so, but when the cooking is stopped and the retort is thrown open there will be an outward strain equal to the internal expansion, and this will gradually decrease until the temperature falls to that at which the tipping is done. When the temperature drops to ordinary room temperature, instead of there being an internal pressure it is from without and at 70° will amount to 7 pounds. This accounts for the ends of the cans being drawn in. The can has therefore undergone a strain, first of pressure from without on being placed in the retort, then from expansion from within when the retort is opened, making a total strain of 25 pounds per square inch. The smaller cans, such as No. 2 or below, are not much affected by these strains, but in the larger sizes leaks are likely to occur. The more suddenly these strains are applied, as by the wide opening and closing of the steam valve, the greater the danger, and the turning on of a large volume of cold water results in buckling. This principle holds good for all products, the variation from these figures depending upon the temperature used.

MODERN FACTORY EQUIPMENT AND METHODS.

SANITATION.

A modern cannery is no longer the rough, crude shed that once was thought to be sufficient for this purpose. First of all the location must be sanitary, away from manufacturing processes which of themselves are objectionable, such as soap making, tanning, rendering fats, etc., or any other processes which may give rise to noxious odors or be productive of organisms of decomposition. The yards and drives about the factory should be cleaned daily, and in summer dust should be prevented by frequent sprinkling or by the application of crude or specially prepared oil to the drives. The application of oil is especially to be recommended where there is much hauling and there is no pavement, or the factory is to be run for a short season only, as in the case of tomatoes. A single application made a couple of weeks before the season opens will suffice for several weeks; by putting the oil on early it will become incorporated in the earth and not be tracked into the factory to any great extent. The drainage must be such as to prevent any surface overflow from adjoining property, and also be ample to keep the stock in good condition at all times. It should be ample to care for the waste, as this is sometime a serious problem. If the natural body of water available is not sufficient, settling tanks or filters may be necessary. Fermenting material, such as tomato trimmings or corn refuse, should not be tolerated within or near the factory. The supply of water should be sufficient for all purposes and of good quality; that used in washing, blanching, and brining should be free from excessive hardness or iron, otherwise the finished products may be damaged. If the water for this purpose is not naturally of the right quality, artificial treatment will be necessary. The water used for washing about the factory should have a good pressure for cleaning. A factory with a poor location, or an insufficient or poor water supply, has a handicap which is difficult to overcome. The facilities for bringing in or sending out of stock should be ample, so that materials used need not be delayed, especially when it may mean deterioration.

The buildings should be designed with reference to the special products to be packed, but there are some features which should be common to all. The ceilings of all rooms should be high, with ample provision for light and ventilation. The light should come from numerous side windows, or, if the rooms are large, from turrets, or a saw-tooth-roof construction. Either of these two arrangements can be made to give a flood of light and at the same time provide good ventilation. An advantage in the saw-tooth construction arises from the cooling and drying effect. When the straight section, or windows, are turned toward the north, the sun beating upon the southern incline will heat the layer of air underneath, causing it to rise. This creates a circulation within the room which tends to dry floors and tables and to lower the temperature. Tests made in factories so constructed have shown several degrees lower temperature on hot days than was recorded in factories having the usual form of roof.

One of the marked contrasts between the newer and older construction is the provision for plenty of light. Light has a beneficial effect upon employees, contributes to cleanliness, and is an active, constant disinfectant. High ceilings and proper roof construction usually render artificial ventilation unnecessary, but if mechanical measures are employed a blower system, with provision for cleaning the air, is to be preferred to suction. An abundance of light and air is a combination which will contribute to the maximum of labor efficiency.

A tight, hard floor is a necessity, and in all rooms where manufacturing processes are conducted it should be pitched about 1½ inches for each 10 feet. The pitching should have special reference to the position of machines and tables where there will be more or less water or waste, so that this may be confined and the floors be flushed clean and kept reasonably dry with the minimum of labor. There should be frequent trap connections with the sewer. The kind of material best adapted for a floor will depend in a measure upon whether it is to be used for dry work and storage or whether water is employed more or less freely. Factories having a short packing season, as in the case of tomato canning, find concrete to be the best. Wood shrinks, swells, and cracks with changes of moisture; the cracks are hard to clean, leakage is almost certain to occur, and these conditions become aggravated in factories which are idle a part of the time. Wood with a smooth covering, such as sheet roofing, makes a good floor, but will not last long. Concrete is more or less porous, wears rough, and is not an ideal floor, but is the best for certain conditions. Asphalt wears away and crumbles too easily. Upper floors should not be chosen for food preparation if plenty of ground space is available, for the reason that it is difficult to keep them tight. Furthermore, the work can be supervised to better advantage on one floor than on many, unless the departments are so large as to demand a superintendent in each. Conveyers can be obtained to handle products from one machine to another, and these are more easily kept clean than are floors. Conveyers and overhead tracks should be used in handling the product as far as is possible in preference to trucks, as the latter are destructive of floors and are not so clean.

The use of slat gratings to cover the floor about the kettles or other places where there is a splashing or overflow of water is especially to be commended. These may be made in sections about 2 by 4 feet, and can be taken up for cleaning. There is no excuse for floors being so wet or sloppy that the workers must wear rubbers, which is sometimes the case. All side walls, partitions, ceilings, and supports should be smooth, to admit of easy cleaning. Preferably they should be light colored and, as far as possible, of such material as can be washed with a hose, as this is the easiest method of cleaning or of applying whitewash. Some factories need to be divided by partitions to prevent unnecessary heating by steam from the cookers. In other cases the room where the material ready for the can is kept should be separated from the rooms in which the preparation is going on, in order to protect it from dust. That part of the factory in which prepared material is in any way exposed should be screened to keep out flies and dust. The latter precaution is often of greater importance than the former, for during the working period the moving of machinery and escaping steam will drive away insects.

The tables used in the preparation of foods should be plain and of a material that is easily cleaned. There should be no sharp angles or grooves where waste can accumulate, nor any places beneath where material can be stored. Hard wood, such as maple or ash, is probably the best material for the majority of factories. These woods will absorb little water or juices, they show soil quickly, and clean easily with soap, water, and scrubbing brush. Opal glass or porcelain makes excellent table tops but is expensive. Enamel-coated metal has come into use, and under certain conditions gives excellent results. The important point is that the tables may be cleaned easily, and that it be done often. The machinery used should be of the most sanitary type, and set in such a manner as to be accessible from all sides for cleaning. Conveyers for fruits, tomatoes, and all other products should have automatic washers and brushes in their course to keep them clean. The amount and kind of equipment varies greatly, depending upon the product. Peas, corn, and beans require the most, fruits the least. The details of the special requirements will be considered under each product. Water and steam pipes, with hose attachment, should be conveniently placed about the factory for cleaning tables, machines, floors, walls, and ceilings. This is a necessary part of a modern equipment.

Provision should also be made for the cleanliness and comfort of the employees. Water should be placed at convenient places that the workers may wash their hands often, and sanitary drinking fountains installed to take the place of the common cup. A factory is not complete without proper toilet and clothes rooms. The toilet should have facilities for washing the hands with soap and water and hand brushes should be provided. There should be lockers for storing the outer clothes, as wearing apparel should not be hung about the factory. Providing special suits and a manicurist are refinements which are found at some factories and are not so much of an extravagance as less progressive firms would argue. For factories running continuously and employing the same help, there is no question but that uniforms are advantageous. For such operations as picking, peeling, and pitting fruits, etc., which can be done as well sitting as standing, stools should be provided. Standing all day at tables is more than tiring, it is exhausting and decreases efficiency. This is clearly evident to every factory inspector, especially after the season has advanced. The stool is to be preferred to the common bench, so that the individual may stand or sit as may be most comfortable. If standing in one place over cement floors is necessary, wooden springboards should be provided for the restful effect upon the feet. The various States provide the general conditions under which labor can be performed, age limit, number of working hours in the day or week, physical condition, etc. No person affected with communicable disease should be employed in a food factory.

METHODS AND PROCESSES.

The steps in canning will vary with the product, but, in general, there are certain processes which are common to all and may be described in this outline, as receiving the product, grading, washing, preparing for the can, filling, exhausting, capping, processing, and cooling.

Raw Materials.

The first requisite in all canning is that the product be delivered in first-class condition, fresh from the fields or orchard, and in a manner to prevent injury. Fruits, such as berries, must be handled in boxes as for the market, tomatoes in shallow crates, corn, peas, and beans in such quantities that they will not heat, and marine products cold or chilled and in compartments to avoid bruising. The condition of the material on delivery is of the greatest importance, and for that reason the factory should be located near the point of production, or, if shipment be made, the distance should be short and direct. A cannery which depends upon long-distance shipments or purchasing the supplies on a city market will generally be found to put out an inferior article. In any delivery the seller should be held responsible for the condition of the material; the grower has no more right to deliver decayed tomatoes than the canner has to use and ship them. The first case is usually a violation of a State law and should be dealt with accordingly; the second may be reached by Federal statute if the shipment becomes interstate.

Grading.

The second step, that of grading or sorting for quality, is one of great importance. A general inspection or classification of all products is made by the foreman at the time of receipt, but this is insufficient. The real grade of any product depends upon the quality of the original stock rather than upon the sirup or brine added or any subsequent operation, and the best time to make a separation is before the work of preparation is begun. A large part of the sorting can be done better by a few especially trained helpers, although some of it may be continued in subsequent operations. The hard and faulty ears of corn can be picked out more easily while it is being conveyed to the silker than by the cutter feeders. These men have enough to do to keep the machines busy and can not take the time to sort properly. A few persons can pick out green, defective, and wrinkled tomatoes which will not peel economically and do a better job before the fruit reaches the scalder than can be done by the peelers. The same principle holds true for peaches and many other products. Those who peel or fill the cans should have the minimum of grading to do. The sorting is usually done upon belts or special table tops to expedite the work. Berries are picked, stemmed, and defects picked out, when graded, to save handling.

Washing.

The next operation is generally that of washing, the method depending upon the material canned. In general, most products are placed in a tank of water to loosen adherent dust and dirt, are gently rolled over by the agitation of the water, and sprayed as they emerge. The spraying is the important step, therefore, it is desirable that the water have force rather than a large volume. A small spray with force will cut off dirt and adherent mold very successfully. The principle is the same as cleaning a floor with a hose having a nozzle, or with one having an open end; the former will use less water but will clean better. Some hard-coated products, as peas, are washed in revolving wire cylinders, known as "squirrel cages." Soft fruit, such as raspberries, require very gentle washing, and if the fruit appears clean some packers object to washing it at all, claiming that it causes injury and loss of flavor. Whatever method is used, the cleaning should be thorough.

Preparation and Blanching.

Many of the fruits need no special preparation other than cleaning and sorting, after which they are placed directly in the cans. Peaches, apples, pears, etc., must be peeled and cut into pieces of the proper size. Nearly all vegetables require more or less treatment; peas are shelled, graded for size and quality, and washed and blanched by automatic machinery; corn is cut, silked, brined, and cooked; beans are snipped and strung, graded for size, and blanched; asparagus is cut into lengths and blanched; sweet potatoes and beets are peeled and graded, and so on. The operation of blanching is in reality parboiling. Vegetables are dropped into boiling water for from one to five minutes, as a rule, to cause softening, and at the same time to remove some of the mucous substances which form upon the surface. The effect produced by a short boiling in the open as compared with boiling in the closed can is surprising. Peas or beans, which are a little aged and hard, will soften quickly in the blanch but retain their condition in the can. In almost any case of very cheap peas some may be picked out which, if thrown upon a table or the floor, will bounce a couple of feet or more. This is evidence that they were not properly blanched, and that softening did not take place in the can. The operation of blanching is of much importance in putting up good vegetables. It is not a matter of whitening, as the name might seem to indicate, though it does have the effect of producing a much clearer liquor than would otherwise be present.

Washing and Filling the Cans.

The cans should be washed just prior to being used. In the shipping and storing, more or less dirt and dust find lodgment on the inside, and washing is the only method of removing it. The quantity of dirt which can be obtained from a thousand cans is usually a matter of surprise. The work is done very effectively at the present time by machines. The filling may be done by hand or by machine. There are many products, especially fruits, which can not be successfully filled by machine because of crushing or otherwise injuring them. When filled by hand the contents should be regulated by weight rather than by volume, so that the finished product will be uniform. If the filling be done by machine, care should be taken to get the best results possible. It is illogical to use care in peeling a 3-inch tomato and then have it squeezed through a 2-inch opening in front of a crude plunger; or that great care should be exercised in washing and blanching peas, which are to be run through a filler that will cut or crush enough to make a muddy liquor. Machines should be designed to fill with reference to the nature of the product and not to be merely "can stuffers." Vast improvements have been made in filling machines in the past few years, so that most of the work can be done with nicety and precision. All filling machines operate upon the principle of delivering a certain volume rather than a given weight, and for most products this method is very satisfactory. In all cases, whether the can be filled by weight or volume, the amount of material used should be all that can be put in the can in first-class condition. Brining and siruping have also been improved, the old-fashioned unsanitary dip box giving way to a sanitary filler.

Exhausting.

After the can is filled the next step is exhausting. This is best for all articles packed cold, but is unnecessary for corn, peas, or products which enter the can hot or are covered with a hot sirup. Exhausting consists in passing the filled can through a steam box and heating the contents to 160° F. or above, the preference being for 180°. The time required for exhausting will vary from one to three minutes.

Capping and Testing for Leaks.

Open-top cans are sealed by a special machine known as a double seamer. The lid is pressed into place and steel rollers crimp it on without acid or solder. This action is automatic, a single can at a time, but at the rate of 30 per minute, or 1,800 per hour. Cans with solder tops are sealed by automatic machinery, 12 at a time, 85 per minute, or 5,000 per hour. The top is wiped, the cap placed on, acid applied, the hot soldering irons drop into place, and the vent is afterwards closed, all in one series of operations, without touching by hand. As the cans pass from the capping machine they may be submerged in a bath of boiling water to test for leaks. Any imperfection in the can or defect in sealing will be shown by a series of air bubbles issuing from the opening, and the can is at once taken out by the inspector for repairs.

Processing and Cooling.

After capping, the cans are processed according to the nature of the contents. The cans are collected in large iron baskets, which usually hold 270 No. 2 or 180 No. 3 cans, and three baskets fill a retort. If the processing is conducted at boiling temperature, the retort is not closed, but steam is turned into the water which covers the cans. If the temperature is to be above the boiling point, the retort is closed and either the steam is turned into the retort until the proper pressure and temperature has been reached, or water is first turned in to cover the cans and the steam is admitted until the temperature has been attained. In processing fruits it is customary to use long vats containing boiling water and equipped with automatic conveyers, which carry the cans or crates through at such a speed as will process them for the necessary length of time. This period varies with the product. Sterilization depends on administering the proper amount of heat, and heating above the required temperature or for longer than is necessary only cooks the material to no purpose.

As soon as the processing is completed, the cans should be cooled with water. Unless this is done, the heat will be held so long that the contents become overcooked—fruits are softened, and tomatoes become liquid, even blacken, peas break and make muddy liquor, while corn acquires a brown color and a scorched taste. The cooling may be done by turning cold water into the retort, by removing the basket of cans to a cooling tank, or by spraying with water in the air. There is less difference in the results obtained by different methods of applying either heat or cold than some claim; the important point is to accomplish these steps quickly.

In canning operations the product, salt, sugar, or other seasoning, and water are the only materials used. No hardener, bleach, or preservative is employed, and in commercial canning there never was as much preservative used as is common in the household operation. Saccharin and sulphites were formerly used in corn and peas, but their use has now been practically discontinued; on the other hand the practice of selling a "canning compound" to housewives still continues, and will only cease when the nature and effects of such chemical preservatives are known, and the lack of necessity for their use is appreciated.

CONTAINERS.

The first container used was the ordinary glass bottle with a comparatively small mouth, and was closed with a cork. The next step was the use of a resinous wax to cover the cork. The bottle was modified to the more convenient or jar form, and a groove run around the top so that a tin cap might be sealed in place with wax. This method of sealing was common in domestic canning until about 1890. The metal screw cap with the rubber ring and various other devices, most of which depend on a rubber or fiber joint to exclude the air, have been introduced since that date. The glass jar is largely used in domestic canning, but not commercially, as it is heavy, breaks easily, can not be handled by automatic machinery, will not stand hard processing without special precautions, and increases freight rates. Glass containers are used for preserves, spiced and pickled fruits, and for the limited canning for which the consumers are willing to pay a fancy price. Very recently improvements have been made in glass jars and the methods of sealing, which may extend their usefulness, especially to such products as can not be preserved to the best advantage in tin.

The earthenware jar was brought out to offset the high cost of the glass jars; some of these were glazed inside, some outside, and some on both sides. They were generally sealed with a tin cap by means of wax, though a few had earthen tops. Various forms were given to these jars, and some may still be found which have been in use for many years in rural districts. The earthenware jars had only one advantage over glass, that is in cost, but they had the disadvantage of having blow or sand holes. The earthenware jar is not used to any large extent in commercial canning, though some are used to pack bulk jams and stock for preserves, etc.

The tin can is preeminently the container used in commercial canning, and it is also used to a very large extent in home canning. Those used for the latter purpose retain the deep ring about the opening for the insertion of caps and sealing with wax; these are commercialy known as wax-top cans. In commercial canning solder is used exclusively for sealing stud hole or cap cans. The tin can has undergone a number of changes. The first cans had flush sides and ends, or plumb joints; these gave way to the stamped-overlapped ends, and all inside soldering has been superseded by lock seams and outside soldering. Most solder caps are hemmed, so that only the amount necessary to seal is used. The solder can has been superseded in many cases by the open top, or so-called sanitary can, and in this case the sealing is done by double seaming on the top, no solder being used on the can except in making the side seam. The former objections to acid and solder, on the ground that they contaminated the foodstuffs, have thus been largely overcome.

The most recent improvement in the tin can is the inside coating or lacquering. This type of can is known to the trade as the "enamel lined" can. Various coatings have been tried at different times without entire success, and while the present lining is not perfect, it does effect a marked improvement in many lines of packing. There are fruits and vegetables which attack the tin coating with more or less vigor, resulting in a loss of color, flavor, and quality, and at the same time form salts of tin which are objectionable. The inside lacquered cans are especially effective in holding such articles as raspberries, cherries, plums, beets, pumpkin, hominy, etc. They do not add to such products as corn, peas, beans, tomatoes, or those which have little action upon the tin. Inside coating is accomplished in two ways—by baking the lacquer on the sheet and by spraying it on the inside of the finished can; further improvement in the container may be expected along these lines. The tin can is made in a great variety of sizes and shapes, but there are certain forms known as standard.

Sizes of standard cans.

Number of can.	Diameter in inches.	Height in inches.	Capacity in ounces.
1	$2\frac{11}{16}$	4	11.6
1 tall	$2\frac{11}{16}$	$4\frac{1}{4}$	12.3
2	$3\frac{3}{8}$	$4\frac{9}{16}$	21.3
$2\frac{1}{2}$	4	$4\frac{3}{4}$	31.2
3	$4\frac{3}{16}$	$4\frac{7}{8}$	35
3 tall	$4\frac{3}{16}$	$5\frac{1}{2}$	39
8	$6\frac{3}{16}$	$6\frac{7}{8}$	104
10	$6\frac{3}{32}$	$6\frac{3}{16}$	107

The size of package used for certain products is fixed by trade custom and not by the needs of the consumer. For example, corn, peas, beans, and such products are almost exclusively packed in No. 2 cans, tomatoes in No. 3, and California fruits in No. $2\frac{1}{2}$ cans. The No. 2 can of high-grade peas or corn contains about 22 ounces, or too much for one service for a family of two, three, or four persons, and with peas in particular the unused portion is not so good when served a second time. A can holding 16 ounces would more nearly meet the requirements. The same is true for a No. 3 can of tomatoes. The excess is waste in many cases and represents not only good material but the labor expended upon it, a larger can than is necessary, and boxing and freight. These are all items which contribute to cost and a consequent lessening of the use of canned foods. The No. $2\frac{1}{2}$ can was developed as a short weight from the No. 3 and does not adequately represent the interval in size between the No. 2 and the No. 3. The No. $2\frac{1}{2}$ sanitary can holds only slightly less than the No. 3 in the older style, as the latter can not be filled so nearly full and sealed. Recently a new style of can has been introduced for California fruits, especially for peaches, known as the luncheon size, which is one-half the height of the No. 2½. These are desirable because they will take in the large pieces of fruits and apparently are meeting a demand. The same style in the square can is being used for asparagus tips.

At the present time some packers are trying to meet certain demands by varying the fill rather than the size of the can. For example, a well-filled can of tomatoes might retail at 15 cents, the packer may reduce the quantity, add water, and make the cans sell two for a quarter, or carry it to an extreme and sell for 10 cents. A customer finding that the 10-cent can will furnish the amount of tomato wanted and without waste will repeat the order. The same methods are used more or less in packing fruits, using a quantity which will make the can sell for a certain price. This is a crude, unsatisfactory, and manifestly expensive method, and also open to fraud by those who are unscrupulous. It would be far better for the packer to determine what size is wanted and use such sizes, filling them properly.

THE LABEL.

The label should tell the truth in terms which are direct and easily understood. It should give the name of the article, the grade, by whom packed and where packed, or the name of the distributor. Neither the names nor the illustrations used should be misleading. A picture of green peas in pods in clear relief and subdued type stating that the contents are soaked is hardly appropriate. If given a geographical name it must be the true one. Corn grown in Iowa is not Maine corn though obtained from Maine seed. The use of such terms as "Maine style" for cream corn is in reality only an attempt to circumvent the intent of a true label.

There are no fixed standards for canned goods, though the canner and the trade do recognize and describe certain qualities in jobbing, and prices are made accordingly. The consumer has not been educated to know these differences. The labels usually carry descriptive terms implying superlative quality, as extra select, extra choice, extra fancy, select, choice, fancy, extra standard, and, less commonly, standard. There are too many designations for the same product, and, furthermore, Mr. A's fancy may not be the same as Mr. B's. The grade may not be the same in two consecutive seasons, due to drought, excess of rain, intense heat, or other cause; neither may it mean the same in different sections of the country in a normal year. In other words, at the present time the grade does not have a fixed character.

Again, when the sirup is one of the factors in grading a product, that fact should be given, though it is not required. A consumer can not go to the grocery and buy peaches in a 40°, 30°, or 20° sirup, though the packers use care in preparing such sirups to use for their different grades. Such designations as heavy, medium, and light sirup are also inadequate. A heavy sirup may mean anything between 35° and 60°, a medium between 20° and 45°, and a light between 10° and 30°, depending on who uses it. These variations are too wide to be carried under such elastic terms. There is no doubt that some fruit packed in light or 20° sirup is just as good as that put up in medium or 30° sirup, but there can be no harm done by giving the exact facts. On general principles, if it is worth while for the packer to select his stock carefuly and put up different grades, the consumer should know how to select them.

A can of any food should be as full as it can reasonably be packed and processed without injuring either the quality or appearance of the product. There is such a thing as overfilling as well as under filling, and one is as much a fault as the other. All foods packed in a liquid or semiliquid condition, or as solids surrounded by liquid, should fill to within one-half inch of the top, and when free liquid is present it should cover the solids. Corn or peas an inch below the top would be a slack fill, even though covered with liquid. The fruits present a more perplexing problem, depending upon the size of the pieces and the degree to which they shrink in the sirup. The very choice large peaches, having only 5 or 6 pieces to the can, will weigh only 18 or 19 ounces and be as full as they can be sealed. A slightly smaller size, of 7 to 9 pieces to the can, will weigh 20 ounces, and for more than 10 pieces the weight will be from 21 to 22 ounces. After they have been cooked in the sirup the pieces will soften, the weight will change, and the fill will not be the same, though in all the amount was as much as could be sealed. If the cans be judged upon weight of the solids alone, the highest grade would be short weight; the quality must also be considered. The presence of only 18 or 19 ounces of low-grade peaches would be manifestly slack filled. Soft berries, like strawberries and raspberries, if filled as full as the can will hold and sirup or water added, will appear only one-third to one-half full of solids upon opening and considerable variation will occur, depending upon their condition. Some foods can be packed so as to give a fairly uniform net weight upon opening, but with others the volume of solids and its own liquid is a fairer measure. The buyer is entitled to a full can and most packers try to furnish it. The net weights given for several products at the close of the descriptions of processing are intended to represent the minimum; the amount actually obtained should exceed these figures. A lower net weight may be regarded as "slack filled."

USE OF THE TERM "CANNED."

The term "canned" as applied to food products put up in hermetically sealed packages is capable of more than one meaning. Originally it meant any food put up in any container which might be hermetically sealed and the preservation accomplished through sterilization by heat. In commercial use the term "canned" applies only to foods put up in tin containers and sterilized by heat. Under that construction any foods put up in glass or other containers than tin are not rated as canned foods, nor are foods put up in tin in which preservation is accomplished by some means other than heat. Fish cured in brine, pickled, or spiced, but packed in tin, is not canned within this meaning of the term. Fruits preserved with sugar, placed in glass or tin jars, and sealed in vacuum are not canned in the commercial sense. The same is true of smoked meats, such as dried beef, and fish, as smoked herring. In domestic canning glass jars are generally used, and the product is referred to in the home as canned. It is unfortunate that the term should have so many meanings. In the trade it is now common to refer to fruit in glass, sliced bacon and chipped beef in glass or tins, sliced or smoked fish in glass or sardines in tins, and candied fruits in glass.

SPOILAGE.

Spoilage may result from insufficient processing, defective containers, or the use of unfit material. These losses are generally classed under the heads of swells, flat sours, and leaks. Formerly losses were heavy at many factories, but these are becoming less each year, due to a better knowledge of what is necessary in material, handling, and improved appliances. More attention is paid to testing for bacteria, and greater care is taken in obtaining accurate thermometers and gauges, automatic temperature-regulating devices, and time recorders, so that little is left to the judgment of the processor or helper.

Spoilage due to insufficient processing is generally divided into two classes—swells and flat sours. In the former there is generation of gas, causing the ends of the can to become distended; in the latter the content of the can is sour, but there is nothing in the appearance of the can to enable the customer to determine the condition until the can is opened. Swells are generally due to underprocessing good material, while flat sours most often result from giving the regular process to material which has been allowed to stand for some time, such as peas remaining in a load overnight or corn left in a car or in a pile until it begins to heat. The raw material may show no evidence of fermentation on superficial examination, but this condition frequently exists under the conditions just cited. Swells are therefore more likely to be associated with rush operations and flat sours with an overstock or delay in getting at the raw material. It is not intended to give the impression that swells and sours may not occur under other conditions, such as changes in the consistency of the corn, nor that swells may not occur in material which has stood, and sours result from underprocessing, but only to state a general rule.

Swelling or souring may take place shortly after processing or the spoilage may be delayed for weeks or even months. Swelling is more likely to occur and be detected early, while souring is apt to be delayed, though it may occur early. The heat used in processing may have been insufficient to kill the vegetative forms or spores, but may have injured them to such an extent that time was necessary for recovery and subsequent development. A microscopic examination of the material a few days after processing, or of the incubating cans during a short period, might not show anything wrong. It is only by incubating samples for a number of days that early recognition can be made of some cases of spoilage or possible spoilage. The canner often sends his goods from the factory with full confidence in their condition, and it is not until after they have been in the broker's warehouse or upon the grocer's shelves many weeks or even months that he becomes aware that anything is wrong. The spoilage may amount to only one can to the case, or the percentage may be high; but in either event the goods are rejected with loss.

Spoilage from the use of improper material—i. e., material which has been allowed to stand until fermentation has begun—is generally more or less sour to the smell and taste, but is sterile, the heat of processing having killed the bacteria.

Can leaks may occur along the side, "seam leaks"; at either end, "end leaks"; at the cap, "cap leaks"; at the tip, "tip leaks"; or may be due to defective tin plate. Can making has reached such a point of perfection that manufacturers guarantee all above two to the thousand. These imperfect cans are usually due to the solder not making a perfect union or to defects in crimping or double seaming. With the use of the automatic capping and tipping machines there are fewer leaks than formerly occurred when the work was done by hand; leaks in sanitary cans are generally due to poor adjustment of the rollers. Leakers are recognized, as a rule, by inspection in the hot bath, few getting into the wareroom. Leaks may be very small, even microscopic in size, and, therefore, difficult to detect, or pieces of the can content may be driven into the opening and seal it for the time. Leaks invariably cause swells. A check on spoilage can be kept by placing a few cans from each day's run in a room kept at a high temperature (98°), as these will incubate much more rapidly than if kept in a storeroom.

There are two conditions, known to the trade as "springers" and "flippers." A springer is a can the end of which will bulge slightly after a time, but on opening there is found neither gas nor spoilage, though the cans have the appearance of being swells. This condition has been found to be due to overfilling or to packing cold. Such goods when placed in a warm grocery will bulge, due to the temperature. A flipper is a springer of such mild character that the head may be drawn in by striking the can on a hard object. It is always possible to tell a swell from a springer by the use of a microscope, as in the former there will be large numbers of organisms while in the latter there will be very few.

While a spoiled can of food should never be eaten, the danger of poisoning from fruits and most vegetables is very remote. Ptomains or other poisons may form in meat, milk, and fish, but rarely, if ever, in vegetables.

EFFECT OF HEAT AND COLD.

Canned foods may be injured by an excess of either heat or cold. Some products are injured more than others. The effect of prolonged heating is to cook the contents to a pulp. This is seen at times, in the case of peas and tomatoes in particular, when the cans have been stacked tightly before being fully cooled. The liquor will become cloudy from short heating, thick and heavy from prolonged heating, and the peas softened and broken if it is continued for a number of days. The writer has seen peas stacked that were warm for three weeks after packing. Tomatoes become soft and pulpy, and often turn a walnut brown if stacked hot and the heat is retained. All fruits become murky and lose their distinctive flavor and odor. Canned foods will stand the high temperature of summer very well, but as far as possible they should not be placed in the hot sun nor kept in a very hot storeroom. The effect of moderate heat is not nearly so marked as might be expected.

Cold seems to have no ill effects upon canned goods unless it goes below the freezing point. Most canned foods will stand a little freezing without appreciable change. Repeated freezing and thawing cause the goods to become flabby and give a flat taste. In all cases the interior of the cans shows a distinct attack upon the tin. With fruits, the coating of the cans is made to appear as though it were galvanized. Canned foods will resist a fair degree of heat or cold without serious injury, but continued heat or a very high temperature, or repeated freezing and thawing will cause deterioration in quality.

Foods properly prepared and kept under reasonably good conditions deteriorate very slowly, so that cans carried from one year to another may be as good as, or better than, the latest pack, depending upon the comparative quality of the fresh product used. On general principles, however, it is desirable that a product should not be carried over several seasons. The amount of tin dissolved also increases with time, which is an additional reason for not holding canned goods any longer than is absolutely necessary.

HOME CANNING.

It is not possible to accurately estimate the amount of home canning that is being done, but it must aggregate many millions of cans. In the rural districts in particular it is considered to be a part of the season's work to put up canned foods for the winter, and from 50 to 100 cans is no unusual stock for a family. The products canned are usually fruits and berries, as these are the most easily handled under home conditions.

The household department of numerous weekly papers gives much space to instructions in home canning, and many cook books give recipes and details of the operation. There are also manufacturers of small home-canning equipments who give glowing accounts of the profits to be made from doing such work. Whether it is profitable to can for home consumption depends upon the cost of the raw material, fuel, and labor. It may be said that it is not generally profitable to buy fruits or vegetables in a city market and put them up in cans. Lots of a bushel, half bushel, or crate generally lack the necessary freshness, are in too small a quantity to permit of grading, and there is too much waste. The labor involved is disproportionately large for the amount handled, and the expense for cans and sugar must not be omitted in determining the cost of the finished product. Home canning may be profitable when the raw stock costs little or nothing, when no account is taken of the labor, and the satisfaction of having one's own handiwork is worth more than the money value of the article.

Home commercial canning is being encouraged to a certain extent and whether it will prove profitable or not will depend upon local conditions. The outfit needed for canning most fruits and tomatoes is very small and where a crop can not be marketed except at a very low price or the labor can not be otherwise advantageously employed, a fair profit may be obtained. The canning of special articles or putting them up in a certain way for an established trade is often successful, but on standard articles like tomatoes, corn, peas, string beans, etc., the chances of home canning in competition with a modern factory are about the same as those of a hand meal grinder as compared with a modern grist mill. The product of the average home cannery will grade in quality on about the same par as country butter. Both depend upon the producer, but as a class neither ranks very high. The small home cannery is useful in saving good food which would otherwise go to waste, and its development should be encouraged, but the idea of large profits should be held in abeyance. For the novice and many others it would be better to learn how to buy the best prepared foods rather than to attempt to pack them.

COST OF CANNED FOODS COMPARED WITH FRESH.

In making a comparison of the cost of canned and fresh products of the same kind, a number of factors must be taken into consideration. First, the cost of the raw material and the waste when purchased in the small quantity used in a single meal; second, the cost of labor and preparation used in making it ready for the table. It is obvious that a comparison can not be made for time, as the canned article may be had throughout the year and the fresh for only a limited season, and purchase of a product out of season is usually at a high cost. In making a purchase of either the fresh or canned article, the smaller the quantity, the higher the price; the single can costs more than if bought by the dozen or case, as does the half peck of apples compared with the bushel or barrel.

Take, for example, a No. 3 and a No. 10 can of whole apples; the former usually retails for 10 cents and the latter for 25 to 30 cents. Those who can use the latter have a decided advantage, as it will contain between four and five times as much as the former. Only in apple districts, and for short seasons, can the same quantity of the fresh fruit be purchased at the same price. Wherever the fresh fruit sells at the rate of $2 per bushel when purchased by the peck, and this is below average prevailing prices in cities, the canned article is the cheaper. In the raw stock there is loss in peel and core, from bruises, short weight, and often rot, all of which is eliminated in the can. The canned variety usually cooks better, and for the pie or dumpling is generally the cheaper.

Neither corn nor peas can be purchased in large cities, nor in many smaller ones, as cheaply as in the can, and then they are not so fresh. In up-to-date canneries the article is put up the day it is picked, while 3 or 4 days may elapse from the time the raw product is harvested in the garden (in transportation, in the hands of the commission house, and in the grocery) before it reaches the consumer's table. It requires nearly 2 quarts of good peas in the pod to make one can, and often more than 3 quarts of the heavy-podded variety found on the market. At no time can the smaller peas nor fine-kerneled corn be purchased as cheaply as in the can. It requires 2 bushels of good peas to yield one No. 2 can of petit pois, or 1 bushel to yield one can of extra sifted, and from 4 to 8 ears of small corn to make one can. The pea and corn packer, however, handles tons of these crops especially grown for him, and uses the highest class of automatic labor-saving machinery in all operations, so that the real labor on a single can is very small. The consumer can not purchase peas at from 30 to 50 cents per bushel, nor corn at $9 to $12 per ton, and these represent initial costs in large quantities.

In fruits, as berries, the consumer must figure that a No. 2 can will require not less than 12 ounces of well-selected fruit, and for a No. 2½ can (22 ounces). The latter is equivalent to two boxes of berries by the time they are picked over. Sirup is added to the can, which offsets the sugar necessary for the fresh fruit.

There is a vast difference in canned foods, and, as in many other lines of commerce, the cheapest in price is often the most expensive. The can of water-packed tomatoes, the green hard pears, the handful of berries in a pint of water, or poor-quality beans disguised with tomato dressing and offered at a low price, when measured by their food value are the highest. Goods which are strictly standard should give the best food value for the cost. Peas, corn, beans, and tomatoes which are good field run, but which lack the uniformity and niceties which are necessary for the fancy article, will have all the nutritive properties, and be just as palatable, but cost several cents less per dozen. There is much that is pure fad in the purchase of canned foods; the asparagus must be white and the fewest possible stalks in a can; the green is just as good and a medium number of stalks furnish a more edible product. The little peas are, naturally, the costly ones, for less than 5 per cent are of that kind; the large ones are the better flavored and more nutritious, and one-third the cost. Similar examples might be cited of a number of other products. Canned foods should be purchased by the dozen or case, straight or in mixed lots, rather than by single cans.

EXTENT OF THE CANNING INDUSTRY IN THE UNITED STATES.

The figures presented by the Bureau of the Census give one a general idea of the importance of the canning industry. In 1909. there were 3,767 establishments engaged in canning and preserving, the capital invested was $119,207,000, that paid for raw material was $101,823,000, and the finished product was worth $157,101,000. The number of cases of the principal vegetables was as follows: Tomatoes, 12,883,414; corn, 7,447,765; peas, 5,873,748; beans, 3,774,923; and all others 3,093,493. The number of cases of the principal fruits was as follows: Peaches, 1,479,601; apples, 1,169,730; berries, 792,244; pears, 628,485; apricots, 562,811; and all others, 717,144. The number of pounds of fish was: Salmon, 99,831,528; sardines, 90,694,284; oysters, 28,192,392; and all others, 16,700,509. The total number of pounds of condensed milk was 494,796,544.

The accompanying table, which shows the time and place of canning the principal fruits and vegetables, is not complete. but was made up from the reports of those canners who replied to the series of questions addressed to them.

Seasons for packing various products in the different States.

State.	Apples.	Apricots.	Asparagus.	Baked beans.
Arkansas	July 23 to Aug. 15			
California	Sept. 17 to Nov. 26	June 1 to Aug. 10	Mar. 25 to July 1	
Colorado	Sept. 1 to Oct. 31		May 1 to June 30	
Connecticut	Sept. 30 to Oct. 30			
Delaware	Sept. 20 to Oct. 10			
Georgia	Aug. 1 to Sept. 1			
Illinois	Aug. 10 to Nov. 15		May 20 to June 20	Jan. to Dec.
Indiana	Oct. 1 to Nov. 15			do
Kansas	Oct. 1 to Oct. 28			
Maryland	Oct. 1 to Nov. 1			Jan. to Dec.
Massachusetts				do
Michigan	Aug. 1 to Nov. 1			do
Minnesota	Aug. 15			do
Missouri	Sept. 18 to Oct. 17			
Nebraska	Sept. 1 to Nov. 1			
New Jersey			May 13 to July 1	Jan. to Dec.
New Mexico	Oct. 15 to Dec. 25	Aug. 1 to Aug. 15		
New York	Sept. 15 to Dec. 31	July 20 to Aug. 20	May 10 to July 15	Jan. to Dec.
Ohio	Oct. 1 to Nov. 20			
Oregon	Aug. 25 to Dec. 1			
Pennsylvania	July 1 to Dec. 1			
Tennessee	Oct. to Nov.		Apr. 15 to May 10	
Utah	July 25 to Dec. 1	July 24 to Oct. 1	Apr. 26 to June 10	
Virginia	Sept. 1 to Oct. 20			
Washington	Aug. 15 to Dec. 10	July 1 to Aug. 1		

State.	String beans.	Beets.	Blackberries.	Cherries.
Arkansas			July 1 to Aug. 15	
California	Aug. 1 to Sept. 15		May 29 to Sept. 10	May 15 to July 28
Colorado				June 15 to Aug. 1
Delaware			July 1 to July 20	
Georgia	July 1 to Aug. 1		June 10 to June 20	
Illinois				June 15 to July 15
Indiana	June 1 to Oct. 1			
Kansas	June 8 to July 27			
Maryland	July 10 to Aug. 20		July 4 to July 20	June 8 to June 30
Michigan	June 10 to Sept. 15	July 1 to Oct. 1	July 15 to Aug. 24	June 25 to Aug. 10
Minnesota		June 20 to Oct. 22		
Nebraska	June 10 to July 15		July 1	July 1
New Jersey		June 15 to July 25	July 5 to July 15	June 9 to June 20
New York	July 1 to Oct. 28	July 15 to Nov. 25	July 23 to Sept. 1	June 20 to Aug. 1
Ohio	July 1 to Sept. 30	June 25 to Nov. 10	July 1 to Aug. 10	June 1 to June 30
Oregon	July 15 to Oct. 15		July 15 to Oct. 15	June 10 to Aug. 20
Pennsylvania	July 10 to Oct. 15	Aug. 1 to Sept. 15		Aug. 17 to Oct. 1
Tennessee	June 15 to July 10		June 15 to July 5	May 25 to June 25
Utah	June 30 to Oct. 1			July 1 to Aug. 15
Vermont	July 20 to Aug. 20			
Virginia	July 20 to Aug. 30		July 1 to Aug. 1	June 1 to June 30
Washington				June 25 to July 20
Wisconsin	July 10 to Aug. 25			

State.	Corn.	Currants.	Gooseberries.	Grapes.
California		June 5 to June 30	May 21 to June 1	Aug. 1 to Dec. 1
Colorado		June 15 to Aug. 30	May 15 to June 30	
Delaware	July 15 to Sept. 15			
Illinois	Aug. 1 to Oct. 1			
Indiana	Aug. 1 to Oct. 15			
Iowa	Aug. 5 to Oct. 1			
Kansas	July 24 to Sept. 15			
Maine	Aug. 20 to Sept. 20			
Maryland	Aug. 1 to Oct. 20			
Massachusetts				
Michigan	Sept. 1 to Oct. 1	July 1 to Aug. 1	June 20 to July 30	
Minnesota	Aug. 1 to Oct. 1		June 1 to July 1	
Missouri	Aug. 10 to Sept. 27			
Nebraska	Aug. 1 to Oct. 1			
New Hampshire	Aug. 25 to Sept. 20			
New Mexico				Sept. 15 to Oct. 1
New York	July 26 to Oct. 17	July 1 to Aug. 5	June 20 to Aug. 1	
Ohio	Aug. 1 to Nov. 1		June 10 to June 20	
Oregon		June 1 to July 15	June 1 to July 10	Sept. 15 to Oct. 30
Pennsylvania	Aug. 15 to Oct. 15			
Utah			June 15 to July 10	
Vermont	Aug. 25 to Sept. 25			
Virginia	July 20 to Oct. 20		June 1 to June 30	
Wisconsin	Aug. 10 to Oct. 10			

Seasons for packing various products in the different States—Continued.

State.	Hominy.	Lima beans.	Okra.	Peaches.
Alabama				July 15 to Aug. 15
Arkansas				Aug. 1 to Oct. 1
California				June 25 to Oct. 25
Colorado	Jan. to Dec.			
Delaware			Aug. 15 to Sept. 15	July 25 to Aug. 15
Florida			June 1 to July 1	
Georgia				June 20 to July 25
Illinois	Jan. to Dec.			Sept. 10 to Oct. 10
Indiana	Jan. to Dec.			
Louisiana			July 20 to Aug. 30	
Maryland		Aug. 1 to Sept. 1	Aug. 10 to Aug. 30	
Michigan		Aug. 15 to Sept. 20		Sept. 11 to Nov. 1
Missouri				Aug. 11 to Sept. 5
Nebraska				Sept. 10 to Oct. 10
New Jersey		Aug. 1 to Sept. 30	June 1 to Sept. 20	
New Mexico				Sept. 1 to Oct. 1
New York	Jan. to Dec.	July 29 to Oct. 15		Aug. 25 to Oct. 20
Ohio	Jan. to Dec.	Aug. 10 to Oct. 30		Aug. 10 to Aug. 31
Oregon				Aug. 10 to Oct. 10
Pennsylvania	Jan. to Dec.	Aug. 15 to Sept. 15		
Tennessee				July 20 to Aug. 20
Texas				June 15 to Sept. 1
Utah				Sept. 6 to Oct. 6
Virginia				Aug. 1 to Oct. 15
Washington				July 15 to Sept. 30

State.	Peas.	Pears.	Pineapples.	Plums.
California	May 20 to June 20	July 1 to Oct. 27		July 1 to Sept. 10
Colorado		June 15 to Aug. 15		
Connecticut			Sept. 30 to Oct. 20	
Delaware	June 1 to June 30	Sept. 20 to Oct. 20		
Florida			May 15 to Sept. 1	
Georgia	June 1 to June 15			
Illinois	June 14 to July 14			
Indiana	May 26 to July 15			
Kansas	June 5 to June 30			
Maryland	June 5 to July 1	Sept. 1 to Nov. 1		
Massachusetts		Oct. 1 to Nov. 1	June 2 to June 10	
Michigan		Aug. 20 to Nov. 5		
Minnesota	June 15 to Aug. 1			
New Jersey	June 6 to June 25	Oct. 10 to Nov. 15		
New Mexico		Sept. 15 to Oct. 15		
New York	June 15 to Aug. 31	Aug. 25 to Nov. 9	May 14 to June 25	Aug. 5 to Sept. 20
Ohio	June 1 to July 10			
Oregon	June 1 to July 20	Aug. 25 to Oct. 10		
Tennessee		July 25 to Oct. 25		
Texas	July 1 to Sept. 1	July 15 to Aug. 30		
Utah	June 10 to July 25	Aug. 26 to Sept. 18		
Virginia	May 20 to June 19	Sept. 1 to Oct. 15		
Washington		Aug. 1 to Oct. 15		
Wisconsin	June 15 to Aug. 28			

State.	Pumpkin.	Quince.	Raspberries.	Rhubarb.
Arkansas	Oct. 15 to Nov. 15			
California	Sept. 15	Sept. 6 to Nov. 2	June 28 to Oct. 6	
Colorado	Oct. 1 to Dec. 31			May 15 to June 30
Delaware	Oct. 10 to Oct. 20			
Illinois	Aug. 10 to Nov. 20			
Indiana	Oct. 1 to Nov. 20			
Kansas	Oct. 1 to Nov. 24			
Maryland	Sept. 10 to Oct. 10			
Massachusetts		Oct. 1	July 3 to July 18	
Michigan	Oct. 1 to Dec. 25		July 1 to July 15	July 1 to Aug. 1
Minnesota	Sept. 25 to Nov. 7		Sept. 1 to Oct. 1	June 1 to July 1
Missouri	Sept. 15 to Nov. 15			
Nebraska	Oct. 1 to Nov. 1			June 1 to July 1
New Jersey	Sept. 1 to Nov. 1			
New Mexico	Nov. 1 to Nov. 15			
New York	Sept. 10 to Nov. 13	Oct. 1 to Dec. 1	June 25 to Aug. 15	May 15 to July 1
Ohio	Sept. 25 to Nov. 24		June 7 to July 20	
Oregon	Aug. 15 to Dec. 1		June 15 to July 15	June 1 to July 30
Pennsylvania	Sept. 20 to Nov. 30			
Tennessee	Oct. 15 to Nov. 15		June 15 to July 8	
Utah	Oct. 15 to Nov. 15		July 15 to July 30	May 15 to June 30
Virginia		Sept. 1 to Sept. 30	June 1 to June 30	
Wisconsin	Oct. 10 to Nov. 12			

Seasons for packing various products in the different States—Continued.

State.	Sauerkraut.	Spinach.	Squash.	Strawberries.
California			Nov. 1 to Nov. 13	July 16 to Sept. 28
Colorado	Oct. 15 to Mar. 31			May 30 to June 30
Connecticut			Sept. 30 to Nov. 20	
Delaware			Oct. 10 to Oct. 20	June 6 to June 30
Georgia	Sept. 1 to Dec. 30			
Illinois	Sept. to Nov.			
Indiana	Sept. 1 to Apr. 1			
Kansas	Sept. 1 to Dec. 1		Nov. 2 to Nov. 24	
Maryland				June 20 to July 4
Massachusetts				June 1 to July 8
Michigan				June 15 to July 15
Minnesota	Dec. 1 to Jan. 1	June 15 to July 1		
Nebraska		June 1	Oct. to Nov.	
New Jersey		Sept. 15 to June 25	Sept. 20 to Oct. 30	June 1 to June 21
New Mexico	Dec. 26 to Feb. 1			
New York		June 10 to July 1	Sept. 15 to Dec. 1	May 30 to July 15
Ohio	Sept. 11 to Nov. 15	May 25 to Nov. 30	Oct. 1 to Nov. 10	May 25 to June 30
Oregon			Sept. 15 to Dec. 1	June 6 to July 20
Tennessee				June 1
Texas				July 1 to Sept. 1
Utah	Aug. 1 to Oct. 20		Oct. 1	

State.	Succotash.	Sweet potatoes.	Tomatoes.
Alabama		Nov. 1 to Dec. 1	Aug. 1 to Oct. 10
Arkansas			Aug. 1 to Oct. 1
California			Aug. 8 to Dec. 1
Colorado			Aug. 20 to Oct. 1
Connecticut			Aug. 15 to Nov. 1
Delaware		Oct. 6 to Oct. 18	Aug. 1 to Oct. 20
Georgia		Aug. 1 to Sept. 1	Aug. 10 to Oct. 1
Illinois			Aug. 10 to Oct. 20
Indiana			Aug. 1 to Nov. 1
Iowa			Aug. 10 to Oct. 15
Kansas		Oct. 8 to Oct. 26	July 27 to Oct. 5
Kentucky			Aug. 1 to Sept.
Maryland	Aug.	Oct. 10 to Nov. 1	Aug. 20 to Oct. 20
Massachusetts			Sept. 1 to Oct. 1
Michigan			Aug. 15 to Nov. 1
Minnesota			Sept. 1 to Oct. 10
Mississippi			July 20 to Oct. 30
Missouri			Aug. 20 to Oct. 1
Nebraska	Sept. 1		Sept. 1 to Oct. 5
New Jersey		Oct. 1 to Nov. 1	Aug. 15 to Oct. 25
New Mexico			Aug. 1 to Nov. 1
New York	Aug. 15 to Oct. 15		Aug. 1 to Nov. 2
Ohio	Aug. 1 to Sept. 15		Aug. 10 to Nov. 15
Oregon			Sept. 1 to Nov. 1
Pennsylvania	Feb. 15 to Sept. 15		Aug. 1 to Nov. 1
Tennessee		Oct. to Nov.	July 15 to Oct. 15
Texas		July 1 to Sept. 1	June 15 to Sept. 1
Utah			Aug. 7 to Oct. 30
Virginia			Aug. 15 to Oct. 15
West Virginia			Aug. 1 to Nov. 7
Wisconsin			Aug. 15 to Oct. 1

DETAILED CONSIDERATION OF THE VARIOUS PRODUCTS.

FRUITS.

General Discussion.

Fruits are the easiest of all articles to can, boiling for a short period being sufficient to sterilize in nearly all cases. Formerly it was the practice to pack all fruit in No. 3 cans, but within the past few years a change has taken place; eastern fruits, especially the high grade, are put up in No. 2 cans. The apple is the one exception to the rule. California fruits are packed in No. 2 and No. 2½ cans, the No. 3 can being almost wholly supplanted by the smaller size. In displacing the No. 3 can, the open-top can has been substituted for the solder top, with the result that the cans may be filled with less injury to the fruit and may be sealed full. The quantity obtained in the No. 2½ open-top can is in most cases equal to or more than was obtained in the solder-top No. 3, and it is in better condition.

In the canning of fruits the general practice is to fill the can level full, or nearly so, without crushing, and then add the necessary sirup. The sirup will abstract a certain amount of juice, so that the can will not be full upon opening, and this condition will vary with the different fruits. The softer the fruit, such as strawberries, the less will be the fill, while hard fruits, such as pears, will be scarcely affected. The question of fill will depend in part upon the variety of the fruit used, the state of maturity, the density of the sirup, and the time of processing. The proper selection and handling of the fruit so as to get a can with all the desirable qualities distinguishes the real canner.

The weight of fruit used in a can will vary somewhat when the fill is made by volume, as the interspaces in the case of large and small fruit or soft and hard are not the same. In order to secure greater uniformity, it has been proposed by one of the packers' associations to fill all fruits by weight, 21 ounces for a No. 2½ and 22 ounces for a No. 3 can, before cooking. This is a fair average fill for small or sliced fruits, but peaches in large pieces or whole pears, plums, etc., will weigh less.

In the packing of high-class fruits sirup is used, and this may vary from a very light to a heavy sirup, or between 10 and 60 degrees. Most fruits require the addition of sugar before they are used, and it should be added during cooking, and in canning it has a great deal to do with the development of the proper flavor. The water pack is used only upon the poor grades, or pie stock. The amount of sugar used will depend upon the acidity of the fruit and the flavor desired. It is unsafe to follow a rule-of-thumb method to get the highest class goods; and as the real flavor will not develop until the foods have been put up for some weeks, it requires an expert to determine the proper sirup.

Apples (Pyrus malus).

Apples used for canning should be of such varieties as cook well. They should be slightly acid, smooth and sound, and without bruised spots. Poor apples can not be used in canning and make a first-class product. The peeling is done by hand or power peelers and the core removed by the same operation or with a coring machine. Apples which are intended for dumplings are left whole and graded into size to give a certain number to the can, but those intended for pies or other cooking purposes are sliced in quarters or smaller pieces. The peeled apple is placed in cans as quickly as possible and hot water added to make the fill. If the apples can not be packed in the can at once, they are held in tubs of cold water to prevent their oxidizing or turning brown. The process on apples is about 8 minutes at 212° F. for No. 3 cans and about 10 minutes for No. 10 cans.

Apricots (Prunus armeniaca).

Apricots are produced almost exclusively for canning in California. They are grown and handled the same as peaches, though not quite so carefully, and are graded for size by running over screens having openings of forty, forty-eight, fifty-six, sixty-four, and sixty-eight thirty-seconds of an inch, respectively. The ripe apricot is not peeled, as a rule, but the skin is well wiped either by hand or machine, after which the fruit is pitted. The canning operation is the same as for the peach, though the sirup used is generally lighter. (See Peaches.)

Blackberries (Rubus villosus).

Blackberries should be given the same kind of treatment as raspberries, though they are more solid and will stand being handled in larger volume. They do not require so heavy a sirup. (See Raspberries.)

Cherries (Prunus cerasus).

Cherries should be brought to the factory in small boxes just as they are handled for the retail trade. They should be stemmed and then washed. The California fruit is graded for size over screens having openings of twenty-two, twenty-four, twenty-six, twenty-eight, and thirty-two thirty-seconds of an inch. The cherries may or may not be pitted, but generally it is preferable that this be done. The new machines do the pitting rapidly and well. The cherry rests in a cup-shaped opening and the seed is forced out by a small cross-shaped plunger. There is naturally some lacerating of the flesh, but not more than is usual in the pitting by hand. After the cherries have been pitted they should not be permitted to accumulate in masses of more than 2 inches in depth. The quantity should be weighed for each can and a heavy sirup added, or they should be heated in a preserve kettle and filled in the cans hot. The latter method gives a better fill, but breaks or tears the fruit to a greater extent. The enameled can is preferable for this fruit. The process is 18 minutes for a No. 2½ can. White cherries are usually canned without pitting, and in a lighter sirup than is used upon the red.

Gooseberries (Rubus grossularia).

Few gooseberries are canned, and these are largely used for pies. The berries are gathered when nearly ripe and are handled in baskets and shallow boxes. The first operation at the factory is to remove the stems and brown blossom ends. This was done formerly by running them over a vibrating screen upon which was directed a strong blast of air. This removed part of the blossoms and stems, and the remainder were either rubbed off by hand or were passed with the fruit. An improved gooseberry cleaner consists of a slitted disk, below which parallel knives revolve. The berries are poured above the disk and made to roll over and over by light dragging chains. This causes the stem or blossom to fall into the slits, where they are cut off close to the berry. The berries are then washed and filled into cans by weight. Those intended for pie making usually have only water added, while those for the general trade have a sirup. The filling, exhausting, and capping are the same as for other berries.

Grapes (Vitis vinifera).

Grapes have not been used very extensively for canning purposes, but there has been a noticeable increase in the past few years. In the East the white variety is used almost exclusively, but on the west coast both the white and the colored grapes are canned. They are gathered when the flavor is fully developed, but the fruit is firm. The bunches are hand picked, washed, and put in cans to within one-fourth of an inch from the top. A hot sirup is added, the cans are exhausted, and then closed. The process is about 14 minutes at 212° F. for a No. 2½ can. In California the grapes are also graded by size, being run over screens having holes twenty, twenty-two, twenty-four, and twenty-six thirty-seconds of an inch in diameter. The sizes thus separated are not indicated on the label and the consumer is unaware of this refinement except as it is indicated by the price.

Peaches (Prunus persica).

The peach is one of the most popular fruits canned and the quantity so used is enormous. It leads all other fruits in value. The principal packing is done in California, New York, and Michigan. In California the lemon cling, or some one of its varieties, is the favorite, while in New York and Michigan the freestone variety is preferred. The growing, picking, and handling are the same as for the market; that is, they are hand picked just before turning soft and handled in crates or baskets.

The conditions for growing peaches are so favorable in California and they acquire such size that they are purchased on the basis of being 2¼ inches or more in diameter, those below that size being received at a reduced price. The eastern packers can not make such close discrimination. If the peaches are well ripened, they are run through the factory at once. If they are under ripe, or hard, they may be kept in a cool place for a time. It is the practice of some to pick the peaches over each day and take them out when at their best, but as a rule they are held until all can be used at the same operation. Holding the fruit in cold storage is not advisable, as the flavor is impaired. Some varieties of peaches are graded for size before peeling, and this is done on an orange grader, the space between the rolls being adjusted to deliver three, four, or five sizes as desired. When the lye-peeling system is used the grading is generally done after peeling. The holes in the screen are sixty-four, sixty-eight, seventy-two, and seventy-six thirty-seconds of an inch in diameter, which, with those that will not go through the largest opening, gives five sizes. Careful grading for size is almost wholly limited to the California product.

There are three methods of peeling: By hand, with the knife; by steaming and slipping the skin; and by the use of lye. There have been some machines devised for peeling, but they have been used but little. The knife used for hand peeling is provided with a somewhat curved blade and a guard to limit the depth of the cut. This is the method used almost exclusively in the East and on a portion of the California pack. After the peach is peeled it is split along the line of natural cleavage and the pit forced out in the freestone or removed with a pit spoon in the cling varieties.

Peeling by means of steam is possible with only a few varieties. This method consists in splitting the peach, removing the pit, and placing the halves in a single layer, split side down, in a tray which has a covering of cheesecloth. When the tray is covered, the cheesecloth is folded over the peaches and the tray slipped into a steam box. The peaches are heated in this way for about 3 minutes and then the skin may be slipped by picking it up between the fingers. This method involves very careful work, but results in a handsome product.

When the lye system is used, the peaches are first split and pitted and the halves placed in special machines containing hot, weak solutions of caustic soda or lye. They are carried through just fast enough to allow the peel to be removed, the time usually being 12 to 18 seconds. As soon as they emerge from the soda solution they are thoroughly sprayed and are kept under sprays or in water until they are placed in the can. Where the lye peelers are installed, the peaches are usually delivered to the filling tables, graded into sizes, as already indicated, but the fillers sort for quality, separating the pieces perfectly ripened, those unevenly ripened or defective in color, and those imperfect in form or in quality.

With these different grades 60°, 50°, 40°, 30°, and 20° sirups are used. In addition peaches are canned in slices, and while formerly it was the practice to use the imperfect halves and small sizes for this class, now equally as good stock is used and siruped in the same way as the halves. There is a grade of water or pie peaches made from the lower grade stock. The cans are filled by weight.

One of the best factories using the steaming system to loosen the skins, placed the peeled peaches on pie plates and weighed the quantity necessary to fill each can. The plate was washed every time it was used.

Hot sirup of the degree desired is added to each can until it is full. It is exhausted for 3 minutes and processed for 25 minutes at boiling temperature.

Pears (Pyrus communis).

Pears used in canning are grouped generally in two classes, hard and soft, the former being represented by the Kiefer and the latter by the Bartlett. While the Kiefer yields very well, the consumption is small, largely because of the poor quality; the Bartlett is much better, but often the label does not adequately tell the story.

The canning of pears is similar to that of canning apples. The work of peeling, coring, and halving, however, is done by hand. Considerable care is taken in trimming to a symmetrical form and in removing the core to cut away only so much as may be necessary to remove all trace of seed cells. They are graded in three classes, dependent upon size or number of pieces required to fill a can, and uniformity of shape and texture. This is done according to the judgment of the filler and not by machine. They are put into cans the same as apples and a sirup is generally used instead of hot water, as it retains the flavor much better. The process is 16 minutes at 212° F. for No. 2½ cans.

Plums (Prunus domestica).

The classes of plums are generally quoted on the market as green gage, yellow egg, and Lombard. Other varieties are used, but these are the popular ones. The plums are selected when just ripening. On the Pacific coast they are graded for size by running them over screens having openings thirty-two, forty, forty-eight, and fifty-six thirty-seconds of an inch in diameter. They are washed, put in cans with sirup, and processed 14 minutes at 212° F. for a No. 2½ can.

Raspberries (Rubus occidentalis and R. idaens).

Raspberries are grown and harvested the same as for the market and should be delivered to the factory in berry boxes. At the factory they are handled in exactly the same manner as are strawberries.

Red raspberries and black caps should be kept separate. Columbia berries are regarded as inferior in appearance to Cuthberts, being less bright in color, but they have excellent flavor. The use of a sirup of the right density has much to do in bringing out the full flavor. The cans should be enameled-lined to retain both color and flavor. The process is 12 minutes at 212° F.

STRAWBERRIES (FRAGARIA VIRGINIANA).

Strawberries used for canning are grown the same as for market, and such varieties as are firm and of uniform size should be used. They should have a well-developed flavor, a little more acid than is desired for eating raw. They should be gathered the same as for the market, in boxes holding not more than 1 quart and preferably only 1 pint, the object being to deliver them in the best possible condition, without bruising or mashing.

A distinctive method of handling berries on the Pacific coast is in a chest of shallow crates. These chests are well made and hold four tiers of five trays each. Each tray measures about 8 inches wide, 15 inches long, and 1½ inches deep inside. The boxes holding the berries are therefore very shallow and there may be two or more in a tray. The fruit arrives at the factory or market with the minimum of bruising.

On arrival at the factory different methods are followed, but one of the best, as practiced by one of the large packers, is as follows: The boxes are delivered to tables, where they are turned out upon enamel pie plates. The berries are stemmed, defective ones sorted out, and any foreign substance removed. The plate containing the berries from a single box is passed to another helper, who washes the fruit under a spray; the next one weighs each plate and adds the correct amount to fill one can. The berries are poured from the plate into the can, in which operation a special half funnel is sometimes used. The can should be filled a little above the level. Hot sirup is added and the can given a 2-minute exhaust, sealed, and processed for 14 minutes at 212° F. The cans should be preferably enamel lined, with open tops.

In the handling of the fruit at this plant the pans are washed after each separate usage. The work involved is greater than in some other systems, but the product can hardly be excelled in cleanliness and in flavor.

At some other plants the berries are stemmed from the baskets and are run through a fruit washer to remove any leaves or dirt; they are then filled directly into cans without weighing or are collected in large pans, and when a sufficient quantity has accumulated are then put into a preserving kettle with sugar and heated until they just come to a boil. The berries and their sirup are then filled into the cans.

Strawberries do not admit of being handled by automatic machinery. The stemming must be done by hand, but in the plate system they are not touched after once being washed. In the system in which considerable dependence is placed upon the fruit washer the cleaning is well done, and in a manner not to injure or break the fruit. Cans which are well filled with cold fruit will not be full of fruit after processing. The heat causes the breaking down of the tissue and consequent loss of juice, so that the berries will float. Berries heated with sugar in the preserve kettle will give a better fill in the can, as more juice is cooked out than can be returned to fill the space between the solids. In this practice there is a distinct difference between the manufacturer who attempts to give a can with the maximum of food solids and the one who cooks the berries to abstract the juice for other use, such as fruit sirups for soft drinks. A sirup should be used in all cans, as it holds the flavor much better than water. Sugar is always used with such fruit, and the proper time for its application is when it is being cooked. The degree or density of the sirup is a matter of taste, but preferably it should be fairly heavy. The enamel-lined can is decidedly the best for preserving flavor and color, and also for resisting the action of the fruit on the can. Strawberries are also put up in glass and given the same general treatment.

VEGETABLES.

Asparagus (Asparagus officinalis).

Almost the entire asparagus pack of the United States is put up in California. The asparagus beds are located on the bottom-lands which have been reclaimed from the Sacramento and San Joaquin Rivers and are exceedingly rich. Dykes have been constructed, canals dug, and pumping machinery installed, so that it is possible for the growers to control the conditions to such a degree as to produce enormous yields of a very high quality. The advantage is so great that other points can not compete successfully.

The asparagus is grown in large fields in rows, and in the fall the plants are cut, the tops acting as a mulch. The earth is banked over the rows to the depth of a foot or more. In the spring the stalks come through this light soil and mulch and are practically bleached. They are cut every day or every other day, the stalks being selected just as they appear through the ground. The work of cutting must all be done by hand by means of a long chisel-like knife, and is very laborious. The object is to cut the stalk back 7 inches or more. The asparagus is collected in hampers or crates and hauled promptly to the cannery. It is essential that the work be done promptly to insure a crisp article. A delay will cause a fine product to become tough and stringy. At the factory the first operation is to turn the crate upon a sorting table, where the stalks are sorted into five grades, based on size, also into two qualities, dependent upon whether the stalks are wholly blanched or partially green. A further sorting is made, dependent upon whether the stems are straight or crooked. All the sorting is done by hand. The five grades for size are known as giant, mammoth, large, medium, and small, and these are based upon the number of stalks which will go into a standard No. 2½ square can. With giant stalks about 14 are required; mammoth, 20 to 22; large, 30 to 33; medium, 40; and small, 50. What are known as asparagus tips are put up in cans just one-half the regular size, and about 30 per cent more stalks are required to fill the can. What are known as hotel tips are the cuttings made in trimming the asparagus to size, and the whole stalks which are crooked or deformed. The quality of these is just as good as the other, though not so pleasing in appearance. Some of the large asparagus is peeled, or stripped, as the operation is more properly called.

After the grading the tips or stalks are cut in lengths to fit the can, and then thoroughly washed in cold water. They are next blanched in wire baskets, the stalks being held in position so that they will not move about. The length of the blanch depends upon the condition of the stalks, being a mere dip in hot water in some cases, and as long as 3 minutes in case of advanced growth. On coming out of the blanch they are dipped in or sprayed with cold water to prevent softening, after which the cans are filled immediately. A light brine is used to fill the interspaces, the can exhausted, the cap placed on, and a process of 240° F. given for 12 minutes. The cans must be well cooled at once.

A great deal of fancy is shown by the consuming public in buying asparagus. The absolutely white is demanded, and brings a premium of from 25 to 50 per cent in the market. The green is just as good and in many instances better, though it does not look quite as attractive, and the liquor is likely to have a more or less cloudy appearance, due in part to the breaking of tips and side buds.

Beans, Green (Phaseolus nanus).

String beans form a regular side dish at almost every hotel, and they are generally the canned article. There is a large pack of beans put up each year, and while hotels and restaurants were formerly the principal buyers, a large demand for home use has been created in the past few years. The beans raised for canning are produced the same as for the market. The growth is best when the season is fairly moist and cool, the majority being produced in northern New York and Michigan, and more recently large packs have been put up in Wisconsin.

The beans are picked by hand and the object is to gather them as young as possible. The best are about 2½ inches long and less than a fourth of an inch in thickness; the large beans become tough and stringy. At the factory the beans are graded in five sizes by means of special machinery, the essential feature of which is a series of vibrating screens made of rods or bars running in one direction. These rods are generally set eighteen, fourteen, eleven, and eight sixty-fourths of an inch apart. The beans are fed in over the coarser screen first and those which fail to pass through constitute one grade, and as they pass to each succeeding screen the next larger sizes are separated and the smallest pass through the last. The work is done better than was formerly done by hand.

The next step is to snip or string the beans. Some varieties of beans are so nearly stringless that the simple snipping of the ends is sufficient, but when they become old, hand stringing is necessary. The cutting of the ends, or snipping as it is called, can be done well by machinery. It is also the practice to cut the large beans in lengths of about 1 inch. All beans are well washed, placed in wire baskets and blanched, or they may be blanched in the cylinders used for peas. The time required for blanching will vary with the age; the small size of young beans will require only about 1½ minutes, the larger ones if tender will require about 4 minutes, and if hard and tough they may require 8 or 9 minutes. It is the rule of good processors to blanch until the beans are tender, irrespective of time, and for that reason many prefer the basket in a tank of boiling water to the pea blancher.

The blanched beans are filled into the can by means of a special bean filler. This machine carries a tray, holding 4 dozen cans, and has a hopper above it with holes corresponding to each can. The beans are poured into the hopper, the quick vibrating motion of which shakes the beans into the can. As a further precaution against short weight, each can is weighed and any deficiency in fill is made up by hand. A weak hot salt brine is used to fill the interspaces in the cans, which are exhausted, capped, and processed for 30 minutes at 240° F.
as for peas. A full can should weigh not less than 13 ounces, exclusive of the liquor.

Beans, Lima (Phaseolus lunatus).

Lima beans are grown for canning both as a green bean and as the bean in succotash. There are two varieties, the pale or true Lima and the bush variety. The former is but little grown for canning, as it must be gathered by hand the same as string beans, while in the case of the bush beans the whole vine is taken up and hauled to the factory, as in the case of pea vines, and then run through a pea viner to shell the beans. The speed of the viner is changed to meet the altered conditions. The beans are graded generally into four sizes, if canned, but are left ungraded if intended for succotash. It is also becoming the custom, as with peas, to can some beans ungraded. A better flavor seems to result from the combination than is found when they are canned separately. The sizes are as follows, and are obtained by sifting over the screens with openings twenty-four, thirty, thirty-one, and thirty-two thirty-seconds of an inch. Those passing through the first screen are called tiny; through the second screen, fancy; through the third screen, medium; through the fourth, standard. Those passing over the last screen are sometimes designated large or mammonth beans. The beans are blanched the same as peas, and the can filled, so that after processing it will be full and just covered with brine. The process is the same as for peas. A full can should weigh not less than 13 ounces, exclusive of the liquor.

Beans, Wax.

Wax beans are handled in the same way as string beans. More attention, however, is paid to sorting, as any spot will show on the light surface. The weight of the beans in the can should be not less than 10 ounces, exclusive of the liquor.

Beets (Beta vulgaris).

Beets grown for canning must be of a deep-red variety, evenly colored throughout. Pale or uneven colored beets present a very poor appearance in the can. The beets used for canning are mostly grown in New York, and are cultivated the same as for the garden, but in large acreage. The tops are cut off and they are hauled to the factory as are tomatoes. The time of packing is in the fall, usually the latter part of September.

At the factory the beets are graded into four sizes—small, sometimes called rosebud, the beet being less than 1 inch in diameter; medium, the beets being from 1 to 1½ inches in diameter; large, those from 1½ to 2 inches; and very large, those over 2 inches. The very large beets must be cut into pieces for canning, and for that reason are called cut beets. The grading is done in a wooden squirrel cage having the slats set at proper distances or over tables having holes of the size indicated.

After being graded the beets are soaked in tanks of water to soften the adherent dirt and then sprayed well. The beets are next placed in large iron crates or heavy iron baskets, placed in the retort, and steamed for 20 minutes at 220° F. This loosens the skin so that they may be peeled with the best possible results. The peeling is done by hand, as is also the filling of the cans. Only water is used on the beets, though salt may be added at the rate of a teaspoonful to the can; enamel cans should be used, otherwise the beets will be discolored. The process on beets is 245° F. for 1 hour.

Corn. Sweet (*Zea mays*).

Canned corn is the result of the persistence of Isaac Winslow, of Maine. He was a sailor by occupation, and in his wanderings upon the high seas visited France and learned of the method of preserving food by canning. The advantage of such foods, particularly to sailors, was obvious. Mr. Winslow began experimenting on the canning of corn in 1839, the first trials consisting in boiling the corn on the kitchen stove for varying periods of time. The cans were marked and a record kept of each lot. The results were mostly failures, but a sufficient number of cans were saved, and these were of such good quality that the efforts were continued. The succeeding years gave essentially the same result. In 1843 he built a small boiler to generate steam and a wooden box in which to put the cans, so that the cooking might be done in a closed steam chamber. As the results were less successful than in the previous years, the steam box was discarded. It was not until 1853 that he had sufficient success to warrant applying for a patent on his method, and it was regarded with so much distrust that the letters were not granted until 1862. Winslow first packed the corn on the cob, but this was bulky, and he believed that the cob absorbed some of the sweetness. He next pulled the kernels off the cob with a fork, and finally cut the corn with a case knife. Winslow's apparatus and methods were crude, but he discovered the principles which underlie the canning of corn. It may also be said that he and his successors brought fame to Maine corn as a canned product, and this reputation persists to the present time.

The canning of corn is a large industry in Maine and other States extending from New York to Maryland, west to Iowa, and north to Minnesota. In most of the Eastern States the crop is grown by numerous farmers in small patches of a few acres, while several of the western factories raise their own corn, covering hundreds of acres. At Hoopeston, Ill., two canneries use the product of 7,500 acres. Claims are made that certain sections produce better and sweeter corn than others. This is not always sustained by facts, for quality is also affected by the variety and state of maturity when gathered. Again, some canners pay more attention to the quantity of corn grown on an acre than to the quality. The seed used is grown by specialists, as a rule, and a very large part of it comes from Connecticut, a State in which no canning of corn is done. The type of corn used now is quite different from that canned several years ago. The effort is to develop a tender, fine-flavored sweet corn. The ears are of two types, those having large, flat kernels arranged in rows and those with small, long kernels irregularly placed. Stowell's Evergreen is typical of the former type and Country Gentleman of the latter. The corn is planted and cultivated like field corn, and is gathered by snapping off the ear when it is in its prime. The ears are hauled to the factory in the husk in order to protect the kernels from injury in handling and from dirt and exposure.

A modern corn-canning plant is a large establishment, equipped with valuable automatic machinery to do the work in a rapid, cleanly manner. When the corn arrives at the factory it is dumped from the wagon onto a conveyer, which carries the ears to different parts of the husking shed as they are needed. Most of the husking is done by hand, but this will undoubtedly give way to machine methods, as the husking machines have been almost perfected in the past year. As rapidly as a bushel measure is husked it is put upon a conveyer, and while on the way to the silking machine is sorted for quality. A high grade can be secured only by selecting ears with grains which are uniformly tender. Corn which is too old or too young to make a fancy grade of goods is taken out and held until a sufficient quantity accumulates to make a run on a lower grade. The silking is done by means of rapidly revolving rolls and brushes. As the ear revolves on its axis and at the same time is carried forward, it is gently wiped by rapidly revolving brushes, which pick up any silk that may be attached. This work is done with remarkable rapidity and by machinery so carefully adjusted for any irregularity in the size of the ears or even in the same ear that there is no chafing or bruising of the tenderest grains. This process is immediately followed at some factories by a thorough spraying with water, while at others this is omitted, the claim being made that a certain flavor is lost.

The corn is cut by machinery, and from the time the ear is fed into the cutter until the corn is sealed in the can it is not again touched by hand. The ear is forced through a series of curved knives, mounted in an adjustable circular frame, so that they will accommodate themselves to the varying size of the cob. Scrapers complete the work by removing the grain and soft bits of kernel at the base. The corn again passes through a machine to remove bits of silk, husk, or cob, so that the final product is as clean as labor can make it. This cleaner consists of a series of wire combs, which intermesh as the corn passes through, and wire cylinders which act as sifters.

The corn is next mixed and cooked, and in this operation it is necessary to add some water, otherwise it would become a dry, tough mass in the can. The quantity of water used will depend upon the consistency desired and the condition of the corn. Some varieties require more than others, but the average quantity used in cream corn is about 5 ounces per can. It is also usual to add both salt and sugar to the corn to give the desired flavor. This is used in all grades, though more carefully in the high grades than in the low. The eastern packers, as a rule, use more sugar than the western.

The care with which the cooking is done before the corn enters the can determines in a large measure its appearance. The addition of too much brine will give a sloppy can, while the use of too little gives a dry can. Insufficient cooking will leave the brine and corn separated; the quantity of brine may be right but the corn may be dry in the bottom of the can and most of the brine on top, or they may be mixed but not blended. The preliminary heating is done by steam, using automatic machinery, which heats and evenly mixes the corn and brine and at the same time fills the cans. The corn enters the cans at about 180° F., and the capping is done in the usual manner.

Corn is one of the most difficult products to process. It requires a temperature of about 250° F. for 75 minutes to insure sterilization. There are packers who process at from 240° to 245° for 90 minutes, and others who process their corn twice to insure keeping. The higher the temperature the browner the corn and the more pronounced the cooked taste. The consistency of the corn makes a great difference in the heat which must be given; the drier the corn the slower the heat penetration.

Corn is packed as "cream corn," or, as it is sometimes called, "Maine style," the kernels being cut as already described and the portion scraped from the cob added. The product should be of a thick, creamy consistency. Again the corn is cut from the cob as closely as possible by knives, but only the whole grains are used, the bits and scrapings being discarded; corn used in this way must have long, slender grains, commonly called "shoe peg," and the quantity of brine be such as to keep the kernels separate. This method of preparation is called "Maryland style" by the trade. In some instances the corn is run through a recutter, which gives a grainy effect or one like the cream corn, depending upon the method of handling. This procedure is also followed in working up corn which has become too old to make a good regular pack. Corn may be run through slitting machines, which cut the grains open on the end and then squeeze out the contents, leaving it free from hull. Cut corn is also run through a "cyclone," a machine for forcing the creamy portion of the kernel through a fine sieve, thus removing all of the hull and giving much the appearance of green corn meal.

Field corn is not used in canning. Some of the sweet corn used produces very large ears and coarse grains, which give rise to the suspicion that field corn has been substituted. There has been a very general improvement in sweet corn in the past 10 years, and it will probably not be long before this coarser variety will give way to a better and sweeter one.

A can of fancy corn upon opening should be well filled (within three-eighths of an inch of the top), should be absolutely young and tender stock, medium moist, practically free from silk or bits of cob or husk, only slightly darker than natural or of a light golden-brown color, and have the distinctive young corn flavor. The weight of the contents should be about 21 ounces. If put up in "Maryland style," the kernels should be separate and the brine nearly clear and the corn should weigh not less than 13.5 ounces, exclusive of the liquor.

A can of standard corn should be well filled, reasonably tender, fairly bright color or slightly brown, and nearly free from silk, bits of cob, or husk. The flavor should be characteristic of young sweet corn. If put up in "Maryland style," a part of the kernels may be somewhat hardened and the brine a little cloudy.

Peas (Pisum sativum).

The transition from growing a small patch of peas in the garden to supply a few meals of a choice vegetable during the growing season to that of growing hundreds of acres to supply a canning factory packing an article available at all seasons is but an incident in the development of a great industry. The garden bed was spaded, raked, and planted by hand. Brush was obtained from the orchard or wood lot, and the rows "stuck" in order to insure the vines proper support. When the green peas were picked and carefully prepared, they made what was at one time styled a dainty dish. The fields are now cultivated, sowed, and the crop harvested by machinery the same as any farm crop. There are several factories which take the entire yield from more than 1,000 acres. The plants selected have sufficient rigidity, no added support being necessary. The whole plant is hauled to the factory while fresh and green, the same as a load of hay.

The canning of peas dates back to the beginning of canning, and is one of the three large crops packed. In this country it is confined largely to those States having a cool spring and plentiful rainfall. The southern limit of successful growing seems to be from Maryland west to Indiana and northwest to Minnesota. Some peas are also grown on the highlands in Colorado and a few on the western coast. Wisconsin, Michigan, New York, and Indiana lead in this crop.

The pea used for canning belongs to the garden variety, *Pisum sativum*, of which there are two general classes, early, or round smooth pea, and the wrinkled pea. The latter are much the sweeter. The Little Gem and Alaska are typical of the first class, and Horseford's Market Garden, Admiral, and Advancers of the second.

The peas are generally sown upon good ground, well prepared, as early in the spring as frost will permit, and no subsequent cultivation given (except in California). Instead of all being sown at one time, the seeding is made to extend over several weeks, in order to prevent too many maturing at one time. When the peas are well grown and are still very tender, they are cut by mowing machines or special pea harvesters, and are then loaded upon wagons and hauled to the factory. Until a few years ago, the pods were picked from the vines in the field and taken to the factory in baskets or bags. This necessitated a very large force of men, women, and children in harvesting, and added much to the cost of the product. There are only a few factories in the United States which follow this method at the present time, and it is limited to a part of the pack.

The vining machine, which is used for separating the peas from the pods while they are still on the vine, is a very simple and ingenious device to accomplish a difficult task—the shelling of the tender pea so carefully that it will not be injured. It consists of a large cylinder, perforated with many holes, which are large enough to permit the peas to pass through, but not the vine. Within the cylinder is a heavy shaft, bearing strong paddles or beaters. The cylinder is made to revolve rather slowly and the beaters very rapidly, in the opposite direction. The vines are fed in at one end of the cylinder, are carried upward by its motion, and fall upon the beaters, which strike the pods, causing them to burst open and discharge the peas. The peas roll out through the holes in the cylinder, and the vines pass out the opposite end. The present vining machine is a modification of the podding machine which was invented by Madam Faure. It was the first important step in the development of the pea-canning industry.

The next step in the process is that of cleaning, and it consists of two operations; first, that of passing the peas through a fanning mill to remove pieces of pods, leaves, and dirt, and second, in washing, which is done in wire cylinders known as squirrel cages. These cylinders are set on a slight incline and made to revolve slowly, so that peas which enter at one end gradually roll out the opposite end, and while doing so they are well sprayed with pure cold water. After the washing, the peas are graded for size. This is done by passing them over vibrating screens, which have holes of a definite size, or through cylinders, with sections having perforations corresponding to those in the screens. The perforations are standard and give the following sizes in the peas: Petit pois, extra sifted, sifted, Early June, marrowfat, and, in the case of late peas, the telephone. If the peas are properly labeled, they should be uniform in size. Some manufacturers, instead of turning out all these sizes, combine two sizes in one. A few peas are sold ungraded or with only the first and second size taken out. The petits pois should pass through an eighteen sixty-fourths inch hole; the extra sifted, or extra fine, through a twenty sixty-fourths inch hole; the sifted, or fine, through a twenty-two sixty-fourths inch hole: Early June, through a twenty-four sixty-fourths inch hole; while the marrowfats pass over the ends of the screens. With sweet wrinkled peas, a twenty-six sixty-fourths inch screen is used to separate the marrowfats and those remaining above pass over as telephone size. These designations, which were partially adopted from the French, have been in use for a long time, and refer to size and not to variety nor to time of gathering, as would be inferred from the name "Early June." The term "Early June" has, in recent years, come to have another meaning, that of including all of the smooth or Alaska group of peas in distinction from the sweet wrinkled varieties. We therefore find smallest-sifted Early June, extra-sifted Early June, and sifted Early June, as distinguished from the same names applied to sweets. The trade terms have little meaning to the consumer and could be supplanted by proper descriptive terms to the advantage of all concerned.

Peas are also graded for quality, those being small, young, and tender, so they will crush easily between the thumb and finger are considered to be the highest grade, while those which have a considerable percentage hard, turn brown upon processing, or cause clouded liquor in the can, are of a lower grade. The grading is done largely upon the judgment of the inspector as the peas arrive, and later by the superintendent.

The peas may be mechanically graded for quality before, but preferably after, grading for size. This is done on the basis that the old or hard peas are heavier than the younger and more tender ones. Peas will not all mature alike on the same vine, nor in the same field, so that it is not possible to cut them to secure absolute uniformity. The more slowly the peas mature under fairly cool moist conditions, the tenderer they will be, so that in some sections the necessity for grading for quality is less than in others. This grading is effected by means of brine, which is made to a strength that will float those that are tender, the harder ones sinking. The first quality can be skimmed off, and those that sink again separated in another and heavier solution, giving a second and third grade. The first grade will be lighter in color, softer on pressure, and give a clear liquor on canning; the second grade will be slightly darker, and the liquor cloudy; while in the third grade, the size will be uneven, the peas dark and hard, and the liquor very cloudy and thick. In dry seasons the grading will not be so good as there is less difference in the weight of the peas. It is possible to get 15 grades of peas, depending upon size and quality, from the same load, the difference being sufficient to be easily distinguishable in the finished product.

When the peas leave the graders they pass over slowly moving belts in a single layer, and those which are split, off color, or defective are picked out. This is the only operation in which it is necessary to touch the peas with the hands.

The peas are blanched, or more properly parboiled. They are boiled just long enough to soften them uniformly and to remove the mucous substance on the outside. The time for the blanching will vary from one-half minute for the very tender small peas, to 15 minutes for the overmatured large ones, some variation being necessary for each size and degree of hardness. Most of the blanching requires from 1 to 4 minutes.

The matter of blanching is exceedingly important, for upon it depends in a large degree the appearance of the peas and the character of the liquor. There are several different styles of apparatus in use for blanching, the simplest being a large trough containing scalding water in which wire baskets containing the peas are placed for the required time. Another device consists of a cylinder which is made to revolve in a tank of water and gradually cause the peas to pass through in a continuous stream by means of a large screwlike conveyer. The latest type is a tank having three compartments; the peas are fed in at one end and the hot water at the other, so that the water in which the peas are first scalded is being constantly renewed from the next tank, and, as the peas emerge, they come from the freshest, cleanest bath. The peas are again washed after blanching and before going to the filling machines.

The pea fillers should measure out a given quantity of peas and deliver it into the can with the minimum of cutting or bruising. The greater the number of injured peas the less attractive the contents, both because of splits and cloudy liquor. The fillers should be adjustable that the cans may receive a fill according to size and age. The younger and smaller the peas the greater the fill, and vice versa. Old peas absorb liquor in the process, while the succulent ones take up very little. The liquor used in canning peas is made up of water, salt, and sugar, the proportions being a matter of taste. The eastern packers, as a rule, use more seasoning than the western. The liquor is added after the peas have been put in the can. The subsequent capping and processing is the same as for corn. The process is from 235° to 240° F. for from 35 to 40 minutes, depending upon the freshness and state of maturity. The cans of peas should be given a cold bath at once after the process is finished, in order to arrest cooking and insure a clear liquor.

The canning of peas requires special care. If a fine product is to be secured, there must be careful selection in the field and continuous and rapid work from start to finish after the vines are cut. "Only an hour from the field to the can" is not literally true, but it is approximately so. The work is almost wholly done by automatic machinery, connected by special conveyers in such manner as to insure continuous action. At all the various steps the washing is of the most thorough character, and in some of the best factories almost a gallon of water is used in the preparation of each can. The highest grade of American peas represents the best that is accomplished in the pea-canning industry, and are unexcelled by any foreign production.

The cost of a can of peas will vary with the size and quality. The very tender smallest sifting peas, or "petits pois," are the most expensive for the reason that but comparatively few are produced; not more than 5 per cent of a good crop will be of that grade. The price gradually decreases through the sizes to the marrowfat, which is the cheapest. There is more nutrition in the larger sizes and, if properly graded, they have the better flavor. Ungraded peas have a particularly good flavor, though they are not so attractive because of lack of uniformity.

A well-filled No. 2 can of peas should have a net weight of about 21.5 ounces, of which slightly more than 14 ounces should be peas and 7 ounces liquor.

A can of first-grade peas should be from selected field stock, or the lightest weight if separated, and the can should be well filled with peas that are uniform and true to the size indicated, even in color, absolutely tender, of good flavor, and covered with a clear liquor. The weight of the peas, exclusive of the liquor, should be not less than 12.5 ounces.

A can of standard peas should be well filled with good field-run stock, the peas fairly uniform, of the size indicated, and covered with liquor, which may be more or less cloudy but not thick. There may be some variation in color, but the peas should be tender, or only a small proportion hard, and of good flavor.

Pumpkin (Cucurbita pepo L.).

It used to be the custom to associate pumpkin pie with the Thanksgiving season, but the tin can has lengthened its season to the full year, and made it especially convenient for the home piemaker.

The pumpkins used for canning should be of a hard, sweet variety, and evenly ripened. The meat should be of good texture, golden yellow, but not watery. It has been the custom generally to grow the pumpkins with the corn, but a few canners find that a more satisfactory yield and a far more uniform quality are obtained by growing in the open field as a special crop.

The pumpkins are carefully selected, stemmed, and well washed to remove any adherent dirt. They are cut into large pieces, either by knives or roller disks, and are given a general washing in a heavy squirrel cage, the principal object being to remove the seeds and loose fiber. The pumpkin is then put into large iron crates and cooked in the retort until it softens, which requires about 20 minutes at 240° F.; it is next run through a cyclone, which removes the hard part of the skin and the tough fiber. The pulp proper is cooked very little if it is of a good consistency, but if light or thin it is evaporated until it is of the right body. It is filled into cans while hot, sealed at once, and processed at 250° F. for 90 minutes.

Some packers cut the pumpkins in halves and peel and core with special revolving knives. This necessitates considerable extra hand work, but is particularly advantageous when the pumpkins do not ripen uniformly. It does not have any apparent advantage over the direct-heating method if the raw material is of uniformly good quality.

Pumpkin is packed almost exclusively in No. 3 cans, which should be enamel lined, thus preventing action on the tin, and also aiding in the retention of better color and flavor.

A good can of pumpkin when opened should be filled within one-half inch of the top; should be fairly heavy, smooth, evenly screened, free from fiber, and uniformly colored. A can lacking an inch or more of being full, coarse, containing fiber, or being thin and watery, is not a first-class article and is short weight. A No. 3 can should contain at least 32 ounces. Squash (*Cucurbita ovifera*) is grown and handled the same as pumpkin.

Rhubarb (Rheum rhaponticum).

Rhubarb is grown in fields, in rows 4 feet apart and hills about 2 feet apart in the rows, and is cultivated the same as are potatoes. The soil must be rich to give a luxuriant growth. It is harvested when the leaf stems are of large size, which may be at any time from the middle of May until the middle of August.

In harvesting the best stalks are selected, the small or undesirable ones being left to take care of the plant. The pulled stalks are made into bundles; the leaf and butt are then cut off and the stems placed in crates to be hauled to the factory. The hauling is done the same as in the case of tomatoes.

At the factory the rhubarb is washed in large tanks of running water and at the same time inspected for any imperfections. The next step is the cutting, and this is accomplished by means of a series of small saws set 1 inch apart on a shaft. The rhubarb is laid on a carrier, which feeds each stalk crosswise to the saw. The pieces ready for the can are therefore 1 inch in length and the size of the stem. The cans are filled with a string-bean filler, and as much is put in as can be shaken below the level of the rim. Hot water is added to fill the interspaces.

The practice in some factories differs in some particulars from that given here. First, in that the stems are stripped or peeled before being cut, and, second, in that the rhubarb is heated in a preserve kettle before filling into the can. In the latter case only a very small quantity of water is used, as in the cooking sufficient juice is extracted to furnish part of the liquor in packing. This style of pack is put up in No. 3 and No. 10 cans. The former is put up only in No. 10 cans for pie purposes. The process is 13 minutes at boiling temperature.

Succotash.

Succotash is a mixture of green corn and green beans, the Lima bean being the one generally used. Succotash has also been made from green corn and soaked beans, as in most places the corn and beans will not come to maturity at the same time. The flavor of succotash made from good corn and strictly green beans is better or more delicate than that made with dried beans; otherwise the latter is in no way inferior to that made from the green bean; but when the dried bean is used the fact should be indicated on the label. In the regular field run of Lima beans some will be further advanced than others; while the pods may all be green, in blanching some of the beans may turn white and on breaking they may appear mealy, and thus give the appearance of being soaked when the can is opened. In fancy succotash these white beans are picked out by hand. A succotash should consist of not less than 20 per cent of beans, and in the high grades there is more nearly 40 per cent beans, either graded or ungraded for size. The cut corn and blanched beans are mixed, after which they are treated the same as corn, being given the same sugar and salt brine, preliminary cooking, and process. The net weight in a No. 2 can should be not less than 19 ounces.

Sweet Potatoes.

Sweet potatoes can be canned to good advantage for use in those sections where they can not be raised. They usually come under two classes, the long yellow variety, growing extensively in New Jersey, and the light or southern variety. The former is preferred in the market at present, partly because of its better appearance. The southern variety turns dark and may become watery.

The potatoes are washed and the skins removed by running them through a potato parer or abrading machine such as is used in hotels, by dipping in a hot, weak lye, or by boiling until the skin can be scraped off easily. If they are not large in diameter, the cooking may be continued until they are tender to the center or two-thirds cooked. If they are large, it may be better to cook first until the skin can be removed and then give a second cooking, either in boiling water or in a steam retort, until they are about three-fourths done. They are packed in the cans as closely as possible without mashing and preferably without the addition of water. They may also be grated or mashed, and in this form are offered for sweet-potato pies. They are then thoroughly exhausted and processed for 70 minutes at 240° F. or for 3 hours in boiling water.

Tomatoes (Lycopersicum esculentum).

The time is easily within the memory of many persons when tomatoes were thought to be poisonous. A few persons in the Eastern States used them 70 years ago, but they did not become common until a much later period. In the West the prejudice against them persisted until less than 40 years ago. The first record of canning tomatoes is that of the work done by Harrison W. Chrosby in 1847 at Jamesburg, N. J. Tomatoes are now used in enormous quantities in the fresh state and head the list of all vegetables as a canned product. Thousands of bushels are also used in the manufacture of ketchups, chili sauce, and soups. The tomato is produced over a larger part of the United States than any other vegetable. It may be handled with few and simple appliances, and may therefore be canned in the home and in small factories where little capital is required, as well as in the large factories.

The development of a tomato suitable for canning purposes has been a specialty in itself. For this purpose the fruit should be moderately large, smooth, so that it will peel readily, ripened evenly to the stem, of a clear, red color, and having a large proportion of solid meat of good flavor. Varieties which ripen unevenly or are irregular in outline are difficult to peel and the percentage of waste is too high. Tomatoes which are yellow or purple do not have an attractive appearance on opening, and those with excessive seed cells or which are soft and watery will give the can the appearance of being slack filled or packed with water. A good pack is therefore dependent upon having a variety possessing the right qualities. The canner can not accept tomatoes of a half dozen or more varieties and get good results. He must therefore specify the variety grown or furnish the plants for his growers. The production of plants in hotbeds and cold frames to supply several hundred acres is of itself a very large task. The plants are grown in the field, the same as other crops, and a single large cannery will use the product of 1,000 acres. One ketchup manufacturer takes the entire product from more than 5,000 acres. A fair yield is 5 tons of fruit for an acre, but good cultivation and fertilization sometimes brings this up to 20 tons or more. Thirty-three bushels weigh about 1 ton.

At harvest time the fruit must be picked every day, or every other day, in order to insure collecting it when it is in its prime—just ripe, without green butts, and not overripe. It is preferable that the tomatoes be put in crates, which are wide and flat rather than deep, and which will hold not more than a bushel. They can be delivered to the factory in better condition in the flat crates than in the deep ones or in baskets, as the fruit will crush if piled in too many layers. The arrival in good condition lessens the time required for peeling as well as the loss in parts cut away. The tomatoes should be delivered to the factory promptly, as deterioration begins soon upon standing.

When the tomatoes are delivered at the factory they are weighed and inspection should be made of each load. One crate is taken out at random and dumped into a tank of water. All defective fruit can be detected at once, picked out, weighed separately, and the load docked accordingly. Rotten fruit can not be used and green fruit must be held to ripen. The separation at the factory entails extra expense in the inspection and sorting. The rotten fruit should not have been picked and the green should have been left in the field; the only way to reduce this waste to a mimimum is by means of a system of dockage.

The first step in manufacture should be proper sorting. This can be done better by a few persons than by the many peelers. Tomatoes which are green should be taken out and held in crates for one or two days, as may be necessary, but small green spots can be cut out by the peelers. The tomatoes with rot should be discarded. Tomatoes which are small, rough, misshapen, and sound, but which will not peel well, can be set aside for pulp. Such a separation will lessen the work and waste in the factory and in the end be economical. The sorting is best done upon a conveyer table, the tomatoes which are passed being fed directly into the washer.

The washing should be thorough and done without bruising or crushing the fruit. It is preferable that the fruit be dropped into a tank of water and rolled over and over gently, either by actually turning the tomato or by strongly agitating the water, and then spraying under a strong pressure as they emerge from the water. This latter operation is of greater importance than is generally supposed. As before stated, a comparatively large volume of water without force behind it is far less efficacious than a much smaller volume having force. The latter cuts the dirt and organisms off, the former only wets the skin and makes it look bright. Allowing tomatoes to dry in the sun after washing by each method will clearly demonstrate the difference. The water in the tank should be changed continuously by the addition of the water used in the spray, an overflow being provided for the tank. The majority of tomato washing machines are inefficient.

The tomatoes are scalded, while passing slowly through a tank or steam chamber, by the continuous action of hot water or steam. The scalding is only sufficient to loosen the skin and not to heat or soften the tomato. As the tomato emerges from the scalder it is sprayed with cold water, which causes the skin to split and arrests the heating of the fruit.

The clean-scalded tomatoes are delivered to the peelers in various ways, in pails and pans by carriers or belts, or by moving table tops, or they are delivered to the tables directly upon belts. Various devices have been used to carry the tomatoes to and from the peelers and to care for the waste, the object being to secure cleanliness and careful handling of the fruit. The bucket system is an old one and is in general use at small factories. The bucket is filled with scalded tomatoes and the peeler works from one bucket into another, dropping the refuse into a third bucket or into a trough under the table. The objection to the bucket is that the fruit on the bottom is mashed more or less before being reached by the peeler, and the same is true of the peeled fruit. Wide shallow pans have an advantage over the bucket in this respect. In peeling from the special tables, the tendency is to heap the bowls too full, which produces the same disadvantages found in using the bucket. Some paint the buckets different colors to indicate whether they are to be used for scalded tomatoes, peeled tomatoes, or refuse. All buckets or pans should be washed each time they are used, no matter how many times a day that may be. All tables and conveyers should be washed each time the plant stops, and oftener when needed.

The peelers hold the tomatoes with the stem toward the palm of the hand, pull the skin back from the blossom end, and close the operation by removing the core with the point of the knife, keeping it well directed toward the center so as not to open the seed cells. This is not only the quickest way to peel the tomato, but keeps it whole. Green and undesirable spots are cut out.

The cans are filled either by hand or by machine. The sanitary or open-top cans are filled by hand, as it gives a better appearance to the finished product. In this class the cans are weighed to insure the desired fill. If filled too full, which may easily happen, " springers " or " flippers " may result, and the product be unsalable though perfectly wholesome. " Springers " or " flippers," as before explained, have the appearance of a swell, but are not due to fermentation. Solder-topped cans seldom bulge in this way for the reason that they can not be sealed when too full, and, as a rule, they weigh from 3 to 4 ounces less than the hand-filled cans. Overfilling also necessitates a longer process, breaking up the fruit and detracting from the appearance of the product. In order to bring out the flavor some canners add one teaspoonful of a mixture of equal parts of salt and sugar, or of one part of salt to two parts of sugar, to each can. This is rarely done except upon high-grade goods and must be done by hand in order to insure uniformity.

There are several types of filling machines for solder-topped cans, which consist usually of a cylinder holding the quantity of tomatoes necessary to fill a can and a piston to force them in. The result is more or less badly broken fruit, though the contents are just as good as in the hand-packed. Some of the newer machines fill the cans on the principle of a collapsible tube, and the result is a decidedly better appearance. In all machine filling the measure is by volume rather than by weight. Cans which are filled full of whole tomatoes by hand are known as " hand-packed " or " solid-packed " in distinction from those filled by machine, or filled part full of whole tomatoes and juice added. The adding of juice is done for two purposes, one in high-grade stock to preserve the tomato whole or nearly whole, and in the standard grade to complete the machine fill or to utilize the entire product. In the first case the juice is taken from whole tomatoes and usually condensed slightly by boiling. In the latter case it is made from the trimmings and often of inferior quality. The use of water in canning tomatoes is unnecessary and is an adulteration.

Somewhat too much stress is being placed upon the quantity of solid meat which will be present after draining on a quarter-inch screen. A very high percentage of solid meat may mean the use of a variety which is hard and inferior, or fruit which is slightly green, in which event the flavor is deficient. The full, rich flavor of the tomato is not developed until it is thoroughly ripe, so ripe that the processing will cause a portion of the tissue to break down, and after long shipments they may be badly broken. While it is desirable to have a considerable proportion of the fruit whole or nearly whole, a broken condition is not of itself evidence of improper methods or poor quality. The cans are next run through an exhaust box, where they are subjected to steam heat for from 2 to 3 minutes, after which they are capped in the usual way. Tomatoes are given a process in boiling water for from 35 to 55 minutes.

Tomatoes are packed in No. 3 cans as a general rule, though they are also packed in all sizes from special cans for individual service on dining cars and cafés to the No. 10, or so-called gallon cans for hotel trade. Some of the latter are put up unpeeled. The No. 3 comes in the regular size and in what is known as extra tall. The tomato is also put up as condensed tomato, soup, paste, and purée. To produce these, the tomato is run through a "cyclone" to remove the hard portions and seeds, and then concentrated to different degrees. The use of condensed tomato or purée prepared from sound material has many advantages for some purposes over the regular canned article, and its use should be cultivated, especially for soups, etc. At the price paid for the standard grade of tomatoes a better article can be obtained as a purée or paste. Some purée is made from peel and waste from the canning. If the material is clean and sound there is no objection to its use, but too often this is not the case, as is made evident by the presence of microorganisms, broken tissue, and products of decomposition. A paste which is made from the whole tomato and from trimmings by a system of spontaneous fermentation and salting is used largely by foreigners. This article is no longer permissible in interstate trade. Another grade of paste is made by evaporating the pulp until it becomes very stiff and heavy. The straining of the juice or pulp from the seeds and hard portions can be done better and with less waste by special machinery than in the kitchen.

Tomatoes are sold under various trade grades, as extra choice, extra select, choice, select, extra standard, standard, and seconds. It is unfortunate that there are so many ways of designating the contents of a can, particularly when the prefix is meaningless. What one packer calls his "extra choice" or "extra select" may be no better than an extra standard or a standard of another packer. The real grade at present is dependent upon the packer's name, not upon what he claims. There should be but two grades—selected or first grade, and standard or field run for the second. A can of first grade tomatoes should be from selected, prime, ripe fruit, having a fleshy body, well-developed flavor, and uniform color. The can when opened should be full and most of the tomatoes whole or in large pieces, free from all peel, core, or defects. The net weight should not be less than 32 ounces in a No. 3 can.

A can of standard tomatoes should be from sound, ripe fruit, having a fair body and good flavor. The can when opened should be full, and part of the tomatoes whole or in large pieces. They should be well peeled and cored. The net contents of a No. 3 can should not weigh less than 32 ounces.

MARINE PRODUCTS.

There is a very large variety of fresh and salt water products put up in cans, and these have received the following classification by Charles H. Stevenson:[1]

[1] The Preservation of Fishery Products for Food. United States Fish Commission Bulletin for 1898, p. 512.

There are five general classes of canned marine products, viz, (1) plain boiled, steamed, or otherwise cooked; (2) preserved in oil; (3) prepared with vinegar, sauces, spices, jellies, etc.; (4) cooked with vegetables, etc.; and (5) preserved by some other process, but placed in cans for convenience in marketing.

The first class includes salmon, mackerel, herring, menhaden, cod, halibut, smelt, oysters, clams, lobsters, crabs, shrimp, green turtle, etc.; sardines almost exclusively make up the second class.

The third class includes various forms of herring prepared as "brook trout," "ocean trout," etc., mackerel, eels, sturgeon, oysters, lobsters, crabs, etc.

The fourth class includes fish chowder, clam chowder, codfish balls, green turtle stew, terrapin stew, and devilled crabs.

The fifth class is made up of smoked herring, halibut, haddock, carp, pickerel, lake trout, salmon, eels, sturgeon, etc., and brine salted mackerel, cod, and caviar.

Crabs (Callinectes hasta).

Canned crab meat in this country was the result of experiments made by James McMenamin, of Norfolk, Va. He began at Norfolk in 1878, but moved to Hampton in 1879, and that has been the chief point of supply up to the present time. The season for catching crabs is from April to October.

The live crabs are placed in large crates, well washed, and then run into a steam box, where they are cooked for 25 minutes. After cooling they are "stripped"—that is, the shell, viscera, and smaller claws are removed. The meat is then picked out of the bodies and large claws by hand, or it may be removed by centrifugal force or by compressed air. The latter methods, which are of recent origin, are effective and save much labor. In the centrifugal method the shell and claw are cut across to expose the cells and a quantity so prepared is placed in a centrifugal drum, almost the same as that used for drying in a laundry. The drum is made to spin at a high speed and all the meat is extracted. The compressed-air method consists of an air compressor and a storage tank, with pipes leading to a nozzle. The shell is held in front of the nozzle, the air is turned on, and the meat blown out. Either method is faster, better, and cleaner than the hand picking.

The meat is filled into cans and processed. The No. 1 cans generally used are first heated for a half hour in boiling water, vented, and then processed for 35 minutes at 240° F.

Crab meat is not so easy to keep as some other kinds, the tendency being to blacken more or less in the cans.

Oysters.

The oyster is a marine bivalve of the genus *Ostrea*, the species used in this country being *Ostrea virginiana*. It is found along the coast, chiefly in the shallow waters at the mouths of rivers and in bays. Chesapeake Bay has long been noted for the abundance of its oysters. They are found naturally all along the Atlantic coast as far north as

Massachusetts, and at one time were abundant in Long Island Sound. Active dredging depleted the beds and now the supply is maintained only by cultivation and restricting dredging operations. Some oysters are canned on the coast of Virginia, the Carolinas, and Georgia, but they are no longer canned north of Maryland. The oyster occurs in the Gulf on the west coast of Florida and along the shore to Texas. There is a large business in canning oysters in Mississippi and Louisiana. A few oysters are found on the Pacific coast, but not in sufficient quantity to warrant canning. The abundance of oysters in Chesapeake Bay made canning operations most profitable there, and the output acquired a reputation which still gives it some preference in the market. Prior to 1900 probably 95 per cent of the canned oysters were put up in Baltimore or in the immediate vicinity. The southern or Gulf oyster, however, has been proved to be equally good for canning purposes and the industry has rapidly assumed large proportions in those localities.

The oyster grows naturally on the hard reefs in from 15 to 180 feet of water, depending upon the temperature. In the Gulf they grow in shallower water. They will also grow in the bayous and flats by transplanting and furnishing shells or hard objects to which the spawn may become attached. Formerly no regulations were deemed necessary as to the places at which oysters might be taken, but since the rivers have become polluted with city sewage it is necessary to guard carefully against oysters from contaminated beds. The different States regulate the time when the fishing may be done, which is generally from the 1st of September until the 1st of May. The oysters for canning are usually taken from the beds between the 1st of October and the 1st of April.

Oysters were among the first products canned in this country. It is recorded that some were put up in an experimental way in New York in 1819, though they did not become a commercial proposition until the work was developed by Thomas Kensett in Baltimore in 1844. In the beginning all the oysters were shucked raw, by hand. In 1858 Louis McMurray, of Baltimore, found that by scalding the oysters in boiling water the shells would partially open and the labor of shucking could be lessened. Two years later the system of steaming them instead of scalding was developed, and no material change in method has taken place since that time. McMurray is said to have had a most excellent reputation as an oyster packer. His method was to save all the liquor and condensed steam from the steam boxes, filter it, and use it in filling the cans. He used neither salt nor water. There is probably no packer in the business at the present time following this method.

Oysters are obtained by dredging and by tonging, the former upon the reefs and in the deeper water, and the latter in the shallow bayous where planting has been done. The usual equipment consists of a schooner of about 48-foot keel, 55 feet over all, and 16-foot beam. When loaded, this will carry about 275 barrels of oysters. The crew consists of a captain and four men. A dredge is carried on each side of the boat and operated by two men. The dredge consists of a heavy iron rake about 3 feet wide, to which is attached a chain or heavy cord purse, the mouth of which is held open by an iron bar just above the rake. The dredge is lowered to the ground and dragged along by the movement of the boat. The rake loosens the oysters from the rock or ground and they are collected in the purse. At short intervals the dredge is drawn on board by means of a windlass, the purse is emptied, and the operation repeated. The oysters are culled in some places, the small ones being returned. The catch is put in the hold if the boat is out in warm weather or is to be gone for more than a day. The trips are generally limited to from three to five days in order to insure delivery in a fresh condition at the cannery. Other varieties of smaller boats are also used, though power boats are generally barred. The Gulf-coast factories pay about 60 cents per barrel for oysters used in canning and 80 cents per barrel for those used in the fresh trade, owing to the difference in size. The barrel is rated by measure and not by weight. On the eastern coast the measurement is by the bushel.

The oysters are rated by size. If there are from 800 to 1,000 to a barrel they are known as standard, from 600 to 800 per barrel as selects, and from 450 to 600 per barrel as extra selects. The largest oysters, known as "counts" on the east coast or as "plants" on the Gulf coast, run less than 450 per barrel and are always sold raw. The larger oysters are found on certain reefs on which work has been prohibited for given periods or in certain water where planting has been done. The term "plants" when applied to eastern oysters refers to those taken from deep water, transplanted in shallow water, and cultivated until they have attained a desired size.

When the oysters are brought in, they are hoisted directly from the boat to the steaming car. These iron cars or crates are 28 inches wide, 19 inches deep, and 8 feet long. They will hold five barrels of 2½ bushels each. As soon as the car is filled the oysters should be given a thorough washing with clean water to remove the dirt and mud attached to the shell before it goes to the steam box, otherwise there is contamination during the shucking. The cars are wheeled from the dock to the steam box, which accommodates three cars. The steamer is a rectangular iron box, just large enough to admit the cars, and is 25 feet in length. There are a few variations from these sizes, but these are standard. The doors are closed at either end; steam is turned on until a pressure of 10 pounds is reached, and this is maintained for 5 minutes. The doors are then opened and the oysters allowed to cool quickly in the air. It is important that the oysters be steamed well so that there will be no shrinkage in the can, but not long enough to cause them to become crummy. Both the time and the temperature at which the steaming is done seems to have been fixed by experience, as none of the superintendents seemed to know what the effect would be if a lower temperature and longer time or higher temperature and shorter time were given.

The car of steamed oysters is pushed into the shucking shed, the shuckers standing around the car and working until it is emptied. The usual number of shuckers is from five to eight, and they are generally women and children.

The steamed oyster has the shell partly opened, the meat being easily removed by means of a short, heavy-bladed knife. The oysters are deposited in pans which are hooked to the oyster car. The shucker receives 5 cents for 3½ pounds of selects or 3 pounds of standards. The oysters are weighed as received from the shuckers, washed, and placed in cans by weight according to the grade and order. The cans are filled with a weak hot brine (2 pounds of salt to 10 gallons of water) by passing the cans through a dip box. This method was used at one time in other lines of canning, but has been superseded by more sanitary methods, and should be in this case.

The cans are capped in the usual manner, either by hand or machine, and are then processed in the retort at 240° F., the No. 1 cans for 12 minutes and the No. 2 for 15 minutes. The different packers vary the time a few minutes, but practically all use the same temperature.

The oysters are cooled as soon as sterilized, and when dry are ready to pack. The oyster is easily sterilized, it is not hard on the can, and there is little loss from spoilage.

The cans used are the No. 1 and No. 1 tall, or shanghai, and the No. 2 and No. 2 tall. These are given different fills, and here the consumer is the victim. The practice in regard to size and fill is best illustrated by the following price list obtained from packers:

Prices of the various grades and sizes of canned oysters.

Size and fill.	Price per dozen.	Price per ounce.
Standard oysters:		
No. 1 can, 1½ ounces	$0.37½	$0.25
No. 1 can, 3 ounces	.60	.20
No. 1 can, 4 ounces	.65	.16
No. 1 tall, 5 ounces	.70	.14
No. 2 tall, 6 ounces	1.30	.22
No. 2 tall, 8 ounces	1.40	.17½
No. 2 tall, 10 ounces	1.50	.15
Select oysters:		
No. 1 tall, 6 ounces	1.30	.22
No. 2 tall, 12 ounces	2.50	.21
Extra select:		
No. 1 tall, 6 ounces	1.50	.25
No. 2 tall, 12 ounces	2.90	.24

The variation in fill is not different from that of some other canned foods, but as there is nothing upon the label to inform the consumer concerning the contents it admits of unfair dealing. As the liquor is nothing but salt water and not juice, as many suppose, its use in excess of the amount necessary for proper packing of the article is not justifiable. It would undoubtedly be better for both packer and consumer if the cans were confined to the standard No. 1 and No. 2 and the "short" and "intermediate" weights eliminated. It is not possible to pack each can to weigh an exact amount, as some variation will take place in the water absorbed in processing, and a single oyster over or under weight, especially the large sizes, may cause a variation of a fourth of an ounce or more either way. They can be packed so that they will average the weights given, and the No. 1 should not weigh less than 4 ounces.

The term "cove" is applied to any canned oyster. It originally meant only the oysters obtained on the western shores of Chesapeake Bay and was distinctive of quality. Gradually any oyster became a cove oyster, and now it refers to canned oysters irrespective of where they are obtained.

Salmon.

Salmon canning on the Pacific coast is one of the large canning industries, and is of so much importance that Government aid is extended in maintaining fish hatcheries in order to keep up the supply. The first salmon canning was done on the Sacramento River in 1864, later on the Columbia River in 1866, in British Columbia in 1874, and in Alaska in 1882. The value of the salmon pack on the Pacific coast is more than $10,000,000 annually.

There are four species of salmon which have large commercial importance, *Oncorhynchus tschawytscha*, the chinook, quinnat, red spring, or King Alaska; *O. nerka*, the sockeye, blue back, or red fish; *O. kisutch*, cohoe, silver, or silver sides; and *O. gorbuscha*, humpbacks or pink Alaska. Preference is given to the bright pink color by the consumer, but for real quality the paler cohoe excels some of the others, the flesh being less dry and containing more oil and a better flavor.

The salmon are caught in the rivers as soon as practicable after they leave the sea on the way to the spawning grounds. They are caught by nets, seines, traps, and fish wheels. The catching of the fish is done on an elaborate scale, an idea of which may be gained from a brief description of a trap. This consists of a steel-wire netting, starting at the shore and carried out into the stream at an upward angle for a distance of about 2,500 feet. This netting is supported by piles placed about 15 feet apart. At the outer end is a large square compartment known as the pot. This is usually about 40 by 40 feet and in water as deep as 65 feet. This pot contains a dip net equal to its area. Just previous to reaching the pot the trap is made to zigzag or assume a heart shape, so that the fish in trying to pass up the stream will be directed into the pot. Adjoining the pot is a spiller, which is similar in construction, but of smaller size, having a tunnel or opening connecting the two. The fish pass from the pot to the spiller and are taken out by the dip net or brailer, which is 12 by 12 feet and is cast and drawn on board the boat by power, literally lifting out hundreds of fish at a time. They are hurried to the factory as rapidly as possible, where they are unloaded upon the dock by means of elevators or pews.

It is the general practice to permit the fish to remain out of water in bins for 24 hours before canning, as a certain amount of shrinkage takes place, otherwise there may be excessive blowing of the juice on venting. The fish are washed free from slime or gurry before they go to the butchering room.

The dressing of the fish, or butchering as it is called, is done speedily, mostly by machinery. The head and tail are sawed off on a band saw, where formerly they were cut off with a cleaver. The fish is then fed into the "chink" tail first and back down. By the revolution of this wheel, the fins are removed by special knives, the body is split open, the viscera torn out, and the interior wall scrubbed by revolving brushes. The dressed fish is delivered into a tank of water, and the offal delivered with the gurry. The iron chink does a better job than is done by hand, and is the most important machine in the canning of salmon. After the fish has been dropped into the tank of cold water, it is scrubbed thoroughly with brushes until it is clean.

The dressed fish is placed upon a special slitted elevator, which feeds it transversely into a series of revolving disks, which cut it into lengths corresponding to the height of the can. There are a variety of lengths used, but there are three which are standard; the No. 1 tall, No. 1 flat, and the half pound. Seven knives are used in the gang for cutting for tall cans, 13 knives for flat, and 17 knives for half-pound cans.

The grading of the fish is done on the basis of solid and less desirable body cuts. The filling of the choice parts is done by hand, and each can weighed. The short weights are supplemented by bits, but overweight is not reduced. Much of the filling, especially of the less expensive cuts, is done by machinery. The cans used must all be open top, and this is later either soldered or the joint made with a double seamer.

The solder capping of the cans is different from that practiced in other packing. First a piece of tin with the corners bent up is placed on the fish, then the can is set in a machine which wipes the upper edge, after which the end is put in place, and the can passed through another machine which crimps the end to the sides. This end contains a small hole or tip. The can then rolls, head downward, into a V-shaped groove which contains flux, and continues its rolling in another section of the groove containing solder, and it is here that the final sealing is done. The heating of the contents, due to the hot solder, causes some steam to be generated, and it is for the purpose of allowing this to escape that the piece of tin is placed within and under the vent. When the can leaves the soldering trough it is turned over and the vent closed or tipped. With sanitary cans no tin nor vent is needed, the cap being attached and sealed by machinery.

The cans are then placed in trays, the standard size being 35 inches square and 3 inches deep. Each tray will hold 160 tall or 86 flat standard No. 1 cans, the cans being on end in a single tier. The test for leaks is to set the tray in boiling water for a few seconds and watch for bubbles. Eight trays make a basket, and this constitutes a charge for the retort.

The process consists of heating at 220° F. for 30 minutes, then taking out the fish, venting, and retipping, and giving a subsequent heating for 1 hour and 15 minutes at 250° F. When open-top cans are used, the filled cans are run through an exhaust box very slowly so that they are thoroughly heated before the cover is attached. Venting becomes unnecessary, but the time of cooking remains unchanged—that is, the single heating is equal to both periods under the old method. The hot cans are immersed in lye to remove grease and oil and are then cooled in water. The net weight of the 1-pound tall or flat can should average 16 ounces.

Sardines.

The sardines caught on the Pacific coast are much larger than those taken in the East and are handled in a different manner. They are caught in nets at night, and on being brought to the factory in the morning are put into bins and kept wet with running water for some hours. They are then dressed, scaled, heads and viscera removed, and again thoroughly washed in two or more changes of water. They are next dipped in strong salt brine for a few minutes, rinsed, and placed in wire trays to dry. In order to expedite the drying the trays are carried through a mechanical dryer so that all surface water will be removed. The crates are then dragged through a vat of boiling oil, the length of time being that necessary to cook the fish thoroughly, usually about 5 minutes. They are left in the crates until cool, which is usually until the following day, placed in the cans by hand, oil or sauce added to fill the interspaces, carefully exhausted, and processed at 240° F. for 1 hour and 15 minutes.

Shrimp.

The shrimp is a crustacean and belongs in the same general class as crabs, crayfish, and lobsters. There are a number of varieties found in this country, but the one used for canning is the Gulf shrimp, *Panaeus brasiliensis*. The shrimp found in the fresh waters and west coast are used fresh, but are too small to be used in canning. The Gulf shrimp resembles a large crayfish and is from 5 to 7 inches long. They inhabit the deep waters and come to the shore twice each year. They are active swimmers and are provided with very long antennæ. The abdomen is the only part of the shrimp that is used, the head and thorax being thrown away.

The first attempt to can shrimp was made by Mr. G. W. Dunbar, of New Orleans, in 1867. His efforts did not meet with success until 1875, at which time he devised the bag lining for the cans. In 1880 a factory was started at Biloxi, Miss., and from that time to the present the majority of all the shrimp canned has been put up in these two cities. It is only within the past 10 years that the canning of shrimp has assumed considerable importance, but is still limited to about a dozen places in Louisiana and Mississippi. A cannery was started in Texas but failed to secure a regular supply, and the oyster canneries in Florida could not secure enough to make it profitable to prepare to receive them. The early supply of shrimp was obtained from Barataria bayou or lake, which gave the distinctive name, Barataria shrimp. The name is often improperly used now. The shrimp sent to England are called prawns.

Shrimp are caught in February, March, and April, and in September, October, and early November. The run is uncertain, and a catch depends upon the state of the weather; the quantity taken is very irregular. The shrimp are caught only in shallow water along the shore. Previous to this year (1911), all catches had to be made in less than 6 feet. Newer apparatus has been invented making it possible to take them in water 10 feet in depth. The shrimp are located by coursing over the ground in a small sailboat or a skiff and trying with a cast net. This is a circular net from 6 to 8 feet in diameter with leads every few inches around the edge and a cord attached for drawing it together. A man stands at the bow of the boat and makes trial throws until a school is located. When the shrimp are found the large seine is anchored on the shore at one end and the boat rowed out and around as large an area as the seine will cover. As soon as the second end is brought to the shore the men bring the two ends together and begin to draw in the seine. If the weights hang close upon the ground the chances for a catch are good, but if the seine should rise the shrimp will find a way out very quickly. The handling of the seine requires wading in water from

2 to 4½ feet in depth. The seine is drawn in such a manner as to cause the shrimp to go into the purse in their attempt to escape.

As soon as the catch is made safe the boat is brought alongside and the shrimp dipped out with scoop nets. They are stowed promptly in the hold of the vessel and well iced if the weather is warm or the trip is to continue for more than a day. The seines used in shrimp fishing are from 150 to 225 fathoms in length (900 to 1,350 feet) and from 140 to 150 meshes wide. (A mesh is three-quarters of an inch, giving a width of 105 to 112 inches.) The new apparatus for handling the seine consists of a stake with special pulleys near the bottom so that the seine may be drawn from below without a tendency to raise it off the ground.

The boat equipment for catching shrimp is essentially the same as for handling oysters, so that they are used interchangeably. The seine takes the place of the dredges and windlass, and the crew is usually made up of five or six men. The boats will carry about 140 barrels of iced shrimp.

Shrimps are weighed instead of measured, a barrel being 200 pounds. The pay for catching is $3.50 per barrel in the fall and $4 in the spring. The fall run is the more certain catch and requires less ice, which makes the difference in the schedule of prices.

When the shrimp are brought on the dock they are stored in ice until ready to use. The ice makes the peeling easier and is necessary to prevent spoilage. The removal of the head and shell is known as "peeling" the shrimp, and this is done for all canned shrimp. The head and thorax break from the heavy tail with ease and a slight squeeze will separate the fleshy portion from the shell. This work is done rapidly; the pay for peeling is about 1 cent per pound. The peeled shrimp are thoroughly washed in two or more changes of water and are then ready for blanching. The blanching consists in boiling the shrimp in salt water, which is done by suspending them in a wire basket in the boiling brine. The time of the blanch is usually about four minutes for the wet pack and five minutes for the dry pack. The salt in the brine is in the proportion of about 1 pound per gallon of water. Up to the time the shrimp go into the blanch they are white or slightly gray in color; the boiling in the brine causes them to become bright pink or red.

The shrimp are turned out upon trays having wire netting. As soon as cool they are filled into cans by hand, each can being weighed. The shrimp are all packed in either No. 1 or No. 1½ cans, the former having 4½ ounces and the latter 9 ounces. There is no attempt at grading.

Shrimp are put up in what are known as dry and wet packs. In the dry pack no liquor is added, while in the wet pack brine is used. The process for dry shrimp is 1 hour at 240° F. or 4 hours at 212° F.

for No. 1 cans, and 75 minutes at 240° F. and 4 hours at 212° F. for No. $1\frac{1}{2}$ cans. The process for wet shrimp is 11 minutes for No. 1 and 12 minutes at 240° F. for No. $1\frac{1}{2}$ cans.

The fill of $4\frac{1}{2}$ and 9 ounces in the No. 1 and No. $1\frac{1}{2}$ cans has the appearance of being light weight or slack filled. Experience has shown, however, that close filling causes matting of the shrimp and an unsightly appearance. The wet-packed shrimp are preferred by those who are familiar with the fresh article. They have better texture, odor, and taste than the dry packed. A barrel of good shrimp will pack 190 No. 1 cans or 100 cans of No. $1\frac{1}{2}$.

Formerly shrimp were put up in bulk with a preservative. These were headless (only the head and thorax removed, the shell left on), and since that method of preservation is no longer approved, very few shrimp are obtained upon the market other than canned. Some pickled headless shrimp are put up in 1 to 5 gallon cans for hotels. These are boiled in strong brine for several minutes and put up in a saturated salt solution. They keep, but are very salty, and as it takes a long time to freshen them they are not available for immediate use.

Shrimp are difficult to keep. Put up in the ordinary tin can they will blacken in a short time and will attack the tin, making minute holes. Success in canning shrimp was dependent upon lining the can. This was first done by Mr. G. W. Dunbar, of New Orleans, in 1875. The method consisted in inserting a sack in the can and filling it with the shrimp to prevent their coming in direct contact with the tin. Later a thin veneering of wood, corn husks, parchment paper, asphaltum, and enamels were used. Parchment paper is used by all packers, with possibly one exception, at this time; in this case wood veneer is used.

MILK.

Canned, condensed, or evaporated milk is one of the large industries in this country. It is put up as plain or sweetened evaporated milk. The condensory is usually located in a good dairy section where a sufficient quantity of milk can be obtained by direct delivery in a very short time. The production must be under similar conditions to those obtaining in city dairying. The cows must be healthy, the dairy sanitary, the milking done in a cleanly manner, and the milk cooled and delivered promptly. The matter of cooling and prompt delivery is more important than in the city delivery, for the production of a slight acidity will interfere with condensing to a consistency where the product will comply with the law.

On being received at the condensory the milk is immediately tested for acidity and fat, and if the former exceeds 0.2 of 1 per cent the milk is rejected for regular trade, though it may be accepted at a lower price for making a cheaper grade for confectioners' use.

The milk is run through a clarifier to remove any foreign material not taken out by the home strainer. It is next drawn into a large tank which will hold an amount sufficient to charge the pan. The milk of several herds is mixed in order to secure uniformity in the fat content. Each tank is tested for fat and solids so that the exact ratio of concentration needed to give a certain result may be known. The milk is given a preliminary heating, usually to 190° F., though there may be some variation in the different plants. The milk is then ready for the vacuum pan, which consists of a large copper kettle completely hooded and connected at the top with a pump. The milk is heated in this kettle by means of a coil on the inside. The pump draws a vacuum of 25 to 29 inches and evaporation with violent agitation takes place at 130° F.; the temperature is usually kept below 150°. When the batch is nearly finished, a " strike " is made or a sample is drawn to test the consistency. The milk may or may not be run through a homogenizer to divide the fat into such fine particles that the cream will not rise in the finished product. It is next drawn into a filler, and in so doing the temperature may be raised to about 165° or 170° F., or the can may be filled cold.

The processing is done in retorts which differ from those used in vegetable packing in that special crates are provided which carry the cans and revolve so that the contents will be kept in a smoother condition. Both the time and temperature for condensation vary in different factories, and in careful work tests are made on a few cans before the batch is processed. In general it may be said that the temperature varies from 225° to 240° F., the time depending upon the degree of condensation desired, the condition of the milk, and the size of the can. Twenty minutes for a 6-ounce and 28 minutes for a 12-ounce can at 240° F. is safe. Immediately at the close of the cooking the cans are cooled, placed in cases, and shaken for three minutes.

Condensed milk can not be used for all the purposes of fresh milk, and is somewhat less digestible than the fresh on account of the cooking. It is an excellent substitute for many purposes and the evaporated—that is, the unsweetened product—has the advantage of being sterile.

SPECIALTIES AND SOUPS.

Beans, Baked.

Pork and beans, beans and tomato sauce, and baked beans are the ways which the labels read on the product which a few years ago was known only as " baked beans." The beans used for this purpose are the small white pea or navy bean. They are chiefly grown in New York, Michigan, and Wisconsin and are a regular field crop, sowed, cultivated, and harvested when ripe and used only in the fully ripe dried state. The quantity used in this way is enormous.

The beans should be of good quality, small, white, machine-cleaned, and hand-picked for defects. The first step in preparation is soaking, and this is done in tanks or barrels and lasts for from 12 to 24 hours, depending upon the method of handling. The water is changed in the tank about once in 6 hours, or, on the fancy article, about once in 4 hours.

From this point on the preparation varies greatly in different factories. For the very cheap trade the beans are boiled in a squirrel cage or pea blancher for a few minutes before placing them in the can; others boil them very slowly in an iron-jacketed kettle from 30 minutes to 3 hours before canning. Some boil them just long enough to slip the skin, the length of time depending wholly upon the grade of the bean.

Before the cans are filled, a piece of pork is placed in the can, then the beans, and finally the sauce. The sauce varies greatly, though tomato sauce is the most popular at present. This is made from a good heavy pulp, salt, sugar, and spices, the proportions being varied to suit the fancy of the packer. Plain sauce is made with water, salt, sugar, molasses, and spice. It is important that just the proper quantity of sauce be added, for in the processing some moisture will be taken up by the beans, and if too little sauce or moisture is added they will be dry and hard, while if an excess be added they will be sloppy.

In these methods there is no real baking, the beans having been soaked and boiled. They are subsequently heated in the can at a baking temperature, but no moisture can escape, and baking generally implies that the material is subjected to dry heat, usually in an oven. The real characteristic is the change in and breaking up of the tissues with loss of weight, due to the escape of moisture. Formerly baking was done under hot ashes or coals, in clay or brick ovens; now it is done in stoves and special ovens, and the latter may be heated by steam. The same results may be accomplished in superheated steam as in hot air. The difference between baking and roasting is not always clear, but between baking and boiling there is a distinction. The term "baked" beans, therefore, implies that they have been exposed to a dry heat. This is accomplished by heating the soaked beans for a short time, until they soften but do not break open or become mushy. They are then placed in large pans in thin layers and allowed to bake in ovens until they become dry and mealy and develop the characteristic brown color. The beans, when poured upon the filling table will readily separate from one another. Another method is to place the beans in large trays in the retort and subject them to dry steam until dry and mealy. The result is almost the same as in the oven—a loss of about 8 per cent in weight taking place and giving the same dry baked bean. These are filled in the can and sauced, as has already been described.

The processing of beans will depend altogether upon the method of preparation, usually from 1 hour to 2½ hours for a No. 2 can, at a temperature of from 245° to 250° F.

There is probably no staple canned which presents more variety in quality and flavor than the bean. The best is a high-grade product, the beans used are expensive, and the dressing, if made of tomato, is good pulp, the same care being given in its preparation as is used in preparing any other. Not so much can be said for some of the very cheap brands, the beans used are inferior, the pulp used is from trimming stock, and the object is to get as much water in the can as possible. The net weight of beans in a No. 1 can should be not less than 19 ounces.

Hominy.

Canned hominy is used in every mining and logging camp in the country. It is primarily the diet for the hard worker, but is also used with milk to take the place of a breakfast food in thousands of homes. It was first packed in 1895 by Mr. I. V. Smith, of Delphi, Ind., and almost immediately others followed.

Hominy is made from selected white corn. The shelled grain is screened to take out all small, defective, or split grains, and any chaff or foreign substance. It is then washed and run into the lyeing machine. Here the corn is treated with a hot solution of lye, during which time it is constantly cooked and agitated until the tough hull loosens. The strength of the lye and the length of time required for the cooking varies at different factories; the time of cooking varies from 20 to 45 minutes. After the lye has accomplished its work the grain is run through a huller, which is in reality a short conical "cyclone," which removes the hull and tips.

The grain is next washed in a squirrel cage, pea blancher, or hominy washer. The different canners use very different methods at this point. Some soak the corn over night in order to have the kernels swell to the maximum before canning; others soak and cook for only a short time, an hour or two; while some fill the cans at once and depend upon the swelling in the process to give the desired result. The soaking has the effect of getting rid of traces of lye, makes a more tender kernel, and a clearer liquor. The cans are so filled that when the process is completed the grains fill the can nearly full and should be covered by only one-fourth inch of liquor. The liquor should be fairly clear and few black tips present.

The standards adopted for hominy by the Indiana Canning Association are—

No. 3 Fancy: Minimum weight after draining a can, 22 ounces, and to fill to one-half inch of the top of the can. Not more than 2 per cent of black tips. Prepared from selected white corn.

No. 3 Standard: Minimum gross weight, 39 ounces, 18 ounces of hominy after draining, and can to be filled to 1 inch of the top when drained. Prepared from medium-sized white corn and to contain not more than 5 per cent of black tips. This weight is too low and should be not less than 20 ounces in a No. 3 can.

Sauerkraut.

Sauerkraut is made by the natural fermentation of cabbage in casks. The cabbage heads are stripped of all outside or green leaves, leaving only the white sound head. It is then cut into thin slices in a specially constructed machine. The long, fine-cut cabbage is evenly spread and well packed in casks. To each layer salt is added at the rate of about 2 pounds per 100 pounds of cabbage. The salt is used as flavoring and to modify in some degree the fermentation. If too much salt is used, a pinkish color results; if too little, the fermented product may become more or less slimy. The temperature of the weather at the time of putting up the cabbage also influences the fermentation. If the weather is very warm, the fermentation is too rapid, the product has a very white but more or less slimy appearance, and the cabbage is tough rather than of a natural crispness. If the temperature is very low, fermentation will be arrested. The best temperature is probably between 60° and 70° F., and the process requires about 4 weeks. Fermentation begins as soon as the cabbage is placed in the cask, but there is only a slight rise of temperature as compared with most fermentation processes. A heavy foam rises to the top, which must be skimmed off every day, and when this ceases to form the brine goes down and the process is complete. Use can be made of the kraut at once, though it seems to be better after standing. The kraut will keep in the casks for a long time, provided there is no leakage, and the spoilage is usually limited to a few inches on the top.

Kraut is easily canned, which is the only clean way of dispensing it in groceries in small quantities. The canning should be done where the kraut is made. The shipping of kraut in barrels to distant points to be canned has nothing to commend it and much to condemn it. The repacking in barrels means labor and loss of material, and in too many cases the loss of natural brine, after which spoilage takes place easily. The canning should be done while it is in the freshest possible state at the point of production. Kraut is easily kept. The cans should be filled full, weighed, and sufficient hot water added to fill the can; then exhausted, capped, and processed at boiling temperature for 25 minutes.

A properly filled No. 3 can should not contain less than 22 ounces of kraut, as determined by emptying upon a sieve of one-eighth inch mesh and allowing to drain for two minutes.

SOUPS.

Soups of almost every description may be obtained in cans. There is no standard, but each one is made according to the formula of the particular packer. Some soups are concentrated, while others are ready for use. They are practically all packed under Government inspection, both of the plant and the materials used. No meat products can enter interstate trade without being inspected, and since nearly all soups contain either meat or stock made from meat, they must comply with all the requirements governing meat inspection.

Soups are classed as meat or vegetable, though there are but few of the latter that are not made from some kind of meat stock. The usual procedure in making soup is to select the meat stock, which is usually beef, though veal or mutton may be added. The meat used by some of the best factories is of the very highest quality, not merely any meat which has passed inspection. This is cut into pieces, the size depending upon whether it is to be used in the soup or only for the stock, and is placed in large steel kettles. These are heated by steam and covered tightly, so that the stock may be cooked slowly without evaporating. The cooking is continued below the boiling point for several hours, depending upon the kind of meat used and the care given to the making of the soup. The slow cooking has the effect of bringing out the extractives, giving a better flavor and a richer product. The liquor is skimmed at regular intervals, and if the stock is for a clear soup or a bouillon, it is clarified with eggs and filtered. If for a soup containing the meat, this last operation may be omitted.

The vegetables used in making soups are carrots, turnips, parsnips, peas, beans, onions, leeks, celery, okra, tomatoes, etc. As far as possible, these should be used in their fresh state, but as it is not possible to have them all fresh at the same time the canned article must be substituted. The vegetables used are prepared separately, washed, peeled, cut into pieces, cubes or special forms, blanched, and in some cases given a separate cooking to get the proper tenderness. These are mixed in the proportions desired, placed in the cans by weight, and the stock added afterwards. The process will depend upon the body, whether thick or thin, and the quantity of meat used.

The making of soups is peculiarly a chef's work; it is not possible to give a formula for so many pounds of meat and vegetables, set a definite time for cooking each, and get a first-class product. The characteristic flavoring depends upon the blending and the condiments used, which is a matter of training and judgment. For meat soups the best packers follow the practice of holding the cans in stock for some weeks in order that they may improve on standing. A good soup requires much work in its proper preparation, much more than is given in the canning of fruits or vegetables. Many soups are made according to formula, and while of good material, are not distinctive.

A list of soups includes the following: Beef, bouillon, celery, ox-tail, mock turtle, veal, chicken, chicken gumbo, consommé, green turtle, clam broth, clam chowder, mutton broth, tomato, tomato-okra, vegetable, pea, asparagus, mulligatawny, vermicelli, and Julienne.

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