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BLS Report No. 57

Case study data on

productivity and factory performance...

PROCESSED FOODS:

Preserves, Jams, and Jellies

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PREPARED FOR THE FOREIGN OPERATIONS ADMINISTRATION
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By the
UNITED STATES DEPARTMENT OF LABOR
James P. Mitchell, Secretary
BUREAU OF LABOR STATISTICS
Ewan Clague, Commissioner

The collection of the data presented in this report has been made possible not only by the cooperation of manufacturers in the United States but also by the advice and assistance of many individuals in the industry, in trade associations, and in labor unions. The men who have contributed their time and technical experience deserve particular appreciation for having made available data on man-hours, output, factory operations, production methods, managerial practices, and machinery--data which represent the results of many years of research and observation.

The term productivity is defined as the ratio of a given quantity of production (output) to one or more of the various "input" factors that are required for such production. As used in this report the input factor concerned is labor, the most important and universal factor and the one that provides the most generally useful common denominator for comparing the efficiency of productive methods and techniques in different units of an industry or between the same industries in different geographic locations.

The material in this report constitutes one aspect of the variety of services offered in the Technical Assistance Program of the Foreign Operations Administration. The Factory Performance Reports are prepared and published as a result of a request from the Organization for European Economic Cooperation, under a project designated as TA-OEEC-94.

Full translation and reproduction rights are hereby granted to those groups desiring to translate this report into their own language for distribution to members of their industry and labor groups. Similar reports covering other industries and products are currently being prepared and will be released as soon as they are completed.

Reports in this series published to date and available are listed on the inside back cover of this publication.

The new Bureau of Labor Statistics Reports series combines in a single sequential numbering system the several special numbering systems previously used on nonperiodical mimeographed and multilithed publications not offered for sale by the Superintendent of Documents.

For the convenience of persons who received material regularly under any of the abandoned series, items issued as BLS reports for a time will also be identified by their former series number.

In addition to the BLS reports series, the Bureau also issues numbered bulletins, offered for sale by the Superintendent of Documents, and numbered reprints from the Monthly Labor Review.

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Case Study Data on
Productivity and Factory Performance

PROCESSED FOODS: PRESERVES, JAMS, AND JELLIES

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FOREWORD

This report is intended to be primarily for the use of European production managers, superintendents, and methods engineers who are concerned with productivity problems. A study of the technical portions of this report should make it possible for these plant officials to compare manufacturing operations in their plants with the operations in one or more of the plants studied. In addition, the general discussion of productivity and the presentation of man-hours per unit in the manufacture of fruit spreads may be of interest to government, labor, and trade association officials in Europe.

The products covered were selected on the basis of requests made by European industry groups and transmitted to the Bureau of Labor Statistics by the Foreign Operations Administration. The plants selected for the case studies are intended to provide examples of the manufacture of these products in American plants but are not intended to represent a statistical sample of the American industry. The criteria used in selecting plants for study are that the product made by the plant be similar to the product specified in the original European request, that the plant selected maintain records in sufficient detail to provide data, and that the cost of collecting the data be minimized.

Description of Report

This report is divided into three chapters. Chapter I is directed primarily to the reader who is interested in the less detailed aspects of productivity in the industry. Chapter II contains detailed case studies of each plant and will be of value to the plant superintendent or the production engineer. Chapter III contains a brief discussion of workers' earnings, and the benefits to the worker which are due to increased productivity and unionization where applicable. The appendixes contain case studies of labor adjustments to technological change, industry background information, and a copy of the questionnaire used. The glossary completes the report.

The data used for the case studies were obtained from plant records and from plant officials by representatives of the Bureau of Labor Statistics who visited each plant for the express purpose of making this study. The amount of detail shown in the case studies varies because some information is not obtainable from all plants, and some information is not usable in the form provided. Supplementary information was obtained from other Government agencies and trade associations.

How To Use This Report

In using this report the following procedure is suggested to plant officials:

1. The plant official should refer to table A, and to the case studies in chapter II, to identify the United States plants in this study with

employment, production volume, and integration most nearly approaching the situation in his plant.

2. Appendix III contains a reproduction of the questionnaire used to obtain the information from the United States plants in this study. If the European production official will use this questionnaire to calculate labor requirements in his plant, he will be able to compare performance and to isolate areas where his plant's performance is relatively good or relatively poor.

3. The European plant official is now ready to compare the machinery and methods described in the report with those existing in his own plant, for those problem areas he has isolated. At this point the report does not give him the precise engineering information needed but it does suggest the approximate requirements in terms of volume, methods, machinery, and manpower for approaching the productivity levels illustrated in the individual case studies.

4. For serious problem areas uncovered in this manner, the expert assistance of engineers, either those within his plant or outside consultants, will be needed. Intensive study must generally be made to correct the conditions found by comparison because these reports do not replace on-the-spot engineers or other specialists, in the analysis of specific situations.

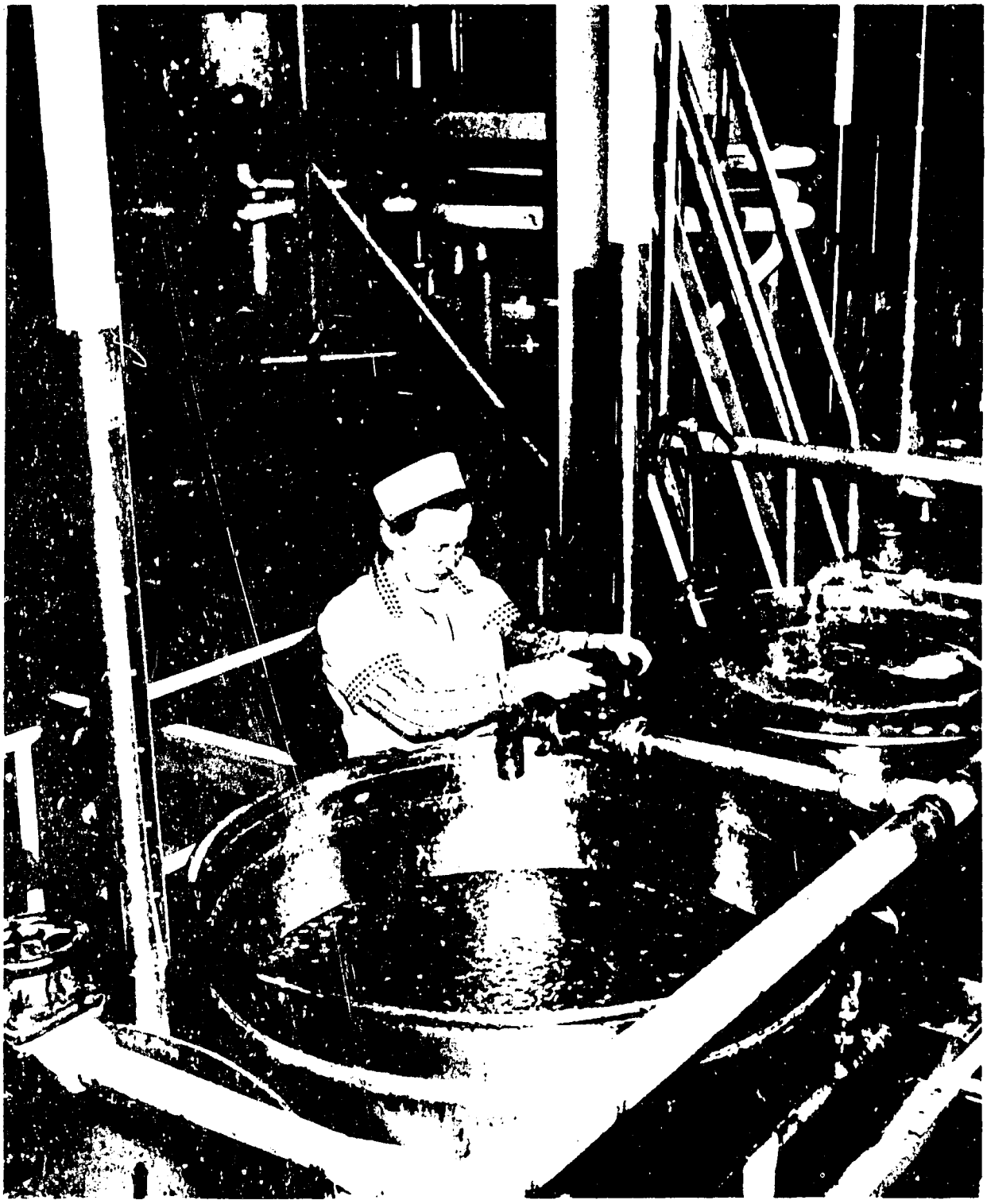

Figure A. Part of a battery of cooking kettles charged with preserves.

Case Study Data on
Productivity and Factory Performance

PROCESSED FOODS: PRESERVES, JAMS, AND JELLIES 1/

CHAPTER I: THE GENERAL REPORT

Highlights

Strawberry preserves and grape jelly were, at the time of the study, the most popular types of fruit spreads (preserves, jams, jellies, butters, and marmalades). Preserves, jams, and jellies accounted for an estimated 80 to 85 percent of all fruit spreads produced in the United States in 1951, as reported by the U. S. Department of Commerce. 2/

Commercial production of preserves, jams, or jelly fruit spreads in certain American factories requires from 4 to 30 man-minutes of labor for a 24-pound case, usually consisting of 2 dozen 1-pound or 1 dozen 2-pound glass jars. 3/ This time includes the preparation of frozen or fresh fruit, pre-heating and cooking, filling, capping, pasteurizing, cooling, labeling, and casing the filled containers. The amount of labor time required by each factory is determined by such factors as the kind and variety of fruit spreads produced, scheduling of production, volume of fruit spread produced at any one time, plant layout, types of machinery used, and the extent of mechanization in the plant.

Care in scheduling has made for increased productivity; for the number of man-hours expended per case has tended to decrease with the large-volume scheduling of the production of a particular type of fruit spread. Because shifts in the use of a production line from one type of product to another are characteristic of plants in this industry, successful planning of production scheduling to reduce the frequency of such shifts has had an important bearing on man-hour requirements.

Another important factor contributing to high productivity has been the effort to improve plant layout and equipment. Since 1946, some of the plants studied in this report have improved the layout of their processing lines,

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1/ Prepared by Thomas G. Gentel, Walter Garbalinski, and Edward Schneider, of the Division of Productivity and Technological Developments.

2/ U. S. Department of Commerce, Office of Industry and Commerce, Fruit Spread Production, 1951, December 1952 (p.1). This estimate was based on a survey by the National Preservers' Association representing 75 percent of the industry's annual production.

3/ Container size refers to the quantity it holds, i.e., a 1-pound glass jar will hold 1 pound of jelly, jam, or preserves.

and rearranged their machinery and equipment to reduce materials handling to a minimum, to make it easier to shift their production among different products. Changes in plant layouts often result when new machinery or materials-handling equipment are purchased. This is particularly true when equipment such as conveyor belts, chutes, overhead monorail conveyors, or other types of fixed materials-handling equipment are installed. New processing equipment has also been purchased and installed by some of the plants; others plan to install similar equipment. Competition and the necessity for reducing costs are the motivating factors that cause plants to seek methods that will increase production per man-hour and reduce costs, and thus allow them to maintain their competitive position.

Product Characteristics

Definition of Products. There are five types of fruit spreads produced in this industry: preserves, jams, jellies, butters, and marmalades. These items have been well standardized and defined by consumer usage, industry standards of identifications, and regulations of the Food and Drug Administration of the Federal Department of Health, Welfare and Education.

Preserves and jams are similar in their production - the whole, sliced, or crushed fruit is not separated from the juice that is extracted during cooking or pressing. Preserves, however, generally contain larger pieces of fruit in the jellied juice than jams. The shape of the fruit is retained in preserves but not in jams.

Jellies are the clear jellied juice from which all particles of fruit have been filtered.

Butters are usually products made from strained fruit pulp instead of filtered fruit pulp. Butters differ from jams by having higher concentration and finer consistency, and are usually heavily spiced. They do not have the same consistency as jelly and their texture is coarser.

Marmalades are similar to jellies except that they are usually made from citrus fruits and suspended slices of fruit or peel are found in the clear jelly.

Standards for Products and Containers. Standards have been developed and administered by the United States Department of Agriculture for many canned foods, including fruit spreads. Samples are submitted for inspection and subjected to a scoring system upon which basic grades are certified and processors permitted to use the United States Department of Agriculture certification on their labels. The use of certified grades has been helpful in sales promotion for the products.

Equally important are the standards developed by the United States Department of Agriculture and growers for grading the fresh fruits that may ultimately be used in fruit spreads. These standards have been an aid to the growers in the sale of their crops.

In recent years there has been a concerted effort by industry and Government to reduce the multiplicity of sizes and shapes of containers. The use of standardized containers has helped reduce costs by permitting smaller inventories of containers and shipping cartons, and standardization of packing machinery.

Plant Characteristics

The eight plants included in this study varied widely in such characteristics as variety of products made, size of plant, machinery and equipment used, plant layout, and production methods.

Specialization of Production. Only three plants specialized in the production of fruit spreads, the types of spread and the particular kind of fruit used varied even among these plants. Some other plants produced such related food products as juices and frozen juice concentrates, honey, and sirup. One plant also produced such products as pickles, relishes, sauces, and luncheon meats. Another made ice cream and other products for sale at soda fountains.

One interesting finding of the survey was that firms specializing in the production of fruit spreads were not necessarily more efficient than multiproduct plants. One reason is that fruit spreads are produced in a department that is usually separate and distinct from the rest of the plant. Also, large multiproduct plants can usually afford better engineering services, and can buy newer and better equipment.

Organization of Plants. Plants B, F, and H are components of multiplant corporations. The other five are single-plant companies. Type of organization apparently does not affect the output per man-hour.

Employment. The plants (or departments of plants) producing fruit spreads ranged in size from about 14 to 40 employees. Size of plant, as measured by the number of employees, had no relationship to output per man-hour. Plant E, employing the fewest workers, had the lowest number of man-hours expended per 100 cases. Plant D, with only a few more employees, had the largest number of man-hours expended (table A).

Buildings and Machinery. Three of the plants were housed in single-story buildings and the others were in multistoried structures. The three single-story plants occupied areas ranging from 10,000 to 50,000 square feet. The other plants of 3, 4, or 5 floors ranged, in space occupied, from 20,000 to over 100,000 square feet. Buildings were constructed of steel, brick, and concrete. Details for the buildings of each plant are given in chapter II.

Six of the eight plants reported information on installations of new machinery or replacements for the period following 1946; one plant indicated that some innovations had been made just prior to this period. Most plants reported that they had built some of the machinery or equipment themselves. One plant, which stated that it had made no new investment in machinery, had

some of the oldest equipment of any of the reporting plants. Its man-hour requirements were in the lower half of all the reporting plants, whereas plant D, the highest in man-hour requirements, had installed some new machinery.

Following is a partial list of new machinery and equipment installed in some of the plants, illustrating the wide variety of installations:

New steam boiler units
Stainless cooking kettles
Magnetic trap for removing metallic particles
Machine to blow lint out of jars before filling them
Filling machines
Vacuum pan and low vat
Closing or capping machines
Spray cooling machines
Automatic packing and labeling machines

Engineering and Research. Engineering functions such as plant layout, production methods and planning, product improvement, and related responsibilities such as cost analysis, are usually performed by the plant staff and operating executives in conjunction with their other duties.

Seven plants provided information on research activities. Of these, all but two indicated they employed chemists on their own staff, chiefly for their quality control laboratories; the two plants not having chemists employed directly used the services of outside laboratories on an annual basis for product analysis and improvement. Visual inspection at the filling station was the only other type of inspection or quality control reported. Only plants B and H reported having separate engineering departments.

Table A. Man-hours expended per 100 cases of preserves, jams, and jellies, in 8 selected plants, U. S. A., 1951 1/

Plant	Man-hours per 100 cases 2/			Percent of indirect to total man-hours
	Total	Direct	Indirect	
A	8.16	4.57	3.59	44.0
B	17.38	13.62	3.76	21.6
C	15.03	11.90	3.13	20.8
D	52.13	43.06	9.07	17.4
E	6.56	5.38	1.18	18.0
F	19.68	16.80	2.88	14.6
G	13.05	8.59	4.46	34.2
H	7.83	5.40	2.43	31.0

1/ Specifications for products reported by each plant are given in chapter II.
2/ 1 case equals 24 pounds of fruit spreads.

Production Planning and Control. All plants surveyed scheduled production from 1 to 5 days in advance depending upon type, flavor, and quantity of product. When frozen fruits are used, the plants require advance planning to enable them to bring the fruit out of storage in time to thaw. The use of frozen fruit has enabled the industry to schedule production throughout the year. Only two plants, B and H, reported seasonal shutdown - from December through March. Other plants close only during their annual vacation period.

The 8 plants reported 3 different methods of scheduling production. Two plants plan production on the basis of orders received and maintain little or no inventories. Three plants maintained a minimum inventory and when this level is reached, production is planned to replenish it. Two plants use a quarterly forecast of orders to maintain their inventory. One plant keeps its long range plans flexible enough to change them as orders are received.

To reduce idle-machine time, cleaning and repairing are generally scheduled when there is a change in flavors or when machinery needs adjusting. Regular maintenance is scheduled also during lunch and rest periods, or after working hours.

Material Inventory Practices. Most of the plants use frozen fruits and by placing them in cold storage are able to maintain inventories that will be sufficient for a normal year's production in some of the plants. Three of the plants have their own cold storage facilities; the other plants lease cold storage space from commercial firms. Maintenance of a large supply of raw materials prevents plant shortages. On the other hand, a large inventory requires more capital and a drop in the market price might entail a large loss.

Practically all plants use liquid sugar in their production of fruit spreads. Delivery can be made to the plant by tank car, tank truck, or barrel. Tanks are used for storage and pipes carry the liquid sugar to the various places in the plant where it is used. Large quantities of sugar are used and the amount stored ranged from 1 day's to 2 weeks' production needs.

One small plant reported it accumulated raw materials, based on orders, 5 days in advance of scheduling production. This practice reduced the amount of capital invested in inventories.

Inventories of jars and containers varied widely. Some plants reported only a supply sufficient for 1 week's production, whereas, others had enough to last for 6 months.

Inspection

Raw Material Inspection. Most of the plants inspected raw materials visually since they accepted only standard grades of fruits. Some plants had chemical analyses made by either their own laboratory technicians, or by outside agencies. Glass containers were inspected visually at various points in the production process.

Finished Product Inspection. Considerable variation existed among the plants. One plant visually inspected the jars or containers at the filling machine, but other plants had more elaborate methods. Plant F had the most careful inspection plan--a continuous inspection of raw materials and finished products was made throughout the various processing operations. Qualified operators using a quality control system tested the finished product. One of the tests provided for tasting the contents to insure a continuity of flavor for consumer acceptance.

Manufacturing Operations

Production methods for preserves and jams are similar to those for jellies. The basic ingredient for preserves, however, is the fruit itself rather than the extracted juice. Operations or processes common to the production of all three spreads are washing, peeling, trimming, coring, cooking, filling, capping, cooling, labeling, and casing. In addition, jelly manufacturing requires the two additional processes--of pressing, and clearing or clarification. Inasmuch as jelly manufacturing includes all the operations necessary to produce preserves and jams, and the sequence is the same, most operations are described for jelly manufacturing only.

Preparation. Jelly-making begins with the preparation of the fruit for cooking. If fresh fruit is used, it must be washed thoroughly to remove dirt, leaves, and other residues such as those caused by insect sprays used during the growth of the fruit. Delicate fruits such as berries are washed either in running water that carries the fruit over baffles, or by gently spraying the fruit with water as it is carried along a shaker-grader. For hard fruits a rougher treatment is more effective and pressure sprays can be used. When the skins of the fruit are to be used with the pulp, insect spray residues are washed with a 0.1-percent hydrochloric acid solution. Berry fruits must have the stem and calyx removed; other fruits require peeling and coring. Peeling is done usually by mechanical means or by treatment in a lye solution. Fruits such as cherries must be pitted.

When frozen fruits or berries are used, the operations described above are not required, having been performed at the processing plant.

Cooking. Some manufacturers begin this operation by dumping the frozen fruit in boiling water, but others allow the fruit to thaw at room temperature.

Preserves or jams are boiled to obtain the maximum yield of juice, pectin, and other extractives. The length of the boiling period varies with the variety and texture of the fruit and is limited to the time necessary for thorough extraction of the juice, but not long enough to make the fruit mushy. Citrus fruits may be boiled for an hour, apples for 20 minutes, and berries for as little as 2 minutes.

Jelly manufacturers obtain maximum extraction from the fruit by additional boilings with fresh water when fruits are very rich in pectin. All

the extractions are mixed and concentrated to a standard volume by the processor. To reduce handling of the solution for the next operation, steam-jacketed, copper kettles are placed on a platform or floor above the press, so that the cooked pulp and juice will flow by gravity to the press.

Pressing. After the fruit has been cooked, the juice is pressed from the pulp in a press. There are several types of presses, but the most popular is the rack and cloth press. In this type, the juice is extracted as follows: crushed, cooked fruit is placed in heavy, coarsely woven cotton cloth bags and then laid in the press. A rack made of heavy wooden slats is then laid on the bag of fruit, another layer of fruit bags is laid on the rack and the process continued until the press is filled. Pressure is then applied to the pile by means of a screw and lever operated manually, or hydraulic pressure is used. After the juice has been pressed from the fruit, it is then clarified.

Clarification. Most of the heavier particles are removed from the juice as it passes through the cloth during the pressing operation. Additional clearing of some fruit juices is obtained by letting the particles settle overnight. In some cases the juice is cleared in centrifuges. Another method used by some manufacturers of jelly utilizes an enzyme such as pectinol to coagulate the colloidal constituents of the juice.

Concentration. All fruit spreads are concentrated by removing excess water. Jellies are concentrated by boiling the clarified juice, Other fruit spreads are concentrated during cooking.

In jelly manufacture, sugar, pectin, and citric or tartaric acid, if necessary, are added before boiling the clarified juice to concentrate the sugar to the point at which jelly occurs. Skimming any coagulated material from the juice during boiling helps to make the jelly clearer. Kettles are generally steam-jacketed and made from any of several different metals, depending upon the fruit to be cooked in them. Kettles lined with glass are now being made. Boiling time should be as short as possible to prevent loss of flavor, injury to color, and hydrolysis of pectin. Boiling the material in a vacuum kettle reduces both the temperature and the time because liquids boil at a lower temperature in a vacuum.

Finish Point. When fruit spreads have reached their proper consistency, they have reached the "finish point." The finish point for concentrating fruit spreads of any type is important in obtaining appropriate consistency. Insufficient concentration will cause jelly failure, and too much concentration causes the texture to become stiff, sticky, or gummy.

All manufacturers use an optical instrument called a "refractometer" for determining the finish point. This instrument is usually calibrated in percent of sugar and can be read in a few seconds after placing a drop of the liquid on a prism of the instrument which is cooled by a water jacket. As concentration progresses, an experienced operator uses the drip or sheeting method to determine consistency. Some of the liquid being tested is allowed

todrip or sheet from a spoon or paddle. If it drips as a thin sirup, the process is not complete, but if it congeals and forms jelly-like sheets, the finish point has been reached. Hydrometer readings may also be taken during boiling. Refractometer readings, however, are the most accurate.

Filling. As soon as the jelly reaches the desired consistency it is placed into containers as rapidly as possible to prevent solidification in the kettles or filling machines. Glass jars or tumblers are generally used. However, enamel-lined tin cans and special paper containers are sometimes used. Automatic filling machines measure a specific quantity of jelly into each container.

Sealing and Pasteurization. There are two types of caps generally used to seal fruit spreads - a vacuum cap and a screw cap. Vacuum caps are frequently used for jellies and the caps are applied by machine. Preserves are sometimes hand-capped. When the containers are sealed at scalding hot temperatures, (180 to 212 degrees Fahrenheit), further pasteurization is not needed as the hot jelly placed in a preheated container will remain sterile. In some capping machines, steam is injected into the space between the jelly and the cap. This sterilizes the space and helps form a vacuum for holding the cap in place. Jelly preserved by heat need not be concentrated to so high a sugar content as that not thus treated, and the saving in sugar may compensate for the added cost of pasteurization.

Some plants use a continuous pasteurizer in which the glasses of jelly are carried by a woven wire cloth conveyor through a tank of water thermostatically controlled at pasteurizing temperature. Some of these continuous pasteurizers are equipped to cool the jars after pasteurization by passing them through several tanks or a series of water sprays at progressively decreasing temperatures.

Labeling and Casing. After the containers of fruit spread have been pasteurized, cooled, and sealed they are labeled and placed in cases for shipping or storage. In some plants, movement of the material is by conveyor from one operation to the next. Although machines have been devised for labeling and casing, these jobs are often done by hand in smaller plants.

Container Usage

According to a survey by the National Preservers' Association (footnote 2, p. 1), glass containers accounted for about 86 percent of the reported fruit spreads packed, about half of which was in less-than-1-pound sizes. About 75 percent of all jellies packed in glass were in less-than-1-pound sizes, and about 78 percent of the fruit butters were in more-than-1-pound jars. About half of the glass-packed preserves and jams were produced in less-than-1-pound sizes, and the remainder was evenly divided between 1-pound and more-than-1-pound glasses.

To stimulate the sales of fruit spreads, many manufacturers pack them in glass containers that have additional uses for the customer after the containers have been emptied. For instance, some glass tumblers are made of thin glass and can be used as drinking glasses. Others have designs printed or embossed on them for decorative purposes and can be used as drinking glasses or vases. Other fruit spreads are packed in screw-cap jars that can be used for storing left-over food in refrigerators.

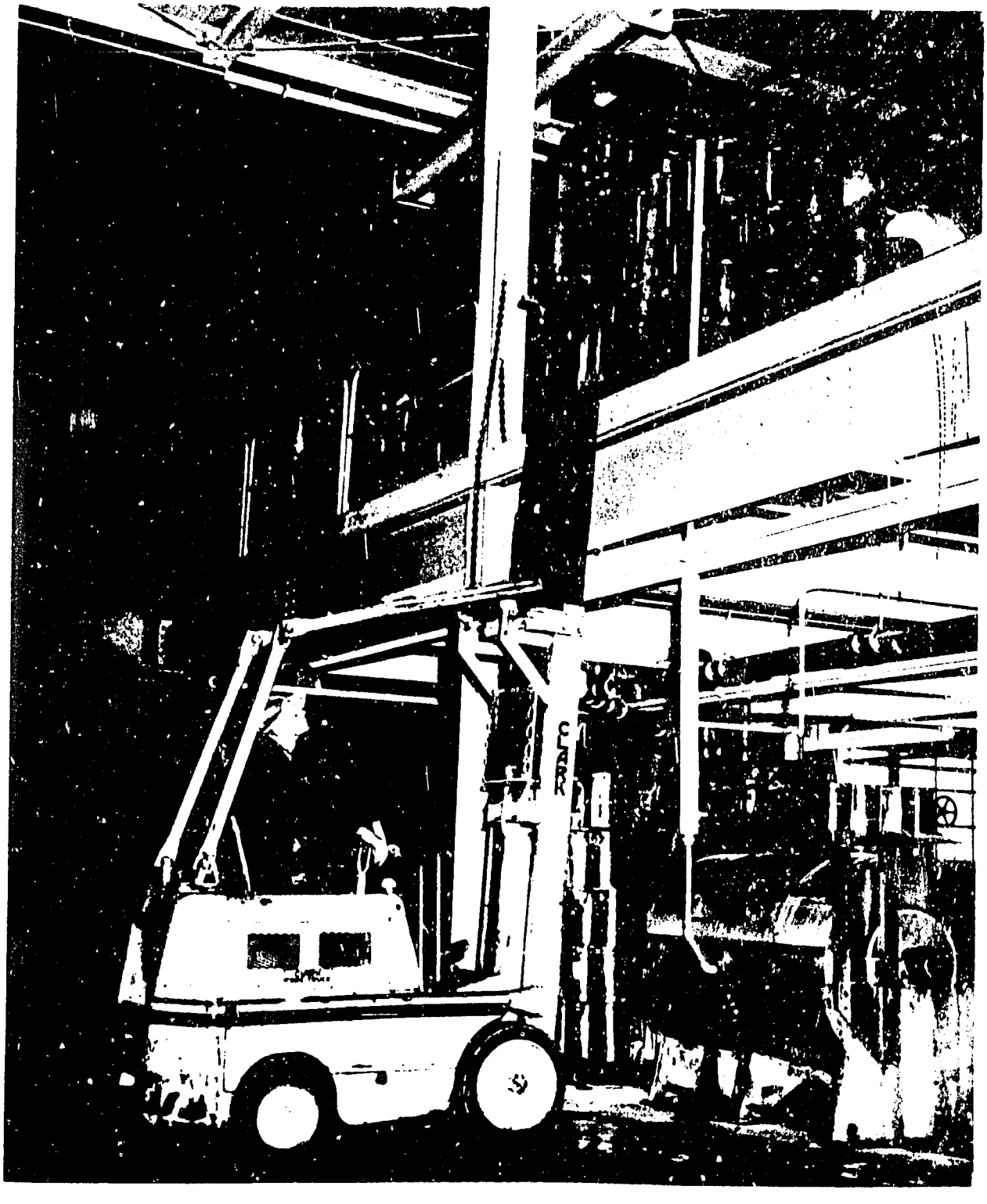

Figure B. Forklift truck handling bulk raw materials in processed fruit plant.

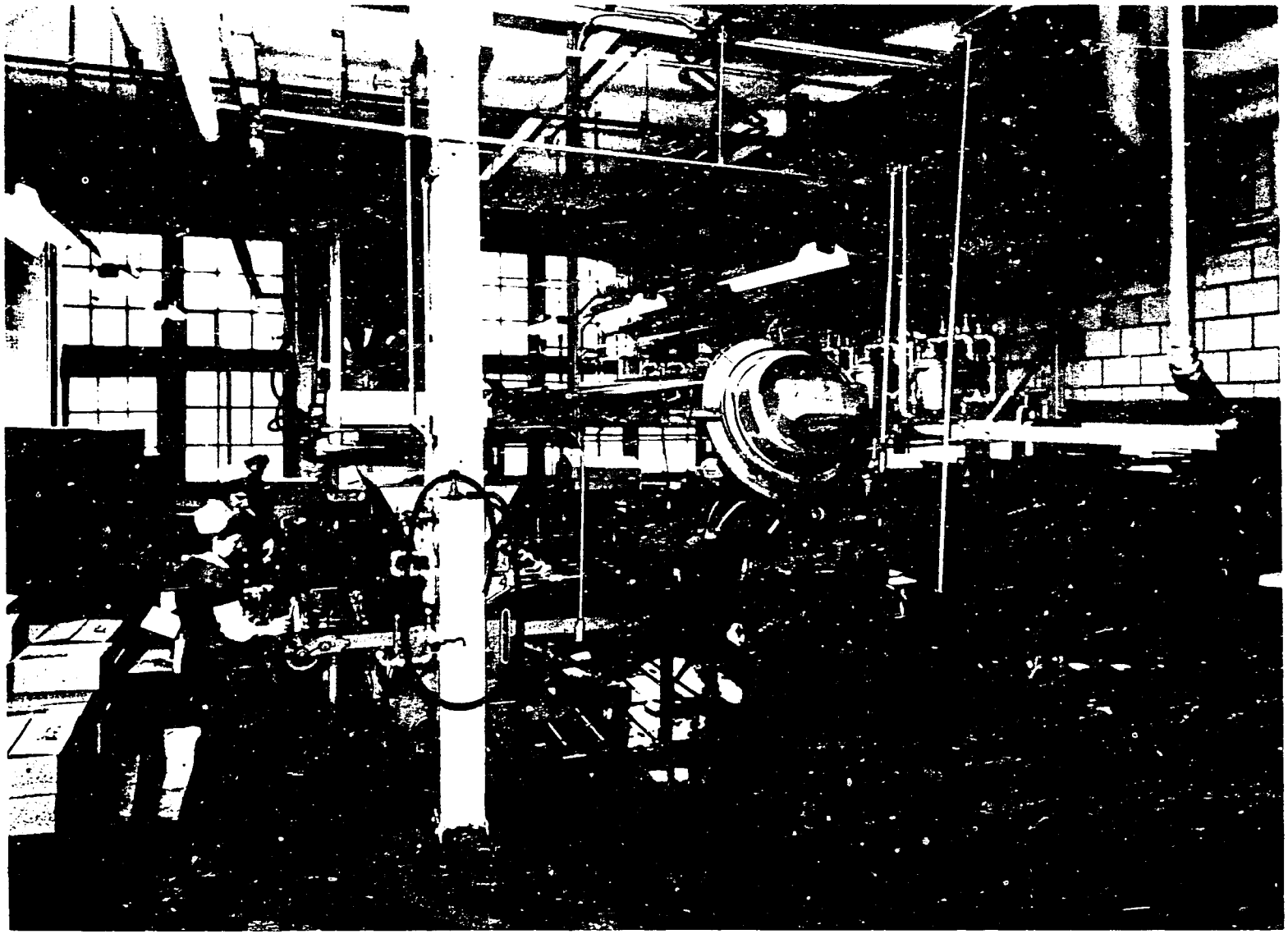

Figure C. Start of filling line. Operators feed jars to filler from which they pass automatically through the vacuum capper for closing.

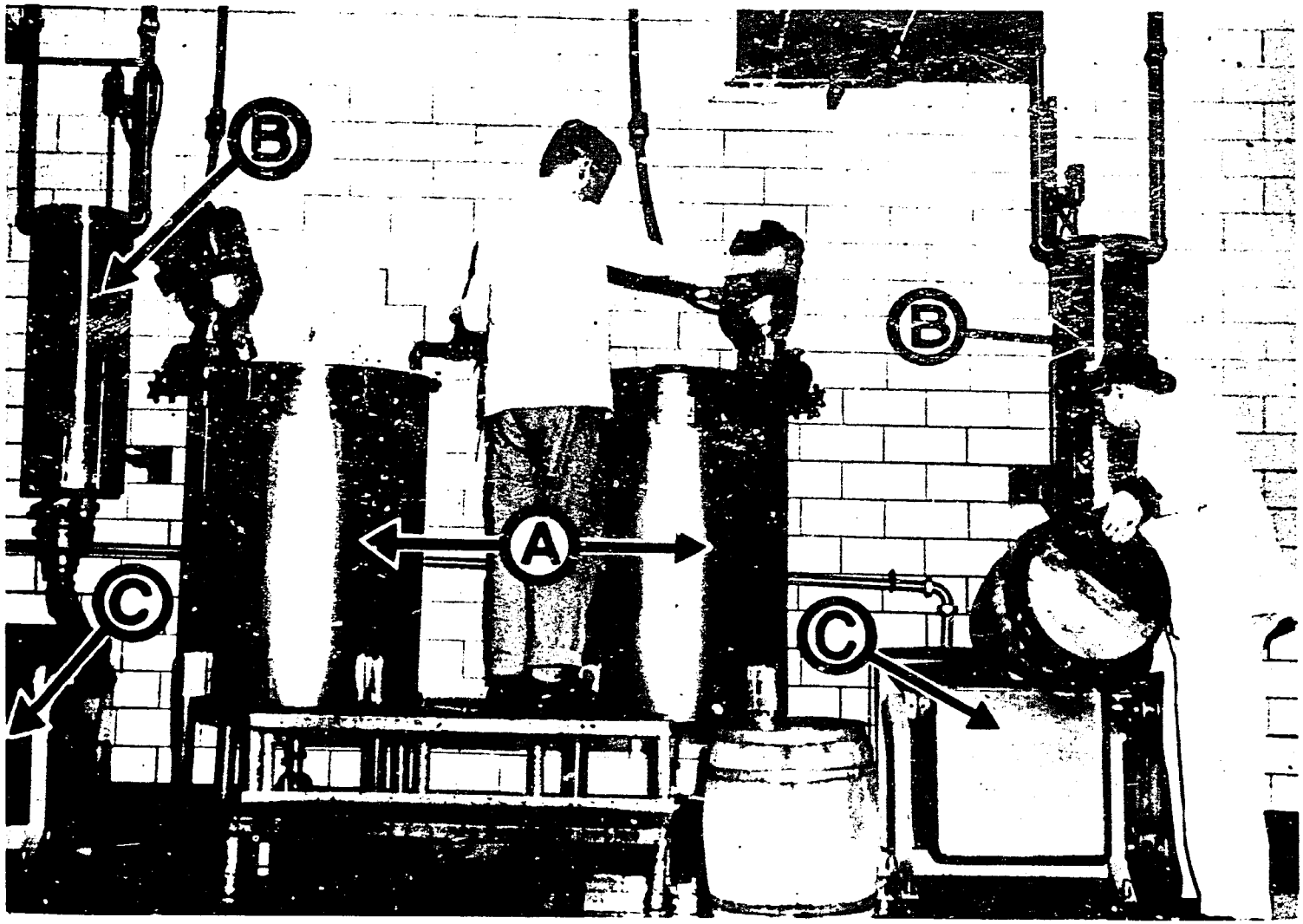

Figure D. To facilitate handling of ingredients, this company installed mixing tanks (A) which prepare fruit-acid and pectin solutions and feed them to cooking area; automatic batch hoppers (B) for measuring juices into kettles and special remote controlled dump bins (C) for batching fruits into cooking kettles on floor below.

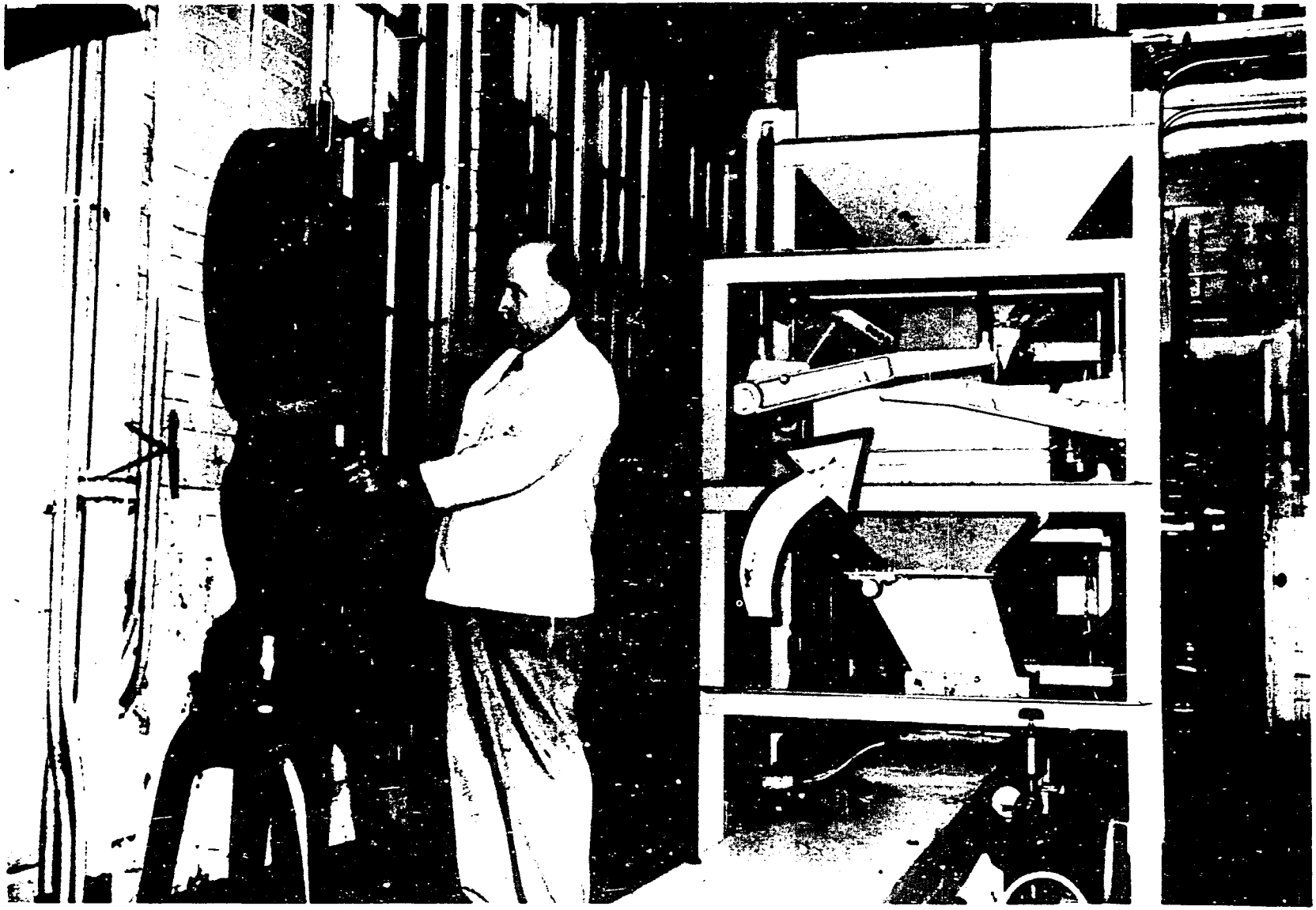

Figure E. Sugar is conveyed from basement storage bins to scale hopper (arrow). Operator is setting the scale.

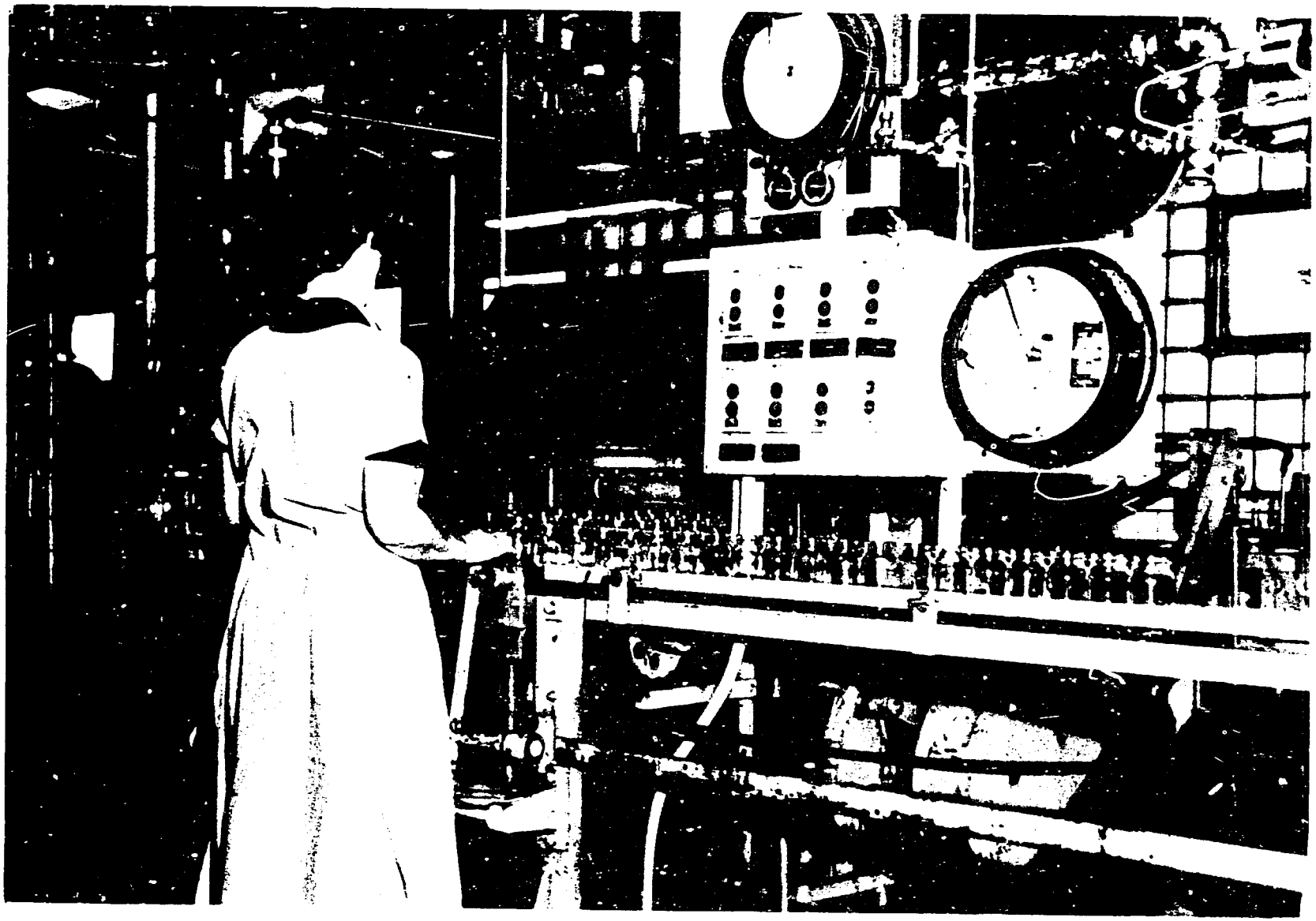

Figure F. Operation of all machines, from unscrambler to jar cooler, is controlled by push buttons on panel adjacent to filling machine.

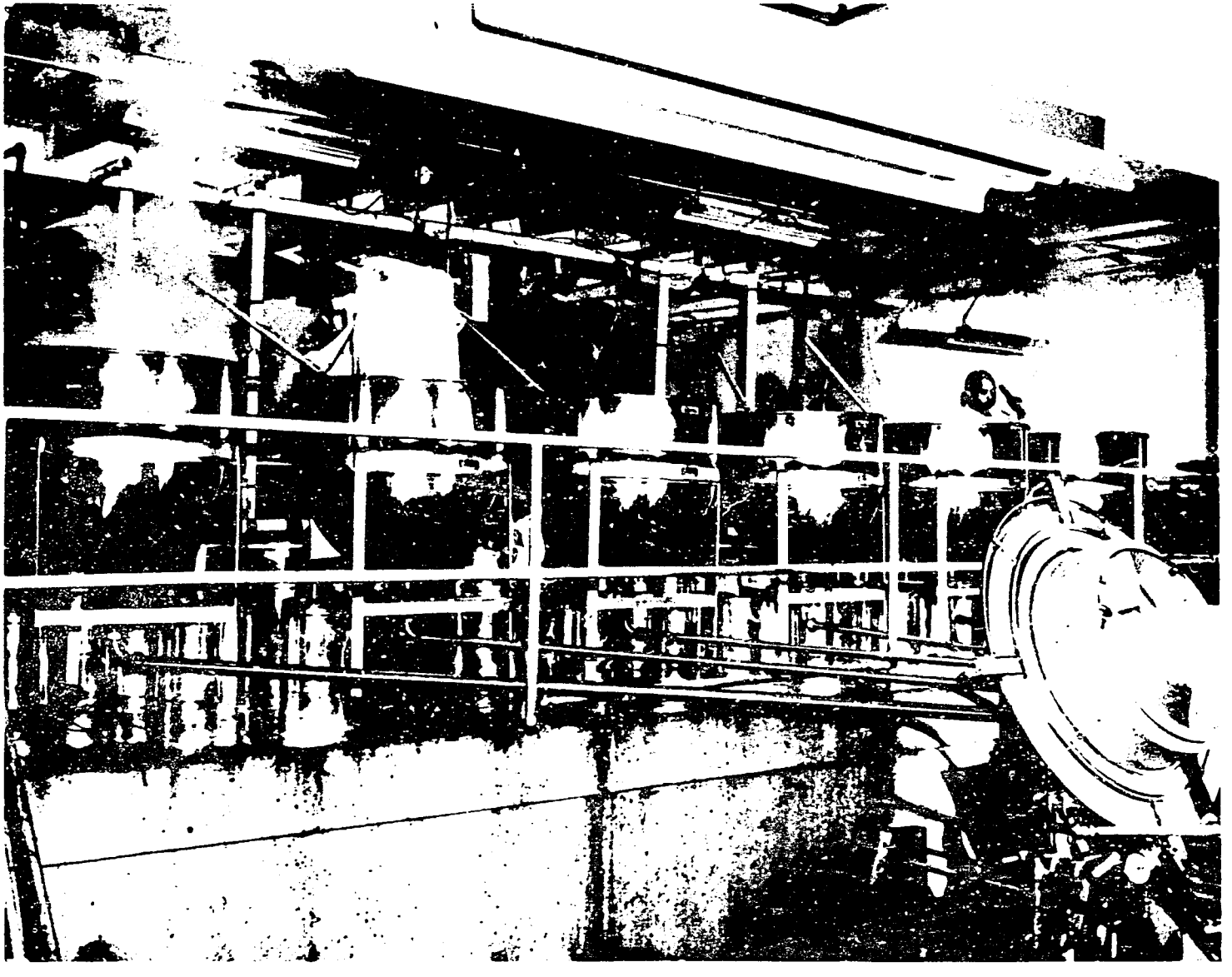

Figure G. Stainless steel is used in this battery of kettles and for all metal that touches the product in this company.

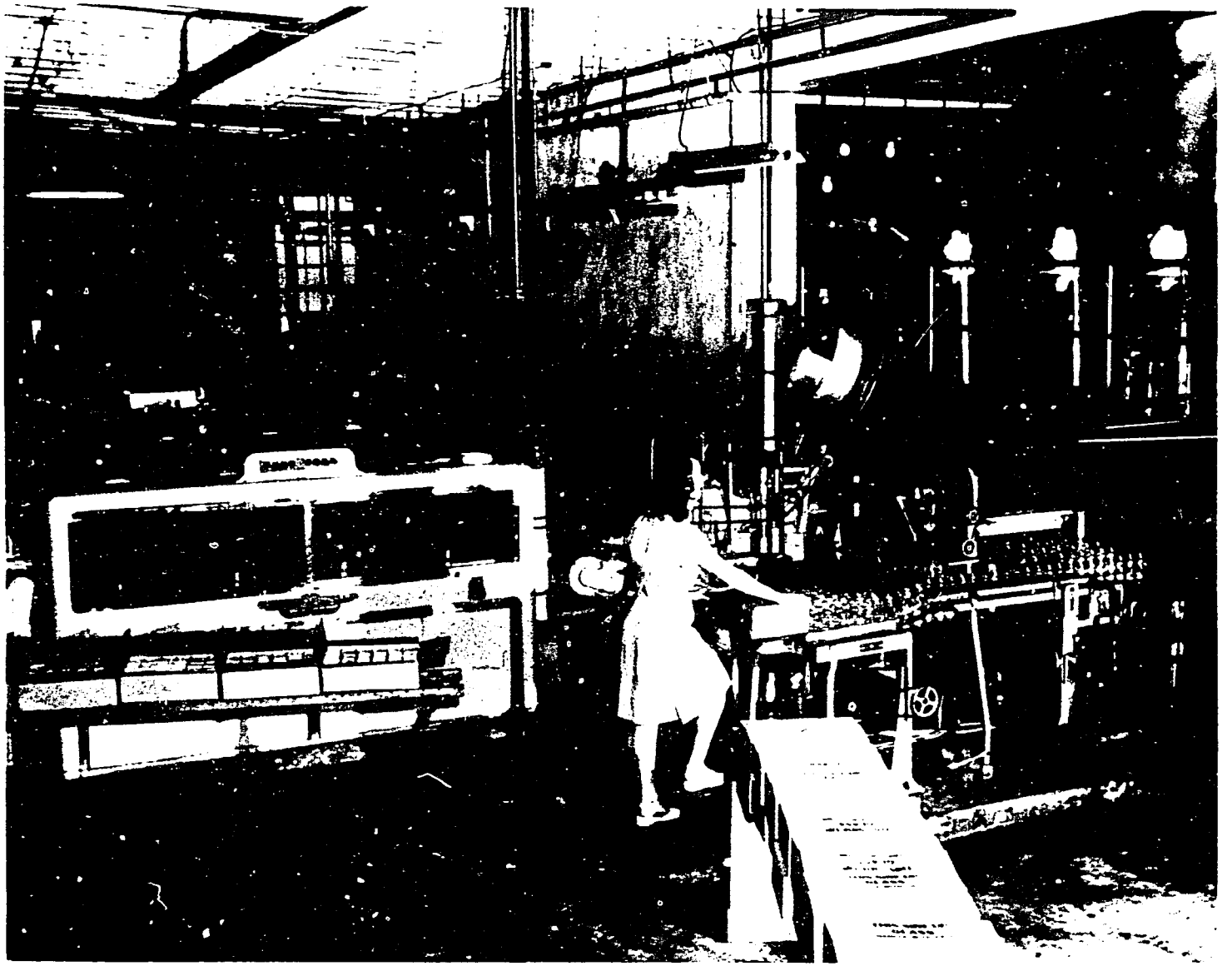

Figure H. The jars make two 90° turns as they go from unscrambler to filler to capping machine. A cooler is at the left.

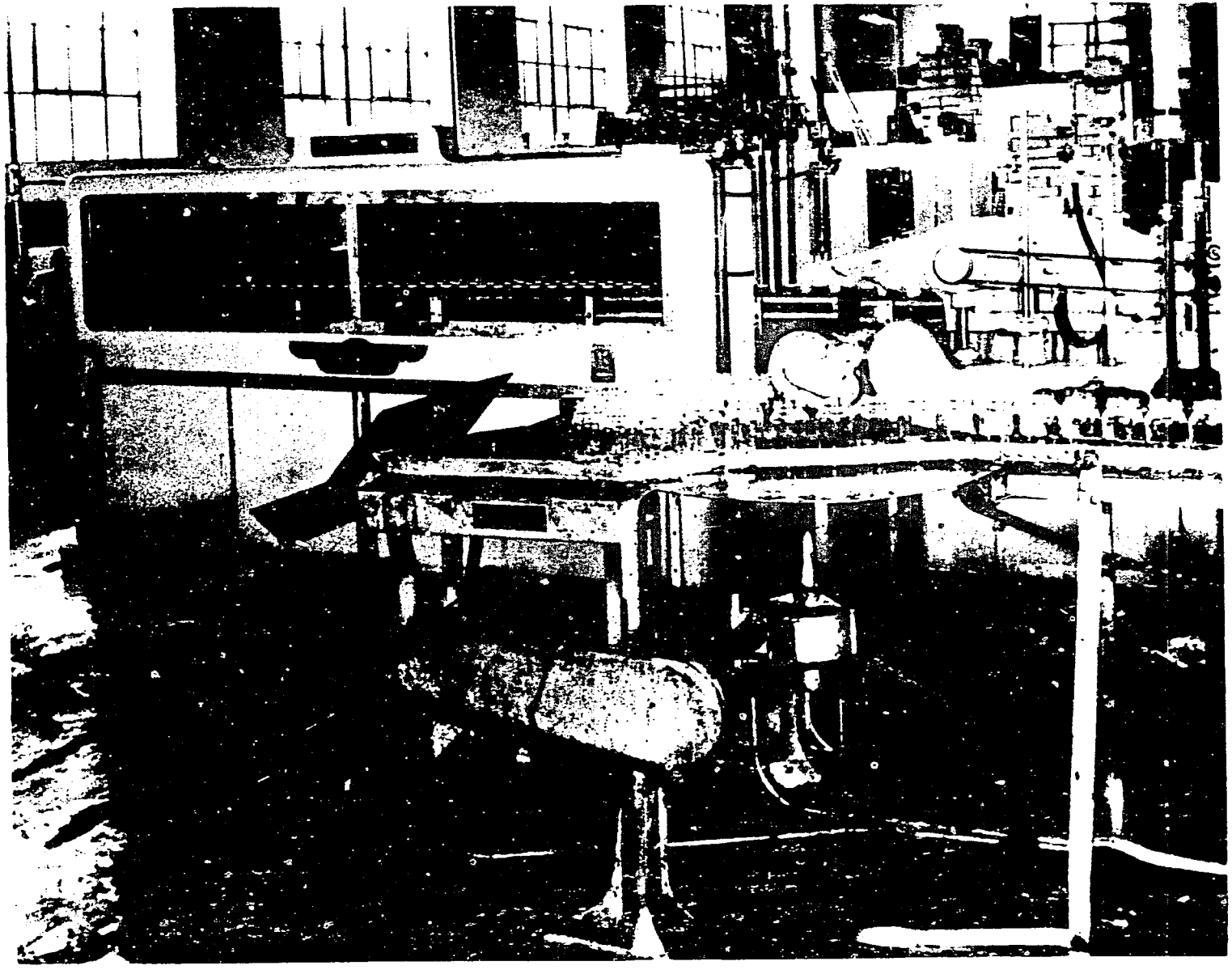

Figure I. A close-up of the unscrambler shown in figure H.

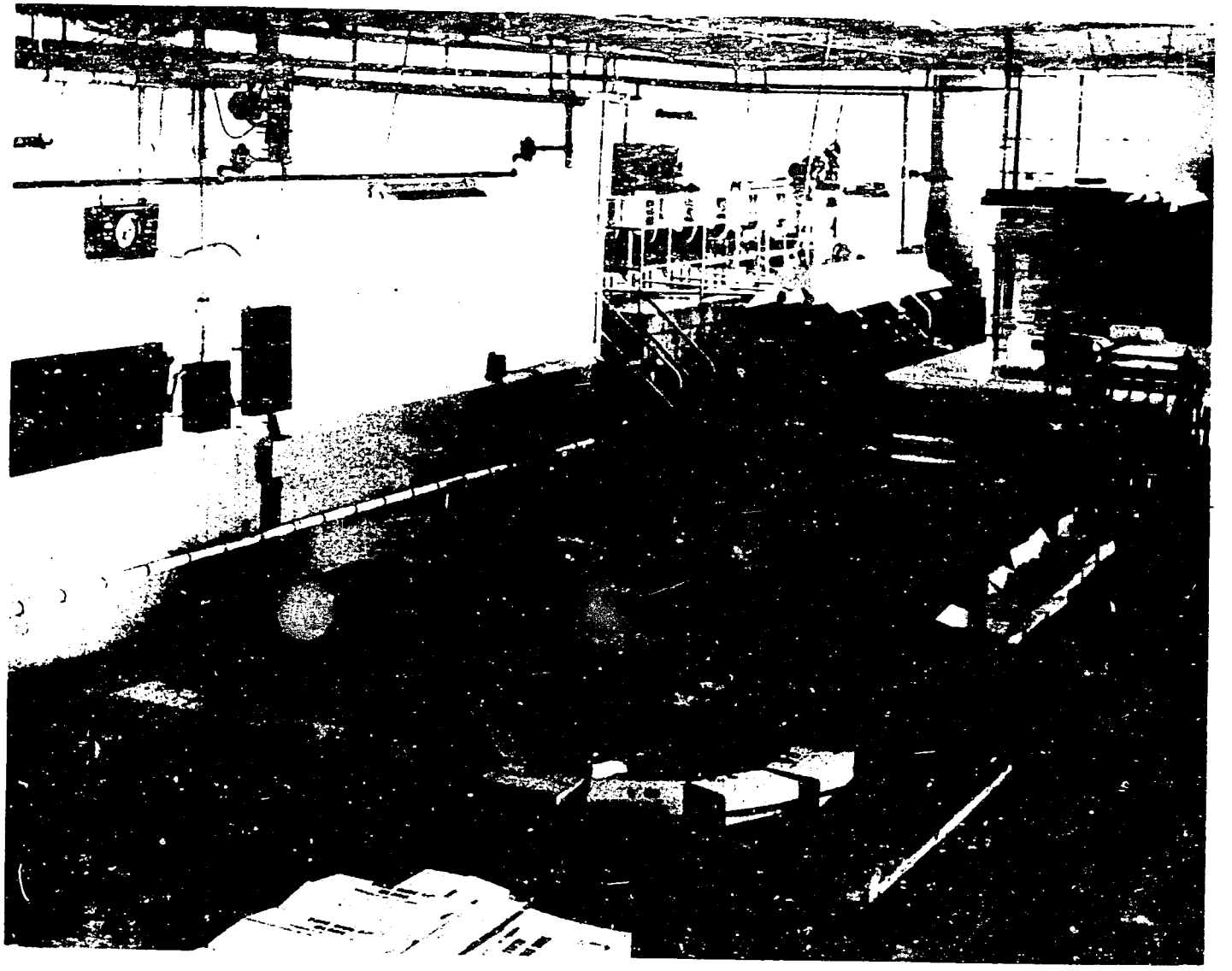

Figure J. Goods in process flow from the kettles in the background through the filler, the capper, the cooler, and the labeler to the case sealer in the foreground.

Case Study Data on
Productivity and Factory Performance

PROCESSED FOODS: PRESERVES, JAMS, AND JELLIES

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PROCESSED FOODS: PRESERVES, JAMS, AND JELLIES

CHAPTER II: CASE STUDIES

Introduction

This chapter contains detailed case studies of eight plants engaged in the production of preserves, jams, and jellies. Each plant's environment and manufacturing processes are described as fully as possible without revealing the identity of the plant.

Man-hours expended in the production of fruit spreads vary among plants for many reasons. Some of these are: type of fruit processed, type of spread produced, degree of mechanization, size of container (large or bulk containers cause a reduction in filling, labeling, and packing man-hours), layout of plant, and volume of production of any one spread.

Collection and Presentation of Data

The preparation of this report involved three major steps. First: the advice and assistance of recognized authorities in labor, management, and trade associations were obtained to help prepare the questionnaire reproduced in appendix III. Second: the questionnaire was developed and tested, and data were collected from cooperating plants by personal conferences with top officials and from company records. Third: the data were analyzed, selected, and arranged into case studies and tables.

Two of the major difficulties encountered in the collection of man-hour data from plants producing fruit spreads were the "product mix," and the nature of the cost accounting records. "Product mix" is a combination of various types of fruit spreads produced during a specified period by the same employees with no allocation of their time to each product produced. For example, during one day in most of the plants surveyed, several types of fruit spreads were produced simultaneously, sometimes on the same production line, and no record was kept of the proportion of time spent on a specific type of jam, jelly, or preserve. In other words, the reporting plants did not keep separate data for the production of a single type of fruit spread. It was decided, therefore, to collect production and man-hour data for a week of full production, noting the size of containers, and the types of preserves, jams, or jellies produced.

Actual production and man-hour data were reported by six plants; plants F and G, however, reported standard man-hours with assurances that there was not more than a 1-percent variation. Executives from each plant selected a period of full production. The selected week fell in different months

(March, August. September, November, and December) for all but two of the plants that, by coincidence, picked the same week in December. The effect of seasonal influences on man-hour requirements was not ascertainable.

Variations in man-hours expended per unit of product, due to differences in classifying workers, was negligible. Reporting plants included as direct and indirect labor the same types of labor with only minor exceptions. As direct labor, all the surveyed plants included workers at the key operations, namely: preparation, cooking and processing, filling, capping, pasteurizing, cooling, labeling, and casing. Indirect labor included foremen, shipping and receiving workers, maintenance men, porters, stock clerks, and clean-up men. Administrative and sales personnel were not included in either direct or indirect labor.

The percent of indirect labor to total labor is the ratio of indirect man-hours to total man-hours or the ratio of indirect labor cost to total labor cost. Plants F and G, the only plants that reported standard man-hour data, used an all-plant ratio of indirect to direct labor, respectively, to estimate the amount of indirect labor to apportion to the fruit spreads reported. In five of the six plants for which actual figures were reported, production data were derived from the daily records and the man-hour figures from the payroll books. Plant B had weekly production and man-hour totals on the same record card.

Any comparison among plants, or the use of data to derive averages for the industry, should not be made because, for the purpose of this study, it has not been necessary to determine the extent to which the plants included are representative. Any general conclusions about the industry from the case studies and the resultant data may be misleading.

PLANT A

Products and Volume of Output

Plant A produces at least 14 varieties of fruit preserves, jam, marmalade, and jelly packed in 4 sizes of containers. Production during the reporting week was confined to the following: grape and strawberry preserves; apricot, plum, cherry, and peach jams. They were packed in 1- and 2-pound jars in cases of 24-pounds each. Table 1 lists some wholesale prices of fruit spreads produced in plant A.

Annual production of jellies and preserves in 1950 amounted to nearly 6.5 million pounds, and required slightly more than 38,000 man-hours expended by production and related workers. During a peak 2-day production period, a group of 15 factory workers, 1 foreman, and 2 shipping and loading workers, produced and packed about 90,000 pounds of jam, in slightly less than 3,500 cases, using a total of 300 man-hours.

In the 5-day production period for which man-hours were reported, more than 235,000 pounds of jams and preserves were produced with an expenditure of slightly more than 800 man-hours.

Plant Characteristics

Employment. Total plant employment ranges from 15 to 22 production and related workers, with an average of 21, including 2 or 3 office employees. The number of women in the working force was not reported.

Buildings. Plant A is located in an upper section of a concrete and steel, fireproof, multistory building of undetermined age. The present production area of 20,000 square feet is only partially used, permitting some expansion if desired. Cold storage facilities are rented by the plant.

Machinery and Equipment. All machinery and equipment reported were less than 7 and more than 2 years old. Some of the more recent equipment installed included a vacuum pan and low vat, an air blower to clear jars of lint and dust, and a magnetic trap in the filler feed line to catch metallic particles.

Operating Practices

Manufacturing Process. Frozen fruit is removed from the cold storage room and taken by freight elevator and hand truck to the production floor where it is allowed to thaw gradually at room temperature. Fruit at room temperature is loaded in large shallow boxes and carried by hand truck to the kitchen area where batches are mixed according to the production scheduled. Ingredients for jellies are placed in kettles of 100- to 150-gallon capacity. Mixtures intended for whole fruit and chunk-style preserves are placed in a vacuum pan and cooked 30 to 45 minutes at 140 degrees Fahrenheit. The bulk of production requires 5 or 6 kettles holding 100 to 150 gallons each, and cooked for about 6 minutes at a temperature maintained between 220 and 225 degrees Fahrenheit. Cooked materials for either preserves, jams, or jellies, are then piped to the low vat where temperature is held at 180 degrees Fahrenheit. This is the filling temperature and also the pasteurizing temperature. Preserves cooked in a vacuum are heated to this temperature to assure pasteurization.

Cooked ingredients are pumped through piping from the low vat to the filling machine, by means of a rotary pump. A magnetic trap is installed in the piping line to catch metallic particles. Glass or tin containers are brought to the filling machine by a conveyor belt. Empty containers are removed from the cases by hand and placed on the conveyor leading into the filling machine. As the containers enter the filling machine, dust and lint are blown from their interiors. Filling is done automatically.

A conveyor belt carries the filled containers to the capping machine while still hot. A moment before capping, a jet of steam scalds the top surface of the jam or jelly. This additional heat, besides sterilizing the space at the top of the container, helps cause a vacuum which insures a tight closure.

A conveyor belt then carries the containers through a water spray where they are cooled fairly rapidly. About 400 cases can be cooled from 180 degrees Fahrenheit to room temperature in about 25 minutes. Rapid cooling prevents overcooking of contents and reduces the danger of discoloration.

After the containers are cooled, they are carried by a conveyor belt to the labeling machine that affixes labels automatically. Containers are placed in their original cases by hand and manually sealed. Full cases are placed on pallets and hauled to the warehouse.

Materials Handling. Piping is used to connect kettles, vacuum pan, low vat, and filling machine. Conveyor belts carry empty containers to the filling machine and carry them filled through the cooling spray and then to the labeling machine. Manual operations include weighing fruit, batch preparation, kettle loading, and moving bulk materials and cases by truck.

Integration. Plant A is a small, completely integrated, independent company.

Production and Inventory Control and Scheduling. Fresh fruit is used in season and dried or frozen fruit at other times. Thus, the plant has year-round stabilized operations. Basic ingredients are kept on hand and replenished as needed. Only a few days' supply of liquid sugar is considered necessary. Supplies of different size containers sufficient for 2 weeks' or 3 or more months' production are kept on hand depending on size, fragility, and availability.

Equipment is cleaned during changeovers from one flavor to another, and when it is withdrawn from production. Major overhauling is scheduled for slack periods, such as the annual vacation period.

Inspection. Materials are tested regularly for quality by a chemist who is an employee of an independent testing laboratory. Visual inspection of the jars and contents is made at the filling machine.

Research. The chemist who tests for quality is also engaged in research leading to improved products.

Table 1. Wholesale price range per case, f.o.b., for fruit spreads, by type and size of container, and number of containers per case, plant A, U. S. A., October 1951

Item	Type and size of containers		
	12-ounce tumblers	1-pound jars	No. 10 tins 1/
Number of containers per case	24	24	6
Wholesale price per case:			
Preserves	$1.75 - $3.50	$2.50 - $4.50	$18.50 - $32.50
Marmalade	1.75 - 2.00	2.25 - 2.50	16.00 - 17.00
Jellies	1.50 - 3.50	2.00 - 3.50	13.00 - 23.00

1/ A No. 10 tin contains a minimum of 8 pounds 6 ounces of fruit spreads.

Table 2. Man-hours required, and machinery used in the production of 100 cases of jams and preserves, by operation, plant A, U. S. A., selected period, 1951

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Total — All operations	8.16	4.57	3.59					
Receiving	.83	—	.83	(2/)	Hand trucks and flats.	10	6	40-50 cases per flat
Preparation (including pulping).	1.24	1.24	--	(2/)	(3/)	(2/)	(2/)	(2/)
Cooking	1.24	1.24	--	Pfaudler (2/)	Vacuum pan	1	2	3,500 pounds.
					Open steam-jacketed copper kettle.	7	3	1,350 pounds. (2 used for preparing for vacuum pan and 5 for cooking)
Filling	.42	.42	--	Pfaudler Karlkiefer. (2/)	Low vat F tary pump filling machine.	1	2	2,700 pounds.
					Conveyor belt feeding glass jars to filler.	1	7	2,700 jars per hour; maximum may be as high as 55-60 jars per minute.
Sealing	.42	.42	--	White	Capping machine 4/	1	2	75 jars per minute.
Cooling	—	—	--	Barry Wehmiller.	Cooler	1	5	400 cases at a time; takes 25 minutes to cool.

See footnotes at end of table.

Table 2. Man-hours required, and machinery used in the production of 100 cases of jams and preserves, by operation, plant A, U. S. A., selected period, 1951--Continued

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Labeling	(5/)	(5/)	--	World Economic.	Twin turret labeling machine.	1	5	120 containers per minute.
Casing	0.83	0.83	--	(6/)	(6/)	--	--	--
Stacking	.42	.42	--	(7/)	(7/)	--	--	--
Shipping and . . loading.	1.83	--	1.83	(2/)	(8/)	(8/)	(8/)	(8/)
Laboratory . . .	.41	--	.41	(9/)	(9/)	(9/)	(9/)	(9/)
Factory . . . . supervision.	.52	--	.52	(9/)	(9/)	(9/)	(9/)	(9/)

1/ 1 case equals 24 pounds of fruit spreads.
2/ Information not available.
3/ If pulping is required, equipment includes pulping, weighing, and charging kettles. If fruit is not pulped, equipment includes dumping and charging kettles.
4/ Rented; not company owned.
5/ Only a few minutes required each day to insert supply of labels into machine.
6/ Apply glue to cartons by hand.
7/ Stack cartons onto pallets.
8/ Same as receiving.
9/ Not applicable.

PLANT B

Products and Volume of Output

Plant B, one unit of a large food processing company produces more than a dozen kinds of jellies, preserves, marmalades, and jams. Total annual production during a fiscal year ending in 1951 was over 19 million pounds packed in bottles, cans, or tumblers ranging in size from 6 to 32 ounces in content, with 12 or 24 containers per case. Grape jam represented slightly more than 3 percent of that production. During 1 workweek of 5 days for which man-hours were reported, more than 167,000 pounds of 6 varieties of jams, jellies, marmalade, and preserves were produced. The products consisted of grape jelly, grape jam, orange marmalade, and peach, blackberry, and strawberry preserves. Direct and indirect labor time amounted to more than 1,200 hours for an average output of 138.06 pounds per man-hour. Finished goods were packaged in 10- and 12-ounce containers, 24 per case.

Plant Characteristics

Employment. The more than 100 production and related workers may be classified as follows: 21 percent engaged directly in the production of jams and jellies; 6 percent, foremen and assistants; 44 percent in general labor and maintenance; 16 percent in shipping, receiving, and storage; 8 percent, custodial and firemen; 3 percent, quality control; 2 percent, clerical help. The distribution of other than direct labor are approximations because other company plants utilized some of the production and storage facilities of plant B. The size of the administrative and sales force, and the number of women workers were not available.

Buildings. There are more than 80,000 square feet in the production areas of this plant's main multistory steel and concrete building. Cold storage tanks occupy a building of about 15,000 square feet, and crate storage occupies a building of 5,000 square feet. Some buildings are less than 10 years old, but the original building was constructed more than 35 years ago. Total refrigerated storage space occupies nearly 75,000 cubic feet.

Machinery and Equipment. Production line equipment was modernized about 5 years ago. A new filler, thermal process unit, capper, and packing equipment were added, and warehouse facilities were improved. No machinery and equipment reported were more than 15 years old.

Operating Practices

Manufacturing Process. Fruit is taken from the refrigerator rooms or, in the case of some juices, from stainless steel, cold storage tanks which are replenished seasonally. A freight elevator brings raw material to an upper story. Two steam-jacketed pans made by the company itself preheat the ingredients for preserves. Six workers are used in the preparation stage.

The preheated material is piped into steam-jacketed, stainless steel kettles. Granulated sugar is delivered to the cooking kettles in containers pushed along an overhead track. The kettles are heated to 125 degrees Fahrenheit. Electric mixers blend the ingredients. Materials for preserves are piped into vacuum pans to reduce excess water, then air-blown through pipes to any of nine kettles and heated at 165 to 185 degrees Fahrenheit.

Six workers engage in the filling and sealing operations. The contents of the kettles are piped to a filling machine. At the same time the containers are dumped into an unscrambler which puts the containers in single file and passes them through a washer to the filler by conveyor. A capper seals the containers by a vacuum vapor process, and the conveyor carries them to the thermo-cooler. The thermo-processing and cooling device is company-made. A steel conveyor belt conducts the filled and sealed containers first through a hot spray and then through a cold one.

On the conveyor belt, the containers pass through a labeling machine. A thermo-plastic binder holds the label to the container.

A casing machine places the filled containers in the original cases from which they were taken. A case sealer and compression unit completes the casing equipment. From preparing the fruit through casing, 13.51 total man-hours are required to produce 2,400 pounds.

The sealed cases are piled on pallets and carried to storage by means of a forklift truck.

Plant B did not list separately the jobs it considers to be direct or indirect labor. It is not known, for example, whether the time of materials moving is included with the time of those engaged in the preparation stage. Table 3 presents the available information on the labor time used in individual operations for manufacturing 2,400 pounds of fruit spread.

Materials Handling. A freight elevator carries the basic ingredients to an upper level. Pipes carry preheated material to kettles. An overhead, manually operated conveyor carries sugar to the kettles. Pipes and pumps serve to transfer materials between kettles and vacuum pans, whereas pipes alone carry the preserves to the filling machine. An unscrambler arranges containers. A belt carries the empty containers through the filling machine as well as the filled containers through the labeler and hot and cold sprays. Pallets and forklift trucks are used in handling sealed cases.

Integration. Plant B, one plant of a multiplant company, shares the use of cold storage facilities, laboratories, cost analysts, and continuing product improvement programs of the parent company. Otherwise its operations are completely integrated.

Production and Inventory Control and Scheduling. Sugar and pectin sufficient for about a week's run are kept on hand. Other ingredients in 3 to 6 months' quantity are maintained. Up to a year's supply of frozen or refrig-

erated fruit and extracts may be drawn upon. Cleaning and maintenance are performed outside ordinary working hours when possible. Some spare machinery and equipment are usually available. A flexible inventory based upon quarterly sales expectancy is the rule. Product scheduling is considered by a plant management group comprised of representatives of the sales department, purchasing department, and the laboratory section, each contributing estimates of volume and labor requirements which are subsequently compared with actual production. (See figs. 1 through 4.)

Inspection. One filled container out of every hundred and batches in process are inspected visually. Full laboratory inspection is done by the parent company.

Engineering and Research. The company employs the full time services of a plant layout engineer, a production methods engineer, a cost analyst, and three persons engaged in product improvement.

Table 3. Man-hours required and machinery used in the production of 100 cases of jams, jellies, marmalade, and preserves, by operation, plant B. U. S. A., selected period, 1951

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Total--All operations. .	2/17.38	2/13.62	3.76					
Preparation. .	3.06	2.82	.24	(3/)	Concrete tanks	9	5	45,000 gallons each.
					Stainless steel tanks.	9	5	145,000 gallons each.
Cooking . . .	3.06	2.82	.24	(3/)	Stainless steel steam-jacketed kettles.	2	5	150 gallons each.
				Lee Metal Products Co.	Steam-jacketed vacuum pans.	2	15	(3/)
					Aluminum kettles	9	1	50-100 gallons each.
				Mixing Equipment Co.	Electric mixers	5	1	50-100 gallons each.
Filling and sealing . . .	2.96	2.82	.14	Ferguson Mfg. Co.	Case printing machine.	(3/)	(3/)	(3/)
				White Cap Co.	Unscrambler	1	6	(3/)
				Homemade	Washer	1	1	(3/)
				Horix Mfg. Co.	Filler	1	3	(3/)
				White Cap Co.	Capper	1	3	(3/)
Hot and cold spraying. . .	1.97	1.88	.09	Homemade	Thermo-cooler	1	3	(3/)
Labeling . . .	.49	.47	.02	New Jersey Machine Co.	Labeler	1	1	(3/)
Casing	1.97	1.88	.09	Standard Kapp Corp.	Case packer	1	3	(3/)

See footnotes at end of table.

Table 3. Man-hours required and machinery used in the production of 100 cases of jams, jellies, marmalade, and preserves, by operation, plant B, U. S. A., selected period, 1951--Continued

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Casing--Con.. .				Ferguson Mfg. Co.	Case sealer and compression unit.	1	5	(3/)
Inspection. . .	0.99	0.94	0.05	(3/)	(3/)	(3/)	(3/)	(3/)
Maintenance . .	.94	(4/)	.94	(4/)	(4/)	(4/)	(4/)	(4/)
Warehousing and custodial	1.95	(4/)	1.95	(4/)	(4/)	(4/)	(4/)	(4/)

1/ 1 case equals 24 pounds of fruit spreads.
2/ Totals do not equal the sum of components because of rounding.
3/ Information not available.
4/ Not applicable.

Figure 1

WORKSHEET FOR PRODUCTION SCHEDULING

Plant B
Date

Product	Size	Inventory as of —	Current orders for shipment	Availability	Planned production to	Minimum inventory required	Percentage of minimum inventory	Cases on orders received last week
Tomato juice . . .	Quarts							
Tomato juice . . .	5-3/4 oz.							
Tomato juice . . .	46 oz.							
	Lb. Oz.							
Apple jelly . . .	10							
Apricot preserves.	10							
Blackberry preserves .	10							
Black raspberry preserves . .	10							
Cherry preserves .	10							
Currant jelly . .	10							
Orange marmalade .	10							
Orange marmalade .	1							
Peach preserves .	10							
Pineapple preserves . .	10							
Plum preserves . .	10							
Red raspberry preserves . .	10							
Strawberry preserves .	10							
Strawberry preserves .	1							
Honey	1							

Figure 2

SUPPLY REQUIREMENTS FOR PRODUCTION REQUIREMENTS

Period _____

Plant B

Date _____

Product	Size	Production requirements (cases)	Amount required (estimate time factor)	Minus: Inventory	Plus: Planned ending inventory	Minus: Unfilled purchase orders	Total period's requirements
Tomato juice	Quarts						
Tomato juice	5-3/4 oz.						
Tomato juice	46 oz.						
	Lb. Oz.						
Apple jelly	10						
Apricot preserves	10						
Blackberry preserves . . .	10						
Black raspberry preserves	10						
Currant jelly	10						
Orange marmalade	10						
Orange marmalade	1						
Peach preserves	10						
Pineapple preserves . . .	10						
Plum preserves	10						
Red raspberry preserves	10						
Strawberry preserves . . .	10						
Strawberry preserves . . .	1						
Honey	1						
Total preserves	10						
Total preserves	1						
Grand total							

Figure 3

PRODUCTION SCHEDULE
FOR

Plant B

Month of _____
Week of _____

	Planned production					Actual production				
Date	Product	Size	Hours	Estimated rate	Estimated total	Product	Size	Hours	Actual rate	Actual total

Figure 4. EXAMPLE OF INVENTORY AND PRODUCTION CONTROL

FRUIT REPORT

Plant B

Date _____

Vertical column headings are:

1. Kind of fruit
2. Description of fruit variety and mix
3. Inventory pounds of fruit available
4. Inventory pounds actual fruit
5. Pounds actual fruit available but use restricted by blend
6. Inventory pounds actual fruit available per recipe
7. Inventory will produce cases 10-ounce preserves per column 6
8. Floor stock inventory cases goods over orders on hand
9. Total availability case goods
10. Average sales per month to date
11. Total cases will cover sales' requirements for following months
12. Months to next fruit harvest season

PLANT C

Products and Volume of Output

This plant produces more than 30 different products including many flavors of preserves, jams, jellies, marmalade, and fruit juices. The following price ranges were indicated per case: 4/ $1.75 - $2.50 for 1-pound jars of various flavors of jellies; $2.25 - $3.25 for 1-pound jars of various flavors of preserves; $11 for No. 10 cans of sweet orange marmalade to $28 for No. 10 cans of strawberry preserves.

During the particular 5-day production period for which man-hours were reported, more than 125,000 pounds of fruit spreads were manufactured, consisting of strawberry preserves, grape jam, apple and grape jelly, and orange marmalade. In addition, about 25,000 quarts of prune juice were made

Plant Characteristics

Employment. Production of the above volume of fruit spreads required an average of 19 direct factory workers, 6 indirect employees, and 2 office employees. The direct and indirect workers were employed as follows:

Operation	Number of direct workers
Pulping and opening containers	4
Cooking	5
Filling	3
Sealing	1
Cooling	1
Labeling	1
Casing and stacking	3
Stenciling cartons	1

Operation	Number of indirect workers
Receiving and shipping	3
Porter	1
Stationary engineer	1
Superintendent	1

Buildings, Machinery, and Equipment. This company conducts its operations in a 4-story and basement structure and occupies 20,000 square feet. It reported no machinery or equipment which was less than 4 or more than 8 years old. The plant layout follows that suggested by the National Preservers' Association and, since 1946, the company has added 3 stainless steel kettles of 150 gallons each and a 150-hp. boiler unit. The plant rents cold storage facilities.

4/ 24 1-pound jars per case, 6 No. 10 cans per case.

Operating Practices

Manufacturing Process. At maximum production, raw materials are handled by 1 electric- and 6 hand-operated trucks. A pulper of 12,000-pounds-per-hour capacity is used for filtering the fruit. The cooking operations are performed in 9 stainless steel, steam-jacketed kettles, each of 1,200 pounds capacity per hour, at a temperature of 230 degrees Fahrenheit for a period of from 7 to 20 minutes. One worker hands cartons of empty containers to two other men who feed the empty containers to the filling machine. The jars or cans are filled in a 6-spout filling machine with a capacity of 5,400 jars an hour or 7,500 pounds per hour when No. 10 cans are used. The containers are sealed by a vacuum capper or two seaming machines, each unit having a capacity of 200 containers per minute. Cooling is done in company-built units, 45 x 4-1/2 feet with the same capacity as the filling machine. Two labeling machines with a capacity of about 90 jars per minute (the same as the filling machine) perform the labeling operation. Stenciling, casing, and stacking the cartons are done by hand. Manually or electrically operated trucks are used to transport the merchandise to shipping or storage.

Materials Handling. Raw materials and finished product are received and shipped by 1 electric- and 6 hand-operated trucks. About half of the materials handled are carried on pallets.

Integration. This is a fully integrated, single-plant corporation.

Production and Inventory Control and Scheduling. Production is planned from 1 to 3 days in advance and is based on orders received. A stock of fruit spreads is not accumulated. Rented cold storage facilities are used to keep a 6-months' supply of frozen fruits. The following raw materials are stocked: 6 months' supply of canned fruits, jars and cans for 1 week, pectin for 1 week, and only 1 day's supply of liquid sugar. A small supply of grain sugar is kept for emergency purposes.

Inspection. This plant maintains a laboratory which analyzes the contents of two containers taken from the line every hour. In addition, the first few batches prepared every day are checked to see if they meet required standards before a full production run is made. Raw materials, such as fruits, must meet the standards of the U. S. Department of Agriculture and finished products are submitted to a private laboratory for analysis to meet required standards.

Table 4. Man-hours required, and machinery used in the production of 100 cases of jams, jellies, and preserves, by operation, plant C, U. S. A., selected period, 1951

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Total--All operations. .	15.05	11.92	3.13	----	-----	----	---	----
Receiving and shipping. . .	1.21	--	1.21	(2/)	Electric truck Hand trucks	1 6	4 4	6,000 pounds. 4,000 pounds.
Preparation. .	2.51	2.51	--	Food Machine Corp.	Pulper	1	5	12,000 pounds per hour.
Cooking. . . .	3.13	3.13	--	(2/)	Stainless steel steam jacketed kettles.	9	8	12,000 pounds per hour each.
Filling. . . .	1.88	1.88	--	Filler Machine Co.	6-spout filler	1	8	3/7,500 pounds per hour.
Sealing. . . .	.63	.63	--	White Cap Co.	Vacuum capper 4/	1	(2/)	200 units per minute.
				Crown Can Co.	Seaming machine 4/	2	(2/)	200 units per minute.
Cooling. . . .	.63	.63	--	Company design	Each unit is 45 ft. by 4-1/2 ft.	2	(2/)	3/ 7,500 pounds.
Labeling . . .	.63	.63	--	Oslund	Labeling machine	2	8	90 units per minute.
Casing, stacking and stenciling. . . .	2.51	2.51	--	----	Hand operation	---	---	----
Supervision. .	.64	--	.64	----	----	---	---	----
Custodial. . .	1.28	--	1.28	----	----	---	---	----

1/ 1 case equals 24 pounds of fruit spreads.
2/ Information not available.
3/ Based on No. 10 cans.
4/ Rented--not company-owned.

PLANT D

Products and Volume of Output

This plant produced 18 varieties of preserves, jams, jellies, and marmalade in 12-ounce jars, 10 varieties in 7-ounce jars, and some special 1-pound jars for a total of about 130,000 pounds of product in the three 5-day periods for which man-hours were reported. Products produced during this period are tabulated below.

Preserves and Marmalade (12-oz. jar)

Kind	Production (Cases of 24 jars)
Apricot preserves	250
Better grape preserves	1,290
Blackberry preserves	179
Black raspberry preserves	383
Cherry preserves	181
Peach preserves	299
Pineapple preserves	170
Purple plum preserves	181
Red raspberrry preserves	522
Red raspberry and currant preserves	176
Strawberry preserves	1,199
Orange marmalade	574
Total	5,404
Pounds	97,272

Jellies (12-oz. jar)

Kind	Production (Cases of 24 jars)
Crabapple	178
Cherry	49
Currant	217
Grape	936
Mint	130
Quince	91
Total	1,601
Pounds	28,818

Preserves, Jellies, Marmalade (7-oz. jar)

Kind	Production (Cases of 24 jars)
Red raspberry preserves	57
Strawberry preserves	50
Black raspberry preserves	73
Pineapple preserves	37
Cherry preserves	30
Grape jelly	98
Crabapple	56
Mint jelly	13
Currant jelly	21
Orange marmalade	47
Total	482
Pounds	5,061

In addition, 161 cases of various fruit spreads, containing twenty-four 1-pound jars were packed. Total production during this period was 7,648 cases containing 131,312 pounds of preserves, jellies, and marmalade. About 2,800 man-hours were used by production and related workers.

Man-hours for plant D are relatively high when compared to other plants in this report. There are two principal factors that contribute to high man-hours in this plant, (1) a preponderance of hand operations, and (2) the relatively small size containers for its products. In comparison, plant E during the reporting period, packed its products in cans holding almost 16 times as much as a 7-ounce jar.

Plant Characteristics

Employment. This plant indicated 18 workers employed in direct operations, 3 in indirect, and 6 office employees. It was noted that direct labor sometimes performs such indirect functions as cleaning up their own work areas and equipment, moving supplies to their workplace, and taking away the finished products. The president of this plant estimated that 20 percent of direct labor time is expended in the indirect functions noted. During the period, the following types of labor (other than office) were reported for the plant:

Direct		Indirect	
Cooks and helpers	5	Foreman	1
Press department	2	Maintenance man	1
Filling and capping machine	2	Stock, receiving, and shipping	1
Labeling machine	1		
Hand labeling	2		
Hand filling and capping	4		
Spray cooler	2		

Buildings. The operations of this plant are conducted in a single-story, brick, concrete, and steel frame building over 20 years old, with 1,500 square feet devoted to production, 7,500 square feet to storage, and 1,000 square feet to office and garage space. Refrigerator storage facilities of 200,000 to 400,000 pounds' capacity are rented for raw materials.

Machinery and Equipment. Most of the machinery and equipment is about 10 years old. Within the past 5 years, however, some new equipment was installed which tended to aid the mechanization of this plant. An automatic labeling machine was added to one production line. Two spray cooling machines, one for each line, were also added. An obsolete capping machine was replaced by a new one.

Operating Practices

Manufacturing Process. The manufacture of jelly, preserves, and jams are described in detail below. Actual man-hours given for various operations does not necessarily represent labor expended over a longer period inasmuch as man-hours given were those used at the time of the visit to the plant. Variations from this given time includes that lost in personnel or machine down time, variations in products run, and similar occurrences during a complete day or week.

In making grape jelly, fourteen 30-pound cans of frozen grapes are thawed out and put for precooking into a 100-gallon steam kettle located in the raw material storage area. The batch is cooked and emptied from the bottom of the kettle into a 3-gallon container and strained through a sieve into a barrel. This operation is repeated until the kettle is empty. The solids are placed in a separate barrel. Precooking and emptying the kettle required 42 minutes and was done by one man.

In making jams, the contents of the kettle are put into a puree machine where pits are removed and both solids and liquid are then taken to the "kitchen" for the next operation by the cook. For example, strawberries used for preserves are put directly into a kettle from the cans in which they were frozen. In this instance, two 30-pound cans are put into one batch that requires about 8-1/2 minutes' cooking time.

In addition to the 100-gallon precooking steam kettle, the plant has one 50-gallon and six 30-gallon cooking kettles. In the "kitchen" or cooking area, the company has one 75-gallon pectin reserve tank in which pectin is kept for adding to those fruits and juices requiring it, and a pectin agitator tank in which to mix dry pectin and water.

For jellies, the solids are taken from the barrel, wrapped in cheesecloth, and placed in a hydraulic press to extract the remaining juice. When processing grapes, the pressing operation is done twice. Pressing the solids from seven 30-pound cans of grapes required 18 minutes. The barrel of juice brought to the kitchen on a hand truck is poured into a 30-gallon kettle to which sugar and cooking fat are added, then the batch is cooked for about 7 minutes. The kettle is emptied into a 25-gallon hopper above the filling machine by a piping arrangement. It takes 3-1/2 minutes for all the juice from the 210 pounds of fruit to move from a kettle to the hopper. A cook and a helper can handle three kettles. While the contents of the kettle are cooking, or the press is in operation, the operators clean and scrub floors or do various other tasks as may be required.

This company has two production lines for filling--a mechanized one for jellies and a manual line for jams and preserves. For jellies, the empty jars are stacked on wheeled-tables from which an operator feeds them to the filler machine that automatically fills the jars, usually at a rate of 30 jars per minute. The filler is capable of operating at the rate of 60 jars per minute, but at the higher speed the jars may tip or become wedged in the machinery. The chain belt conveyor moves two jars at a time from the filler to the capping machine, and, by means of a rotating disc, arranges them in single file.

Preserves are hand-filled into containers, sealed, and placed on the conveyor for carrying to the spray cooler. After cooking, the contents of the kettle are put into a pan and placed near the filling table. Filling and capping is done by a team of two persons. A girl places the empty jars on a table, and, scooping preserves from the pan, fills the jars. A man puts a screwdown cap on each jar the girl has filled and places the jar on the conveyor for carrying to the cooler. It required 11 minutes to bring the preserves from the kettle, stack the jars on the table, and fill and cap 118 jars containing 12 ounces each. The hand filler teams are paid on an incentive basis, the standard set at 3.5 kettles per hour during World War II. The company is seeking a machine to perform the job without crushing or wasting the fruit in the preserves.

From capping, the conveyor carries the filled and capped jars of jams and jellies through a spray cooler having a capacity of 480 jars. A warm water spray is used first, followed by a cold water spray.

The jellies move from the cooler to an automatic labeler which labels 50 jars per minute. The labeling machine handles the work in balance with the filling and capping machines on the jelly line. The preserves are removed from the cooler and stacked on platforms to await the freeing of the automatic labeling machine from use on jelly production. If the workers have

free time, the jars of preserves may be hand-labeled. Generally preserves are labeled about 45 minutes in the morning before steam is available to operate the filler, during lunch hour, or about an hour in the late afternoon when the filler stops. The operator of the labeling machine also packs 24 jars in each case one layer high. Sectional roller conveyors are used to move cases short distances. A portable belt conveyor is used to stack cases higher than one level, if necessary.

Materials Handling. A portable belt conveyor is used to unload and load trucks and stack cases over one level high. A chain belt conveyor is used to move jars from filler to capper and thence to cooler. A chain belt bed is provided in the cooler for moving jars under the spray.

Integration. This is a fully integrated, single-plant corporation.

Production and Inventory Control and Scheduling. Production is based upon orders; there is no accumulation for stock. About 2 days are allowed before beginning production on an order so that frozen fruit may be brought from the cold storage warehouse and permitted to thaw. The plant has rented refrigerator space providing for from 200,000 to 400,000 pounds' capacity. A full year's supply of fruit is kept in these warehouses. Frozen fruits are used for preserves and jellies. A year's supply of raw material for making orange and pineapple marmalade is kept at the plant warehouse. A month's supply of glass jars is kept on hand and a 3- to 4-days' supply of sugar is kept. A slow period occurs in June, July, and August in which only a 3- or 4-day week is spent in production. The plant indicates that there are almost no layoffs throughout the year, direct labor being employed on general duties during the slow period. Production has been leveling off through the year because of more equalized sales and the use of frozen fruits.

Inspection. The company maintains a laboratory which is operated by the head cook who takes occasional samples for testing to determine cooking time, rate, and sugar content. All jars of finished products are inspected during casing and stacking. While casing, the operator will remove any defective jars as he puts them into cartons. The company reported 1.26 percent of total production as rejects. Materials rejected because of partially filled containers, poor labeling, or container defect are recooked with a new batch.

Table 5. Man-hours required, and machinery used in the production of 100 cases of all fruit spreads, by operation, plant D, U. S. A., selected period, 1951

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment 2/				
	Total	Direct	Indirect 3/	Make	Description	Number of machines	Average age (years)	Capacity
Total -- All operations	52.13	43.06	9.07					
Fruit press and preheat	4.51	4.51	--	Lee	Steam kettle 4/	1	10	100 gallons.
				(5/)	Puree machine 6/	1	10	(5/)
				(5/)	Hydraulic press	1	(5/)	(5/)
Cooking	13.25	13.25	--	Lee	Steam kettles	7	10	6-30 gallons each. 1-50 gallons each.
				(5/)	Pectin reserve tank	1	10	About 75 gallons.
				(5/)	Pectin agitator tank.	1	10	(5/)
Filling	5.30	5.30	--	Philadelphia	Filler machine	1	5	30 jars per minute.
				(5/)	Filler conveyor and rotating disc.	(5/)	(5/)	(7/)
Sealing	7.29	7.29	--	Resina Machinery Co.	Capper	1	3	30 jars per minute.
Cooling	5.56	5.56	--	Island Equipment Co.	Spray cooler	8/2	3	480 jars.
Labeling and casing	7.15	7.15	--	Eco Machine Co.	Turret labeler	9/1	4	50 jars per minute.

See footnotes at end of table.

Table 5. Man-hours required, and machinery used in the production of 100 cases of all fruit spreads, by operation, plant D, U. S. A., selected period, 1951—Continued

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment 2/				
	Total	Direct	Indirect 3/	Make	Description	Number of machines	Average age (years)	Capacity
Maintenance . .	3.03	--	3.03	(5/)	(5/)	(5/)	(5/)	(5/)
Stock clerk . .	3.02	--	3.02	(10/)	(10/)	(10/)	(10/)	(10/)
Supervisor . .	3.02	--	3.02	(10/)	(10/)	(10/)	(10/)	(10/)

1/ 1 case equals 24 pounds of fruit spreads.
2/ Excludes any equipment used in hand filling or hand capping operations largely associated with the production of other than jellies.
3/ See text for explanation of some indirect functions performed by workers whose actual time has been wholly attributed to direct operations.
4/ For jellies and seedless fruits; to heat before removal of pits or crushing in press.
5/ Information not available.
6/ Used to remove pits from fruits used in preserves.
7/ Filler conveyor moves 2 jars at a time and rotating disc places in single file.
8/ Separate units for automatic jelly line and manually filling and capping of preserves.
9/ For automatic jelly line; preserves hand-labeled unless machine is free from jelly line.
10/ Not applicable.

PLANT E

Products and Volume of Output

This company produces approximately 300 different products--jams, jellies, preserves, marmalade, ice cream, chocolate drink mix, and various soda fountain specialties. The preserves, jams, jellies, and marmalade are packaged in twenty-four 1-pound jars, six 1-pound jars, or six No. 10 tins per case, or in 50-pound pails. The price range of the jellies to which this case study is confined ranged from $2 to $4 per dozen 1-pound jars and from $7 to $21 per half-dozen for 4-pound jars.

From data selected for 5 days during which jellies only were produced, 5 separate flavors (quince, apple, crabapple, apple-cherry, and grape) in No. 10 cans totaling about 255,000 pounds were reported. About 700 man-hours were expended in their production.

Plant Characteristics

Employment. The total number of workers employed at this plant during the reported period was 43 of which 29 were direct factory workers, 10 indirect, and 4 office employees. This company is departmentalized according to product and has 14 employees engaged directly in the production of jams and jellies. Direct employees were divided among operations during the 5-day period reported approximately as follows:

Receiving	1/2	Filling	3
Preparation	2	Sealing	1
Cooking	2	Thermal processing and cooling	1
Labeling and casing . . .	5		

The company employed 10 indirect workers, consisting of 2 foremen, 1 maintenance man, 2 truckdrivers, and 5 shipping and receiving employees, and the time of these employees allocable to jellies produced during an average workweek was equivalent to the full time of 1 supervisor or foreman and 1 maintenance man. About one-fourth of an employee's time was devoted to cleaning.

Buildings. This company conducted its plant operations in a 1-story concrete, brick, and steel structure including 20,000 square feet allotted to plant and 600 square feet to a boiler room. It has office space in a wooden frame structure of 750 square feet.

Machinery and Equipment. Of the machinery and equipment used for jelly-making, some of which are also utilized for other products, only two 5,000-gallon tanks were over 10 years of age. Some of its retorts, filling- and closing-machines were acquired about 5 years ago to replace obsolete equipment, and some additional filling machines and stainless steel kettles were installed in 1950. The company has constructed some retorts, holding pans, and tanks. Two steam boiler units were purchased in 1947.

Operating Practices

Manufacturing Process. Frozen fruits are shipped in from outside cold storage facilities, weighed, unpacked, thawed, and mixed in 6 copper or steel kettles holding 125 to 175 gallons each. Six portable electric mixers are attached to the kettles. Hooded ventilating systems are placed over each kettle to carry off steam vapors.

From the kettles, the jellies are drained into 2 water-jacketed holding pans, each of 1,000 pounds' capacity, for cooling. When jellies are sufficiently cooled, they are pumped to a 150 gallon filling tank. Empty No. 10 cans are placed on a track and pushed past a manually controlled spigot on the tank. After the cans have been filled, they are manually pushed to a can sealing machine. The sealed cans are placed in 8 retort trays holding 80 to 120 cans.

By means of an overhead electric hoist, the retort trays are lifted into 8 retorts, each holding 1 retort tray. The retorts are flooded with water and heated to sterilizing temperature of about 190 degrees Fahrenheit. The trays are then lifted from the retort, cans removed from the trays and placed on the concrete floor where they remain overnight for air cooling. These cans are not labeled but are rubberstamped on top with identification. Six cans are packed in each case. About 50 cases are placed on a pallet and moved to the warehouse by a lift truck.

Materials Handling. In the description of the manufacturing process, it should be noted that pumps and pipes are used between the holding pans and filling tank. Other materials are handled mechanically by an overhead electric hoist or a lift truck.

Integration. This is a fully integrated, single-plant corporation. Production, however, is departmentalized, each department making a particular type of product.

Production and Inventory Control and Scheduling. Production is scheduled according to orders, and sufficient raw materials are purchased to fill orders. Ordinarily it requires about 5 days after receiving orders for this company to accumulate the necessary raw materials. A stock of raw materials for about 2 to 3 days' production is kept in cold storage plants. The machinery is cleaned and repaired after working hours. Major spare parts and machinery are kept in duplicate to be used when breakdowns occur.

Inspection. This company has two employees in its laboratory who continuously inspect raw materials and finished products. It maintains this laboratory not only for quality control but also for studying new products before commencing production and to analyze the products of its competitors. This plant reports an "infinitesimal" number of rejects.

Engineering and Research. No special professional services are maintained or used other than the laboratory maintained for quality control and product improvement noted above.

Table 6. Man-hours required, and machinery used in the production of 100 cases of all jellies, by operation, plant E, U. S. A., selected period, 1951

Department or operation	Man-hours per 100 cases1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Total—All operations.	2/6.56	2/5.38	1.18	----	----	---	---	-----
Receiving. . .	.21	--	.21	(3/)	Tanks	2	12	5,000 gallons.
				Toledo Scale Co.	Scale	1	7	1,000 pounds
Preparation. .	.76	.76	--	Burkhard	Copper or steel kettles.	6	4	125-175 gallons each.
				Mixing Equipment Co.	Portable electric mixers.	6	5	(3/)
				Colleer Citrus Pectin Co.	Pectin machine	1	6	(3/)
				(3/)	Hooded ventilating system.	6	(3/)	(3/)
Cooking. . . .	.80	.80	--	Wexler Thermometer Co.	Thermometers	6	4	(3/)
				Homemade	Water jacketed holding pans.	2	6	1,000 pounds each.
				Homemade	Tank	1	12	150 gallons.
Filling. . . .	1.13	1.13	--	(4/)	(4/)	(4/)	(4/)	(4/)
Sealing. . . .	.38	.38	--	American Can Co.	Can sealing machine, model 8.	1	9	(3/)
				(4/)	Retort trays	8	(3/)	80-120 No. 10 tins.
Thermal processing	.39	.39	--	United Electric Hyster Co.	Overhead electric hoist	1	3	----
				Homemade	Retorts	2	8	80-120 No. 10 tins.

See footnotes at end of table.

Table 6. Man-hours required, and machinery used in the production of 100 cases of all jellies, by operation, plant E, U. S. A., selected period, 1951--Continued

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Labeling and casing. . . .	1.93	1.93	--	Hyster Co.	Lift truck	1	3	(3/)
				(3/)	Skids	(3/)	(3/)	(3/)
Cleaning . . .	.09	--	0.09	(3/)	(3/)	(3/)	(3/)	(3/)
Boiler and maintenance .	.46	--	.46	(3/)	(3/)	(3/)	(3/)	(3/)
Supervision. .	.42	--	.42	(5/)	(5/)	(5/)	(5/)	(5/)

1/ 1 case equals 24 pounds of fruit spreads.
2/ Total does not equal sum of components because of rounding.
3/ Information not available.
4/ Hand operation of spigot on tank only and manually pushed on truck; information not applicable.
5/ Not applicable.

Table 7. Man-hours required in the production of 100 cases of apple-cherry and grape jelly, by operation, plant E, U. S. A., selected period, 1951

Department or operation	Man-hours per 100 cases 1/	
	Apple-cherry jelly	Grape jelly 2/
Total—All operations	5.91	3/ 6.36
Total—direct operations	4.82	3/ 5.24
Preparation	.68	.72
Cooking	.68	.81
Filling	1.03	1.09
Sealing	.34	.36
Thermal processing	.34	.40
Labeling and casing	1.75	1.85
Total—indirect operations	1.09	1.13
Receiving	.20	.20
Cleaning	.09	.08
Boiler and maintenance	.42	.44
Supervision	.38	.41

1/ 1 case equals 24 pounds of fruit spreads.
2/ Single product only made on selected day.
3/ Total does not equal sum of components because of rounding.

PLANT F

Products and Volume of Output

Fruit preserves, jams, and jellies are a small part of the variety and volume of this plant's total annual production. A recent advertising brochure of the company shows about 90 items of many different types of preserved foodstuffs, packed in both glass and tin containers. The price ranges for fruit spreads were not available.

Plant F reported production of about 1,500 cases of strawberry preserves in a selected 1-day period. These were packaged in 12-ounce containers, 24 per case. Total production by weight was 27,000 pounds.

Plant Characteristics

Buildings. All food processing is done in a 3-story, brick building more than 20 years old. Because of the heterogeneous production, floor space devoted to the processing of jams, jellies, and preserves could not be reported.

Machinery and Equipment. One mixing can suffices for six vacuum kettles made by the Pfaudler and Mojonnier Co. One electrically controlled filler of the Filler Machine Co. is used. A Foulder Co. sealing machine and a Barry Wehmiller pasteurizer complete the machinery used for preserves.

Employment. Average employment of the company during 1949 was nearly 400, about 48 percent of whom were female workers. Twenty-five production and related workers were engaged in the production of strawberry preserves during the 1-day period. There were 21 operators and 1 setup man classed as direct labor, and 1 foreman, 1 assistant foreman, and 1 clerk classed as indirect labor.

Labor Practices. A union agreement between plant F and the Amalgamated Meat Cutters and Butcher Workmen of North America (AFL) was in effect.

Fringe benefits such as premium pay, paid holidays and vacations, provision of uniforms, and rest periods were included under the terms of the contract.

Overtime was paid at time-and-one-half rates beyond 40 hours, which was the scheduled workweek. The union agreement takes cognizance of the exemption of the company from overtime payment for 14 weeks, allowed under the Federal Fair Labor Standards Act for processors of seasonal or perishable products. But the agreement specifies that the company will not avail itself of the exemption during the period of the agreement. The average weekly hours of plant F were 47.5 for an 11-month period in 1951, whereas the entire canning and preserving industry during the full calender year of 1951 averaged 40.0 hours.

Gross average hourly earnings in this plant were $1.132 for the 11-month period in 1951 compared with $1.27 for the entire canning and preserving industry.

Premium pay of 5 cents an hour was granted under the union agreement when the majority of an employee's hours were scheduled after 7 p.m. and before 7 a.m.

Incentive pay is not included in the company's method of wage payment.

Uniforms are furnished at half the original cost to employees where required by the company or if desired by the employees. Raincoats, boots, and similar clothing are furnished to employees in stores department without cost but must be returned to the company or be paid for by the employee. Employees are paid for 12 minutes before and 12 minutes after actual working time for changing clothes.

Rest periods of 10 minutes during each 4-hour work period, and one-half hour unpaid lunch period were in effect.

Six paid holidays annually were granted at regular time rates. When one of these holidays is included as a part of the regularly scheduled workweek, it is paid at double the regular time rates.

Vacation pay for 1 week is received by regular employees with 1 year's service prior to June 30 of the year in which vacation is to be granted and who have worked at least 80 percent of the allotted work hours. The vacation pay is equal to 44 hours at straight time. Employees with 5 or more years' service receive 2 weeks' paid vacation at straight time for 88 hours.

Operating Practices

Manufacturing Process. Frozen strawberries already washed and graded are received in 30-pound cans and 450-pound barrels. Fresh berries also are used, if readily available. Thawed berries are mixed to achieve a uniform grade. Six vacuum kettles are used to perform the cooking. An electrically controlled filling machine takes empty containers, fills them with the preserves, and sends them to the sealing machine. After sealing, one pasteurizing machine completes the process. This battery of machines handles about 27,000 pounds of strawberries a day. Detailed information on labeling, cooling, and casing is not available, nor was information given for the number of workers per machine or operation.

Materials Handling. Trucks and a freight elevator move the strawberries from refrigerator to mixing cans. Pipelines carry the berries from kettles to filler. Conveyor belts bring empty containers to the filling machine and carry the filled containers to the sealing machine and to the pasteurizer. Trucks carry filled cases to the warehouse. The degree of mechanization is estimated at 95 percent.

Integration. As a unit of a large company, this plant shares in services that control the quality and packaging of raw materials, oversee shipping, provide extra workers and production facilities if warranted, and conduct quality control and special studies. Otherwise it is completely integrated in terms of its own production.

Production and Inventory Control and Scheduling. The amount of basic ingredients kept on hand is not known. Extensive mechanization in the plant permits utilization of relatively unskilled labor under proper guidance. Production scheduling is dependent upon actual orders received rather than in anticipation of demand.

Engineering and Research. A laboratory is maintained to devise new bacteriological control methods and conduct special studies, as well as to exercise quality control. The staff employed by the plant often collaborates with representatives of machinery manufacturers and other outside advisory services to improve the quality of products.

Inspection. Rejected goods are reduced to a minimum by stringent control of the quality of basic ingredients. During processing the production workers are alert to detect any possibility of accidents which might damage the quality of the product before harm is actually done. The amount of rejected material among total production is reported to be negligible.

Man-Hours by Operation. Detailed data were not furnished from which man-hours by operation could be derived. Standard man-hours in terms of direct and indirect labor required per dozen units of preserves, jellies, and marmalade were reported from which the estimates of man-hours required per 100 cases of twenty-four 1-pound containers shown in table A were derived. No allocation of employees among operations was reported.

PLANT G

Products and Volume of Output

Plant G reported on production of three kinds of preserves and one flavor of jam. All were filled in 12-ounce jars packed a dozen per case; the comparative data in chapter I was adjusted to standard units of cases containing 24 containers. This plant processes at least a dozen flavors.

During 1950, nearly 1,800,000 pounds of strawberry, raspberry, and peach preserves, and grape jam were produced using frozen fruit in cartons, pasteurized fruit in tins, or fresh fruit when in season.

Plant Characteristics

Employment. Total plant employment was over 150, 50 percent of which was direct factory labor; 15 percent comprised the indirect labor engaged in maintenance, custodial services, and power supply; about 4 percent were foremen; 10 percent were office employees; and 21 percent constituted the administrative and sales force. The proportion of female employees reported among direct workers' teams producing the 3 preserves and 1 kind of jam varied from 50 to 63 percent, and all were listed as being in the filling department.

Buildings. Total production and office space occupies an entire multistory building having more than 137,000 square feet. The brick building was not originally designed for its present use. Outside cold storage facilities are used.

Machinery and Equipment. Most equipment was about 15 years old. A Mojonnier Vac-cooker with auxiliary pumps and valves was purchased 7 years ago. The preheating tanks and pulpers used for fresh grapes are from 4 to 15 years old.

Operating Practices

Manufacturing Process. Plant G maintains storage space on an upper floor served by a freight elevator. A three-man crew prepares canned or barreled fruit for cooking. Four men are required for frozen berries. Direct man-hours per 2,400 pounds of fruit prepared range from 1.37 for grape jam to 1.93 for strawberry preserves.

Two workers operate the two Pfaudler preheaters. These units contain agitators and are served by sirup tanks and pumps, a sugar elevator, and three open-cooking kettles, all of synchronized capacities. Three glass-lined and one stainless-steel vacuum cookers, with auxiliary pumps, feed lines, and hot valves, are tended by one man.

Two or three workers are required to dump containers in the homemade unscrambler that arranges them in single file for the filling machines. Man-hours in terms of 2,400 pounds of finished product ranged from 1.28 to 1.69. Associated with filling for strawberry and peach preserves is an additional 0.85 man-hours per 2,400 pounds required to manually remove any fruit particles from the jar rims. Two filling machines are used.

A line of 2 capping machines, 2 washers, and 1 spray cooler, the latter 3 units of company design, requires 1 or 2 workers. One worker suffices for capping strawberry preserves. The labeling operation is synchronized with the capping line.

Casing is a hand operation performed by 1 worker for strawberry preserves, and 1 or 2 workers for the other items reported. Stenciling of cases and sealing and loading of cases are also performed manually.

Materials Handling. Freight elevators carry materials to an upper floor where containers are opened; gravity assists in mixing and distributing ingredients. Pipelines, sugar elevator, and sirup pump are used in preheating and cooking stages. Pipelines carry cooked ingredients to filler. Belt conveyor carries empty containers to filling machine and filled jars to capper, through sprayer and labeler. Pallets and power trucks handle raw and finished goods.

Production and Inventory Control and Scheduling. Production is planned 1 week in advance. Each month's production usually contains some preserves and jams. Fruit is purchased seasonally when possible. Other materials sufficient for 30 days' production are kept available.

One mechanic is assigned regularly to the production line. The plant machine shop has developed "homemade" auxiliary units with capacities that are balanced with purchased machinery.

Inspection. During processing, the firm's own laboratory tests samples hourly for acidity, weight, body color, and flavor. Incoming materials are also inspected.

Engineering and Research. In addition to other duties, 2 cost analysts and 1 chemist cooperate with staff executives on product and method improvement studies.

Man-Hours by Operation. Plant G submitted standard man-hour requirements in terms of direct man-hours per pound of selected flavors of preserves and jams. The man-hours were based on standard crews to perform the necessary operations. Standards were said to vary less than 1 percent from actual hours. Tables 7 and 8 present some of the information upon which the standards were based. Indirect labor was estimated to be 52 percent of the direct labor expended on preserves and jams.

Table 8. Direct man-hours required in the production of 100 cases of selected preserves and jam, by operation, plant G, U. S. A., specified period, 1951

Operation	Direct man-hours per 100 cases 1/			
	Strawberry preserves	Red raspberry preserves	Peach preserves	Grape jam
Total—All operations	10.64	7.54	7.88	7.02
Cooking:				
Prepare fruit	1.93	1.87	1.38	1.37
Operate preheaters . . .	1.28	.93	.92	.92
Operate vacuum pans . . .	.64	.47	.46	.46
Filling:				
Dump glass	1.69	1.28	1.28	1.28
Top off	.85	--	.85	--
Operate capper	.85	.85	.85	.85
Operate labeler	.85	.85	.85	.85
Case	.85	.43	.43	.43
Stencil	.85	.43	.43	.43
Seal and load	.85	.43	.43	.43

1/ 1 case equals 24 pounds of fruit spreads.

Table 9. Type and number of machines and equipment used, in the production of preserves and jams, by department, plant G, U. S. A., 1951

Department or operation	Make	Description 1/	Number of machines
Receiving	(2/)	Freight elevators	2
	(2/)	Skids and power trucks	(2/)
Fruit preparation . .	(2/)	Preheating tanks	3
	(2/)	Pulpers	2
Operate preheaters . .	Pfaudler	Preheaters with agitators	2
	(2/)	Corn sirup tanks	2
	(2/)	Pumps	2
	(2/)	Sugar elevator	1
	(2/)	Open pectin cooking kettles	3
Operate vacuum pans .	Pfaudler	Glass lined vac-cookers	3
	Mojonnier	Stainless steel vac-cookers	1
	(2/)	Auxiliary pumps	(2/)
Dump glass	Own make	Unscrambler	(2/)
Filling	(2/)	Filler machines	2
Operate capper	White Cap Co.	Capping machine	2
Thermal processing . .	Own make	Washers	2
Cooling	Own make	Spray cooler	1
Operate labeler . . .	(2/)	Pneumatic labeler	2
Seal and load	Own make	Case sealer	1

1/ Company indicated the average age of all its equipment at 15 years with a range of 7 to 15 years.
2/ Information not available.

PLANT H

Products and Volume of Output

During the course of a year, this plant processes 3 kinds of juices, 4 jellies, and 13 other fruit-flavored spreads, packaging them in bottles, cans, and tumblers, containing from 6 to 32 ounces each.

Total production of nearly 1.5 million cases of all products was reported for 1951. A reporting period of 1 week was selected during which about 450,000 pounds of grape jam was produced. No other products were run during this period.

Plant Characteristics

Employment. There were 29 production and related workers employed during 1 workweek (5 days) when grape jam alone was produced. These employees were distributed by operation as follows:

Operation	Direct workers	Indirect workers
Preparation	4	1
Cooking	3	1
Filling and capping . . .	6	
Washing and cooling . . .	1	
Labeling	1	1
Casing	3	
Inspecting	2	
Maintenance	-	2
Warehousing	-	3
Custodial	-	1
Total	20	9

Buildings. There are four buildings. The production area has 3 stories averaging over 27,000 square feet per floor. The brick office building is also multistoried. Two other buildings that are made of brick and steel and used for storage contain 20,000 square feet. All were specifically designed to meet plant requirements. The most recent construction is about 7 years old.

Machinery and Equipment. Aluminum kettles with electric mixers, a company-made washing machine, and a new labeler were installed during 1949 and 1950. The vacuum pans, oldest of the equipment, were reported to be 15 years old. All other machinery and equipment were acquired 3 to 5 years ago.

Operating Practices

Manufacturing Process. Extracts of pressed grapes are pumped from concrete, refrigerated, storage tanks to aluminum, steam-jacketed kettles.

The heated extracts are piped to vacuum pans for reduction to the proper consistency. Automatic scales are used when adding the required amount of sugar.

Pumps and pipelines carry the prepared jam to the filling machine where washed tumblers are brought by conveyor belt. Sealing is done by the vapor-vacuum process, and inspection takes place immediately after filling.

Belt conveyors carry the sealed tumblers through a hot spray bath, then through a cooling spray. Both processes together entail 0.27 direct man-hours per 2,400 pounds. Labeling and casing use 1.08 man-hours per 2,400 pounds of finished jam. The sealed cases are taken by forklift truck to storage.

Materials Handling. Freight elevators bring the ingredients to an upper floor where preheating takes place and batches are mixed. Air pressure and gravity force the materials to hot wells where an overhead carrier supplies sugar, and from which pipelines feed kettles and vacuum pans. A pipeline and pump provide material for the filling machine. Cased empty containers are brought by rail to the unscrambler where they are dumped, set in file, and carried to the filler. Conveyor belts carry the containers through the capping and sealing machine, past the inspector, through the sprays and labeler, and to the casing machine where they are placed in cartons. Forklift trucks take the sealed cartons to storage.

Integration. Plant H is part of a large company that maintains pools of materials for all its plants in the vicinity. The company buys fruit in season and is located in a large fruit-growing area. In all respects the plant is fully integrated.

Production and Inventory Control and Scheduling. Company administrative, sales, purchasing, and laboratory personnel assist the plant manager in planning production. Every season they circulate estimates of the market demand. Cost analysts compile statistical information to be used in contemplated product improvements. From 2 to 10 days' supply of sugar and 3 or more months' supply of other ingredients are kept on hand. Standby machinery and experienced labor from other plants can be brought into service as conditions or expectations warrant.

Inspection. The laboratory appraises raw materials. After being certified, materials in process are inspected visually. Where products fail to meet standards, they are destroyed. When possible, however, materials rejected because of insufficient filling and poor labeling of containers are salvaged.

Engineering and Research. Company specialists in production methods, cost analysis, plant layout, and product improvement work in coordination with plant and company officials in planning future production.

Table 10. Man-hours required, and machinery used in the production of 100 cases of grape jam, by operation, plant H, U. S. A , selected period, 1951

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Total—All operations .	7.83	5.40	2.43					
Preparation	1.35	1.08	.27	(2/)	Concrete tanks	9	5	45,000 gallons each.
					Stainless steel tanks.	9	5	145,000 gallons each.
Cooking	1.08	.81	.27	(2/)	Stainless, steamjacketed kettles.	2	5	150 gallons each.
Filling and sealing	1.72	1.62	.10	Ferguson Mfg. Co.	Case printing machine.	(2/)	(2/)	(2/)
				White Cap Co.	Unscrambler	1	6	(2/)
				Own make	Washer	1	1	(2/)
				Horix Mfg. Co.	Filler	1	3	(2/)
				White Cap Co.	Capper	1	3	(2/)
Thermal processing and cooling .	.29	.27	.02	(2/)	(2/)	(2/)	(2/)	(2/)
Labeling	.29	.27	.02	New Jersey Machine Co.	Labeler	1	1	(2/)
Casing	.86	.81	.05	Standard Kapp Corp.	Case packer	1	3	(2/)
				Ferguson Mfg. Co.	Case sealer and compression unit.	1	5	(3/)

See footnotes at end of table.

Table 10. Man-hours required, and machinery used in the production of 100 cases of grape jam, by operation, plant H, U. S. A., selected period, 1951—Continued

Department or operation	Man-hours per 100 cases 1/			Machinery and equipment				
	Total	Direct	Indirect	Make	Description	Number of machines	Average age (years)	Capacity
Inspection	0.57	0.54	0.03	(2/)	(2/)	(2/)	(2/)	(2/)
Maintenance and . . custodial	.81	(3/)	.81	(3/)	(3/)	(3/)	(3/)	(3/)
warehousing	.86	(3/)	.86	(3/)	(3/)	(3/)	(3/)	(3/)

1/ 1 case equals 24 pounds of fruit spreads.
2/ Information not available.
3/ Not applicable.

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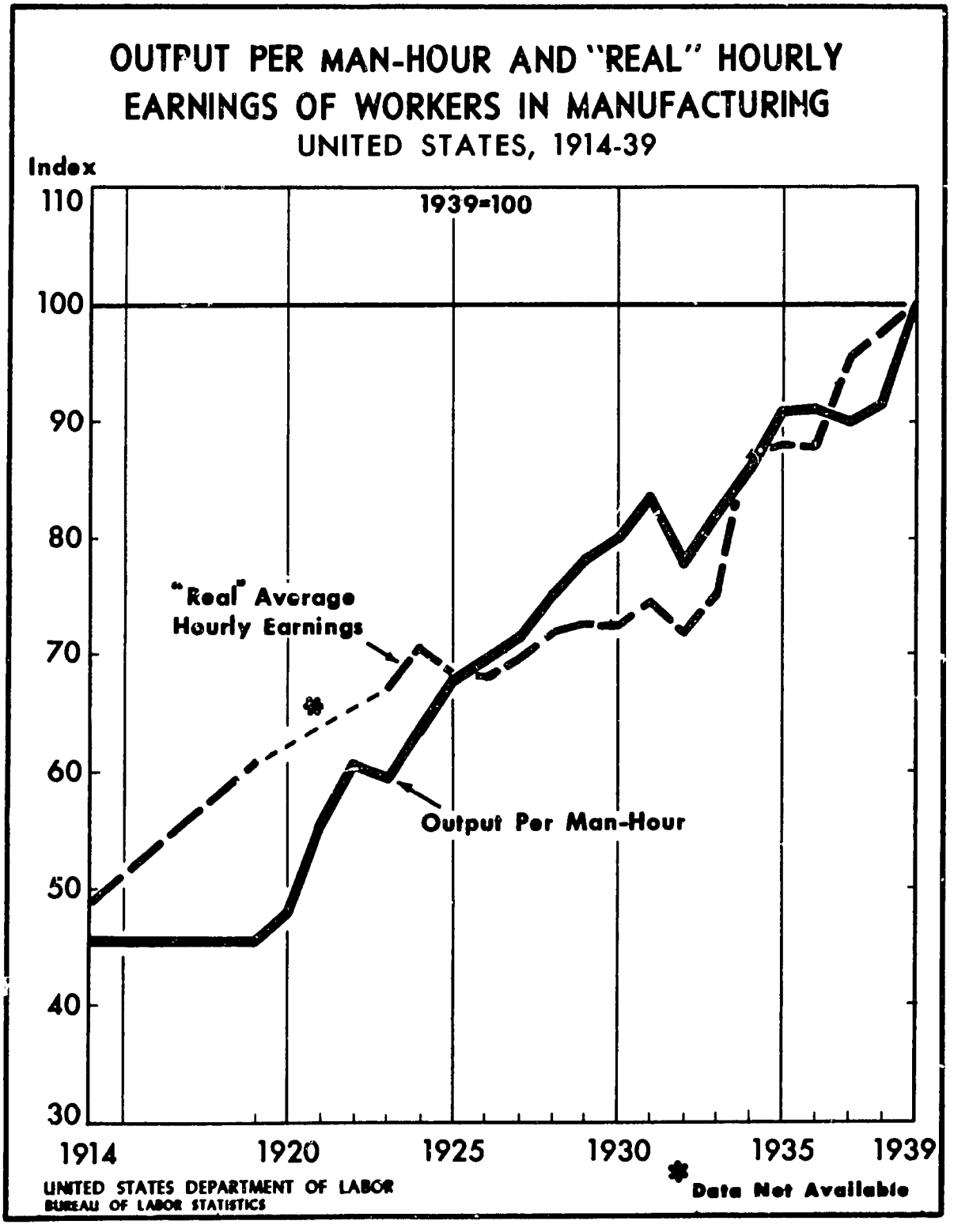

Figure 5 Output per man-hour and "real" hourly earnings, manufacturing, U. S. A., 1914-39

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CHAPTER III: LABOR IN THE CANNING AND PRESERVING INDUSTRY

(NOTE: THIS CHAPTER IS NOT INTENDED TO BE A COMPLETE STUDY OF LABOR OR LABOR CONDITIONS IN THIS INDUSTRY. IT IS PRESENTED PRIMARILY TO ILLUSTRATE THAT THE UNITED STATES FACTORY WORKER HAS ACHIEVED A HIGH STANDARD OF LIVING IN HIS HIGHLY PRODUCTIVE ECONOMY.)

Labor Gains and Increased Productivity

Factory workers' earnings, and the earnings of other groups in the United States, have increased, over time, in real as well as in monetary terms, along with the almost continuous improvements in productivity (fig. 5). The Bureau of Labor Statistics estimated that between 1909 and 1947 the average real weekly earnings of factory workers doubled, whereas the workweek declined one-fifth. These substantial improvements in income could not have been attained except for the increased output per man-hour of work made possible by a constantly improving technology of production. Although all workers have benefited from greater productivity, workers in industries having strong unions have generally been in the forefront in obtaining a share of the gain from increased productivity. In addition to greater pay and a shorter workweek, workers have shared the returns from greater productivity in the form of "fringe benefits" such as paid holidays, vacations, pensions, and rest periods.

Despite the advantages arising from technological change, both organized and unorganized labor have on many occasions resisted the introduction of new methods or machinery because of the threat of short run unemployment and the natural resentment of change. Examples of how management and labor working together have successfully coped with the problem are given in appendix I.

Average Hours and Earnings

Manufacturers of fruit spreads are included in the Canning and Preserving Fruits, Vegetables, and Sea Foods Industry. 5/ Average hourly earnings

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5/ Standard Industrial Classification Industry number 203 includes the following industries: canned sea food (S.I.C. 2031); cured fish (S.I.C. 2032); canned fruits, vegetables, and soups as well as preserves, jams, and jellies (S.I.C. 2033); dried and dehydrated fruits and vegetables (S.I.C. 2034); pickled fruits, and vegetables and vegetable sauces, seasonings and salad dressing (S.I.C. 2035); and frozen fruits, vegetables, and sea foods (S.I.C. 2037).

Table 11. Average weekly hours and gross earnings of production workers in all manufacturing industries and in the canning and preserving industry, U. S. A., selected years, 1909-52

Year	Consumers' Price Index 1/ (1947-49=100)	Gross average weekly earnings		Average weekly hours		Gross average hourly earnings	
		Canning and preserving industry	All manufacturing industries	Canning and preserving industry	All manufacturing industries	Canning and preserving industry	All manufacturing industries
1909	(2/)	(2/)	$ 9.84	(2/)	51.0	(2/)	$0.193
1939	(2/)	(2/)	23.86	(2/)	37.7	(2/)	.633
1947	95.5	$41.33	49.97	39.7	40.4	$1.041	1.237
1950	102.8	46.81	59.33	39.3	40.5	1.191	1.465
1951	111.0	50.80	64.71	40.0	40.7	1.27	1.59
1952	113.5	51.88	67.97	39.3	40.7	1.32	1.67

1/ Consumers' Price Index for moderate-income families in large cities, U. S. Bureau of Labor Statistics.
2/ Information not available.

in this industry rose from $1.04 in 1947 to $1.32 in 1952, an increase of 27 percent during that period, whereas the average workweek remained about the same. The average levels of income for workers in American factories and in canneries, in recent years are indicated in table 11. There was very little difference between average workweeks of cannery workers and all factory workers. The big difference between them, however, was in their average hourly earnings and their average weekly earnings. Average weekly earnings of cannery workers were $16 below those of the average factory worker.

During the same period, the Consumers' Price Index rose about 19 percent. This index, maintained by the U. S. Bureau of Labor Statistics, represents changes in the prices of a fixed "market basket" of goods and services purchased by moderate-income families in large cities. A larger increase in earnings than in prices paid by the cannery worker resulted in an increase in real earnings. The cost of common commodities, in terms of work time required by the average cannery or factory worker to buy selected food and clothing items during 1947, is shown in table 12.

Collective Bargaining

In the United States, collective bargaining agreements range, from those purely local in scope and negotiated by representatives of a local union with individual employers, to collective bargaining agreements which are national in scope affecting an entire industry and signed by the national representatives of organized workers and organized employers. Most of the agreements covering cannery workers are local in scope and are negotiated individually

with the canneries. There are a few collective bargaining agreements in this industry which are negotiated on an area basis, but there is no industrywide contract for the canning industry.

In 1951, approximately two-thirds of the production workers in the Canning and Preserving Fruits, Vegetables, and Sea Foods Industry were unionized. The unions prevalent in this industry classification are: International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America, (AFL); Amalgamated Meat Cutters and Butcher Workmen of North America, (AFL); Federal Labor Unions with local unions directly affiliated with AFL; and the United Packinghouse Workers of America, (CIO).

Fringe Benefits 6/

Fringe benefits have been included in collective-bargaining agreements and are often important aspects of personnel policies of establishments where union agreements are lacking. A relatively recent survey of wages and related practices restricted to selected canneries in the Baltimore, Md. area by the Bureau of Labor Statistics 7/ showed that about two-thirds of the employees worked a scheduled 40- or 44-hour week; another 20 to 25 percent worked 45 to 50 hours. Sixty-two percent of the employees in the survey received either 5 or 6 paid holidays per year. About 54 percent of the plant employees benefited from insurance or pension plans. Paid vacations ranged from less than 1 week after 6 months' service, to 2 weeks after 15 years. About 75 percent of the employees received 1 week paid vacation after 1 year of service and 2 weeks after 15 years. Only 15 percent of the employees received no paid vacation.

Pension Plans. Virtually every worker in the United States employed by business or industrial firms, including the employees of the firms in this study, is eligible to receive a pension at the age of 65. This program is required by Federal law and is known as Old Age and Survivors' Insurance. To finance this pension plan, employers are required to contribute periodically an amount equal to 1-1/2 percent of each employee's wages, and the employee contributes an equal amount. 8/ The benefits from this pension plan are distributed either to both the worker and his wife, or, on the worker's death, to his surviving wife and children, and range in amount from a minimum of $25 to a maximum of $168.75 per month. The amount of the benefits depends upon the average wage received and the number of dependents. A worker who had averaged, during his period of employment, $67.97 per week, which is

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6/ Various nonwage benefits such as shift differentials, paid vacations and holidays, rest periods, and insurance and pension plans.

7/ Study included only canneries with 21 or more workers and represented an estimated 7 of 9 establishments and 1,983 of 2,233 employees in the area.

8/ The contributions will be progressively higher starting in 1954. For years 1954 to 1959, the contribution will be 2 percent and will eventually reach a maximum of 3-1/4 percent by 1970.

Your Social Security, a pamphlet describing Federal Old Age and Survivors' Insurance, U. S. Government Printing Office, Washington, D. C.

Table 12. Amount of worktime required of average factory workers and of average cannery workers to buy selected food and clothing items, U. S. A., 1947

Item	Unit of measure	Factory workers		Cannery workers	
		Hours	Minutes	Hours	Minutes
Food					
Milk	1 liter		9		11
Eggs	1 dozen		34		40
Oranges	1 dozen		21		25
White flour	1 kilogram		11		13
White wheat bread	1 kilogram		13		15
Butter	1 kilogram	1	28	1	45
Salt pork	1 kilogram		49		58
Potatoes	1 kilogram		7		8
Coffee	1 kilogram		51	1	1
Clothing					
Men:					
Heavy wool suit	1	36	43	43	38
Work shirt	1	1	19	1	34
Socks	1 pair		16		19
Street shoes	1 pair	6	32	7	46
Workshoes	1 pair	5	56	7	3
Women:					
Wool coat	1	17	53	21	15
Street dress	1	8	20	9	54
Housedress	1	2	31	2	59
Rayon and nylon stockings	1 pair		53	1	3
Street shoes	1 pair	5	26	6	27

the national average production worker's earnings for 1952, would be eligible at 65 for a pension amounting to $84.18, and his wife would receive an additional $42.09, for a total of $126.27 per month.

In addition to benefits under the Federal law, some States have extensive payments to aged workers which serve to supplement the above amounts.

Over and above these legally required pension plans, some employers, often after negotiations with the unions in their plants, have set up pension funds to which the employers contribute all or part of the cost. In the event that all the cost is not paid by the employer, the employees contribute the remainder.

Adjustments to Technological Change

Labor and management in the United States have always been faced with problems arising from changes in processes and the introduction of new machinery. The problems generally include determination of earnings, workloads, work schedules, displacement of special skills by new machinery and methods, and in some cases, actual displacement of workers. Over the past 25 years, with the more rapid growth of labor unions, adjustments and solutions to these problems in many instances, have been reached on a case-by-case basis as a result of negotiations between the two parties. The success of the solutions and adjustments has depended entirely on the attitudes with which labor and management approached each case and only incidentally on the technical details of the change itself. Moreover, negotiations over technological change in many fields of manufacturing indicate that the experience gained in one industry is applicable to problems of change in other industries. Consequently, the methods and ideas developed in negotiations over technological change are used in many industries beside the one in which the problem first appeared. Technical details concerning machines, processes, and conditions of employment still require agreement on a case basis within the framework of ideas and methods handed down from past experience.

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APPENDIX I: CASE STUDIES OF ADJUSTMENTS TO TECHNOLOGICAL CHANGE

NOTE: THE CASE STUDIES USED TO ILLUSTRATE ADJUSTMENTS TO TECHNOLOGICAL CHANGE WERE NOT MADE IN THE CANNING AND PRESERVING INDUSTRY. THESE EXAMPLES WERE SELECTED BECAUSE OF THE TECHNIQUES AND PROCEDURES THEY DEMONSTRATE, WITHOUT REGARD TO THE INDUSTRY IN WHICH THEY OCCUR.

Example A 9/

"The union has not challenged management's right to introduce new machinery or methods or to set the speed of work, in part because the stability of employment and the gradual expansion of the industry have meant that the exercise of these rights has not threatened the security of the individual worker. At the same time, most of the improvements have made the work easier and, because of increased mechanization, some have resulted in higher job rates under a job evaluation program which places great emphasis on responsibility. Management has also retained the right to hire, partly because the slow inflow of new workers has constituted no threat to the unions. Nor have the unions sought to represent the foremen, partly because the foremen were no threat to the unions because of the generally favorable attitude of management toward the unions.

"Certainly, management in pulp and paper no longer enjoys unrestricted powers. It has yielded its traditional rights chiefly in those fields now generally conceded to be subject to collective bargaining: wages, hours, vacations, and the like. Only in the joint safety program has it gone beyond the customary boundaries. Management has retained the essential right to direct, and the necessary powers to operate efficiently: the right to hire, the right to discharge for cause, the right to promote partly on the basis of efficiency, the right to change methods and machines, the right to set output standards, the right of sole control over foremen, and the right to have work proceed without interruption. At the same time, consultation with the unions has been widely practiced and management has discussed many problems with them on which it still has the sole discretion to make decisions. Almost without exception, plant managers assert that time spent in conference with union representatives is not a grudging concession but a real investment paying steady dividends.

9/ Crown Zellerbach Corporation and the Pacific Coast Pulp and Paper Industry. Causes of Industrial Peace Under Collective Bargaining, Case Study No. 9, National Planning Association, Washington, D. C., 1948.

"If sovereignty of management means retaining those powers essential to the achievement of quantity and quality of production, then little, if any, real impairment of it has taken place."

Example B 10/

"Steelworkers, in common with all other Americans, naturally welcome increasing labor productivity, if only because they realize it augments the fund from which higher living standards may be realized. Yet increasing labor productivity, whether reflecting technological improvements or more effective human teamwork, also arouses the workers' natural fear of demotion or displacement. The steel industry has not yet solved this long-standing human problem or even approached it as broadly as has the automobile industry - exemplified in the latter case by the General Motors contract of 1950.

"Nevertheless, both management and union leaders at Minnequa are making a sincere effort to minimize the adverse effects on workers of introducing modernized and improved mechanical and human teamwork processes. This is reflected in the care with which incentives arrangements and seniority problems were handled when a new Morgan rod mill was installed at the Minnequa plant in 1949. The same case illustrates the painstaking attention which is given to the classification of jobs involving new processes. Technological displacement was handled by the parties in conformance with a subsection of the contract's seniority clause, which outlines a procedure of mutuality in the instance of interplant transfers required by additions of new plant and discontinuance of other plants.

"After the new mill was put into operation, following the voluntary shift of workers from the old rod mill, unpredictable kinks had to be resolved, and these were still being straightened out 8 months after installations had been completed. The mill not only ran at partial capacity for some time, but also job classifications had to be tentative, and incentive standards were temporarily held in abeyance, with retroactive pay to be based on production records from the time the mill started.

"The union accepted the company's tentative job classifications with the understanding that time would be allowed for jobs to 'jell.' This involved no demotions, but take-home pay was diminished in those instances where incentive earnings, temporarily held in abeyance, would have exceeded hourly rates. This was offset to some extent by the fact that 10-hour shifts were adopted, with the contract providing for overtime premiums for work in excess of 8 hours.

10/ Minnequa Plant of Colorado Fuel and Iron Corporation and Two Locals of United Steelworkers of America. Causes of Industrial Peace Under Collective Bargaining, Case Study No. 9, National Planning Association, Washington, D. C., 1951.

"In approaching the comprehensive task of establishing job classifications for the new mill, the initial step of management and the union was to reach agreement on job descriptions. Then followed a reexamination of the company's tentative classifications in the light of the agreed-upon job descriptions. Based on the 30 labor grades established by the national committee studying wage inequities, a method of pooled judgment was applied in an attempt to 'slot' the jobs, as mutually defined, into corresponding labor grades. Although the contract provides that in cases of disagreement the company may proceed unilaterally (subject to later appeals through the grievance procedure) every effort was made to reach agreement by this method of pooled judgment which drew on practices in comparable situations in other plants and in the industry generally. Of 23 job classifications discussed in April 1950, 10 were accepted by the union without dispute, the company made concessions on 7, and the union provisionally withdrew objections on the remaining 6. The outcome was that many workers were upgraded, owing to the fact that some jobs which were reclassified affected relatively large concentrations of workers. An example was the flying shear job, which was raised from labor grade 9 to labor grade 10 in a mutual attempt to harmonize the new rod-mill rates with rates generally paid for like or similar work. In all of this processing, the union did not waive its contractual right for reconsideration in the light of further information or living experience.

"Essentially the same mutuality exists at Minnequa in the classification of new jobs as in the reclassification of old jobs affected by technological change or organizational flow changes. In all such proceedings the company's position is based on data prepared by the industrial engineering staff. The union in its turn acts directly through its committee on wage inequities rather than indirectly through the grievance procedure. Sometimes the advice of the United Steelworkers' wage experts is also sought. Thus, it may be seen that both union and management handle the difficult job of dealing with everchanging job content on a high factual level.

"This is a long step forward from the old days in the steel mills, with their lush growths of scattered wage rates. Today the industry has a simplified, understandable, and comprehensive wage structure based on mutual agreement. This wage structure is by no means a straitjacket for it serves only as a guide to the classification of particular local jobs. Nor is it a static wage structure, for the parties in their joint wage inequity committees have the means of keeping abreast of changes as they occur. The existence of a guiding wage structure and of arrangements for applying it to changing conditions is a major contribution to industrial peace."

APPENDIX II: INDUSTRY BACKGROUND INFORMATION

The first commercial cannery in the United States was established in New York City in 1819. The next year another cannery began operations in Boston, Mass. Between 1840 and 1860, canneries were established in Maine, Maryland, Pennsylvania, New York, and Delaware. During the Civil War (1861-65), heavy demands for canned foods for the Federal (northern) Armies engendered a rapid expansion of the number of plants and the volume of production. In the years immediately following that war, the industry continued to expand as a result of increasing technology and the trend of the population from rural to urban areas. By the beginning of the 20th century, processing plants had been established all over the United States.

Both World WarsI and II exerted expanding influences on the canning industry. Between 1942 and 1945, the industry produced a record wartime quantity of canned foods to meet military and civilian demand.

Today, the canning industry in the United States is a billion dollar industry with canneries in 45 States and in Alaska, Puerto Rico, and the Hawaiian Islands. Estimated fruit-spread production in the United States for 1951 was about 625 million pounds, an actual decrease of about 7 percent from 1947 when 671 million pounds of preserves, jams, jellies, marmalades, and butters were produced.

In 1947 there were 2,265 establishments primarily engaged in canning fruits and vegetables; fruit and vegetable juices (including soups); and in manufacturing preserves, jams, and jellies. These establishments employed an average of 135,974 persons of which 121,916 were production and related workers. Of these 2,265 canneries, 1,634 or 72 percent employed an average of fewer than 50 persons per establishment, but they accounted for only about 21 percent of the total employment in this segment of the industry.

According to the preliminary 1950 Annual Survey of Manufactures 11/ the Canning and Preserving, Except Fish, Industry had an average of 129,499 employees in 1950. Of this number, 113,780 were production employees who worked 213,893,000 man-hours and received $237,991,000 in wages.

Distribution of the product of the canned and preserved foods industry is usually effected through several agencies. The products ordinarily move from manufacturer to consumer via brokers, wholesalers, and retailers. The chain becomes complex because a single agency may perform more than one

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11/ U. S. Department of Commerce.

function. Certain functions are performed only in part by each agency. Each agency usually maintains storage or warehousing facilities, advertises or carries on other sales promotion, and finances its operations. Canners themselves usually do little direct distributing of their product except to institutional customers such as hospitals, universities, and governmental agencies.

A food broker acts as a selling agent to find markets for the products since a large number of firms packing canned goods do not maintain any sales organization. Merchandise brokers do even more, they buy canned foods for their own account and sell under their own brand labels. Wholesalers buy many kinds of food items, break down large volume units into the smaller units as desired by retailers, assemble and keep in stock many varieties of goods, advertise, contact retailers, and make final sales to retailers. Retailers carry foods wanted in stock, make their stock known to the general consuming public, and sell. Some diversion from the usual channels occurs when canners develop their own sales organization and are thereby enabled to fulfill broker and wholesaler functions. The distribution of the products of the industry entails financing of the various agents--farmers, processors, brokers, wholesalers, transport, and warehousing agencies. The many institutions providing financial aid are banks, investment and insurance companies, and individual stockholders and bondholders.

APPENDIX III: DATA COLLECTION

Field agents of the Bureau made personal visits to the plants covered in this report. At each plant visited, the questionnaire that follows was filled out for each type product processed. Actual figures from the plant's records were used and officials of the plant answered the questions.

The questionnaire was specially designed for this report. The actual questionnaire had more space allowed for the answers to questions. To conserve space in this report, the space allotted for answers is only indicated. Agents were encouraged to use additional paper to record as much information as possible.

It was not possible to get usable answers to all the questions from all the plants. All useful information received was included in this report.

UNITED STATES DEPARTMENT OF LABOR
Bureau of Labor Statistics
Washington 25, D. C.

CONFIDENTIAL

PRODUCTIVITY AND FACTORY PERFORMANCE

PROCESSED FOODS

Plant name _____ Address _____
Parent Company _____ Address _____
Name of officials interviewed: (Cross out "Co." or "Plant")
(Co.) (Plant) _____ Title _____
(Co.) (Plant) _____ Title _____
(Co.) (Plant) _____ Title _____

The data submitted on this questionnaire will be seen only by sworn employees of the Bureau of Labor Statistics. The data will not be available in any form which permits identification with any specific company, without written permission.

Survey made by _____ Date _____

PART I. REPORTED PRODUCT DATA

A. SPECIFICATIONS

1. Reported product:

a. Enter the name and description of reported product _____

b. Type of container: Can ___ Glass ___ Size ___ Number per case ___

2. Reported period:

Select a one-week period in which production of the reported product was at a high level. Period begins _____ and ends _____

B. PRODUCTION AND MAN-HOURS

1. Total production during reported period of reported product _____ dozens of cans (or glasses) (Specify if other unit)

2. Man-hours:

a. Actual factory man-hours on reported production during the reported period: Total _____ Direct _____ Indirect _____

b. List the labor accounts included in the above direct and indirect man-hour figures.

Direct labor accounts	Hours	Indirect labor accounts	Hours

c. Describe the source and procedure whereby the preceding man-hour figures were obtained. _____

3. Materials handling for reported product: General description (for aspects not covered in part IC) _____

D. PRODUCTION SCHEDULING AND CONTROL

1. Production scheduling:

a. Approximate time required to attain line capacity (time from the beginning of the first operation through thermal processing) _____

b. Describe extent and frequency of interruptions to production of reported product due to normal repairs and cleaning of machinery _____

2. Production control:

Briefly describe how production is planned, scheduled and controlled. (This includes all methods and procedures used to insure continuous and efficient operations to attain optimum production per man-hour.) Secure illustrative material such as scheduling forms, operations, tickets, etc. _____

3. Plant layout: Briefly describe. (Obtain diagram if possible.) _____

4. Describe any major changes that have been made in equipment for reported product since 1945-6 _____

5. Inspection of reported product:

a. Does this plant have a statistical quality control system? Yes ____ No ____. If yes, describe _____

b. Other types of inspection systems: Describe _____

c. Rejects: Percent of total production ____. Describe procedure for handling rejects _____

Inventory practices:

If plant has refrigerator storage facilities for raw materials used to produce the reported product indicate the following:

a. Size in cubic feet _____.

b. Stock of raw materials for how many days of production is kept on hand _____?

C. FACTORY OPERATIONS AND MACHINERY FOR REPORTED PRODUCT

1. Operations and machinery for reported production (B1) during reported period (A2):

   Enter the data indicated below in the operational sequence of the flow of production. Include steps for material movements and inspection.

Operations and brief description	Actual man-hours		No. of workers	Equipment					Other products run on this machine
	Direct	Indirect		Name, make, and model of machine	No. of units	Age (Yrs.) Av.	Age (Yrs.) Range	Capacity	
Receiving:									
Preparation:									
Mfgr. processing:									
Filling:									
Sealing:									
Thermal processing:									
Cooling:									
Labeling:									
Casing:									
Total:				XX	X	X	X	X	XX

2. Man-hours and use of machinery:

   a. State reasons for any differences between total man-hours by operations and total man-hours in question B2a. _____

   b. Describe the method used to obtain the man-hours above. _____

   c. Name the months of the year that any of the above machinery stands idle. _____

   d. In thermal processing, state for the reported product: Pressure _____
   Temperature (degrees F.) _____ Cooking time _____

PART II. GENERAL DATA

A. PLANT INFORMATION

1. Size of firms:

   a. Total number of different products produced in this plant during the past year _____ (Do not include size or style variations of the same product in this number.)

   b. Number of separate plants directly operated by this company _____

2. Plant buildings:

Name and use of building	Sq. ft. by floor			Age	Type of constructions and special features
	1	2	3		

3. Engineering and research:

   a. Check whether this plant has a special department to conduct research for improvement of the following and if so, enter the number employed in each.

	Yes	No	No. employed
(1) Plant layout			
(2) Production methods			
(3) Cost analysis			
(4) Product improvement			

   b. If yes, briefly describe the nature of their activities, and illustrate how they have affected unit man-hours during the last five years _____

   c. If no, are these services obtained from outside sources? Yes _____ No _____. If yes, describe _____

4. Describe other factors or developments which contributed to increased productivity in this plant during the past five years _____

5. Employment in the entire plant during the reported period (IA 2):

Type of labor	No.	Type of labor	No.
a. Total plant employment		c. Factory indirect labor	
b. Factory direct labor (Specify labor accounts)		(1) Foremen (Forewomen)	
(1)		(2) Maintenance men	
(2)		(3) Watchmen	
(3)		(4) Other (specify)	
(4)		(5)	
(5)		(6)	
(6)		(7)	
(7)		Total indirect labor	
Total direct labor		d. Office employees	

GLOSSARY

Butters	:	A type of fruit spread usually made from strained fruit pulp rather than filtered jelly; butters differ from jams because of higher concentration and finer consistency and are usually heavily spiced.
Centrifuging	:	Using rapid spinning to separate ingredients of differing densities; used to clarify extracts and jellies.
Chain belt bed	:	The foundation and guide along which a linked conveyor travels.
Cheese	:	Layers of crushed fruit in coarsely woven cotton cloths separated by wooden slats; they are placed in a press for extracting juice.
Clarification	:	Rendering a liquid or semiliquid such as jelly, clean of particles by distillation, centrifuging, or filteration.
Dolly	:	A small wheeled-truck used in moving heavy cases.
End point: (Also called "finish point")	:	That moment during processing at which jams, jellies, or preserves have been cooked to the proper consistency for filling.
Finish point	:	See "End point."
Gelatin	:	An animal substance having some of the characteristics of pectin, and capable of being substituted for pectin in the production of jellies.
Hydrolysis	:	A chemical process of decomposition involving the addition of the elements of water; often induced by the presence of a small amount of an enzyme, dilute acid, or other agent.
Jams	:	A type of fruit spread containing whole, sliced, or crushed fruit, usually smaller than that contained in preserves; original shape of the fruit is not retained.
Jellies	:	A type of fruit spread which is a clear, jellied juice from which all particles of fruit have been removed, usually by filtering.

Jellying point	:	The stage at which boiled fruit extracts have lost enough water to become viscous upon cooling because of the relatively higher amount of pectin or gelatin in the composition.
Marmalade	:	A type of fruit spread generally made from citrus fruits, differing from jelly in having suspended slices of fruit or peel in the clear jelly.
No. 10 cans	:	A standard, large-sized food container holding 3 quarts or 8 pounds, 6 ounces of jams, jellies, or preserves; also referred to as " No. 10 tins."
Pasteurization	:	The partial sterilization of food accomplished by sustained heating below the boiling point of water at sea level; pasteurization may take place from 175 degrees to 190 degrees Fahrenheit for jams, jellies and preserves.
Pectin	:	Water soluble substances found in plant tissues capable of becoming semisolid, as in jellies.
Preserves	:	A fruit spread which contains whole, sliced, or crushed fruit; distinguished from jams by generally containing larger pieces of fruit in the jellied juice than jams.
Puree	:	Fruit boiled to a pulp and passed through a sieve.
Refractometer	:	An instrument using variations in the path of light traveling through materials of different densities to determine the proper consistency or finish point of jellies.
Spreads	:	Substances usually spread on slices of bread, among which are jams, jellies, preserves, butters, sauces, and meat spreads.
Tartaric acid	:	A plant derivative often used as a substitute for lemon juice.
Thermal processing	:	Subjecting sealed containers of jams, jellies, and preserves to heat long enough to insure continuing sterility and preservation of the contents.
Thermo-cooling	:	Rapid heating and cooling of sealed containers of jams, jellies, and preserves accomplished by sprays or baths, usually at progressively decreasing temperatures.

Turret machine (capper, labeler)	:	A pivoted and revolving machine attachment carrying tools of different dimensions or functions, so that various size containers can be capped or labeled.
Unscrambler	:	A device for placing containers in single file before they enter a filling or labeling machine.
Vacuum-pan	:	A closed kettle from which air is exhausted permitting a cooking temperature lower than at atmospheric pressure.

Photographs courtesy of:

Food Engineering, McGraw-Hill
The Glass Packer, Ogden Publishing Company

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