APPENDIX 3

CAN-MAKING AT LEBANON

EVERY CANNERY MUST HAVE PRODUCED A LARGE WASTE PILE. The Lebanon pile has fortuitously survived for study, to give us a glimpse into the working conditions and thought processes of can-makers. As a stage in the development of American manufacturing, the Lebanon cannery provides insights into the larger history of technology.

Tinsmithing is an ancient art, practiced by highly trained craftsmen who draw upon a long craft tradition. A master tinsmith could make the finest tin cans, but they would be too expensive and there would never be enough of them. As the canning industry began to grow, a new kind of tinsmithing was invented to meet the demand for cheap containers made quickly in quantity. Streamlined tinsmithing persisted in can shops for a half-century before it was supplanted by machine manufacture.

Cans in America

Tinware manufacture began in America around the time of the Revolution (Fontana and Greenleaf 1962). Tin-plate steel sheets had long been used for utensils in Europe, as early as the thirteenth century. However, tinplate was not used for long-term wet food storage until the first third of the nineteenth century.

In 1795, the French Directory offered a reward of 12,000 francs for a method of food preservation to support Napoleon's armies. A French pickler, Nicholas Appert, won the prize in 1809 for a method using corked bottles and gained the title of "father of canning." He published a treatise in 1810, describing the process, which involved heating the bottled provisions in a water bath, with emphasis on excluding air (Minchinton 1957:254). A similar process was advocated by an Englishman named Saddington in 1807 (Sim 1951:12-14). Peter Durand, another Englishman, patented tinned cans for food packaging and marketed them under the unappetizing name of "embalmed provisions." He introduced a handmade can to America in 1818. Durand's cans were made by tinkers who could produce as many as sixty a day. Each can had a hole in the top, into which the product was placed; after the can was filled, a cap was soldered over the hole. This hole-in-top design became the standard food can through the rest of the nineteenth century (PLATES 29, 30, 31).

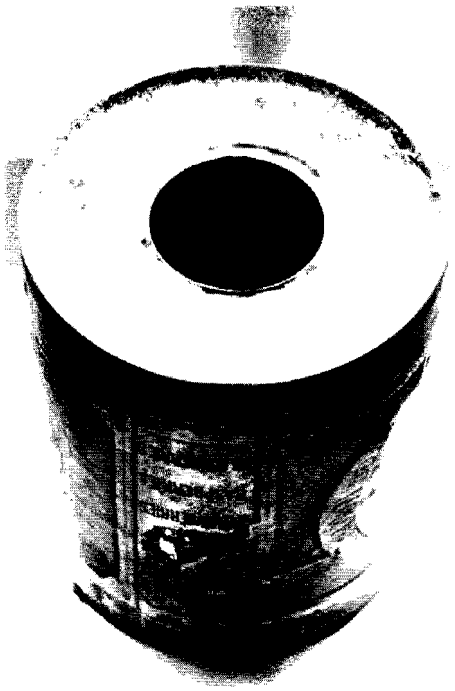


Plate 29

Plate 30

The two cans above, from the Lebanon cannery, have been opened by prying off the fill cap. Several can opener patents were issued during the period when these cans were becoming popular. The can on the left is a tomato can, and the one on the right is a peach can, with the appropriate-size fill holes (TABLE 1). These are the same cans illustrated in plates 21 and 22, page 40. They were collected and given to the Delaware State Museum by Dr. E. D. Bryan.

Below are three more Lebanon cans, also from Dr. Bryan's collection. On the left is a Collins, Geddes tomato can like the one above. The center can is a John S. Collins tomato can, and on the right is a Collins peach can. All the cans on this page are New Jersey #3 size.

Plate 31

The last major improvement in canning technology before the end of the nineteenth century was the process of "exhausting," introduced by Pierre Antoine Angilbert in 1823. Each cap had a small pinhole, which was left open while the contents were cooked. While the can was still hot, a drop of solder was placed on the hole; the cooling can then contracted and a partial vacuum formed inside (Sim 1951:15). Without an adequate understanding of bacteria, canners believed that the vacuum preserved the food. A reassuring hiss was regarded as the sign of safe canned goods, as it is popularly today. Louis Pasteur in 1860 demonstrated that the effectiveness of this technology was due to the fact that it killed bacteria and kept new ones from invading the product.

The first can ends were cut out individually for each can. Allen Taylor in 1847 invented the foot-powered press, which could form and cut the tops and bottoms in one operation. (Sim 1951:22). Such presses mechanized one of the most time-consuming steps of can manufacture. Cooking time, a costly matter, was reduced from five hours to thirty minutes around 1860 when it was discovered that calcium chloride would raise the boiling point of the water bath. Pressure cookers, introduced in 1874, further reduced the cooking time (Alberts 1973:48).

Pioneer Kent County canners

Some of the first canners were tinsmiths who developed methods that could be followed by workmen who would never become skilled craftsmen. Each worker was assigned a simple task in a sequence, producing a can that was serviceable but never was intended to be perfect. When professional tinsmiths ran canneries, innovation could be expected to continue; other products came out of the shops during off seasons. Richardson and Robbins in Dover (1855) and Stetson and Ellison in Camden (1856) continued to make architectural tin, special tinware containers, and other tin goods even after their primary businesses had become food canning. In 1873 Richardson and Robbins provided the architectural metal for the Dover Post Office.

In 1865, Richardson and Robbins first packed chicken and turkey, as their advertising proclaimed, "expressly for Excursionists and Travellers for their luncheons." Each food has its own canning techniques, for which developers created a number of devices. Richardson and Robbins originated several specialized cans for meat, as did the Underwood firm in Massachusetts. While a few special purpose cans survive in the marketplace today, the present variety is scant compared to the age of experimentation, around the time of the Civil War.

TABLE 1

CAN SIZE STANDARDS, 1883 AND TODAY

[EXPRESSED IN INCHES AND OUNCES]

NOMINAL SIZE	1883 DIAMETER	1883 HEIGHT	1988 DIAMETER	1988 HEIGHT	1988 VOLUME
#1	$2^{3}/4$	4	$2^{11}/16$	4	10 ounces
#2	$3^{7}/16$	$4^{9}/16$	$3^{7}/16$	$4^{9}/16$	19
#$2^{1}/2$	4	$4^{3}/4$	$4^{1}/16$	$4^{11}/16$	28
#3	$4^{3}/16$	$4^{7}/8$	$4^{1}/4$	$4^{7}/8$	32
#3 (N. J.)	$4^{1}/4$	5			
#6	Varies, always double #3		Uncommon today		would be 64
#10 [gallon]	$6^{1}/4$	7	$6^{3}/16$	7	105
[modern gallon]			$6^{3}/16$	8	128

HOLE SIZE STANDARD DIAMETERS IN 1883

Small Hole ..... $1^{1}/2$
Medium Hole ..... $1^{3}/4$
Peach Hole ..... $2^{1}/16$
Pineapple Hole..... $2^{7}/16$
Extra Pineapple Hole..... $3^{1}/2$

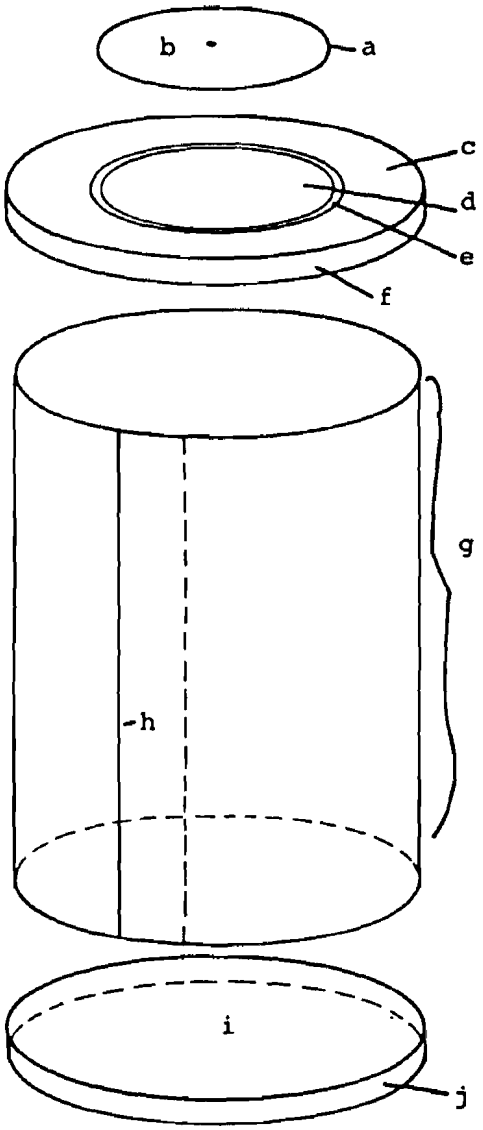
Standard 1883 dimensions were provided by Dr. E. D. Bryan, Dover. Modern dimensions were provided by the Division of Weights and Measures, Delaware Department of Agriculture, Camden.

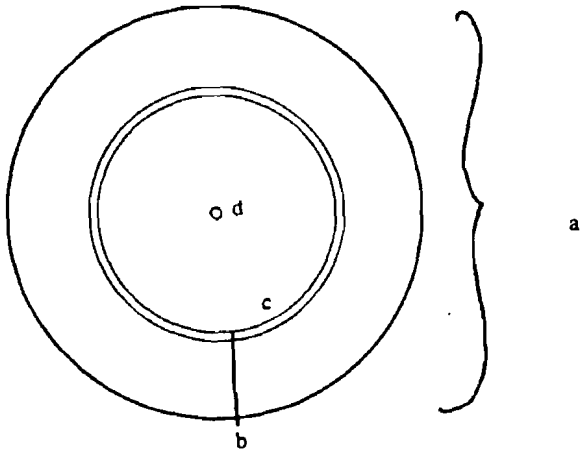
Figure 13

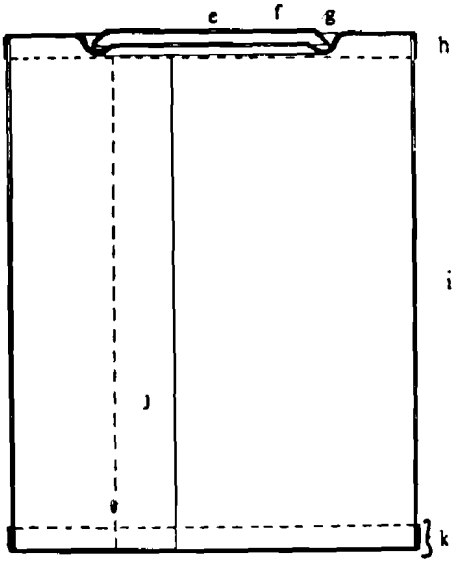
Anatomy of a can

The glossary on page 105 and the drawing below are derived from Parks Canada Manuscript Report 299, *Manufacturing typology for tin containers from the Arctic Salvage Project,* by Barbara J. Wade, 1978. The illustrations are plates 1 and 2, by J. Métivier.

Left:
a. cap
b. air vent
c. top end
d. filler hole
e. channel
f. flange
g. can body
h. lapped side seam
i. bottom end
j. flange







Right:
a. end
b. channel
c. cap
d. air vent
e. air vent
f. filler hole cap
g. solder
h. end
i. body
j. lapped seam
k. bottom end

CAN GLOSSARY

AIR VENT: pin-prick hole in the cap, or in the end if there is no filler hole
BODY: cylindrical, conical, or elliptical shape of the can sides
BOTTOM END: end of the can opposite the top end, often on the top as the can was shelved
CAP: a tinplate disk that was soldered over the filler hole
CHANNELLED: a term that describes a top end with a channel around the filler hole
END: two covers for openings at opposite ends of the can body
FILLER HOLE: a flanged hole in the top end of the can, into which product was inserted
FLANGE: collar around the circumference of the end, which may be stamped in one piece with the end or soldered to it in two-piece construction.
LAPPED SEAM: seam in which one piece is placed atop the other and soldered
PLAIN: term describing a top end that is not channelled around the filler hole
ROLLED SEAM: seam in which two edges are placed together and folded over
SEAM: vertical joint up the side of a can
TOP END: end containing the fill hole, which often was on the bottom after the can was labelled

Since southern Delaware was part of the Philadelphia agricultural hinterland, Delaware canners could be expected to benefit from that city's expansion with the completion of transcontinental railroad system. Philadelphia was the eastern terminus of the Pennsylvania Railroad, which in 1869 obtained lines to both Chicago and St. Louis, opening continental markets in the arid west for Delmarva's fruit and vegetable producers. From the other end of the line, Libby McNeill and Libby was formed in 1868 in Chicago to can meat for shipment; they later owned Stetson and Ellison and many other Delmarva canneries (Minchinton 1957:256). H. J. Heinz started his Pittsburgh pickle operation in 1869 as well (Alberts 1973:8)

Philadelphia's steamboats and schooners tied the Delaware and South Jersey coasts together commercially and linked them to the west, where preserved foods brought premium prices. Glass containers and can-making machinery from Millville, Salem, and Bridgeton could cross the bay easily to Delaware canneries. As long as regular steamboat service continued, Delaware and South Jersey continued to be socially and economically linked.

Collins, Geddes and Company

Collins, Geddes and Company was a partnership formed in 1869 to operate a cannery at Lebanon. The partners were John S. Collins, a nurseryman of Burlington County, New Jersey; Samuel Geddes of Pennsylvania, and Jacob G. Brown of Kent County, who was to manage the plant. Under the "Star" brand, they began canning tomatoes, peaches, and other products at Lebanon, probably during the 1870 season. Can labels were printed at Geddes Sons, 724 Chestnut Street, Philadelphia, and the wholesale agent was C. P. Knight and Brothers, Philadelphia.

Collins bought out his partners, Brown in 1872 and Geddes in 1874, and changed the name of the firm to John S. Collins and Company. The new labels, copyrighted in 1874 and printed by Geddes Sons,

bore the Collins name alone. He listed himself, at 260 South Front Street, Philadelphia, as the wholesale agent. Like the old labels, the Collins labels proclaimed that the plant packed tomatoes, peaches, peas, blackberries, raspberries, and strawberries, but the new label listed asparagus as well.

When he left the Lebanon company in 1872, Jacob Brown helped to organize the Farmers Fruit Preserving Company at Rising Sun, at the western end of the Tidbury tract. He became the new cannery's first general superintendent (Scharf 1888:1131).

The era of the Lebanon cannery was a period of extremely fast growth for the American canning industry. American production of canned vegetables increased from 4 million cases in 1870 to twenty million in 1889. In 1870 there were less than a hundred American canneries; by 1900 there were eighteen times as many (Minchinton 1957:258). During that same period, American dependence upon the British tinplate manufacturers ended, as our own industries began to meet demand. By 1897 there were 180 tinplating mills in the U.S. and eleven under construction (Minchinton 1957:67).

State of can-making technology, 1869-1882

Tinplate manufacture was a traditional industry, with standard sheet sizes that would influence the size of any products made from them. Each weight of tinplate was manufactured in a different sheet size, which changed from time to time. The earliest traditional standard size sheet apparently was 16 inches square (Lapsansky 1982:76). In 1780, the standard weight of tinplate was shipped in single sheets $13^3/_4$ inches by 10 inches; a double sheet was $16^1/_4$ inches by $12^1/_2$ inches. The lightest weight, called "$^1/_3$ X," came in these sizes. A heavier weight, for kettles and other utensils, was called "common small doubles" and was made in sheets 15 by 11 inches (De Voe 1981: 9, 125-126). By 1915, the standard sheet for tinsmiths had increased to 14 by 20 inches (Lapsansky 1981:76).

After tinsmiths developed the technology, entrepreneurs from other backgrounds entered the trade. These second-level entrepreneurs employed a simplified technology in which parts of the manufacturing process were mechanized, while other steps were simplified and assigned to relatively unskilled workmen who did not possess the full range of skills and traditions known to a professional craftsman. The relatively untrained Lebanon workmen made only cans, according to prescribed procedures, whereas the tinsmith-canners made other tin products and could be expected to innovate more readily.

Two of the leading producers of can-making machinery were the Ferracute company of Bridgeton, and the Ayars Machine Company of Salem, New Jersey, both port towns on the Delaware easily available to Delaware and New Jersey canners. The Ferracute foot press, first built in 1865, became the industry standard, of which 112 had been built by 1877 (Sim 1951:70). Lebanon's technology almost certainly

came across the bay. Cans from Lebanon conformed to the "New Jersey" size standard, and the owner was a New Jersey resident who later leased the plant to a company from that state.

Even though cans continued to be made individually, they were filled on an assembly line, in which the cans passed from one worker to another. To serve the constantly improving can-filling and can-sealing machinery, inventors introduced machines for peeling fruit and shelling peas. Canning machinery became standardized, conforming to standard dies provided by the stamping-machine makers. By 1883, today's can sizes had been largely established (TABLE 1). Interchangeability was made possible by by standardization of machinery and by the availailability of parts; caps for fill holes, for example, were available from suppliers.

The system of breaking skilled work into unskilled components, and of simplification for the sake of production, is called the American System of Manufacture. The Collins, Geddes cannery represents a step in this shift from a craft to an industrial process, in which some workers performed several tasks at a single workstation (PLATE 34). By 1880, it was estimated that a mechanized can shop with two operators could produce 1500 cans a day (Alberts 1973:49). This speed did not favorably impress the hand can makers, who feared for their jobs. The next step, as they had feared, would be a can factory in which the workman was replaced by machines and individual sheets by huge rolls of tin. The end came in 1899, when the Max Ams company introduced the modern machine-made, open-top can, which could be filled and sealed entirely by machinery.

Hand manufacture techniques

To increase each workman's production in a few years from sixty per day for an individual tinker to 1500 for a mechanized canmaker, the can-maker's work routine experienced significant changes. When one examines the literature of the period, there is little obvious change in the way cans were made or the tools that were used. Instead, the organization of work changed, together with workstation design .

A typical craft tinsmith's shop (PLATE 32) of the pre-industrial period was staffed by a master and helpers who cut and soldered sheet tin into utensils. Each piece was made, from start to finish, before the next piece was begun. This way of working reqwuired a smith to set up for each task in each operation on each group of products.

A machine for stamping can ends (PLATE 33) was the first step toward industrial manufacture of cans. Introduction of such presses virtually eliminated the hand work of cutting and shaping the ends and caps. Stamping became a separate job from can-making, and before long, caps and ends were being sold separately.

Plate 32

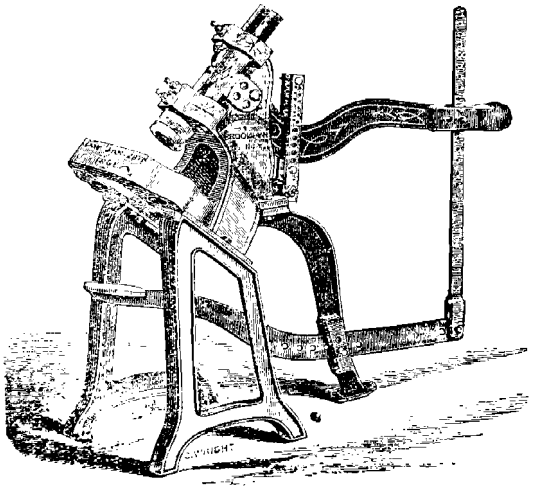
Traditional tinsmith shop and tools

Nineteenth-century wood-engraved illustrations of the craft, as reproduced by Reader, 1976, and elsewhere

Plate 33

End stamper

This illustration is from the 1877 *American Grocer* advertisment of Bliss and Williams of Brooklyn, manufacturers of presses, dies, and special machinery for working sheet metal. The stamp bears a patent date of 1868 the year before the Lebanon cannery was built.



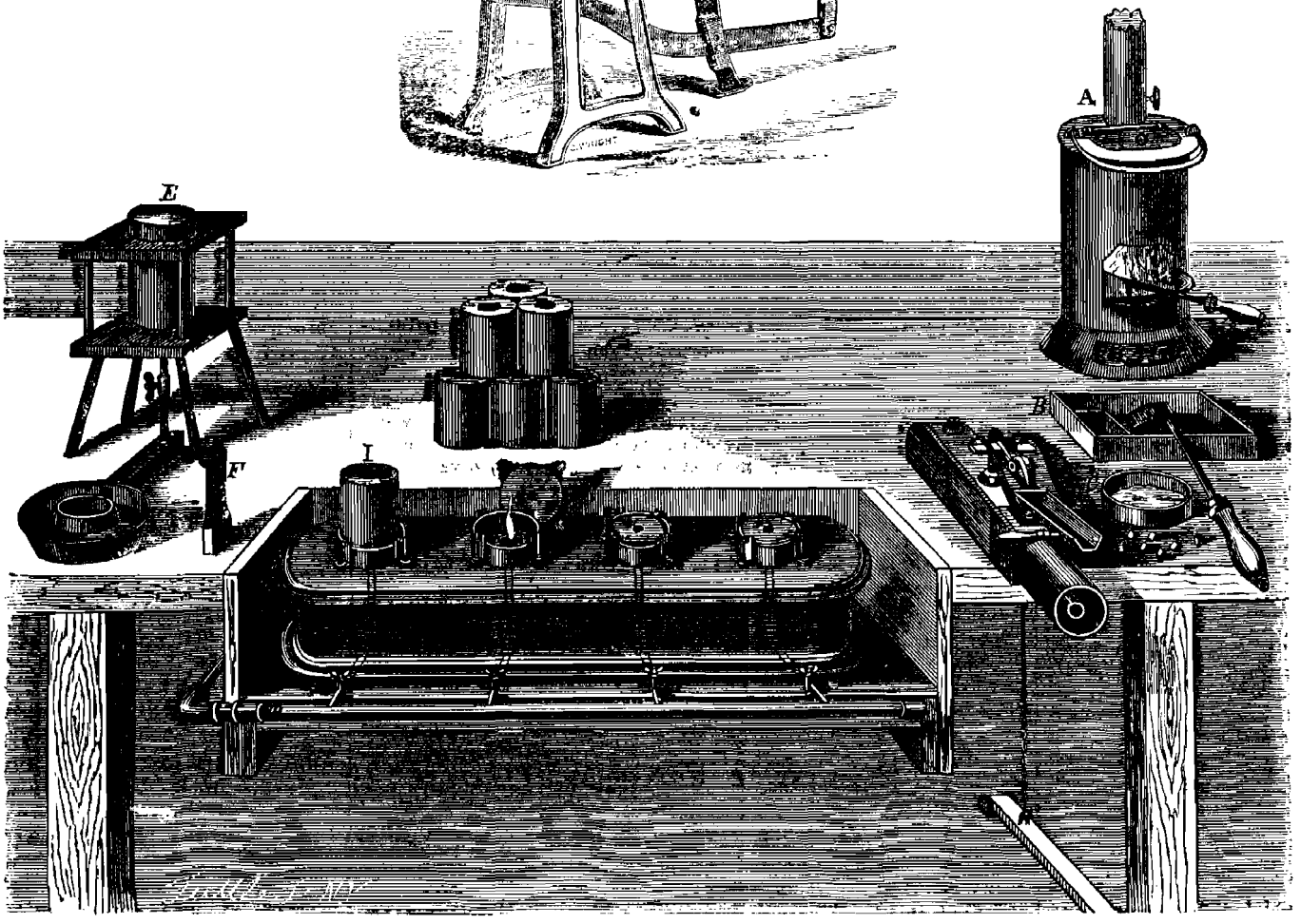


Plate 34

Hollingsworth's can-soldering apparatus

This illustration from *Scientific American,* May 11, 1867, shows a newly-invented can-making workbench

Robert J. Hollingsworth's can-soldering apparatus (PLATE 34) was described in *Scientific American* May 11, 1867, with the statement that "Unskilled labor can be employed in making cans by this process and with this apparatus." Traditional tinsmiths' soldering irons, bench furnace, and other tools remained the principal parts of the new system, which was alleged to have a capacity between 6,000 and 10,000 cans per day.

The parts of the Hollingsworth system, labelled on the plate, were: A. bench furnace; B. bench tray; C. rosin box; D. seaming apparatus; E. rosin dispenser; F. anvil for drawing in can edges. In the center is a furnace with four cups for "floating" the ends onto the body with solder. The can body was dipped in rosin. An end was then placed on the furnace and solder was melted onto it. Then the cylinder, I, was clamped onto it until the solder joint was firm. As illustrated, the Hollingsworth apparatus used gas as fuel, although the inventor claimed that it could be adapted to kerosene. Such a machine probably was not used at Lebanon, since the fuel listed in the plant's insurance declaration was charcoal, which would not work with such apparatus. At the same time, the Camden cannery was using gas.

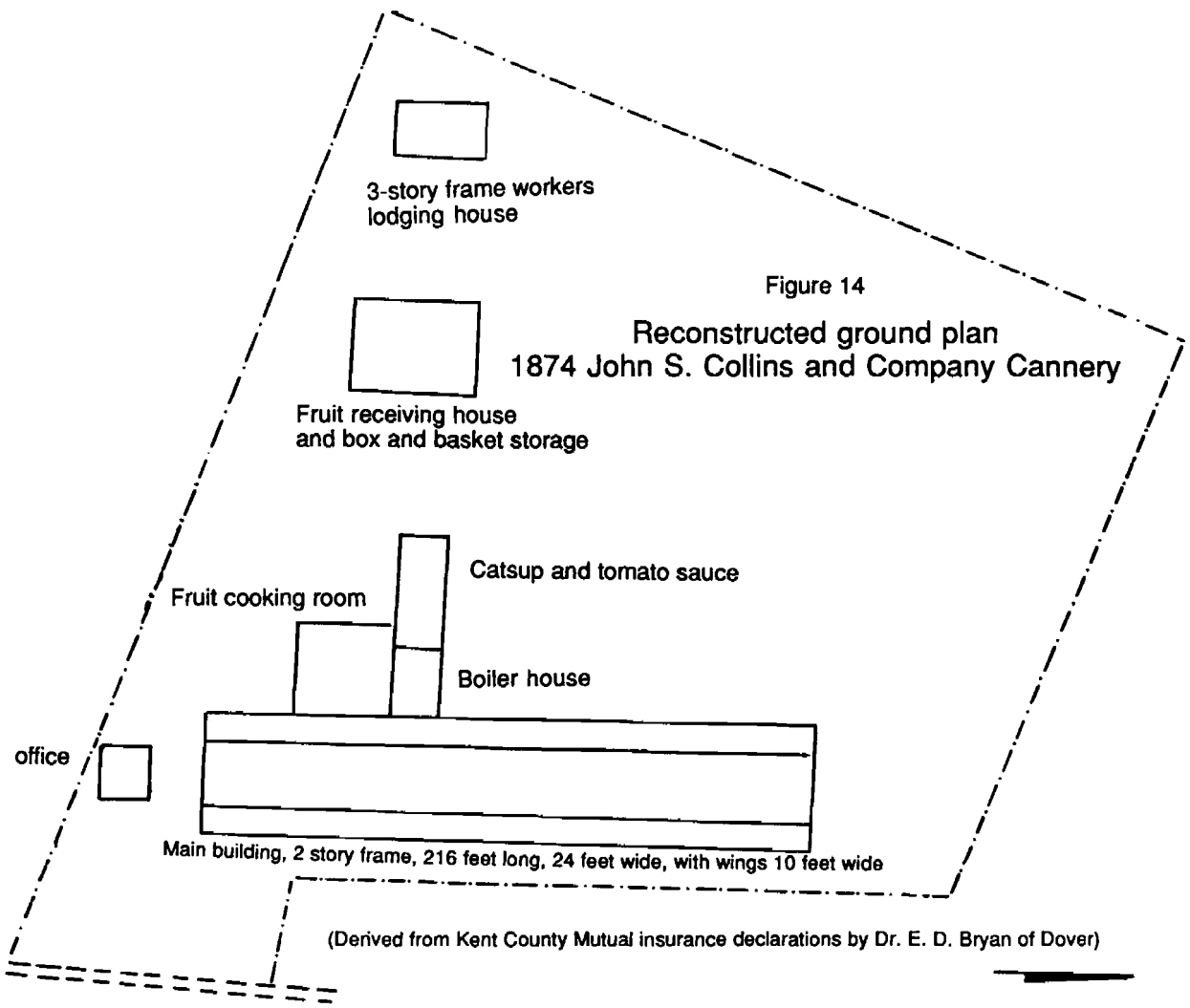


Figure 14

Reconstructed ground plan
1874 John S. Collins and Company Cannery

(Derived from Kent County Mutual insurance declarations by Dr. E. D. Bryan of Dover)

Plate 35

Peeling Room, Richardson and Robbins Cannery, 1879

Delaware artist Howard Pyle described the Dover cannery in his article "A Peninsular Canaan," in *Harper's New Monthly Magazine,* 1879. Like most canneries of the period, Richardson's peeling room was staffed by young women. The Collins cannery at Lebanon probably had a room that resembled this one.

Finds at Lebanon, ER 22

The immense quantity of can-making waste at Lebanon could not be surveyed by the usual method of test squares. Since much of the surface material had rusted away, excavation was a matter of searching for places with good preservation. Dr. Bryan had found several of these, and presented his entire collection to the state. The authors gathered a total of eleven lots from a test unit, numbered ER22, and catalogued with a decimel extension from one to eleven. Dr. Bryan's material is catalogued as ER22.12.

Catsup bottles are found throughout the site. Many are smooth-necked, embossed with the John S. Collins label shown on the front cover of this report. Complete specimens are illustrated in plates 19 and 20, page 40. Another style, also widely represented at the site, had a faceted necks and no embossed label; these probably were labelled with paper, as were other makers' catsup bottles (PLATE 36). The basic shape of the catsup bottle has not changed appreciably in the century since the Lebanon cannery burned; today's bottle is faceted, with a pronounced string rim at the mouth, even though today's embellishments are less vigorous.

Most of the finds were related to tin can making and canning. The material fell into two major categories: mistakes and trimmings. The problem of tinplate waste appears frequently in press reports of the period, as inventors suggested ways to recycle the material. The most effective defense against waste was well-known to tinsmiths: careful layout and careful execution. There is evidence that sheets at Lebanon were laid out to make optimum use of the raw material. There is also evidence of attempts to salvage usable material from mistakes.

Can ends accounted for most of the waste, and for most of the variation within the collection. Ends were stamped by a machine (PLATE 33) that formed and cut the end in one stroke. Each end had an impressed gutter just within the flange, which was intended to confine the solder used to attach the body.

The can waste provided an opportunity to view the can-sealing process from inside; a damaged can found in the trash has its fill hole intact, with the bead of solder in place (PLATE 38). By the time the Lebanon cannery was built, the public was becoming conscious of the dangers of lead poisoning from solder. Manufacturers advertised that their seams had no solder on the inside, but they were never able to eliminate the drop inside the vent hole. Some canners tried to prevent solder contamination by placing a small piece of metal inside the fill hole to catch the solder that might drip into the product from the vent.

The varieties of caps and cap-making waste often were found bunched together in the waste dump (FIGURE 39 AND TABLE 1), as if all the punching tasks were performed at a single machine. A piece of waste (PLATE 40) afforded insights into this process. It is a small piece of scrap, from which two #3 lids

had been cut. In the scrap, someone has punched the channelled hole for a peach-size fill hole. Only the following sequence of events can explain this piece of scrap. First, the operator made a series of New Jersey #3 lids, some of which were to have peach holes. Then he took the large die out of his machine and inserted the smaller die for making a channelled hole in the top ends. He used this piece of scrap, which was lying by the machine, to test or seat the new die.

A standard method for cutting tops from sheets was to pre-cut a sheet from which six ends were stamped (PLATE 41). From the waste space between, two fill caps would be stamped. Two end sizes were cut from such sheets: for #2 and for #3. The blanks for #2 cans were about 8.7" by 12". The blanks for #3 can lids were about 10" by 14". An operator's mental template called for a pattern of six-big-and-two-little pieces in either size, but there apparently was only one mechanical guide to help position the sheets.

The one guide must have been adjustable, located on the side away from the operator (PLATE 33). Since the press shaft was fixed, the guide would have been adjusted whenever the die size was changed. It is evident from the scrap that the guide was adjusted so that the die cut nearly to the edge, along the long dimension of the sheet. While all the holes are virtually tangent to the long edge, they are neither the same distance apart nor a uniform distance from the short edge. The operator's eye, therefore must have guided the lateral positioning of the sheets. To stamp caps from the waste, there was apparently no guide at all.

The presence of two sizes of holes in the same sheet indicates that the same shop was making both ends and caps in close proximity, if not on the same machine, within a very short time, if not simultaneously. If the waste had been allowed to accumulate for very long during such operations, it would have been impossible to work. In the waste dumps, it was not unusual to find piles of sheets so similar that they appeared at first to have been stamped together or on a gang-stamping device.

The large number of rejected ends in the collection gives evidence that the eye was not always so accurate. If a lid overlapped an earlier hole even slightly, the flange would be incomplete and the lid would be rejected. Such rejects were recycled, to be punched for caps (PLATE 42). This recycling waste was intermixed with the large sheets, indicating that inspection or quality control took place simultaneously with stamping. Other ends (PLATE 43) were rejected after the fill hole had been punched.

Another group of end-stamping scrap consisted of pieces eight inches wide from which two ends had been cut. These may have been leftover or incorrectly cut can bodies salvaged to make ends. What is remarkable about these pieces is the fact that there is enough metal remaining on the sheets to have made caps from what was thrown away. The shaping of can bodies was evidently a wholly hand process, since there is considerable variety among the small trimmings (PLATE 27).

Plate 36

Catsup Bottles

The bottle neck at left was found in the dump at Lebanon. The whole specimen with a paper label, at right, is the same design with a different lip treatment. The complete specimen was collected by Dr. E. D. Bryan.

Plate 37

Two #3 can ends.

The one on right has been fully formed, but appears to have been rejected. The one at right consists of just a flange and a thin strip of metal. It may have been part of a two-piece closure, sometimes used for fancy vegetables that were positioned in the can individually. ER 22.12.

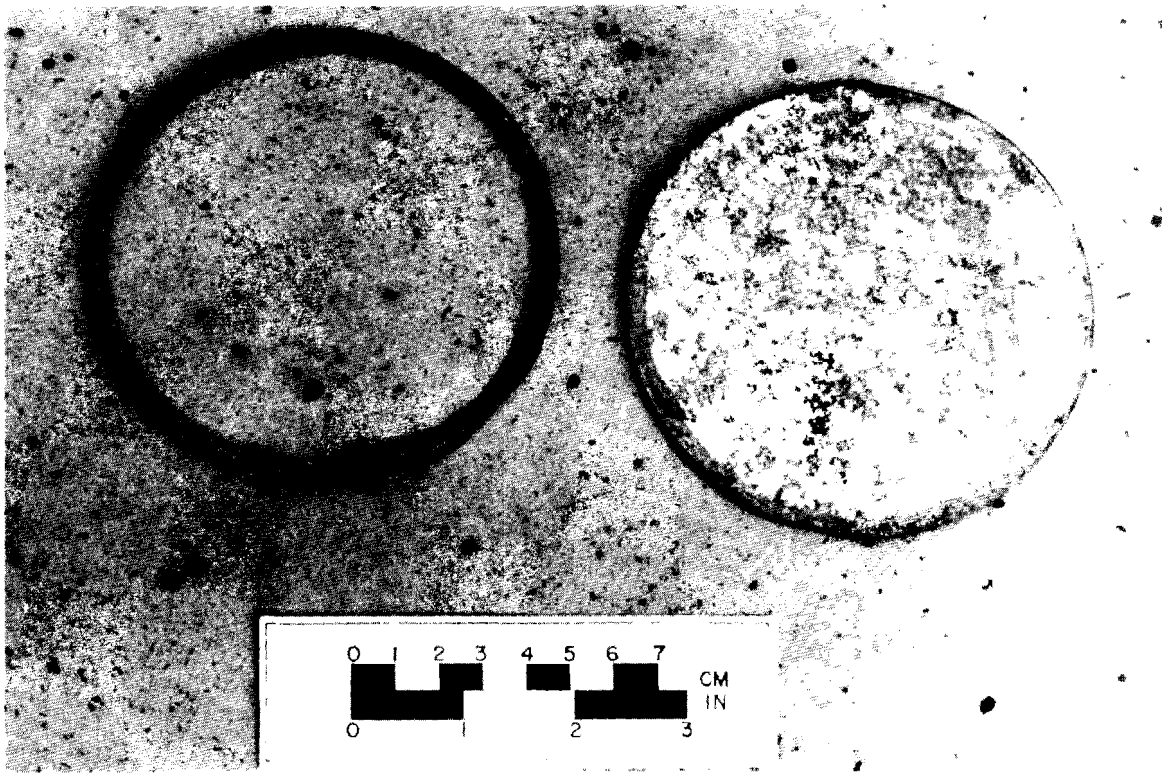


Plate 38

Inside of a can

This specimen, found in the dump, has its cap intact, with the drop of solder. ER 22.12..

Plate 39

Caps and fill-hole waste

From left to right: 1. a peach cap, 2.35" diameter; 2. medium, or tomato, cap, 2.05" diameter; 3. 2" disk, possibly from a peach fill hole; 4. small cap, 1.6" diameter; 5. blank disk 1.3" diameter. This appears to represent the entire variety at Lebanon. ER 22.12.

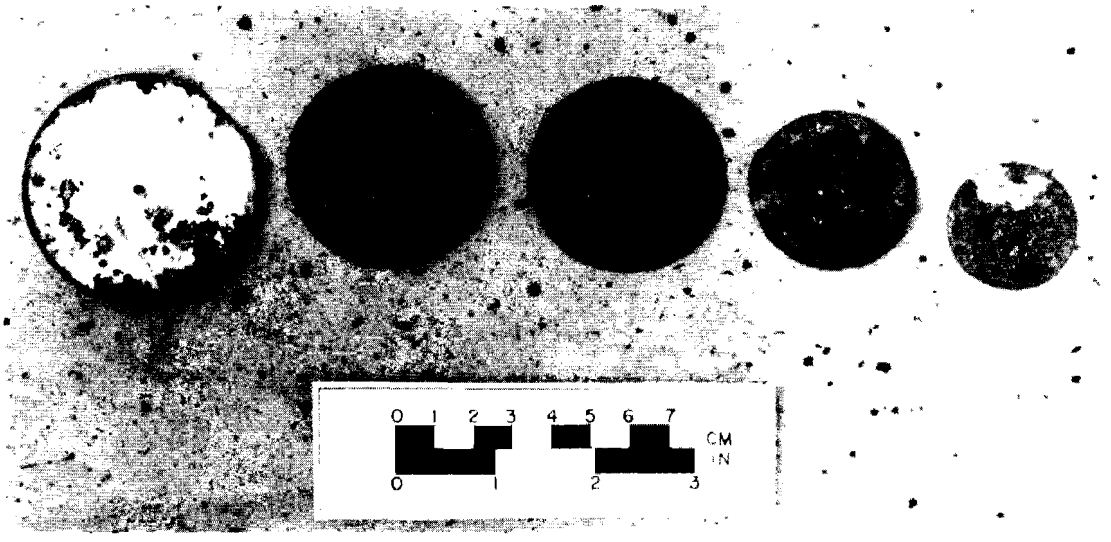


Plate 40

Evidence of machine retooling

In this piece of scrap, ends have been punched, and then the machine has been reset to stamp the fill holes in the lids. This piece of scrap was a test piece created when the die and guides were changed. ER 22.12.

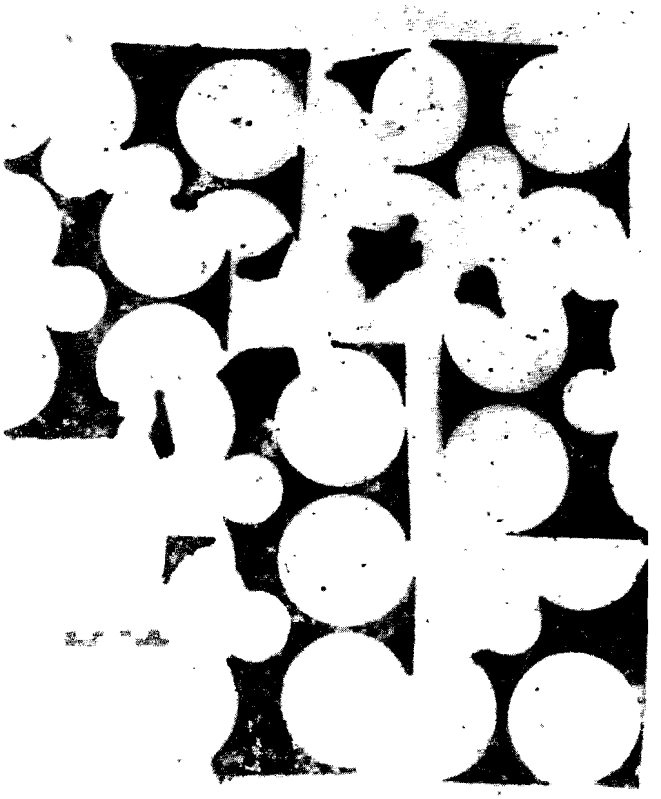


Plate 41

Sheets from which can ends have been stamped

Regardless of sheet size or the can size being manufactured, workmen followed a set mental template for laying out the sheets of tin. ER 22.4

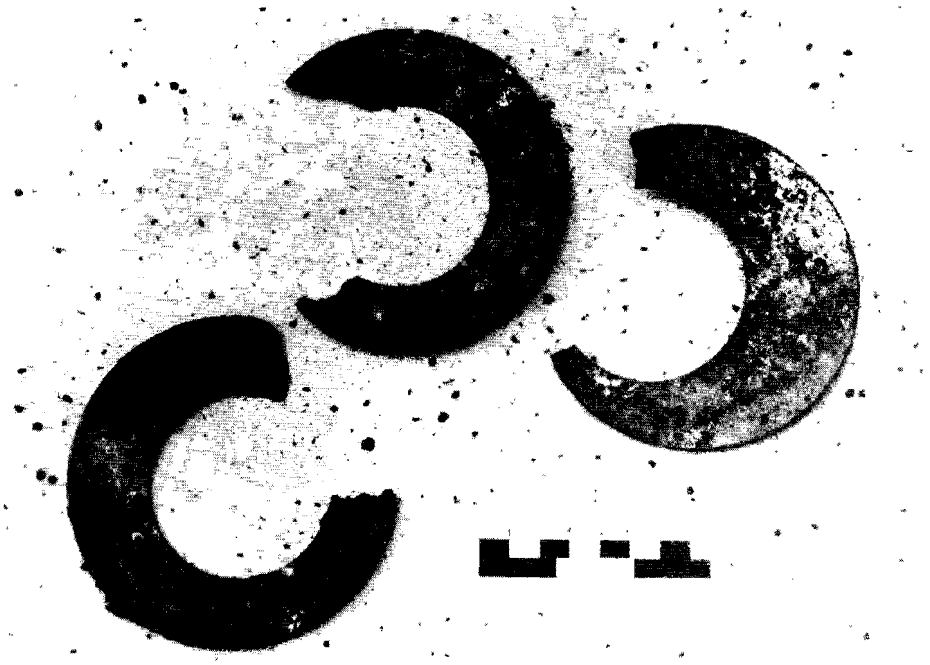


Plate 42

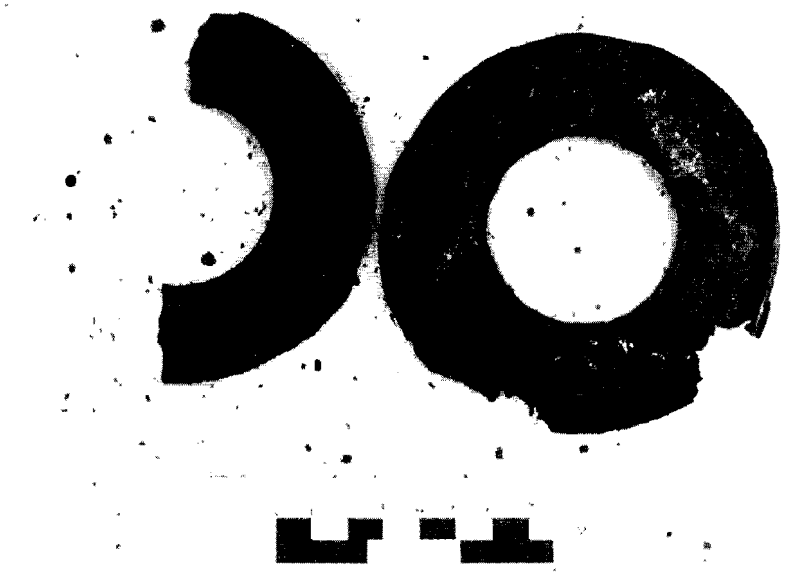
Recycled wasters

These can ends were salvaged to make caps . ER 22.12.

Plate 43

Completed top ends

The reason for rejecting these ends is not known. ER 22.12.



Division and organization of labor at Lebanon revealed by artifacts

Lebanon cannery represents a middle stage in the transition from craft to factory. Can making at this time was a low-skilled subset of tinsmithing, but had not yet become a mechanized or dehumanized process. Parts of the sub-processes had been separated, but had not yet become so routine or regimented that recognizable human variability was removed from the process and its products. Workmen performed their own quality control, and attempted to reduce loss caused by manufacturing errors; the skill of each workman determined the quality of his production.

It should be possible in a stratified waste pile to identify individual workers' output, as it is possible in a pottery waster dump to identify potters. It should also be possible to follow the year's cycle and changing product mix. Unfortunately, the Lebanon waste is spread across a hillside without discernible temporal organization.

Conclusions

Throughout the nineteenth century, can makers tried to improve their product and their production methods, but most cans continued to be made individually by workers in the loft over the canning rooms. Can making was a streamlined or de-skilled craft, no longer a skilled artisan's traditional calling, but not yet a dehumanized and mechanized industrial process. The waste pile gives evidence that mass production values prevailed, but the workers retained a craft attachment to product integrity. Neither fish nor fowl, Lebanon's can shop represents an industry in the process of becoming.

Americans patented many different processes and machines, which may be useful as dating evidence on sites where cans have survived. Some of the innovators founded canneries that produced their peculiar cans; Richardson and Robbins' famous tapered plum pudding can was made in Dover within living memory.

By 1902, modern open-top cans had replaced most hole-in-top styles; these cans are made by machine in separate manufacturing plants. After a half-century of growth, the industry changed its emphasis from can-making to food processing. No longer required to keep large year-round staffs to make cans, the processors could employ almost entirely seasonal help and concentrate on marketing the contents rather than making the containers. As the can manufacture and canning industries separated, food containers became standardized and less sensitive to archæological analysis.

TABLE 2

THE CAN-MAKING PROCESS AT LEBANON

Off Season:

1. Tin sheets are cut to size

2a. Ends and caps are stamped

2b. Can sides are cut

3. Cans are assembled and soldered by a can-maker

In Season:

4. Cans are filled

5. Caps are soldered in place over the fill holes

6. Cans are exhausted by cooking and sealed with a drop of solder

7. Labels are affixed, with the fill hole downward