The Origins of Offset

Above: Java and Mocha Gold Band Coffee. The Thompson and Taylor Spice Co.

Tin cans from the collection of Carolyn Hulbert

By Randy Silverman

The connection between this printed magazine you are reading and a discarded tin of tuna fish packed in oil or spring water is particularly fascinating, but requires a bit of historical sleuthing, and a brief excursion through the increasingly industrial 19th century.

The story begins in France with the benevolent Nicholas Appert, who some have called "a Benefactor of Humanity." In 1810, Monsieur Appert published his discovery that for long periods of time food could be stored without spoiling by using a process we now call "canning." His technique for preserving fruits, vegetables, meats and soups consisted of heating glass food jars sealed with cork stoppers to force the air out. This simple procedure, developed after fifteen years of experimentation, made significant inroads toward the elimination of 19th century dietary problems such as scurvy and malnutrition. His work secured Appert a 12,000 franc reward from France's Consulting Bureau of Arts and Manufactures in 1809 and, with the publication of his book the following year, quickly became world news.

Simply purging air from bottles of food, as we now know, solves only part of the problem of pasteurization. But microbes killed through Appert's "sterilization" process remained unidentified for 50 years until Louis Pasteur identified this "sea of organisms" microscopically during his wine fermentation experiments of 1863. The significance of Appert's discovery was poetically summarized in the journal *Courier de l'Europe* (Feb. 10, 1809) as follows: "M. Appert has discovered the art of fixing the seasons. With him spring, summer, and autumn exist in bottles like delicate plants that are protected by the gardener under a dome of glass against the intemperance of the seasons."

As a result of the French Revolution, economic conditions in France at the beginning of the 19th century were not conducive to capitalizing on discoveries such as Appert's. This was not the case in England, however; far from it. The Industrial Revolution was fueled by the availability of capital, and driven by men dedicated to manufacturing commonplace amenities specifically marketed to the working class consumer.

John Gamble was such a man; an entrepreneurial engineer. Gamble is better remembered for his involvement in the development of the first continuous web papermaking machine (see "Paper Trails," *Graphic Arts Journal*, February 1995). While visiting France on business, Gamble learned of Appert's preservation process. Realizing its potential, he sought help from Bryan Donkin and John Hall, men he had worked with closely in the past. Donkin, the brilliant engineer employed by the Fourdrinier

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brothers to perfect the prototype of the papermaking machine, and Hall, the millwright who had trained Donkin and manufactured the machine in his factory, were eager to collaborate on the commercialization of canned food.

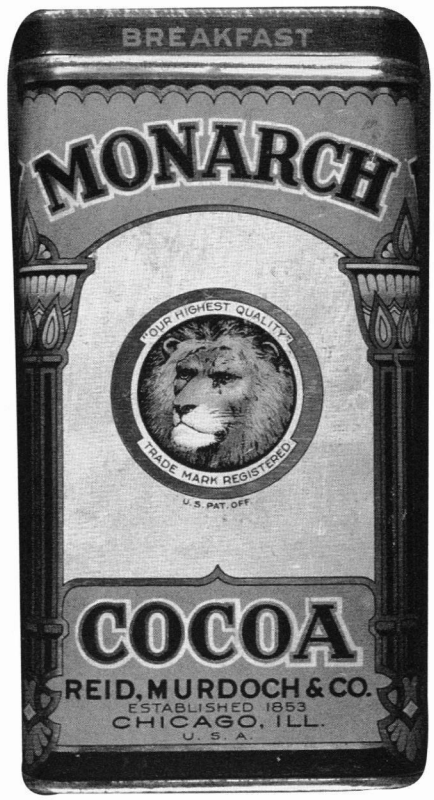
Above: Mazawattee Tea. Right: Monarch Cocoa. Reid, Murdoch & Co.

The trio encountered legal as well as technical impediments to the development of this new technology. Hall's company records indicate that 1,000 pounds were paid for the English rights to Appert's patent; but discrepancies in the story exist, since Appert never owned a patent on his process nor is this transaction corroborated in his firm's ledgers. Additionally, August de Heine and Peter Durand are known to have secured English patents in 1810 for the use of iron and tin containers (respectively) for preserving food, but neither is mentioned in the account of Gamble, Donkin and Hall. In addition to these problems related to the transfer of earlier research, it was discovered that the process for storing preserved food required significant modification before it could be marketed.

Donkin's investigations revealed that the cork stoppers specified in Appert's technique were not air-tight and that, in fact, complete sterilization was not occurring. His experiments led to the use of airtight tinplate canisters—iron coated with a layer of tin cut, formed and soldered together along the seams. Donkin's grandson recounts that these were subsequently "heated very gradually in a bath of chloride of lime," to "render the albumen" in the foodstuffs "insoluble."

By 1813 the process was sophisticated enough for presentation to members of the Royal Household for sampling. Upon receiving favorable acceptance from that quarter, canned foods began to circulate widely; and with them, Donkin's reputation. With this notoriety came recognition. Among other accolades achieved during his lifetime, Donkin became a Fellow of the Royal Society, Chairman of the Society of Arts, and today is remembered as the father of the modern canning industry.

The Royal Navy was one of his early customers for canned meat, and by 1815 tins containing preserved roast veal and carrots were travelling to the Poles with explorers such as Captain Sir Edward Parry. Opening these early canned foods presented no problem for this rugged class of consumer; the instructions printed clearly on the label proscribed simple access via hammer and chisel! By 1810 this method was modified by the use of a small tin stopper that was soldered into the opening at the top of the can. This stopper included a pinhole in the center of its patented design. The hole allowed steam to escape while the can was heated in boiling water during processing, after which it was soldered to seal in the food. These stoppers could simply be pried out to open the can, but a more genteel approached included a thin metal strip in the closure, the end of which could be pulled to break the solder seal.



The earliest method applied to identifying the contents of canned foods was a printed paper label glued onto the side of the tin. Due to the paper's friability, these labels were easily damaged and, by 1811, were replaced by durable embossed metal labels affixed with solder directly to the body of the can.

The next approach to identifying and decorating canned goods employed a variation of Alois Senefelder's lithographic process. By 1847, images printed on paper from Solenhofen lithographic stones could be effectively transferred onto the metal surface of the can by rubbing the freshly printed wet ink. Transfer printing was a time-consuming process that allowed only one reproduction per print, but it offered promise that intricate pictures applied directly to the tinplate surface were possible.

Direct lithographic printing on tinplate occurred first in England. In preparation for this breakthrough, lead-based inks suitable for printing on metal were patented in 1864. This was followed in 1869 by a patent for paints, some containing metal alloys, for decorating tinplate, and another in 1870 for clear lacquer used as a surface varnish.

In 1868, French printer Hippolyte Marinoni developed a technique that eliminated the need for lithographic limestone as the printing surface in traditional lithographic stone-printing. Marinoni substituted a flexible zinc plate for the gray lithographic stone and fitted it onto a printing cylinder mounted directly above the flatbed press. Printing *(Continued on page 37)*

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from zinc plates proved less than satisfactory, however, as the plates rapidly wore out from friction caused by direct contact with the tinplate.

This problem was overcome in England in 1875. Robert Barclay and J. Doyle Fry patented a system for transferring the image from the zinc printing plate to an impression cylinder which, in turn, came into contact with the tinplate to be printed. The surface of this impression cylinder was initially coated with a specially treated cardboard, but by 1880, this material was replaced by the now familiar rubber blanket. In addition to manufacturing the first tins decorated by direct lithographic printing, Barclay and Fry's London firm also built and sold lithographic presses touting this novel design.

Lithographic zinc plate printing during the 1870's and 1880's was done in one color. To add contrast to the finished work, a solid base color was usually printed on one side of the tinplate, which required air drying (taking the better part of the day) before the lithographic image could be applied. This image was often sealed beneath a coat of clear lacquer that also required time to air dry.

Offset color lithography (chromolithography) was not applied to commercial tinplate printing until the 1890's. The process required significantly more time and effort to print than did the single-color images. Each color required not only a pass through the press and appropriate drying time, but a separate varnish coat after each impression! Frequently, the most vivid colors in a design—especially red and white—had to be printed twice to achieve the desired degree of intensity. Sometimes, separate plates were even used within the same color run to add subtle details that varied in tone depending upon the image's location beneath the multiple varnish layers. A suite of multi-colored tin boxes could take days to print.

The time required to form the printed tinplate into containers was a significant factor in their production at the beginning of the 19th century. Early cans were produced entirely by hand. A skilled craftsman could assemble only about five or six cans per hour. By 1847, a die-stamping press was patented that cut out the ends of cans from sheets of tinplate. This invention was followed by a foot-operated jig that held the formed can in place while its seam was soldered, so that by 1870, one person could produce approximately 60 cans per hour. In 1883 Edwin and Oliver Norton of Chicago invented a machine that mechanically soldered the can's seam, raising production statistics to 2,500 cans per hour. This figure doubled within a decade as the Norton brothers introduced their automated stamping machine, capable of die-cutting complete can bodies with a single impression. Also adding to production speed, continuous drying ovens were introduced by 1914 that allowed tinplate to be printed and "stoved," in a continuous operation that eliminated the need for human handling.

Advertising with multi-colored tinplate images proved so effective it was commonly applied to household commodities of all types from the end of the 19th century on. Coffee containers, peanut butter tins, metal tea boxes, talcum powder canisters, tooth paste tubes, and English biscuit tins all required the lithographer's attention. By 1909, even tuna fish had found its way into cans, changing the way many of us envision our lunch. Chromolithographic metal tins, now savored and preserved by collectors, paved the way for modern industrial canning.

Most remarkably, however, offset lithography, the workhorse of the modern printing industry, was not used to print onto paper until 1904 or 1905. All of the components were available during the 19th century, including continuous web paper formation (1803); the cylinder printing press (patented by Donkin and Richard Mackenzie Bacon in 1813); color lithography (1798); and even color printing from metal plates (1875). Yet, the substitution of paper for tinplate was delayed for 30 years until the problem was considered by someone outside the printing industry: Ira W. Rubel, a papermill owner from Nutley, New Jersey. While the origins of lithographic offset printing have yet to be documented, it is interesting to speculate whether the web was finally attached to offset merely to expand one man's market. GAJ