Cereal Cartons, Tin Cans and Pop Bottles: Package-Converting Technologies that Revolutionized Food and Beverage Marketing, 1879-1902

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During a short two-decade period (1879 -1902) the processes for making paperboard folding cartons, tinplated cans and glass bottles were mechanized. The three package forms, mechanized by American entrepreneurs, Robert Gair, Edwin Norton and Michael Owens, became the building blocks for the modern age of mass food marketing the self-service supermarket.

INTRODUCTION

Before the Civil War, food was either homegrown or sold through a system of central retail markets in cities. It is generally well accepted that diversification of food products began thereafter, due to American improvements in food processing, preservation and packaging (Kiernan 1985).

But it is less well known why or how the packaging industry enabled this transformation. This paper tells the story of the practically simultaneous mechanization of three key package-converting operations in the late 1800s: making paperboard cartons, tinplated cans and glass bottles. The making of the American mass market "depended in part on the new technology, as inventors and entrepreneurs applied themselves to packaging materials and processes" (Strasser 1989, 31).

The second half of the 19th century marked a revolutionary period of transition from handicraft to mechanized production in America. The people who created this "anonymous" history replaced the motion of human hands with the motion of machines to mass produce "humble objects of everyday life... shaking our mode of living to its very roots" (Giedion 1948, 3).

Packages were among such "humble objects of everyday life," but prior to 1950 packaged food was expensive. By the time of the Civil War, glass bottles, paperboard boxes and metal cans were used for commercial consumer food products, more extensively in England than in the US. The commercial value of the package forms was clear, from the time when their material technologies were developed between the 1600s to the early 1800s, largely by British and French engineers. The early cartons, bottles and cans were costly because they were manually produced in slow processes.

During a short two-decade period (1879 -1902) the three package-converting technologies were mechanized, resulting in mass production at dramatically lower cost. These three converting breakthroughs by American entrepreneurs, who were simply trying to reduce their production costs, became the building blocks for the modern age of branding and mass marketing.

The ability to sell mass-produced food in mass-produced consumer packages brought profound changes to the relationship between consumers, grocery stores and food producers. It enabled marketing strategies that created an exponential increase in demand for products like processed food, since branding and advertising created new needs that could only be satisfied by a branded product in a recognizable trademarked package. Packaging innovations stimulated product development and innovation. Branded packages enabled manufacturers to bypass the traditional wholesalers to form relationships directly with retailers and consumers (Strasser 1989).

The three converting breakthroughs gave the United States a head start in mass produced food and self service shopping. They ultimately enabled development of the supermarket, the "symbol of modern America" (Hine 1995), staffed with packages acting as its "silent salesmen" (Pilditch 1961).

The purpose of this paper is to highlight the role and development of the three technologies, to make less anonymous the men that created them, and to highlight the relationship between their innovations. This paper honors the collective contributions of Robert Gair, Edwin Norton and Michael Owens to packaging and marketing history.

Each section will describe the background of the innovation and provide a short biography of each man, focused on the diffusion of his innovation.

PAPERBOARD FOLDING CARTON MECHANIZATION: 1879

The earliest thick paperboard was made by hand, by dipping the paper mold multiple times into a slurry of rag fibers. The papermaking process was first mechanized in

1800 on a machine invented by a Frenchman, Nicholas-Louis Robert, and built by the British engineer Bryan Donkin (funded by the Fourdrinier brothers whose name this type of machine bears to this day). This was followed by the invention of pulp made from straw in the1830s and wood in the1850s. "Pasteboard," made from multiple layers of paper pasted together, was used to make the early paper-based boxes (Hunter 1947).

While most of the early development of paper occurred outside of the United States, mechanically produced paperboard was principally an American development. Following the invention of the cylinder paper machine by the Englishman John Dickenson in 1809, and the method for pulping straw in 1827 by William McGaw (also British), the American George Shyrock found a way to form multi-ply strawboard by building up layers on a single cylinder and then cutting it off in 1831. But it was not until 1870 that the process for making thick paperboard was fully mechanized, also by Shyrock, using a series of cylinder machines to build up layers (Bettendorf 1946).

The first paperboard boxes were rigid set-up boxes made from strawboard. These were substitutes for small wooden boxes (like cigar boxes). Since neither the thin wood nor the early boxboard had a surface that was smooth or white enough for printing, they were covered with paper labels. In the early 1800s, band boxes, match boxes, pill boxes and hat boxes were common in London. Most of these had a circular shape with taped joints (probably because the material was difficult to score and fold crisply). In America, the box making business began in Philadelphia where Andrew Dennison, in 1855, developed a way to mechanically cut out set-up boxes (Davis 1967).

Folding cartons were developed to simplify the process of making a box. A folding carton is different from a set-up box, inasmuch as it is made from a one-piece blank that is scored, folded, glued along a "joint." Folding cartons are flattened for shipment to the filler. The filler erects the three-dimensional carton, fills it and closes it with tuck flaps or glue.

The predecessor of the folding carton used for cereal and crackers was a package folded up by a store clerk for holding carpet tacks, first used in about 1850. The folding carton form was developed over the next 20 years, during which time each carton was hand-made (Bettendorf 1946).

Robert Gair

Since the classic folding carton form is made in the form of a tube, similar to the way that paper bags are made, it is no surprise that it was a paper bag maker, Robert Gair, who played a key role in mechanizing the process.

Gair had grown up around paper mills and print shops in Edinburgh, and at the age of 12 went to work in a dry goods store. Two years later, in 1852, he immigrated to America, where he found work in a New York store. He served the Civil War in the "79th Highlanders," an all-Scottish regiment. These were the origins of his reputation for Scotch thriftiness and hard work (Smith 1939).

When he returned from the war in 1864, Gair started a paper jobber business in Manhattan, selling wrapping paper to retailers. His customers ranged from department stores to butcher shops. He hired girls to make, by hand, paper bags that he sold to department stores like Lord and Taylor for women's apparel (ranging from billowy crinolines to hats). He was one of the first to print the name of the merchant on shopping bags. With George West, who owned a license on the new technology for mechanically making bags, he pioneered tough jute-paper bags for hardware stores, and was the first to develop a paper flour bag strong enough to replace cotton, which was scarce after the war (Smith 1939).

He persistently sought new things to do with paperboard, advertising "If It's Made of Paper, We Have It." He made some of the earliest paper plates, cups and corrugated fiberboard shipping containers (Smith 1939, 61).

He made some of the earliest folding cartons. His 1878 catalog showed the "New Style Boxes," folding cartons that offered great advantages compared to set-up boxes:

> Being made of one piece of paper the cover is always in place ready for closing, they pack flat, thereby saving bulky freight, store room, and leave less surface exposed to danger of being soiled. (1878 Gair catalog, quoted by (Smith 1939, 44).

Furthermore, the multi-ply paperboard could have a top layer of white fibers, which could be directly printed to eliminate the need for a wrapper or label.

These early folding cartons were relatively expensive and produced in small numbers because they were made one at a time. The process was slow and labor-intensive, involving a series of cutting, scoring and gluing operations. In a letter, Gair describes the process:

> I first manufactured folding boxes by the slow process of dieing out the shape with a knife made to conform. This was pressed through twenty or thirty sheets at a time. The blanks being ready, they were then creased lengthwise and across on a platen press one at a time, after which they were folded and seamed on a hand-gluing machine. Some were fitted with tape, a convenience in carrying, and for the first time tasteful ornamentation appeared on packages carried away by the purchaser. The elite shops bought them eagerly, and as the demand on my manufacturing facilities increased I pondered on more expeditious methods of production (Bettendorf 1946, 54).

The thrifty and ambitious Scot found the way to mechanize the cutting and scoring process by accident, in 1879[1]. When a careless pressman ruined 20,000 seed bags

– by accidently allowing a press to cut through the bags – Gair found a way to use the mistake:

> The clean incisions across the seed bags struck the eye of Robert Gair at a moment when his mind was ready and receptive for the sight. It came to him, in a flash, that there was a way of constructing a multiple die that would cut and crease box board in a single operation (Smith 1939, 64-5).

The ruined bags gave Gair the simple idea to set sharp cutting blades a little higher than the blunt creasing rules in the press, thus cutting and creasing in one operation. He could now mass-produce folding carton blanks from strawboard. His first press could cut and score 750 sheets/hour with 20 dies each. One press cut out as many cartons in 2½ hours as his whole factory had previously made in one day (Smith 1939).

Of course his presses were also used for printing. Printability has come to be one of the chief sources of value for folding cartons. Gair said:

> At first folding boxes were chiefly used for containing notions, confectionary and loose merchandise such as had been packed in bags. On the theory of Polonius that "the apparel oft proclaims the man," I added designs by printing, lithographing, and embossing to the exterior of the folding box, thus establishing a standard whereby the merits of the contents could be judged" (Bettendorf 1946, 54).

Gair's business success grew along with the market for cartons. In 1888 he built a huge new factory in Brooklyn, in the shadow of the newly built Brooklyn Bridge. For decades, his 6-block complex and pier dominated the waterfront. His buildings were the first to use sprinklers for fire protection, and included one of the first to be built with reinforced concrete (Smith 1939).

The decade of the 1890s was a period of folding carton market penetration. Cartons for cigarettes, bottles, crackers and breakfast cereal were adopted by companies like P. Lorillard, Kelloggs, National Biscuit Company and Quaker Oats, and began to fill grocery store shelves. The first carton with a moisture barrier liner, developed for "Uneeda Biscuit" crackers, was a landmark in packaging technology and marketing.

The Uneeda Biscuit folding carton, first made in 1896 by Gair's factory, is hailed as the "first consumer package." But this not because it was really the first; clearly cartons, as well as cans and bottles, were used prior to this time. The Uneeda carton's reputation rests on its symbolism: it symbolizes the birth of 20th century mass food production, with a household-sized, sanitary package -- and an advertising strategy that tells the consumer what "you need" (Twede 1987).

Other incremental innovations improved productivity. The first automatic gluing machine was invented in 1895 by Mr. Cowles of the Rochester Folding Box Company in New York; he added a folding machine in 1900. E. G. Staude in Minneapolis invented a machine to make cartons from roll stock for the fast growing market for breakfast cereal (Cream of Wheat, Ralston Purina, Kelloggs and Post). By 1906 the carton-making machines even had an automatic counting device. All of these processes were based on the straight line folding/gluing machines developed earlier for the paper bag industry. Automatic equipment for erecting, filling and closing cartons followed (Bettendorf 1946).

At the same time, Gair was a pioneer in the corrugated fiberboard box business. He foresaw the profit potential in the lightweight, strong package form. The belligerent Scot argued that he was the inventor of the process for corrugating board. After settling a lawsuit over patent rights with Thompson & Norris in 1890, he entered into a partnership with them that monopolized the corrugated box industry for the next five years (Twede 2007).

The folding carton manufacturers formed an association in 1917 (earlier attempts had began in 1905) called the Folding Box Manufacturers International which joined with the manufacturers of fiberboard shipping containers in 1925. By 1923 there were about 203 companies making folding cartons and by 1925 almost 700,000 tons of paperboard were used annually for cartons.. (Bettendorf 1946).

By 1927 Gair's folding carton division consolidated and moved into a new factory in Piermont, NY that specialized in producing color lithographed cartons. At that time, his was the largest company in the US making paperboard folding cartons and corrugated boxes with throughput of 300,000 tons of boxboard/year (National Cyclopaedia of American Biography 1955).

TIN CAN MECHNIZATION: 1883

The Frenchman Nicholas Appert invented the process for heat processing food in glass bottles in 1809, in part due to a challenge by Napoleon to find a practical way to preserve foods, especially for feeding the military. The early heat processed meat, fruit and vegetables were packed in glass champagne bottles and later in wider necked glass jars. "M. Appert has found the art of fixing the seasons. At his hands spring, summer and autumn live in bottles" (Burke 1987).

To overcome the fragility of glass and porosity of corks, the heat process was first applied to food in cans made from tin plated iron. The process was patented by Peter Durand and engineered by Bryan Donkin (here he is again, an early hero of package engineering) in Bermondsey, England.

Britain dominated the world tinplate industry at that time. Tin-plated iron was in widespread use at the time to make tinware. Germany had previously dominated the tinplate industry from the 1400s until the early 1700s when England imposed tariffs to develop its own industry. Besides heat processing, "tins" with lids were used for chocolates, cosmetics, tobacco and biscuits (Davis 1967; Clark 1977).

Compared to glass jars, "tins" brought down the cost of heat processed foods. Their lower cost and lighter weight gave the British an advantage in sea voyages, exploration and empire building (Naylor 2000; Shephard 2000).

Heat processed bottling (which was then and is still called "canning") came to the US in 1817-19. The first canneries were built by William Underwood in Boston and Thomas Kensett in New York for seafood, which was the first widespread use. Tin-plated iron cans began to be used in the US in 1839 when they became less expensive than glass bottles (Clark 1977).

Until the Civil War, can-making was a cottage industry. Water-driven hammers and, later, rollers thinned and flattened the iron. It was descaled in a foul-smelling brine and then dipped in molten tin. The tinplate was cut into rectangles and round ends; the seam was lapped and sealed with lead solder; and the ends were soldered on. A skilled can maker could only make 5-6 cans per hour (Clark 1977).

The can maker often also filled the cans, with chopped food through a small hole in the center of the top that was then soldered closed with a small disk with a vent hole. The filled can was cooked and then the vent hole was closed with another drop of solder (Clark 1977).

The early tinplated iron cans were very thick and had to be opened with a hammer and chisel. By 1860 the can thickness had been reduced enough so that practical consumer can openers were developed (Panati 1987). Iron was used because there was very little steel produced before the development of the Bessemer process in the 1850s and the open hearth process in the 1860s (Busch 1981).

Canned goods fed soldiers during the Civil War, not as a part of ordinary rations but was sold to them by suttlers who followed the troops. Products included canned milk developed by Gail Bordon in 1861, and canned fruit produced by the western canning industry, which had been stimulated by the overabundance of fruits planted there during the California Gold Rush. After the war the fruit canning industry grew, and soon ships were carrying American canned fruits to Europe and around the world to be consumed in any season (Collins 1924).

There were many incremental productivity improvements. In 1847 an American, Henry Evans was granted a patent for the pendulum press which, when combined with a die device, could make a can end in a single operation. A pedal-operated fixture was invented to hold the cans in place as they were soldered. By the 1870s mechanization had increased productivity to 60 per hour (Clark 1977; Can Manufacturers Institute 2008).

Edwin Norton

Edwin Norton, the owner of a can-making company, Norton Brothers of Chicago, developed the machinery for automatically making cans.

Norton had served in a Pennsylvania regiment during the Civil War, and returned to take a job as a clerk in a Toledo hardware store. In 1868 he began to make cans on a small scale. Two years later, with his brother Oliver, Norton opened a factory in Chicago. Oliver was the business manager, and Edwin, a "mechanical genius," handled the engineering (Ingham 1893).

In 1883 Norton developed the first semi-automatic machine for soldering the side seams and the ends. Over the next ten years Norton invented machines for stamping an entire can from a sheet of tinplate and soldering it together (Clark 1977). Altogether, he had 300 patents, and by 1890 he successfully installed the first automatic can-making line:

> By this process a sheet of tin plate was transformed into a tin can without touching human hands. The bodies were cut by high-powered slitters and the ends by huge gang presses. The bodies and ends were assembled in body forming and heading machines and then passed in automatically to end soldering machines, testers and dryers, and from the dryers conveyed to warehouse or freight car. A line thus equipped, working ten hours, produced 30,000 cans per day, a tremendous advance over previous methods (National Cyclopaedia of American Biography 1937, 167).

By 1895 the US began to engage in large-scale steel production, and at this time steel began to replace the iron in tinplate. The new steel cans could have a thinner layer of tin than their iron forerunners. Production was a hot and heavy process of flattening red-hot steel bars with rollers (Clark 1977).

For many years, Norton Brothers was the largest can manufacturer in the United States with subsidiaries in New York, Baltimore and Ontario. They also were the first to make automatic machinery for making tinplated steel (Ingham 1893; Can Manufacturers Institute 2008; Reilly 2008).

Norton Brothers' customers who could fill cans year-round, like Campbell's Soup, Bordon Milk and Heinz, became the largest in the business. As production increased, so did the number of foods that were canned. Campbell's condensed soups were introduced nationally in 1899 at 10¢/can[2]. By 1900 sixty-three kinds of meats were available in cans, and in 1909 tuna was successfully canned (Can Manufacturers Institute 2008).

Edwin Norton went on to develop two of the largest can-making companies in history: American Can and

Continental Can. In 1901 Norton Brothers merged with 60 other firms (collectively with 123 factories) to form the American Can Company, with Norton as its first president. The number of canning plants had grown from less than one hundred in 1870 to nearly eighteen hundred by the turn of the century (Clark 1977; Can Manufacturers Institute 2008).

In its first year, American Can promptly raised prices by about 25% in the middle of the canning season, which attracted the attention of President Teddy Roosevelt and the trust busters.[3] This angered the best can customers and attracted competitors into the field (Stolk 1960). Norton was the President of American Can for only a year before he resigned (National Cyclopaedia of American Biography 1937).

He sold out to the "tin can trust" and urged others to do likewise. He had agreed not to re-enter the can business for 15 years or within 3,000 miles of Chicago, but there was no prohibition about setting up his son, Edwin Kenneth, in business. So in 1904 he and Edwin Norton Jr. formed, as a rival, Continental Can, along with several American Can executives who brought with them the account of Campbell Soup, at that time the world's largest user of tin cans (Canned Profits 1934).

American Can did try to monopolize the can making industry. Although there were some competitors, like Continental, at the time they were much smaller. In 1916, American Can was finally sued for restraint of trade. The Federal Court decision found that while there had been some early attempts to restrain competition, and its size gave it potential to monopolize, no public interest would be served by dissolving it because the end result had been lower, not higher, prices for cans[4] (United States Courts 1918; Stolk 1960). Of course, lower prices would have been inevitable, given the economies from mechanization.

Of the three package forms discussed in this paper, metal cans underwent the most incremental development before and after their mechanization. The style of can that is used today, which is filled from an open top and has a crimped-on (non-soldered) end, was developed in 1897 by Charles Ams and commercialized in 1904 by the Sanitary Can Company (later purchased by American Can) (Stolk 1960; Clark 1977; Rock 1984). Cans that could hold and preserve carbonated beverages like beer and soda were developed by American and Continental Can in the 1930s. And, in the 1960s, two-piece aluminum cans and tin-free steel cans were developed (Clark 1977).

GLASS BOTTLE MECHINIZATION: 1902

The last of the three industries to automate was the glass bottle industry. This is a little surprising, since glass is an ancient material – certainly the oldest of the three discussed in this paper.

The earliest glass is believed to have been formed by sand fusing under a beach bonfire made by Phoenician sailors. The first glass containers were made by Egyptians who developed a process to cast it in molds. The Greeks made cast bottles, as did the Romans, who also developed a process for making windows (Diamond 1953).

It was not until sometime between 300 and 20 BC that glass makers found a way to blow glass into shapes. During the Middle Ages, the Venetians took glass to a higher level, concentrating their industry on the island of Murano to keep the process secret. They advanced the production of clear glass as well as colors. They invented wine bottles, at first used only for tableware because they were too light and fragile to ship (Diamond 1953).

Glassmaking made its way to England (by way of France) where commercial bottles were developed. Coal was substituted for wood fuel by Thomas Percivall after the British government, for a short period in the early 1600s, forbade glass manufacture in order to conserve wood. In the 1620s Sir Robert Mansell bought the rights to make glass in coal furnaces. The greater heat generated by coal made possible crystal clear "flint" glass (to which lead oxide is added), developed by George Ravenscroft in about 1675. In the 1630s Kenelm Digby invented a stronger, heavier shape that could be used to ship wine, a style described as "in the English fashion" when it began to be used in France 1709 (Diamond 1953; Johnson 1989).

In America, the first successful glass factory was established in 1739 in Salem County, New Jersey by German-born Caspar Wistar, a contemporary of Benjamin Franklin. His factory supplied bottles to the rum distillers who were beginning to evade British trade regulations by smuggling molasses from the West Indies. But it was not until about 1820, after recovery from the War of 1812 and more skilled workers immigrated from abroad, that the American glass industry began to produce on a larger scale. Glass-making centers developed in Pittsburgh, New York, New Jersey and West Virginia, largely due to the proximity of coal for fuel. The first significant move towards automation was "sandwich" pressed glass pioneered by Deming Jarves beginning in 1817 in New England (Diamond 1953).

Bottles could not be pressed because of their narrow neck geometry, so bottle blowing remained a manual process (Glass Container Manufacturers Institute 1960). They were made in "glasshouses," and the work was done by men and boys. Glassmaking was a batch process, using sand, soda ash, potash, lime and recycled glass known as "cullet." The batch, contained in a refractory pot, was melted in a kiln at a temperature of 1400-1600° C (2600-2900° F). It was "gathered" onto a blow pipe, and reheated in the "glory hole," where a crew of 5-8 worked the batch of glass. Each bottle was blown in a mold and then, in the words of one 19th century writer, "stuck up on a punty, the shoulder, neck and finish being shaped by the blower with a pair of shears, the bottle being reheated several times at the furnace." The master glassblower, known as a "gaffer," held a high social status, attended by his assistant and the boys who transferred pieces and assisted the journeymen. A worker could only make about18 dozen bottles per day, even though the day lasted 12-14 hours (Diamond 1953, 84-5).

One of the reasons why mechanization came relatively late to the glass industry was resistance from the unions. Skilled glass workers were paid the highest of all skilled labor. The jobs were controlled by lodges like those of the Irish immigrants that began to unionize, beginning in 1865. These became the most powerful unions in America (Davis 1949).

On the other hand, the boys worked under conditions that could only be seen now as child slavery. There was strong public outcry against glass factory methods. Child labor, under horrible working conditions little better than coal mining, was widespread (National Cyclopaedia of American Biography 1940; Skrabec 2007).

Michael Owens

Michael J. Owens, who was to revolutionize the bottle making industry, did not begin as an entrepreneur – his career began in the glass business as a furnace boy, firing the glory hole.

The son of Irish immigrants, his parents encouraged him in 1869, at the age of ten, to enter the craft in a split shift of 10 hours/day, six days/week for only 30¢/day. His first job was to open and close bottle-making molds (Skrabec 2007).

Owens took advantage of the apprenticeship to work his way up. He rose to become a union leader, supervisor and then manager for Edward Libby's glassworks in Toledo, developing a partnership with Libby that extended through the rest of his career. He was an ambitious worker, and found that he had skills as an inventor, scientific manager and process innovator. Although he did not have the mechanical skills of a machinery builder, he successfully designed and communicated with engineers.

He understood the glass business from the bottom up, and so it is no surprise that his first invention, in 1891, was an automatic mold opening machine that eliminated what had been his first job. That same year he also automated the process for making lightbulbs (Skrabec 2007).

But the bottle blowing process was more difficult to automate. An automated "press and blow" technique[5] had been developed in the 1880s for jars (used for home and commercial canning) and drinking glass tumblers. Owens improved the process, but continued to seek a way to mold narrow bottle necks.

By 1902 he had successfully invented the first "blow and blow" machine to automatically blow bottles. It was based on the principle of a "revolving pot" that was continually fed from the furnace. The molten glass was taken from a continuously moving surface free from cool spots by a "sucker-upper" that pulled the glass into the mold by vacuum. A plunger at the top of the mold formed the neck and finish. The "parison" was then moved from the first mold to a finishing mold, where the piston pushed forward, forcing air to form the jar. With his Machine Number 4, he solved the problem of forming the long bottle neck and finish, and its first test produced 8 pint beer bottles/minute – automatically and with no dedicated operator (Skrabec 2007). A video clip of the machine is available (Lindsay 2008).

In addition to labor resistance, another reason that automation came so late to the glass bottle industry is the complexity of the machinery. Owens had automated the entire operation:

> There being no intervention of human hands from the feeding of the glass-making ingredients into the melting furnace at one end of the factory to the unloading of the finished bottles at the other end...The Owens bottle machine entirely revolutionized the bottle blowing industry, rendering obsolete methods which had been universally practiced since the middle ages" (National Cyclopaedia of American Biography 1940, 146).

This was a major breakthrough, considering that a non mechanized "shop" of three skilled men and three boys could only make 5 pint beer bottles/minute. It cost $1.25/gross to handcraft beer bottles, while Machine 4 could do it for 8-10¢/gross (Skrabec 2007). Owens' machines did more to end child labor in glass plants than all previous legislative and philanthropic efforts combined (National Cyclopaedia of American Biography 1940).

Glassmakers were slow to adopt Owens' first machines due to their high cost and capital improvements. So Owens incorporated his bottle machine and bottle making companies, and became the fifth member of the "Toledo Faction" including Libby and his companies, Libby's brother-in-law, and two lawyers: Clarence Brown and William Walbridge. The lawyers were key because they patented and licensed the technology (Scoville 1948).

They limited the machines to one licensee per product type, allowing a single automated producer to dominate that segment. These included: Thatcher milk bottles, Ohio Bottle for beer and soda bottles, Heinz catsup bottles, Illinois Glass and Bolt whiskey bottles, Ball Brothers fruit jars and Hazel-Atlas Mason jars.

Eventually Owens Bottle even vertically integrated, trading bottles for shares of their licensees' companies, giving the Toledo Faction an "invisible monopoly" that controlled their customers' prices for bottles and labor costs. The Toledo Faction kept below the radar of the government because of private ownership far from Wall

Street, interlocking stock and board arrangements, and the fact that the government was distracted by dealing with big industries like oil, steel and railroads. Libby and Owens were known as "benevolent monopolists" and "paternal industrialists" because they did not allow automation to reduce wages, and therefore had little labor strife (Scoville 1948; Skrabec 2007).

At the time of his death in 1923, 94% of the bottles produced in America were produced on Owens Bottle Machines. He also mechanized the production of flat glass (Miller 1984). The cheap production of bottles led the way for a proliferation of soft drinks, alcoholic drinks, food, household cleaners and pharmaceuticals (Floyd 2006).

Mechanization led to standardized bottle shapes, color and closure types. By the 1930s the variety of bottle shapes had been greatly reduced, colorless "flint" glass replaced green and amber, and the cork was replaced by metal closures. The standard bottles led to automated filling operations and to uniform weights and measures (Miller 1984; Miller 1985).

The Owens machines were gradually overshadowed by more efficient "gob feeder" (gravity flow glass feeding) machines beginning in the 1920s. Owens machine production declined gradually, from producing about 30% of the total American production in 1947 to the end of use in 1982 (Miller 1984).

PILE IT HIGH AND SELL IT CHEAP

Many factors during the late 1800s helped to reduce the cost of processed food. There were productivity improvements in the agriculture system, innovations in food processing technology – and mechanization of packaging technology.

A comparison of the history of cartons, cans and bottles reveals the same pattern of mechanization during the same two-decade period. This is not surprising since it was a widespread period of mechanization, replacing hand craft for making many objects, including food. Increasingly household crafts of cooking, baking and canning were outsourced to the factory.

Mechanization collectively shifted the economies of scale for making consumer packages -- despite efforts by the package making industrialists (including Gair, Norton and Owen) to keep prices high by monopolistic behavior. Mass produced packages enabled the mass production and filling of branded food products. New kinds of factories, based on continuous flow, were developed initially to pack meat and can vegetables (decades before Henry Ford) using conveyors and a series of operations. Prices of processed food fell, increasing demand (Strasser 1989).

Demand was further stimulated by the growth of advertising made possible by branded, mass produced food products that could be recognized from their trademarked package. Demand grew for the sanitation – "untouched by human hands" -- symbolized by consumer packaging which protected from deterioration and bore the manufacturer's assurance of quality (Strasser 1989).

The three new mass produced container forms converged to revolutionize the production and distribution of processed food and beverages -- first in America.

The growing mass production was met by a new mass retailing demand from grocery chains. National brands began to have the power to bypass wholesalers. Mass production of packages happened at the right time to enable a new competitive strategy for grocery stores, based on economies of scale and volume buying, rather than high profit margins. The Great American Tea Company was the first chain, in the 1870s renamed Atlantic & Pacific (A&P) to symbolize its stretch from sea to shining sea.

The early chain stores were much like the country stores that they replaced. Stocked primarily with bulk packages (like bags, barrels and tea chests), they required the shopkeeper to do the measuring and packaging. While there was some food in cans, bottles and cartons behind the counter, these were rare and expensive – and all of the packages were handmade.

By the 1880s, when Gair began to mass produce cartons, the A&P chain already had 100 stores (Great Atlantic and Pacific Tea Company 2008). By 1900, as Owens fine-tuned his bottle machine, there were 21 American grocery chains, which grew to 500 chains with 8,000 stores by 1914 (Barger 1955; Zimmerman 1955).

By the 1920s, grocery stores were filled with food in mass produced packages. The first book about the advertising potential of packaging, written by an Advertising lecturer and a *Printers' Ink* editor, chronicled the American progress to "packages that sell":

> Slowly, quietly, unobtrusively, the package has revolutionized modern merchandising. It has changed the buying habits of a nation....The package has changed the very appearance of stores. It has revolutionized window display. It has brought about surprising economies for both the manufacturer and the consumer, and it has given to the consumer great gifts in the way of convenience. It has opened new markets and almost completely changed the character of old outlets (Franken 1928, 1).

Franken and Larabee found that the first companies in each category to supply packaged product gained an immediate advantage, and then competitors followed, improving on the package graphics and function.

That was when retailers discovered a second competitive advantage from the new packages -- the ability to dramatically reduce labor cost with self-service shopping. The increasingly brighter, cheerful graphics on cartons, can labels and bottles replaced surly sales clerks and the cost of labor. The supermarket, staffed with packages acting as "silent salesmen" became the symbol of modern America (Pilditch 1961).

Piggly Wiggly, America's first true self-service grocery store, was opened by Clarence Saunders in Memphis, Tennessee in 1919 (although there had been some self-service by other retailers like Alpha Beta and Humpty Dumpty). The new low cost self-service stores had a "cash and carry" requirement that gave the Depression shoppers an incentive to shop at the low cost stores and to reduce the retailers' credit burden. Self-service led to the necessary development of the shopping cart and a range of display options, including shelves around the perimeter of the store, stocked from the back (Zimmerman 1955).

Mass produced processed food made possible the large one-stop shopping supermarkets that opened beginning in the 1930s with King Kullen in New York and large self-service stores in California. Supermarkets were entirely self-service in the grocery department, and were based on the theory of "Pile it High and Sell it Cheap" (quote attributed to T. A. Von Der Ahe of Von's Grocery Co. (Zimmerman 1955, 18).

Beyond retailing, packaged food enabled a profound change in the character of production and consumption. Whereas at first packaging was seen as enabling production and distribution, it was soon apparent that packaging can enable the advertising of new kinds and brands of products. Advertising began to lead consumers into temptation, but packaging *was* the temptation (Hine 1995).

CONCLUSION AND FUTURE RESEARCH

This paper has chronicled the automation of three package-converting technologies – carton-making, can-making and bottle-making – and has shown how the three package forms became building blocks for the development of chain stores, supermarkets, and, for that matter, modern consumer society.

The accomplishments of Robert Gair, Edwin Norton and Michael Owens are not entirely anonymous. Each is named in the history webpage of each of their industry's association (Can Manufacturers Institute 2008; Glass Packaging Institute 2008; Paperboard Packaging Council 2008). Owens and Gair have full biographies (Smith 1939; Skrabec 2007) and all three are chronicled in The National Cyclopaedia of American Biography (National Cyclopaedia of American Biography 1937, 1940 and 1955).

From their biographies it is clear that the early experience of all three men, Gair in the grocery store, Norton in a hardware store, and Owens in the glasshouse, contributed to their understanding of the need for marketing and mechanization from the bottom up. They eventually came to understand it from the top down too; all three were entrepreneurs who profited handsomely from their ingenious, post Civil War, "Yankee" inventions.

Yet the three men share an "anonymous history" inasmuch as their accomplishments have been thoroughly woven into the tapestry of American industrial and marketing history. Today the three men's companies have morphed so far into others that only Owens is still remembered by his successors, largely because the Owens-Illinois company still bears his name.

Future research may document the volume growth of package production and retailing. It can explore consumer acceptance of the package forms. There were clearly many other, even more "anonymous," men and women responsible for other incremental innovations in each container's development which are beyond the scope of this paper.

Ironically, for a short period all three companies had a common relationship. In 1956, long after the death of all three men, Gair's company was purchased by Norton Jr's Continental Can which at the same time merged with the Hazel-Atlas glass bottle company (the third largest glass container manufacturer at the time, still producing on Owens' machines) to become the largest package making company in the world. It was to be charged with a landmark anti-trust suit that debated how a market segment should be defined, and whether package forms like bottles and cans serve the same market. The suit went all of the way to the Supreme Court (United States v. Continental Can Co., 378 U.S. 441,1964) which upheld the district court finding in Continental's favor that it had not monopolized any one market (defined as cans, bottles and beer). One year after the mergers were declared lawful, Continental divested itself of the companies.

Nothing of Gair's company survived intact although some of his factories and markets have been purchased by others (including his landmark Brooklyn waterfront buildings which have now been converted to condominiums). Hazel-Atlas was sold to Brockway which was later purchased by Owens-Illinois, the largest glass container manufacturer in the world. And the canmaking portion of American Can has since been purchased by the global packaging manufacturer Rexam (where today they can't even find a picture of Norton).

The recurrence of anti-trust accusations in the packaging industries is a matter for a different research paper. But this paper surprisingly uncovers that is clear that this has been a strong tradition. The package-converting industries were repeatedly charged with price collusion. It is clear that Norton and Owens manipulated markets for their containers. Although there is no evidence of price fixing or "trust" behavior among the folding carton industry, there was clearly collusion between Gair and the other corrugated fiberboard makers. The industries' strong trade associations and the concentration of their markets in a few large customers have played a significant role, despite the industries' relatively low technology and barriers to entry, existence of many smaller scale competitive customers, and the availability of packaging technology substitutes (Goldberg 1986).

The three package forms were the building blocks in the creation of the American mass market. When considered alongside the automation of food processing and package filling -- and the widespread use of inexpensive, lightweight mass-produced corrugated fiberboard shipping containers, it is clear that mechanization of packaging technology was a vital tool in transforming the production and distribution of food in the early 20th century. In the context of the emerging marketing strategies of the time, packaging played a significant role in developing the national market for standardized, advertised, brand-name goods.

NOTES

[1]1879 is also the year that Edison developed the first incandescent lamp Bettendorf. (1946) finds it difficult to say whether lights or fiber boxes have had a greater influence on our life.

[2]The red and white labels were inspired by Cornell University's football jerseys and the gold medallion at the center represented a gold medal the company won at the 1900 World's Fair in Paris.

[3]The industry was already on the regulation radar. Thirty-eight tinplate makers had merged in 1898 to form the American Tinplate Company, also known as the "tinplate trust," controlling about 95% of production. It was purchased in 1901 by J. P. Morgan to join the giant steel trust, United States Steel (Moody 1904)

[4]In 1950 they were to suffer a more serious anti-trust decision when the government decided that it was unfair to make canners sign 5-year sole-source "requirement contracts" and closing machinery leases.

[5]The press and blow process has three steps. A gob of molten glass is gathered into a press mold in which a plunger forms the mouth and neck. This parison is transferred to a blow mold. Then the blower completes the bottle. This is still the process used for wide-mouth jars.

REFERENCES

Barger, Harold. 1955. *Distribution's Place in the American Economy Since 1869*. Princeton: Princeton University Press.

Bettendorf, Harry J. 1946. *Paperboard and Paperboard Containers: A History*. Chicago: Board Products Publishing.

Burke, James. 1987. *Connections*. Boston: Little, Brown and Co.

Busch, Jane. 1981. An Introduction to the Can. *Historical Archaeology* 15 (1): 95-104.

Can Manufacturers Institute. 2008. A Brief History of the Can. Can Manufacturer's Institute.

Canned Profits. 1934. Canned Profits. In *Time*, Reprinted: http://www.time.com/time/magazine/article/0,9171,754460,754400.html?iid=chix-sphere.

Clark, Hyla. 1977. *The Tin Can Book; The Can as Collectible Art, Advertising Art and High Art*. New York: New American Library.

Collins, James Hiram. 1924. *The Story of Canned Foods*. New York: E.P. Dutton & company.

Davis, Alec. 1967. *Package and Print: The Development of Container and Label Design*. London: Faber & Faber.

Davis, Pearce. 1949. *The Development of the American Glass Industry*. Cambridge: Harvard Univ. Press.

Diamond, Freda. 1953. *The Story of Glass*. New York: Harcourt.

Floyd, Barbara, Ann Bowers and Kimberly Brownlee. 2006. Time in a Bottle: A History of Owens-Illinois Inc; An Exhibition. Ed. U. o. T. L. Ward M. Canaday Center for Special Collections. Toledo: University of Toledo.

Franken, Richard B., and Carroll B. Larabee. 1928. *Packages that Sell*. New York: Harper & Brothers.

Giedion, Siegfried. 1948. *Mechanization Takes Command, a Contribution to Anonymous History*. New York: Oxford Univ. Press.

Glass Container Manufacturers Institute. 1960. *The Story of Glass*. Washington, DC: Glass Container Manufacturers Insititute.

Glass Packaging Institute. 2008. Quality of Glass: Historical Notes. Alexandria, VA: Glass Packaging Institute.

Goldberg, Robert C., Craig S. Hakkio and Leon N. Moses. 1986. Competition and Collusion, Side-by-Side: The Corrugated Container Antitrust Litigation. In *Antitrust and Regulation*. Ed. R. E. Grieson. Lexington, Mass.: Lexington Books, 105-125.

Great Atlantic and Pacific Tea Company. 2008. The Great Atlantic & Pacific Tea Company Milestones by Decades: The Great Atlantic and Pacific Tea Company.

Hine, Thomas. 1995a. The Packaging Made the Product...and Made the American Grocery Store. *Audacity: The Magazine of Business Experience* 3 (Summer): 28-31.

______. 1995b. *The Total Package : The Evolution and Secret Meanings of Boxes, Bottles, Cans, and Tubes*. Boston: Little, Brown.

Hunter, Dard. 1947. *Papermaking: The History and Technique of an Ancient Craft*. New York: Alfred A. Knopf.

Ingham, John N. 1893. Norton, Oliver Willcox and Edwin Norton. In *Biographical Dictionary of American Business Leaders*: Greenwood Publishing Group, 108-109.

Johnson, Hugh. 1989. *Vintage: The Story of Wine*. New York: Simon and Schuster.

Kiernan, Thomas. 1985. *The Road to Colossus; A Celebration of American Ingenuity*. New York: William Morrow and Company.

Lindsay, Bill. 2008. Bottle Glossary. Miller, George L. and Antony Pacey 1985. Impact on Mechanization in the Glass Container Industry: The Dominion Glass Company of Montreal, a Case Study." *Historical Archaeology* 19 (1): 38-50.

Miller, George L. and Catherine Sullivan. 1984. Machine-Made Glass Containers and the End of Production for Mouth-Blown Bottles. *Historical Archaeology* 18 (2): 83-96.

National Cyclopaedia of American Biography. 1937. Norton, Edwin. In *The National Cyclopaedia of American Biography, Volume XXVI*. New York: J.T. White, 167-168.

______. 1940. Owens, Michael Joseph. In *The National Cyclopaedia of American Biography, Volume XXVIII*, 145-146.

______. 1955. Gair, Robert. In *The National Cyclopaedia of American Biography, Volume XL*. New York: James T. White, 58-59.

Naylor, Simon. 2000. Spacing the Can: Empire, Modernity and the Globalization of Food. *Environment and Planning A* 32: 1625-1639.

Panati, Charles. 1987. *Extraordinary Origins of Everyday Things*. New York: Perennial Library.

Paperboard Packaging Council. 2008. Genesis of the Folding Carton. Springfield, MA: Paperboard Packaging Council.

Pilditch, James. 1961. *The Silent Salesman; How to Develop Packaging that Sells*. London: Business Publications Ltd.

Reilly, Mike. 2008. Tin Company Histories. In *Transitions Lifestyle*: Market America Inc.

Rock, James T. 1984. Cans in the Countryside. *Historical Archaeology* 18 (2): 96-111.

Scoville, Warren Candler. 1948. *Revolution in Glassmaking; Entrepreneurship and Technological Change in the American Industry, 1880-1920*. Cambridge,: Harvard Univ. Press.

Shephard, Sue. 2000. *Pickled, Potted and Canned; How the Art and Science of Food Preserving Changed the World*. New York: Simon & Schuster.

Skrabec, Quentin R. Jr. 2007. *Michael Owens and the Glass Industry*. Gretna, LA: Pelican Publishing Co.

Smith, H. Allen. 1939. *Robert Gair: A Study*. New York: Dial Press.

Stolk, William C. 1960. American Can Company; Revolution in Containers. In *Newcomen address*. New York,: Newcomen Society in North America, 28 p.

Strasser, Susan. 1989. *Satisfaction guaranteed : the making of the American mass market*. New York: Pantheon Books.

Twede, Diana. 1987. Uneeda Biscuit: The First Consumer Package?" *Journal of Macromarketing* 17 (2): 82-88.

______. 2007. "The History of Corrugated Fiberboard Shipping Containers. In *Marketing History at the Center: Proceedings of the 13th Conference on Historical Analysis and Research in Marketing*. Ed. B. Branchik. John W. Hartman Center for Sales, Advertising & Marketing History, Duke University, Durham, North Carolina 243-248.

United States Courts, John L Lott, Roger Shale. 1918. United States v American Can Co, in Federal Anti-trust Decisions, 1890-1917 v.6. Ed. U. S. Courts. Washington, DC: Government Printing Office, 450-645.

Zimmerman, Max Mandell. 1955. *The Super Market; a Revolution in Distribution*. New York: McGraw-Hill.