THE DEVELOPMENT OF THE ICE CREAM FREEZER

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The ice cream industry was one of the laggards in the mechanization process of the industrial revolution for reasons which are probably twofold. On the one hand it was slow to attain a full measure of growth—the first wholesale ice cream manufacturing plant was established by Jacob Fussel as late as 1851—and on the other the vicissitudes in the demand for the product had made an extensive early localization in factories economically infeasible. Not until the latter part of the past century did ice cream-making, firmly intrenched as it was, leave the small shop of the confectioner and the kitchen of the housewife for the factory of commerce. This move brought notable results for ice cream became the product of a vast and well regulated manufacturing industry, a standard article of commerce within the reach of every one, a food as well as a confection. Such changes cannot rightly be accounted for by any single factor; yet without the development of the modern freezer, which has enforced the advantages of large scale production, few of these changes would have occurred and ice cream might still be the simple "cream ice", the frozen cream of past years. It should prove worth while, therefore, to look into the history of ice cream freezers and thus gain an appreciation of an important phase in the development of the science of ice cream making.

Parkinson *(1)*, a "practical confectioner of Chestnut Street, Philadelphia" in 1849 prepared a statement of what was probably the typical equipment of American ice cream makers until the middle of the nineteenth century. The utensils requisite in that period for making this food, and descriptive comments thereon, are reproduced in his own words, to wit:

> "1. Pewter pots of various sizes suitable to the quantity of mixture intended to be frozen. Tin or zinc will not answer the purpose as it congeals the mixture too quickly without al-

lowing it a sufficient time to become properly incorporated, and forms it in lumps like hailstones.

2. Moulds.

3. Ice pails.

4. The spatula. This is an instrument somewhat resembling a gardener's spade; it should be made of stout copper and tinned, the blade being about four inches long by three in width, round at the end, and having a socket to receive a wooden handle; this is for scraping the ice cream, etc., from the sides of the pot as it freezes and for mixing it.

5. Either a large mortar or pestle, or a strong box and mallet for pounding the ice.

6. A spade wherewith to mix the ice and salt together, fixing your pails, etc.

7. A tin case or box—for keeping the ices in form of fruits after they are finished."

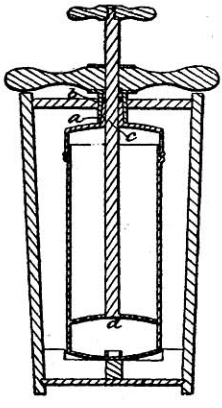
It has been reported *(2)* that a Nancy Johnson, the wife of a young naval officer, invented the ice cream freezer shortly after Dolly Madison had "officially" introduced this confection to Washington society. Be that as it may, however, letters patent on a similar piece of apparatus which was a combination of revolving freezer and beater were granted for the first time in the United States in 1848 *(3)*. The patentee, Young, before proceeding to describe his invention says in part,

> "Many devices have been resorted to for expeditiously freezing ice cream, but all have been found to be defective. The best now in use is that known as 'Johnson's', which is, like the ordinary freezer, with a revolving shaft inside it, on which are two curved wings that move round and cause the cream to revolve in the freezer and be thrown to the outside. I find that the operation is greatly facilitated by causing the freezer itself to move rapidly as well as the cream inside."

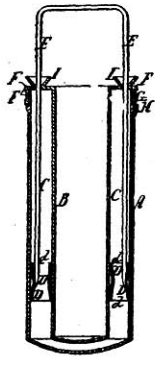
Describing his invention he says,

> "— there is a beater, full of holes, for the purpose of moving the cream inside, while by turning the freezer in the ice the ice is brought into close contact with it, and the cream is so put in motion as to bring all of it rapidly into contact with the cold sides of the freezer, which cannot be done by stirring alone, while, by the aid of the beater, the cream is lightened and the air allowed to come between the particles as effectually as by any other mode of stirring, and by their united operation the cream is more perfectly and speedily frozen and well beaten than by either of the modes now used."

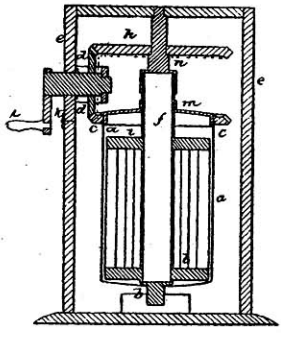
Two other patents on freezers were issued that same year. One of these *(4)* was for a device for congealing the cream in the annular space between two concentric cylinders when the smaller one was filled with ice and salt and the larger one was



W. G. Young
Patent No. 6501
May 30, 1848



A. H. Austin
Patent No. 5775
Sept. 19, 1848



H. B. Masser
Patent No. 5960
Dec. 12, 1848

surrounded by this refrigerant. The cream was agitated with a specially constructed plunger which served also to scrape the frozen product from the walls. The other *(5)* covered a contrivance which suggests in a sense the modern household freezer. In describing his invention, the patentee explains,

> "My invention consists in constructing a freezer so as to revolve the dasher within it and also at the same time to turn the freezer in an opposite direction within the ice box, and I form the spindle in the dasher large and hollow for the purpose of containing ice."

During the next year two more freezers were invented. The first *(6)* one embodied a minor structural feature for making more convenient the use of a central freezing core, but the second *(7)* one apparently did not suffer from a lack of novelty. The inventor proposed to freeze the cream by forcing through it a current of cold air for he says,

> "The nature of my invention consists in causing a blast of chilled air to permeate, be diffused through and disturb the liquids and materials of which ice cream is made. I chill the

> blast by drawing it from the atmosphere into a receptacle which is made to surround the sides and bottom of the vessel containing the ice or refrigerating mass. Within this vessel the can containing the liquids and materials of which the ice cream is to be formed is placed, and the interval between the two packed with ice or the freezing compound. The air may be drawn off at a central opening in the bottom of the air chamber. A section of elastic hose is fastened in any usual way to the opening and similarly attached at its other end to an ordinary double bellows, mounted on a suitable frame. . . . To the nozzle of this bellows I append a tube which passes down through the middle of the ice cream tub and separates into four or more horizontal branches open at their ends at the bottom of the same. . . The chilled air blast being forced through the horizontal branch tubes, bubbles up through out the whole body of the liquids and materials intended for ice cream and besides abstracting caloric from them by its own immensely extended contact therewith, it thoroughly disturbs them and brings every portion of the same into continually repeated contact with the refrigerating surfaces . . .".

Coffeen, the inventor of this device, was perhaps ahead of the times and public taste with his air bubbling freezer that would turn out ice cream with a scandalously high over-run—providing, of course, that the contrivance would function as claimed. And granting that it did work, the product made with it would probably not have enjoyed any large measure of popularity. Until almost the end of that century people generally had looked upon ice cream as a luxury rather than as a readily ingested food, as an out-of-the-ordinary dessert whose sweetness should remain upon the palate as long as possible. The turn of the century still found a popular preference for a "heavy" ice cream as the following comment *(8)*, which incidentally gives us a hint of the then accepted and genteel mode of eating this dessert, testifies:

> "Ice cream made from cream containing but 16 or 20 per cent of fat will lack body or character; when put into the mouth it immediately vanishes which is disappointing to the lover of good ice cream."

France, already rich in ice cream lore, is also in a position to claim the distinction of having granted early patents, for it is recorded that such were issued to Garnier (1829), to Koymans (1833), and to Columbin (1837) *(9)* for various types

of freezers. Such early inventive activity was no doubt stimulated by the perfection and popularity which ice cream had attained in its capital for the Parisians of that day were already well acquainted with this dish through the ice cream "parlors" operated by the Italians Velloni and Tortoni.[1] From Paris, too, comes what is probably one of our earliest *printed* recipes (1768) for making this confection *(10)*.

Like the simplicity-loving Yankees, the British did not develop the niceties in manufacturing this table delicacy until some years later yet they did anticipate American invention in this field by letters patent granted a Thomas Masters in 1843 *(11)* for a device whose name suggests that the uses to which it was adapted were many. It consisted essentially of a pewter can containing a three-bladed revolving "spatula" and surrounded by a "frigorific material" such as ice, new-fallen snow, or mixtures of the two and common salt, sal ammoniac, salt petre, ammonium nitrate, or calcium chloride. Lacking any of the latter the operator might also use, *mirabile dictu,* diluted sulphuric, concentrated muriatic or sulphurous acids in conjunction with the snow! The inventor summarized his claims in the following words:

> "Firstly, freezing, cooling, churning, and ice-preserving may be conjointly and simultaneously effected.
>
> Secondly, the solution of which ice creams and water ices are made may be beaten up while in the act of freezing.
>
> Thirdly, the apparatus may be applied occasionally to some of the said purposes only and occasionally to others, and
>
> Fourthly, each of the several parts of the apparatus may be used with advantage either in combination or separately."

Master's invention of a freezer, or "churn", was soon followed by the publication of his "Ice Book" (1844) which was "a compendious and concise history of everything connected with ice from its first introduction into Europe as an article of luxury" up to the time of the appearance of this treatise. Besides which it was "a valuable collection of the most approved recipes for making superior water ices and ice creams at a few minutes

[1] In 1798 Velloni established a magnificent place, outfitted with lounges, mirrors and marble top tables, for the serving of ice creams, etc., at 10 Boulevard des Italiens and similar branches throughout the city. He failed in this enterprise and turned it over to Tortoni, an employee, who made a success of the business while poor Velloni committed suicide. Tortoni retired in 1825 with an annual income of 100,000 francs.

notice." The publication of this book, which is deemed to be the first one devoted exclusively to water ices and ice cream, was marked by the simultaneous appearance of newspaper advertisements circulated in the hope of educating the public in the use of his freezers.

Since the evolution of the modern ice cream freezer is due in a large measure to improvements in refrigeration processes, a brief history of the latter will reveal some of the paths of that evolution. In 1755 *(12)* a Dr. William Cullen is reported to have developed an apparatus for freezing water by evaporation in a partial vacuum. It was not until the middle of the following century, however, that mechanical refrigeration began to assume any practical value for then Perkins (1834), Twining (1850) and Harrison (1857) devised refrigerators that employed the principle of evaporating a highly volatile liquid under diminished pressure. Certain inherent defects in the construction of the machinery necessary in operating with the liquids in question apparently led to the development of the ammonia refrigerator by Carre (1859). His apparatus consisted of two strong vessels, a boiler containing a concentrated ammonia solution and an evaporating chamber, joined together with a tube. In appearance and operation it was not unlike the small domestic refrigeration unit which was developed several years ago for use in those communities where electricity is not available. To operate this machine, one raised the temperature of the saturated ammonia solution solution in the boiler to 130-150°C. whereupon the liberated ammonia, driven over under high pressure into the water-cooled refrigerator, condensed to a liquid. The boiler was then placed in cold water, the effect of which was a fall in temperature which was accompanied by a reduction of the pressure in the apparatus, a rapid vaporization of the liquid ammonia in the refrigerator and the production of an intense cold. Reece (1869) improved upon this machine in that he used brine flowing through a coil within the refrigerator.

German brewers are said to have employed artificial refrigeration as early as 1867. Its use in sugar refineries, meat-curing houses and for cold storage also began at a rather early date, but the only really extensive application which these machines found was in the manufacture of artificial ice. And in this con-

nection it may not be untimely to add the thought that it requires no stretch of the imagination to picture a union of the ice cream and artificial ice industries in that the latter found in the former a convenient outlet for its surplus or unsaleable ice.

Until the beginning of the twentieth century freezing an ice cream mix with manually operated equipment was still a common procedure as witness the following reminiscence *(13)* of the "good old days" by F. D. Hutchinson, one of Iowa's pioneer manufacturers: "I remember on the Fourth of July of 1890 we shipped out three hundred gallons all frozen by hand power." The advent of commercial electricity made it possible, of course, to utilize a cheaper form of energy in turning the freezer crank.

The precursor of the modern brine freezer and storage tank is probably of the type said to have been operated by Edward Walker in 1902 *(14)*. During the same year the Miller brine freezer was developed and this was soon followed by the Miller-Tyson machine. The reception accorded this type of freezer by industry is reflected rather well in the following conservative prediction, *(15)* "It may safely be assumed that the brine freezer will never put the ordinary ice and salt freezers out of business. It bids fair to play an important part in the development of the industry from this time on." Commenting further on this subject the author says, "There are some manufacturers who still pin their faith to the steam engine regardless of cost of installation and operation, the complicated nature of the plant required and the necessity of employing a licensed engineer, who, in all likehood, will ever be found too busy to do more than look after his engine. This is difficult to understand for surely economy is as necessary in the ice cream business as elsewhere."

During the first decade of the present century there were in use *(16)* several types of commercial freezers. Among them were the vertical-batch ice freezer, a very common type which at that time had already been in use for many years; a similar one cooled with brine; a horizontal brine machine which seems to have been much preferred because excellent results were obtainable with it and little trouble experienced in getting "swell" *(17)*; and an open horizontal continuous brine freezer which was said to possess advantages not shared by the closed machines, especially in affording the operator an opportunity

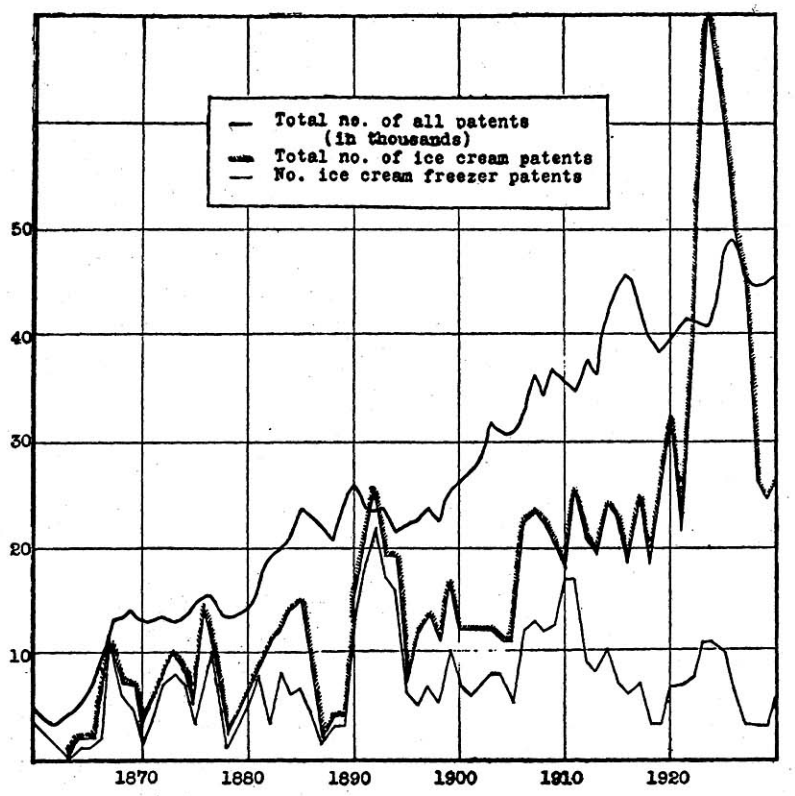


FIG. 2. Patents annually granted in the United States during the period 1860–1930.

for a more frequent use of the thermometer. Within the past fifteen years the temperature of the refrigerants of the batch type of freezers has been lowered by five to ten degrees, a change in technic which has resulted in an improved texture of the product and an increased output per unit of freezer capacity.

A direct expansion or ammonia type of freezer was brought out in the year 1914 but it was not well received until, some eleven years later, it had undergone numerous modifications and improvements. The new machine immediately became popular. It has certain advantages over the brine type of freezer for, among other reasons, refrigeration losses were materially reduced.

One more freezer requires mention for it enjoys a wide popularity. The machine in question is the so-called horizontal con-

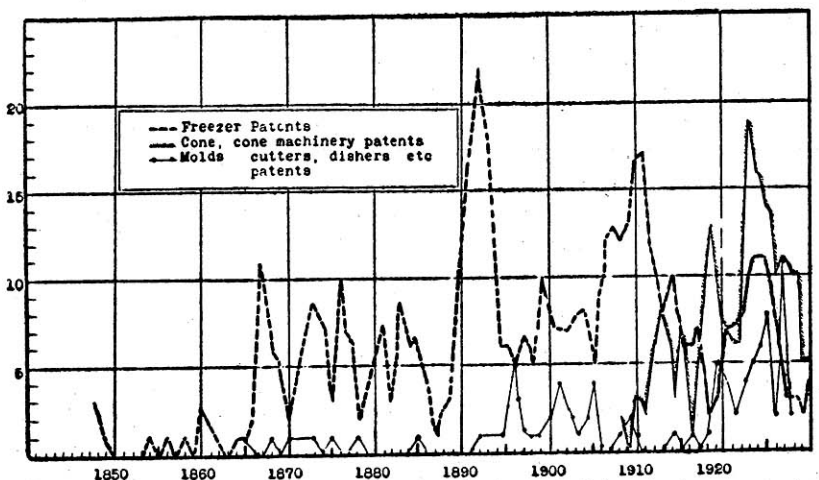


FIG. 3. Number of certain types of patents pertaining to ice cream issued in the United States 1848–1930.

tinuous disc freezer which was introduced in 1928 as an improvement over early machines of this type which were not entirely satisfactory, although the theory of their operation was attractive. The ice cream made in them invariably was coarse and fluffy. Not so, however, the present machines with

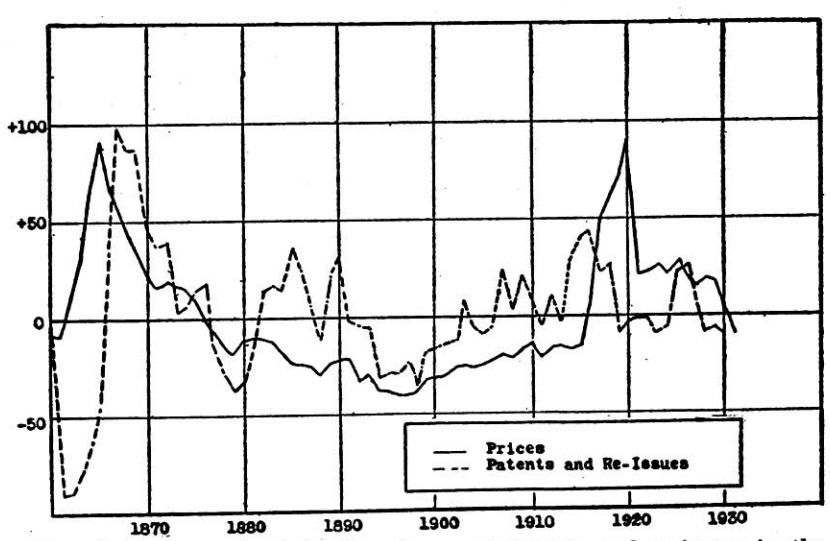


FIG. 4. Indexes of wholesale prices and patents and re-issues in the United States 1860–1930. (Expressed as percentage deviations from the trend in multiples of the standard deviation.)

which the manufacturer is able to turn out a uniform product of a fine texture because of a more rapid freezing at a low temperature.

The degree of perfection which freezers have attained is reflected in the general high state of development of ice cream manufacturing processes. A glance at Figure 2 shows that the annual number of ice cream freezer patents has not exhibited any appreciable upward long time trend within the past twenty years, perhaps because the need and the possibility for the improvement of freezers was not as large as for the improvement of other ice cream equipment. If we look into this more closely, we find, indeed, that during the same period the number of patents for equipment and apparatus designed primarily to facilitate the distribution and consumption of ice cream has shown a large increase. From this one is led to believe that ice cream manufacturers have pursued the general course of others in shifting the main emphasis from improvements in the methods of production to improvements in the methods of distribution.

Inventive activity, as exemplified by the number of patents granted, in the ice cream field seems to follow the course of general inventive activity except that the amplitude of the cycli-

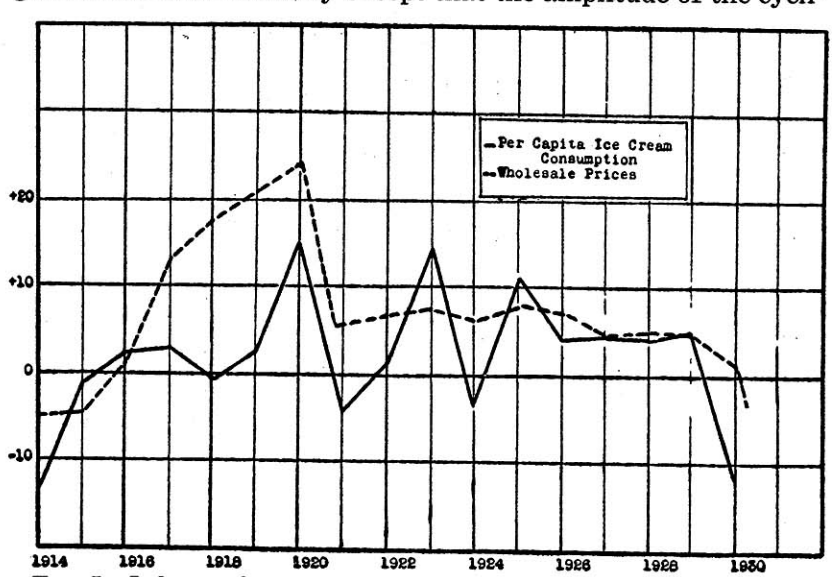


FIG. 5. Indexes of per capita ice cream consumption and wholesale prices in the United States 1914–1930.

cal fluctuations in the ice cream patent curve is larger (Figure 3). This latter circumstance may be attributed in part to the small numbers which we are considering—less than fifty—but a more definite meaning is suggested when we consider the large positive degree of correlation existing between the percentage deviation from the trend of patents and of wholesale commodity prices (Figure 4). Ice cream is a food yet not an essential one, hence its consumption (Table I) is dependent at least to some extent upon the purchasing power of the consumer.

TABLE I. *Annual per capita consumption of ice cream in the United States for the period 1914-1930.*

Year	Gals. per capita	Year	Gals. per capita
1914*	1.68	1922	2.43
1915	1.88†	1923	2.68
1916	2.08	1924	2.50
1917	2.07	1925	2.80
1918	2.14	1926	2.77
1919	2.49	1927‡	2.85
1920	2.46	1928	2.92
1921	2.28	1929	3.02
		1930§	2.80

*Data for the period 1914–1926 from Pirtle: A Handbook of Dairy Statistics, Bur. Agric. Economics, U. S. Dept. Agric., 1928, p. 5.
†Interpolated. Data for the period 1927–1929 from Bur. Agric. Economics, U. S. Dept. Agric.
‡Yearbook of Agriculture, U. S. Dept. Agric.
§Based on estimate made by Bureau of Service and Statistics of the International Association of Ice Cream Manufacturers. *Ice Cream Trade J.*, 27, No. 4, 56 (1931).

While other commodities show a more ready adjustment to changes in the price level, the retail price and the composition of ice cream as fixed by statute, definition or public taste remain nearly constant over long periods of time. Thus it becomes apparent that ice cream consumption should be doubly "sensitive" to changes in general prices or economic conditions. Figure 5 bears out this assumption.[2] Minor fluctuations in ice cream production could perhaps be attributed to weather conditions; but the diversity of climate over the United States furnishes us with a fairly reliable statistical sample. Thus it is to be noted that while the weather conditions in 1930 were "good"

[2] It must be borne in mind that the manufacture of ice cream was partially restricted during the period of the World War which accounts for the low level of production for the years 1916-1919.

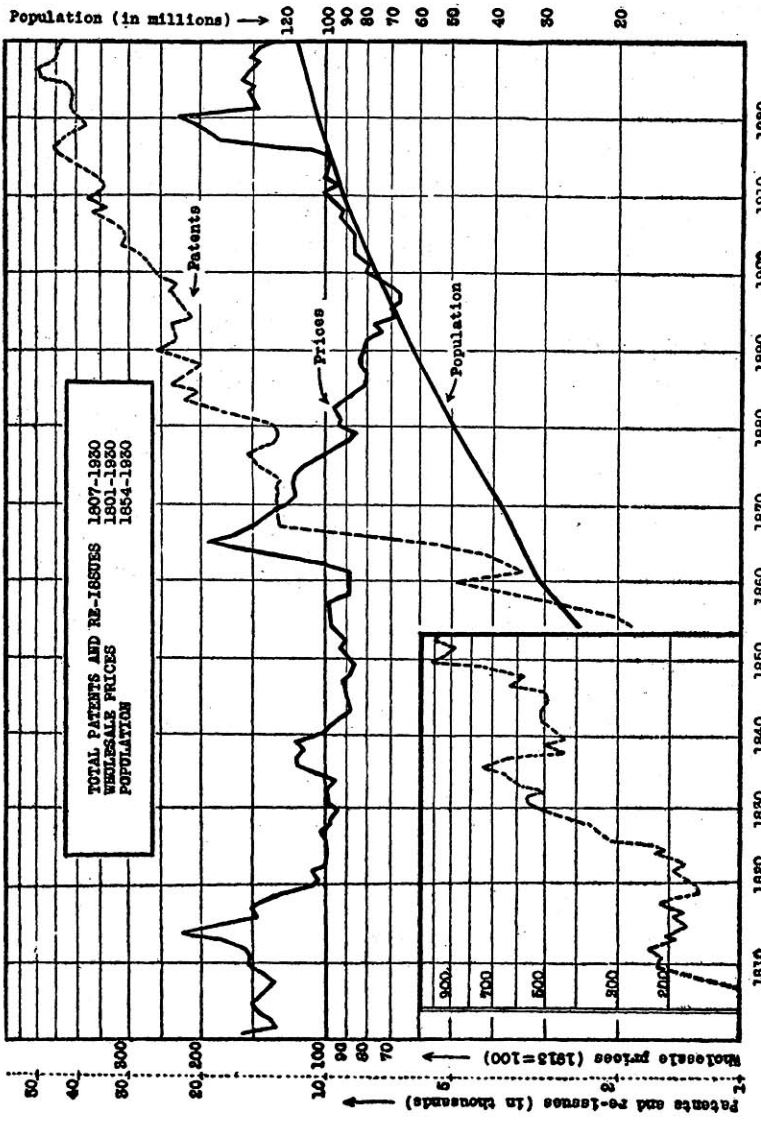


FIG. 6. Patents, population and wholesale prices of ice cream in the United States.

from the manufacturers' point of view, a sharp decline in production occurred during that year *(18)*.

Turning again to a comparison of the number of patents granted annually and wholesale commodity prices (Figure 6), we may conclude that there is a definite relation between variations in these two factors. Yet the question of which is the

forerunner or the cause in initiating the movements of the cycles can not be answered as readily as would appear at first sight; for the simplest view that high prices and a high general level of business activity should result in a larger demand for inventions does not explain the sharp drop in the number of patents granted in 1919 and 1928, years just preceding the "depressions". As a possible explanation of this it may be suggested that during the height of a business cycle there is a diminished incentive for seeking better methods of production; businesses almost run themselves and everyone runs a business. The smaller annual variations in the number of patents granted probably are an indication of the intimate connection between the forces operating in the patent market and the forces operating in other markets. As a fruitful source for speculation we can see in these curves a relation between invention and money; a graphic illustration of Dean Hoover's view on the utility of wars in stimulating inventive activity (but certainly not ice cream inventions); and a hint of the extent of future ice cream freezer development.

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