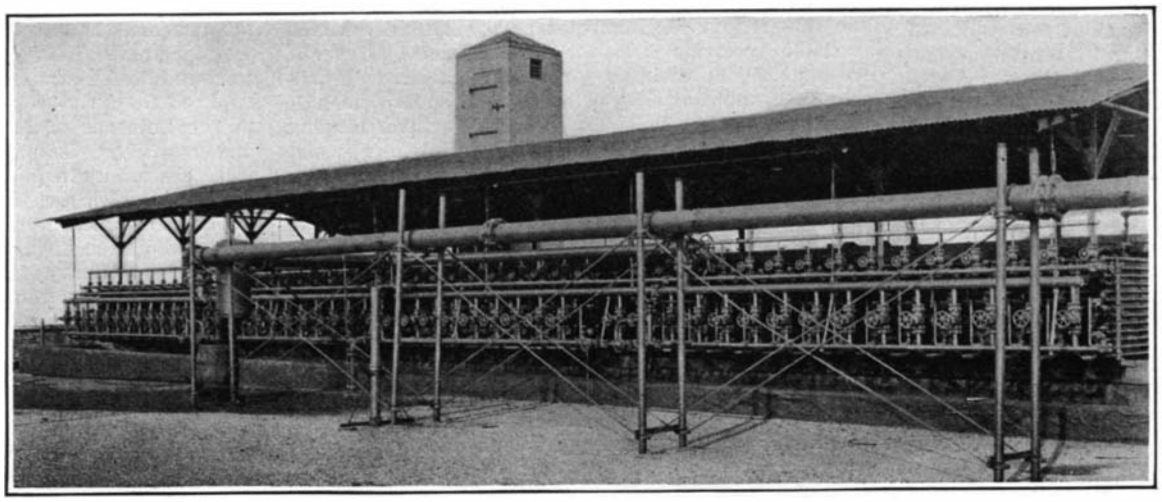
The Ice Cream Factory

How This Industry Has Been Taken Out of the "Domestic" Category

By William A. McGarry



Condensers located on the roof of the plant

UNTIL relatively recent years the manufacture of ice cream was in the class of the "home industry." It was carried on, as a rule, either as a side line in small bakery and confectionery stores, or in small plants with little mechanical equipment and correspondingly limited output. Ice cream was considered a seasonal dainty, profitable only in warm weather. But all this has been disproved in Philadelphia, which is just as famous for its ice cream as for its scrapple and cinnamon buns.

In that city today there is a two-and-a-half-million-dollar, six-story steel and concrete plant built solely for the purpose of manufacturing ice cream. Its present capacity, which is being enlarged, is 150,000 quarts a day, or enough ice cream to furnish a standard six-to-a-quart plate to nine hundred thousand persons. Ultimately the company operating this plant will be able to advertise "a million plates a day" and perhaps more.

Ice cream making as still carried on in the home for family consumption, in the small freezers sold by many manufacturers for that purpose, is a swift and simple operation. It consists of little more than mixing cream and milk, or condensed milk, with fruit and sugar, placing the milk in the freezer and turning the crank until the stuff hardens. But the work is not as easily done in a great modern ice cream plant. Contrary to the popular supposition that ice cream is "perishable," the fact is that the ingredients are actually "aged" for twenty-four to forty-eight hours before being frozen, and after that, with proper icing, the stuff will keep indefinitely without turning sour. A sour taste in the cream indicates either that the mix became sour before freezing through carelessness, or that the ice cream was allowed to become soft and warm enough for bacterial action to begin.

This particular plant is protected against both possibilities. Its freezing rooms are equipped to reach a temperature of twenty degrees below zero under normally cool conditions of temperature, which insures the ideal temperature for ice-cream-freezing purposes of five degrees below in the hottest kind of weather. Experience has shown that ice cream subjected to the more intense degrees of cold is not nearly as palatable as that frozen in from zero to five degrees below.

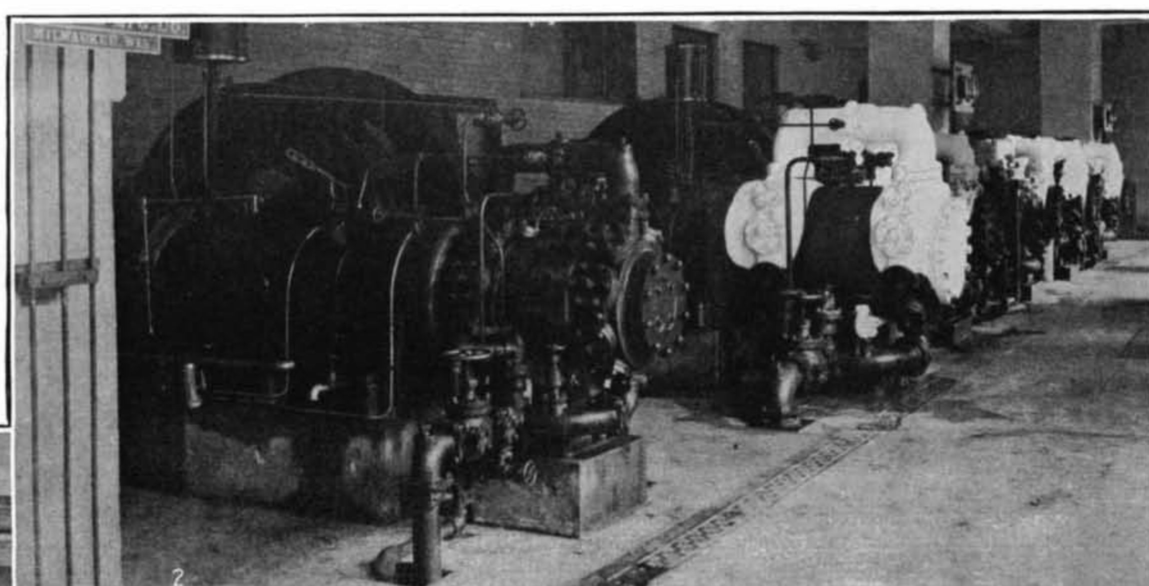
In this plant the practice is to use forty per cent cream, to which is added first the milk and sugar. Milk supply comes from many dairies in four states in order to eliminate danger of a shortage. When the milk reaches the plant it is pumped through a two-inch glass-lined pipe to the top floor, where the mixing process of milk, cream and sugar is performed in glass-lined pasteurizing tanks. From that point the mixture moves altogether by gravity until it passes from the final mixing machines or ice cream freezers into the large cans in which it is delivered to the dealer.

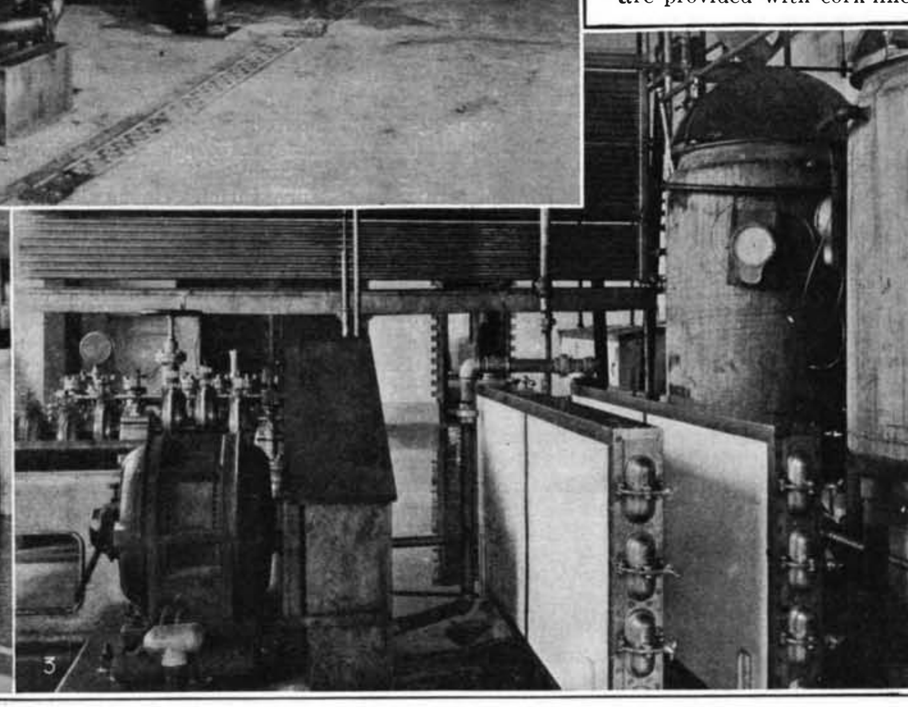
The first drop from the pasteurizing tank lets the mixture into a machine known as a homogenizer. In this it passes, under light pressure, through a series of discs that rub together with a circular motion similar to the rubbing of the palms. The purpose of this is to break up all the minute globules of butter fat in the milk and cream and to insure a smooth, velvety texture to the ice cream. So thoroughly does the machine do its work that these fatty particles, so essential to the food value of the ice cream, are completely distributed throughout the mass and never reunite.

From the homogenizers the mix is dropped again, this time to the glass-lined holding tanks, which are kept at cold storage temperatures. Here occurs the aging process. At the end of that period another valve is turned and the stuff drops again. There are fourteen 80-quart and six 160-quart freezers, large tanks containing paddles. The two-inch glass-lined pipe lines are equipped with feeders to supply these freezers. The fruit or flavoring is added at this point. When the mass begins to thicken slightly a door is opened in the front of the freezer and the thoroughly mixed ice cream slides slowly into the delivery cans.

Each of the mixing machines completes its work on a single batch in a little less than fifteen minutes, producing nine batches every two hours. The cooling medium is circulating calcium chloride, used instead of brine because it will not damage any metal parts with which it comes in contact. Each freezer is equipped with a double jacketed cylinder for the circulation of this cooling material.

The cans are capped at the freezer and moved by trucks to the hardening rooms. Extreme precautions have been taken to assure permanent low temperatures at any time of year in these rooms. The insulation is eight-inch cork blocks and the cooling is by what is known as the indirect system of refrigeration, supplied by the latest type of high-speed compound direct-connected refrigerating machines. The cans also are provided with cork-lined





1. Where the factory makes its own ice. 2. A group of refrigerator units. 3. Pasteurizing tank at the right, coolers in the center (the flat tanks), and homogenizer at left background

Some of the machinery of the ice cream factory

tubs in which they are iced for delivery. Cabinets supplied to the dealers are likewise cork lined.

Despite the fact that there is a very great length of two-inch pipe to keep at low temperatures, to say nothing of the freezers, the cold storage rooms in which the milk is stored to await pumping, the holding tanks in which the first mix is aged, and the cold storage rooms for the preservation of the fresh fruit in prime condition, the bulk of the refrigeration in the plant is used for the icing of the cans for delivery. For this purpose the plant is equipped to manufacture ice. With an output of 400 tons a day it is the largest single producer in the city, and fully 300 tons of this is used up in icing cans of ice cream.

Operating at full speed, the big refrigerating machines have a capacity of twelve hundred tons of refrigeration. But cold alone, even at the lower temperatures, will not make sanitation sure. Therefore in this plant, at the conclusion of a day's run, every piece of the glass-lined pipe through which the mix passes is taken apart, washed and left overnight in a cleansing solution. The same solution is used for washing the freezers, pasteurizers and homogenizers, as well as the cooling tanks.

Ice cream from this plant is sent to virtually all the New Jersey coast resorts and to many other points far distant from the city of its manufacture. In addition there are sixty-six delivery routes within the greater city limits. Cork-insulated bodies are made in a special department of the plant for the automobile trucks used for delivery. These bodies are water tight. All wood and metal signs, cabinets and tubs also are made within the plant so that there may be no danger of losing customers in a busy season through delay in the delivery of this kind of equipment.

When production is at its height tons of fruit pass into the plant every day, and out again in the form of ice cream. The handling of this must be surrounded with as much caution as that given to the milk and cream, and here again glass-lined, air-tight tanks are used to hold the fruit after it has been cleaned and crushed to the proper consistency for mixing. Crushing machines used are of types already familiar and in more or less common use. In making ice cream, however, it is necessary to have the mix absolutely smooth. The householder making it for himself will not object to large lumps of uncrushed fruit, but he is quick to protest if the commercial article is not smooth and velvety.

The ice cream habit apparently has taken a great hold on the American people, as the records show that its consumption is increasing year by year far out of proportion to the increase in population. This is doubtless due in part to the entrance of such companies into the field as that described here, in which a uniform standard of quality is reached and maintained at all times. Even in the winter ice cream is widely used in all the hotels and restaurants, and apparently it is coming into greater use every year in the home. It is given to athletes who have gone stale, as one of the quickest means of getting them back on edge; and doctors frequently prescribe or permit it to be given to invalids. When it is pure it is a food product of great value, and when it is made as we have described it can hardly help being pure.

Dr. Nimführ's Soaring Airplane

DR. RAIMUND NIMFÜHR, the Austrian scientist and inventor of the new type of airplane bearing his name, has recently published a number of articles on the subject of motorless flight. Dr. Nimführ calls attention to the difference between soaring, gliding and flapping flight, and shows that it is impossible to learn to "soar" by starting with a motorless glider. In flapping flight, the bird moves its wings up and down somewhat in the manner of an oar (like a pigeon or a crow), and when the motion of its wings ceases, we have gliding flight. When, however, a bird soars it holds its wings stretched out motionless, like a sail—hence the expression "sailing" or soaring flight. All the large seabirds and birds of prey, like the albatross, seagull, eagle and vulture, cover considerable distances in soaring flight; and in the middle of last century even scientists thought that the frigate bird spent most of its time in soaring flight, only settling for the purposes of breeding, while even today the coast dwellers of Borneo believe that the frigate bird lives on air. Audubon, together with other observers, claims the frigate bird to be the fastest flyer over the sea.

The three necessary conditions for mechanical and automatic soaring are safety from nose-diving and capsizing; that is to say, the airplane should not lose its equilibrium even when it is practically motionless in the horizontal direction, or when the rudder becomes useless in an air pocket. (2) The "lift" or buoyancy of the machine must be unimpaired even when it is traveling at reduced speed or when it gets into a downward air current. (3) A soaring airplane must be fitted with wings of variable size and variable angle of set, that is to say, the load on the planes or wings must adapt itself to the variations in the altitude of flight which take place periodically when soaring.

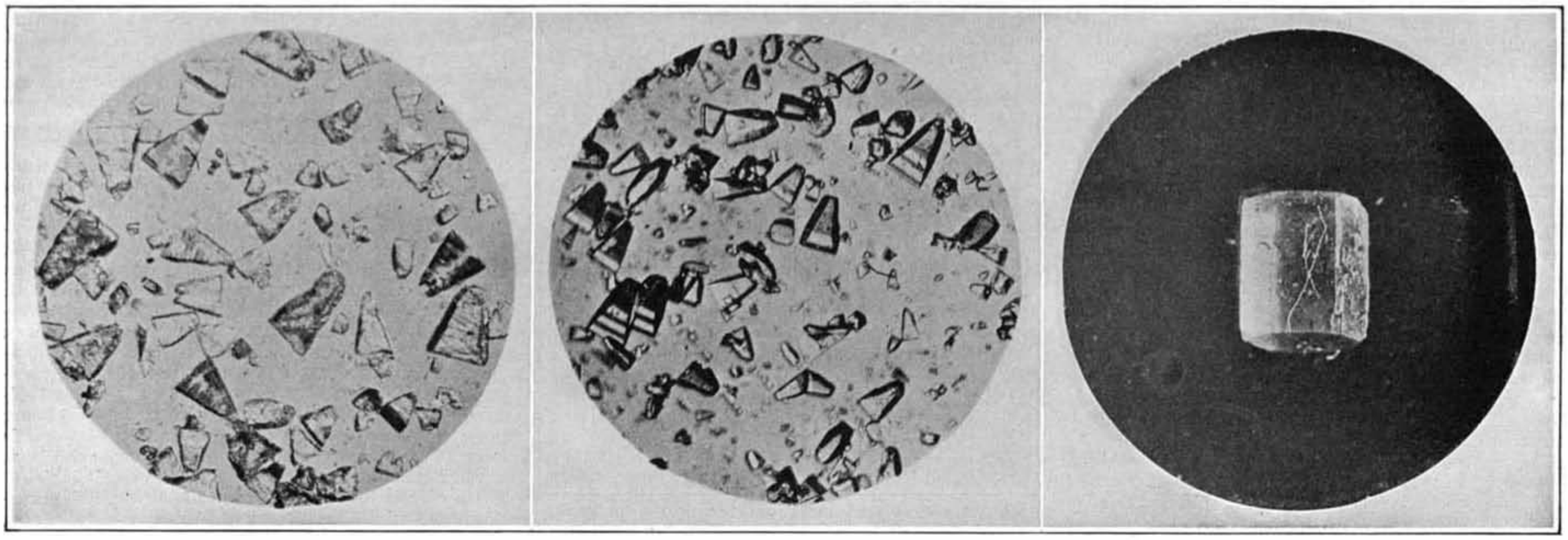
Dr. Nimführ's machine fulfils all the above requirements. To make it secure from nose dives and capsizing it is fitted with a number of "pressure-feelers" at different points. These pressure-feelers are nothing more than very sensitive aneroids or pressure gages which, instead of actuating a pointer, close an electric contact and set into motion servo-motors which in their turn automatically shift the wings slightly backward or forward as required, so as to reestablish the stability which may have been displaced by sudden sharp gusts or some other disturbing force.

The unique feature of the new airplane, however, is the pneumatic pulsating wings, which imitate to a certain extent, and mechanically, the swirling flight of certain birds such as the colibri (hummingbird), swallow, etc. In the case of the colibri, the number of wing-impulses are so great that the wings become practically indistinguishable. It was found impossible, however, to give this rapid pulsating motion to the entire wing of a mechanical flyer, so Dr. Nimführ conceived the idea of making the under wing surface pneumatic and pulsating. In the hollow space between the upper and lower wing surface are fitted airtight pockets, which are rapidly inflated and deflated by compressed air or the cooled exhaust gases of the engine, and so cause the wing to pulsate. These pulsations cause the under side of the wing to exert a compression impulse against the air strata immediately underneath, thus forming a sort of permanent air cushion on which the airplane rides. It is thereby possible for the machine to keep its altitude even in still air or in the descending branch of an air wave. Dr. Nimführ's airplane, which may be truly described as the most perfect transition between the airplane and the ornithopter (a machine exactly imitating the flight of the bird); further, it combines all the advantages of the airplane and the helicopter (the airplane which can ascend vertically and remain suspended by virtue of its vertical suspensory screws).

This new system of soaring flight opens up immense prospects of cheap and safe transport, as there are recognized routes where the winds are highly favorable to it. Moreover, the engine power required is but a fraction of that necessary in ordinary airplane flight.

Sandy Ice Cream

SANDINESS—crystalline texture and the presence of large, hard, fine gritty crystals like starch—has long been objectionable in commercial ice creams, but has never been explained previous to the conclusion of recent investigations conducted by H. F. Zoller and O. E. Williams, government scientists. These experts have isolated and identified the cause of sandiness as lactose and have carefully studied the growth of the sand crystals under the microscope. They have proved that the form of lactose appearing in ice cream is the normal "a" crystal—familiar to sugar manufacturers and chemists—which crystallizes from water solutions in tomahawk-shaped prisms and from protein solutions in more rugged or maize-shaped crystals.



Left: Isolated "sand" crystals from ice cream that exhibited this defect. *Center:* Pure recrystallized lactose hydrate from condensed whey. *Right:* A single crystal of pure sucrose. This is magnified five diameters; the two others, 90 diameters

Photomicrographic studies of the crystals in ice cream, which show the origin of "sandiness"

Ordinary mixes of commercial ice cream were made and placed in hardening boxes, the ice cream being repacked each day. On the fourth day, the fine, sandy crystals began to develop and subsequently were studied carefully day by day under the microscope. The general form of the crystals remained the same throughout the 20 days that the observations were conducted, although they increased greatly in size during this interval. Microscopic study was facilitated in each case by placing a drop of ice cream upon a glass slide and then viewing it through the microscope in polarized light. Subsequently, the sandy crystals were separated out by allowing some of the ice cream to melt at a temperature of 25 degrees Centigrade. It was then poured into large centrifugal tubes and centrifuged at 2000 revolutions per minute for 10 minutes. This resulted in all sandiness properties being concentrated in the sediment which could be studied under the microscope and subjected to various lactose and sucrose identification tests.

Samples of pure lactose and sucrose made expressly for this purpose in the government laboratories were also used for comparative purposes, and ultimately the chemical and dairy specialists found out positively that the lactose crystals caused the sandiness in ice cream. These conclusions are complete upsets so far as the dairying manufacturing industry is concerned, as the accepted theory was that sucrose was responsible for unavoidable presence of these objectionable crystals. The next investigational activities of the dairy scientists will be to ascertain satisfactory methods for the elimination of these sandy crystals from our popular, frozen dainties.