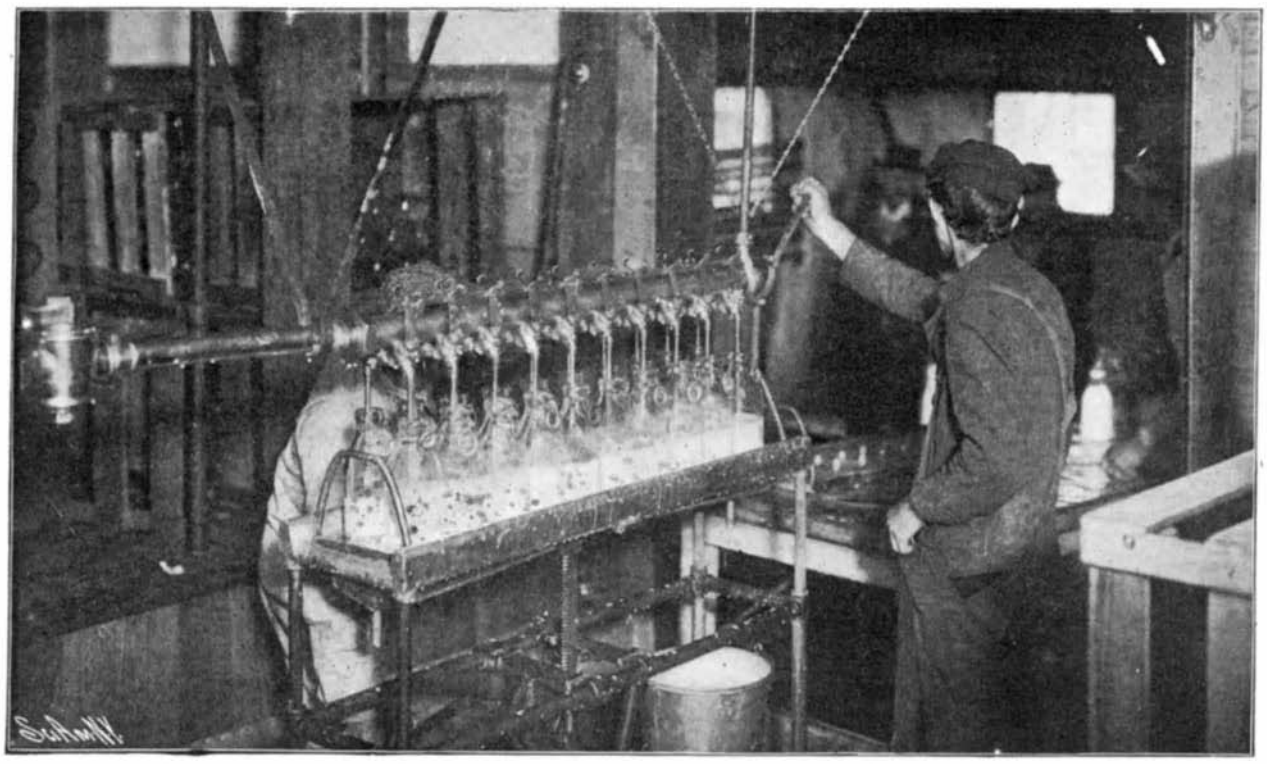
ing three years in the famous British naval college at Greenwich. On returning to Japan he was enrolled in the Japanese navy as an ensign, and on the opening of the war with China in 1894 he had risen to the command of the then crack cruiser "Naniwa," of 3,650 tons. It is a curious fact that in that war, as in this, he struck the first serious blow, for the "Naniwa" on coming up with a Chinese transport, the "Kowshing," of which he had been sent in search, ordered her to heave to, and on her refusing promptly sent her to the bottom.

For his distinguished services in the Chinese war, 1894-5, he was given two Japanese orders and a pension. He was appointed a member of the board of admirals in 1895. For his service in Formosa he received further rewards, and he was appointed vice-admiral in June, 1898, with the commission of commander-in-chief of Sasebo naval station. In 1900 he was appointed commander-in-chief of the standing squadron, and during the diplomatic controversy at the close of 1903 that led up to the present war he was appointed commander-in-chief of the first fleet. The naval *attaché* of the Japanese legation, Washington, states that Admiral Togo has well earned his sobriquet of "the silent man." Before the war, among the Japanese naval officers, he was held in the very highest repute as a strategist and fighter, and his conduct of the war, and the fact that after destroying one of the greatest of naval powers he should have in hand a fleet practically as powerful as that with which the war opened, proclaims Admiral Togo as one of the very greatest admirals of this or any other age. What he has done has not only never been equaled, but has never been approached.

The first-class battleship "Mikasa," Togo's flagship throughout the war, is probably better known than any other ship that has figured in the present conflict. Built by Vickers, Sons & Maxim at Barrow, she was at the time of her launch in 1900 the largest battleship afloat, and at the opening of the war she was the largest battleship in commission in any navy. With a length over all of 436 feet, beam of 76 feet, and a draft of 27¼ feet, she displaces 15,200 tons. She is a thoroughly up-to-date vessel, and includes the accepted ideas as to speed, armor, and armament of naval designers. The only points on which ships of later design surpass her are those which are due to the lessons that have been taught by the war in which the "Mikasa" has figured so largely; namely, the substitution of large guns of from 9 to 10-inch caliber, emplaced in turrets, for the more numerous battery of 6-inch guns mounted behind side armor which constitutes the secondary armament of the "Mikasa" and her type of battleship. She is driven by twin triple-expansion engines, for which steam is supplied by a battery of twenty-five Belleville water-tube boilers. As in the other battleships of the Japanese navy the main battery consists of four 12-inch wire-wound guns of high velocity; the secondary battery is made up of fourteen 6-inch guns. For protection the vessel carries a 9-inch belt of Krupp steel and a wall of side armor 6 inches in thickness extending amidships from the main belt to the main deck. The very striking picture of the "Mikasa" which we herewith reproduce represents her leading the Japanese fleet into an engagement. She is stripped of her boats, rails, stanchions, and everything that might interfere with gun fire or, by intercepting the enemy's shells, burst them and be knocked into flying splinters that would endanger the crew. The "Mikasa" has been present and taken a prominent part in all the battleship engagements of the war. She has been subject to attack by the guns of the enemy's fleet, by the coast defense guns of Port Arthur's fortifications, and by the deadly mine and torpedo. Yet to-day, as far as we can learn, she is in first-class fighting condition.



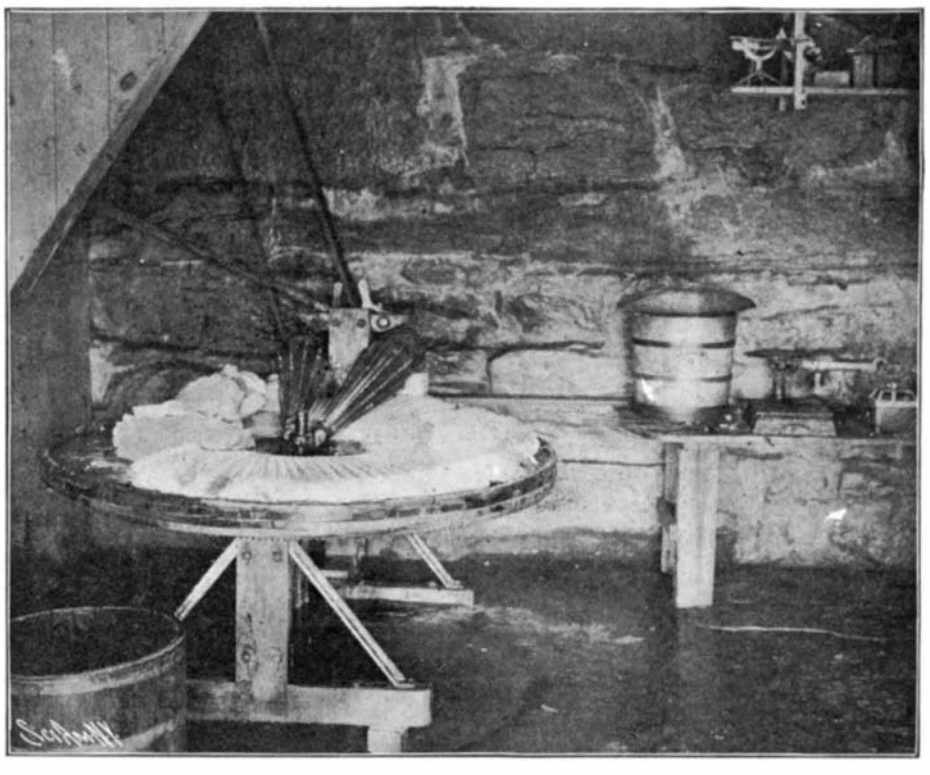
After Leaving the Cooler, the Milk Runs into a Large Tank, from Which It is Drawn into the Bottles.

MODERN SCIENTIFIC DAIRY METHODS.

New York city drinks two million quarts of milk every day. Could this milk be delivered to the consumer within an hour or so from the time it is milked, there would be little danger of its spreading disease, provided it came from healthy cows and was handled with due precautions. But, unfortunately, our transportation systems have not been so highly developed as to permit of such rapid delivery. The supply is brought in from distant farms in New Jersey, Connecticut, central New York State, and Vermont. Even if fairly clean when shipped, which is not often the case, the long journey permits the growth of millions of bacteria, so that by the time it passes through the distributing station, and is finally delivered to the consumer, the milk may be teeming with all kinds of germs. Of course, most of these germs are harmless. Nevertheless, milk affords an excellent breeding ground for all bacteria, and should any disease germs gain access to it, they would in a few hours multiply to an astonishing number. The milk of a healthy cow contains, at the outset, only very few bacteria per cubic centimeter; but by the time it arrives in this city it seldom contains less than four hundred thousand bacteria, with the exception of certified milk, and often as many as six or seven million bacteria per cubic centimeter. A cubic centimeter, by the way, is equivalent to less than one-third of a teaspoonful. After this many hours may elapse before the milk is delivered, and then it may be exposed to all the filth and disease of a tenement for hours, ere it is finally fed to some sickly infant. Small wonder that the death rate in the tenement district is so high.

In Germany and France, the law requires much greater care to be exercised in the handling of milk, and all milk that is brought into the cities must be pasteurized before delivery. Within the last two or three years, modern dairy machinery has been introduced into this country, and we can now boast of a number of establishments in which the milk is purified both by destroying the bacteria and by filtering out all dirt and foreign substances. Our engravings illustrate the apparatus installed in one of these enterprising dairies. The milk, as it comes from the farms in ten-gallon cans, is poured into a receiving vat, shown at the extreme left in one of the illustrations, and is thence pumped up to an elevated reservoir. From this point it flows by gravity through the filter and pasteurizer. The pump used for elevating the milk is of a new design. Every part that comes in contact with the milk is made of brass, nickel-plated, and the pump is so constructed that it may be readily taken apart and cleaned. The filter comprises three strainers, each covered with a four-inch layer of pure quartz sand, which arrests all foreign substances in the milk. The sand is washed and sterilized every day in a special machine. From the filter the milk passes through the pasteurizer, which is built on what is known as the "regenerative" plan. A better idea of this apparatus may be had from the section view, shown herewith. The pipe leading from the filter opens into the receptacle, *H*, whence the milk flows

Taking the Butter from the Steam Churn, Which Holds 350 Gallons. The Tubs of Butter Were Churned in One Hour.



The Butter-Working Machine, Where the Butter, after Coming from the Churn, is Mixed with Salt.

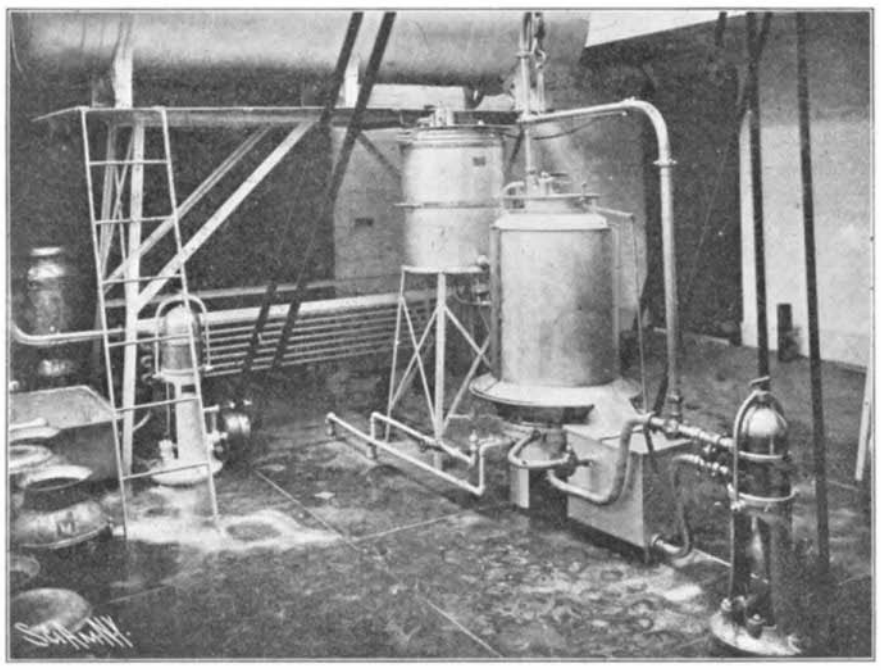
MODERN SCIENTIFIC DAIRY METHODS.

down over the corrugated casing, *A*, to the trough, *B*, and thence into a tank below (shown in the photograph). From the tank it is forced by one of the sanitary pumps above described, through pipe, *C*, to the top of the inner chamber of the pasteurizer, down the annular space between the steam chamber, *D*, and a bell, *E*, and up again between this bell and the outer corrugated casing, as indicated by the arrows. The bell, *E*, is rapidly rotated to prevent the milk from adhering to the heating chamber, and its walls are hollowed and filled with heat-insulating material, to prevent the passage of heat from the inner side of the bell to the outer side. This arrangement is very clever, and results in a great saving of heat. The milk reaches its highest temperature at the point, *I*, where the thermometer, *T*, should register 164 deg. F. From this point an exchange of temperature takes place between the hot milk, rising within the corrugated cylinder, *A*, and the cold milk flowing down its outer surface. The latter which, in receptacle, *H*, registers about 40 deg. F., becomes heated to 120 deg. by the time it reaches the trough, *B;* while the hot milk within is cooled to about 90 deg. by the time it reaches the outlet, *F*. It is estimated that by this construction a saving of 60 to 65 per cent of the steam is effected over the old-style heaters. The requirements in this country are different from those in Europe, where pasteurizing is enforced by law. In Germany the milk is heated to a higher temperature, thoroughly sterilizing it and entirely destroying all bacteria. This, however, results in a chemical combination of the milk and cream which we Americans object to. Our custom requires that the milk should show a "cream line." Under these conditions the highest temperature to which the milk can with safety be raised is 168 deg., and then the heat must be immediately lowered. At this temperature most of the bacteria are destroyed, but about 20,000 per cubic centimeter are left. However, this is as pure as the milk sold as certified milk.

From the pasteurizer, the milk is conducted to the cooler, which is specially designed to provide a large cooling surface and prevent too rapid flow of the milk. It is built up of coils of pipe of triangular cross section with flat faces upward, thus forming stepped or corrugated surfaces, over which the milk flows. Cold water runs through the upper half of the cooler, and a freezing mixture from a refrigerating machine through the lower half. From the cooler the milk passes to a bottle-filling machine, which fills a large number of bottles at a time. The filled bottles are kept in a cold storage room to await shipment to customers. In this room a temperature of 30 deg. is maintained, which prevents breeding of the bacteria. The empty bottles are soaked, washed, and sterilized in the basement of the building, and brought up to the main floor by means of a conveyor; which is interesting from a mechanical point of view. The milk cans, after being emptied in the receiving vat, are washed and sterilized in a special machine before being sent back to the dairy farm.

Aside from its direct use for city consumption, milk is employed in large quantities for the manufacture of butter, cheese, casein, etc. In the manufacture of butter, the milk is first heated or pasteurized and then run through a separator at blood temperature, that is, 98 deg. F. This machine whirls the milk around at a rate of 6,000 revolutions per minute, separating it by centrifugal force into cream and skim milk, the latter, due to its greater weight, being thrown to the periphery of the revolving receptacle. The smaller separators run even as high as 11,000 revolutions per minute. De Laval, the well-known Swedish engineer, is one of the men who brought this machine to perfection, and as a matter of fact his steam turbine was developed after experiments with the De Laval separator. The other machines and apparatus we have described are the invention of Mr. Joseph Willman, an enterprising German inventor.

After the cream leaves the separator, it is first cooled and then run into a ripening vat, where it is ripened (that is, slightly soured) by means of a special ripener made of skim milk. On the following morning it is drawn off into a churn, where it is churned into butter. To remove the buttermilk, it is brought onto a butter worker and salted with two to three per cent salt. Then it is put in cold storage, and on the next day again worked over to remove the salt water. The skim milk is cooled after coming from the separator and returned to the farmers, who use it for feeding calves, hogs, etc., or else it is treated with acid, tried, and turned into casein. The latest use of casein is for a substitute of celluloid. Skim milk is also reduced to powdered form, and employed in large quantities in the Russian and Japanese armies.



The Strainer and Pasteurizer.

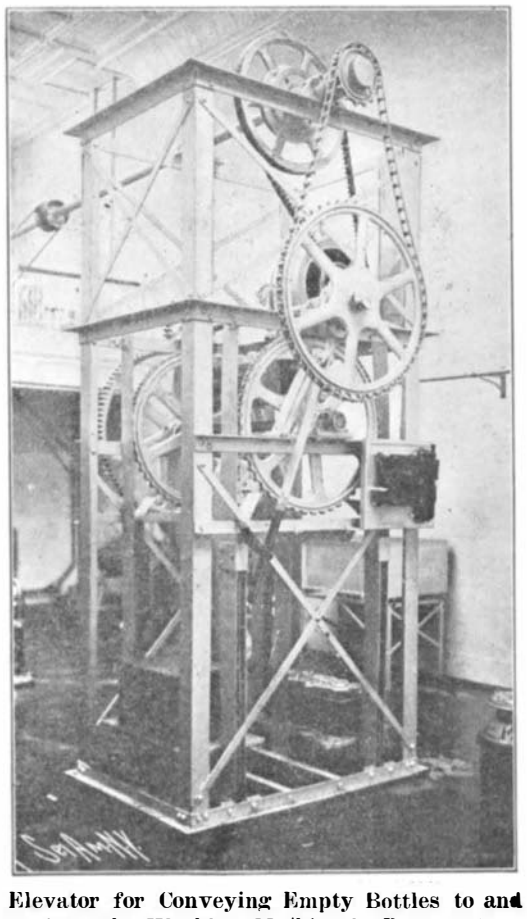
The milk is pumped from vat at extreme left to reservoir above, whence it flows through the filters and over exterior of pasteurizer to the tank shown in foreground, whence it is pumped back through interior of pasteurizer.

Earthquakes.

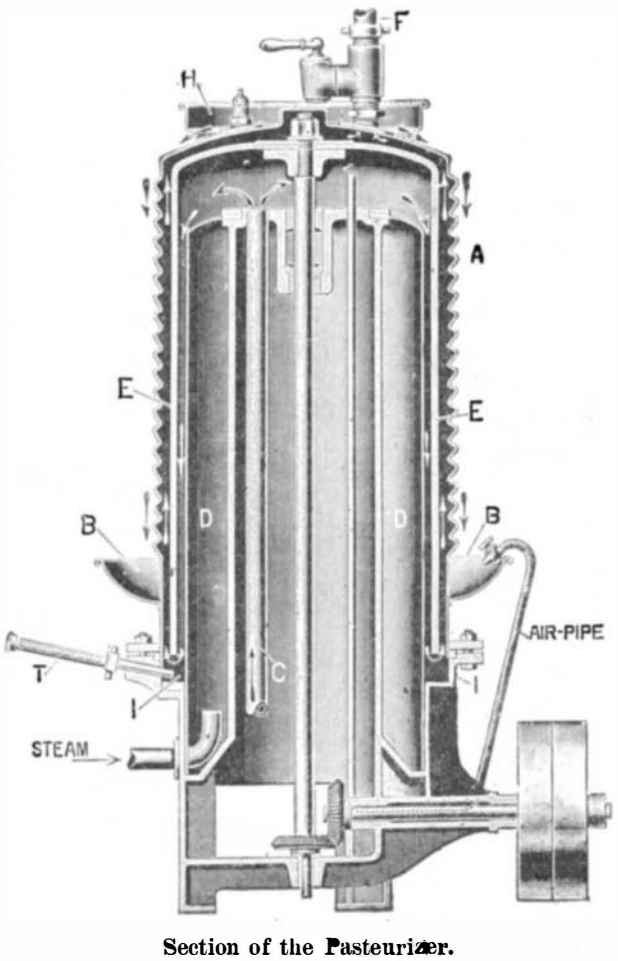
On this topic Audubon wrote (quoting from a recent number of Science):

"Traveling through the Barrens of Kentucky . . . in the month of November (1812), I was jogging on one afternoon, when I remarked a sudden and strange darkness rising from the western horizon. Accustomed to our heavy storms of thunder and rain, I took no more notice of it, as I thought the speed of my horse might enable me to get under shelter of the roof of an acquaintance, who lived not far distant, before it should come up. I had proceeded about a mile when I heard what I imagined to be the distant rumbling of a violent tornado, on which I spurred my steed, with a wish to gallop as fast as possible to a place of shelter; but it would not do, the animal knew better than I what was forthcoming, and instead of going faster, so nearly stopped that I remarked he placed one foot after another on the ground, with as much precaution as if walking on a smooth sheet of ice. I thought he had suddenly foundered, and, speaking to him, was on the point of dismounting and leading him, when he all of a sudden fell a-groaning piteously, hung his head, spread out his four legs as if to save himself from falling, and stood stock still, continuing to groan. I thought my horse was about to die, and would have sprung from his back had a minute more elapsed, but at that instant all the shrubs and trees began to move from their very roots, the ground rose and fell in successive furrows, like the ruffled waters of a lake, and I became bewildered in my ideas, as I too plainly discovered that all this awful commotion in nature was the result of an earthquake. . . . The fearful convulsion, however, lasted only a few minutes, and the heavens again brightened as quickly as they had become obscured; my horse brought his feet to their natural position, raised his head, and galloped off as if loose and frollicking without a rider. . . . Shock succeeded shock almost every day or night for several weeks, diminishing, however, so gradually as to dwindle away into mere vibrations of the earth. Strange to say, I for one became so accustomed to the feeling as rather to enjoy the fears manifested by others. . . . The earthquake produced more serious consequences in other places."

A reversible petrol engine was described recently in France Automobile. In principle this engine makes use of an extreme retardation of the ignition for slowing up the engine, the exhaust valve being raised at the same time; at the instant of oscillating before stopping the ignition circuit is interrupted, the valve striker falls into a different guiding channel—these channels take the place of the usual cams—and ignition can then take place with the spark moderately advanced in the new direction of rotation.



Elevator for Conveying Empty Bottles to and from the Washing Machine in Basement.



Section of the Pasteurizer.

MODERN SCIENTIFIC DAIRY METHODS.

The Cream Cooler, Containing Ice-Cold Brine.

The cream from the separator flows over the corrugated exterior and thence into cans.