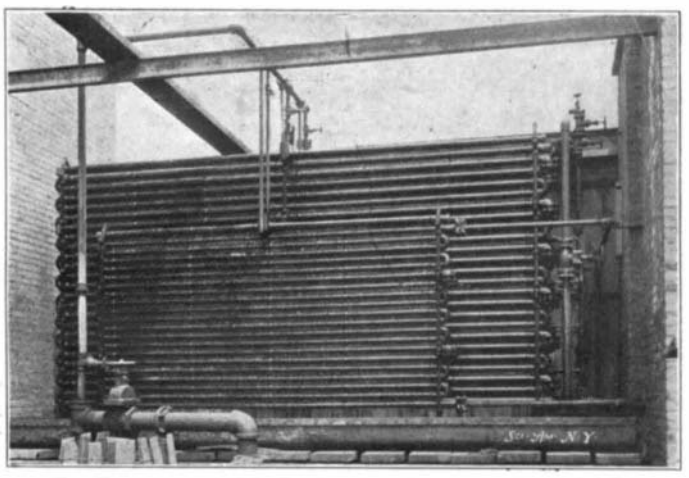
MANUFACTURE OF CARBONATED MINERAL WATERS.

In the year 1772 the English chemist, Priestly, suggested the employment of water impregnated with carbonic acid gas for medicinal purposes, and fifteen years later Selters water was being made at Stettin, Germany. The manufacture of carbonated water in the United States began in the early part of the century, and in 1810 a patent was granted for saturating water with "fixed air." It was only, however, when the science of chemistry had developed so that an accurate analysis could be made that we find mineral waters prepared scientifically. The therapeutical value of natural mineral waters has been recognized for centuries, but their use was practically confined to well-known spas, owing to the difficulty of transporting bulky material, and because natural waters lose their original virtues more or less when removed from their sources; therefore, artificial mineral waters were warmly welcomed. These waters when properly prepared have practically all the efficiency of those obtained from the natural springs, and they have the advantage of being of definite chemical composition, while the natural waters vary somewhat from time to time. The name soda water is a misnomer. Carbonated waters were originally made in England by the reaction of sulphuric acid on sodium bicarbonate, whereas all of our aerated waters are now made with the aid of marble or dolomite and sulphuric acid.

Without doubt Americans are the largest consumers of aerated and mineral waters in the world, and the number of these beverages is very great, including as it does ginger ale, root beer, etc. Such waters are very far from being confined to medical use and the ubiquitous siphon is found in the smallest village as an article of daily necessity. Where the water supply is questionable, carbonated waters, when scientifically prepared, are most valuable. The recent outbreak of typhoid fever at Ithaca is an example of what a serious matter the contamination of water really is. Unfortunately competition in the production of siphon water is very keen and in many cases the water is carbonated without being distilled, and put up under unhygienic conditions and, in fact, the Board of Health of the city of New York was compelled, a few years ago, to pass stringent ordnances regulating this business. Purity and accuracy are the two things which the manufacturer must keep constantly in view, and in the plant which we have selected for illustration, that of Carl H. Schultz, of New York city, every safeguard is employed to prevent the slightest contamination. All of the water used is distilled and is taken from the city mains. It is first conducted through coke filters which remove all suspended matters. It is then pumped into boiling tanks on the top floor of one of the buildings. Here it is boiled with the aid of steam coils and the volatile organic matter is thus driven off, the boiling being conducted under a slight vacuum, which is necessary to remove the steam. The water falls down by gravity into the feed boxes which are constructed to maintain a constant level of water in the stills. The stills are eight in number, the total capacity being 20,000 gallons per day, and are arranged in four sets of two each. They are constructed of heavy copper and are thoroughly tinned inside. They are surmounted with a dome and separator to prevent any solid particles from being carried over with the steam. The stills are provided with water and steam gages, two hand-holes on each side for cleaning, and two glass peepholes on opposite sides on the top. In front of one of these holes a gas jet is kept burning, which lights up the inside so that the operation can be watched. The condensation of the steam takes place in tall, vertical cylinders containing a large number of small pipes through which cooling water is pumped. A large amount of cooling effect is obtained indirectly from river water, and to guard against even the remotest chance of contamination which would result from the river water coming in contact with the distilled water by reason of any unseen defect in piping, the river water is pumped to the top of the building and is allowed to flow over coils containing only Croton water, which is run through the condensers. This hot water is then cooled down for use again in the condensers. Distillation is accomplished by steam supplied by two large boilers. There are no coils in the stills, but the steam is conducted into what are termed "lenses," which resemble a double-convex lens. This steam, which is still very hot when it leaves the still, is conducted to the top floor and used for preheating the water before distillation, thereby utilizing all the heat. The hot distilled water after leaving the condensers passes down through



Cooling Croton Water for Condensing, with Sea Water.

a series of heat exchangers, where it is cooled down as much as possible by the filtered Croton water, and then through a second set of heat exchangers, where it is cooled down to about 40 deg. by cold water from the refrigerating machine. It is then stored in large covered tanks provided with cotton plug vents to prevent any contamination from the air, the water being kept at a temperature below the germinating point of bacteria. All of the pipes are either lined with block tin or are silverplated on the inside, and all of the fittings are also silverplated, for distilled water acts more powerfully on metals than does ordinary water. The water is now run into large demijohns for the use of those who care for a water which is not aerated; or it flows by gravity to the carbonating machines.

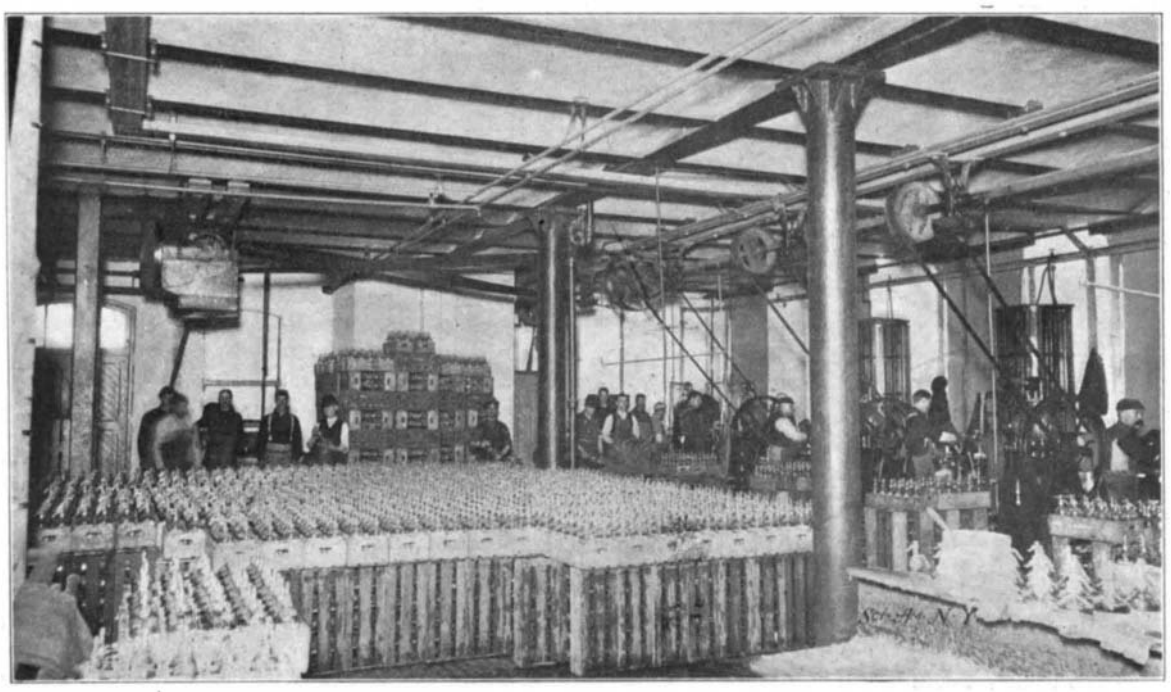
Siphon Filler.

The carbonic acid gas employed in charging the waters is produced by the action of sulphuric acid upon dolomite, which is calcium magnesium carbonate containing 54.35 per cent of calcium carbonate and 45.65 per cent of magnesium carbonate. It is ground and placed in cylindrical generators constructed of copper. The acid flows from lead-lined iron reservoirs placed in proximity. The ground dolomite is poured into the generators through a hand-hole, which is then closed. The water and acid are added and the contents are constantly kept in motion by an agitator which resembles a paddle. This is kept in motion by means of power, its shaft passing through the end and having a pulley attached to it. The evolution of the carbon dioxide gas is rapid. After a thorough purification the gas is stored in gasometers, from which it is drawn to the various carbonating machines.

In a spacious working laboratory are prepared the solutions which are used in making the various mineral waters. They are compounded with the greatest care, every precaution being used to secure results which shall be scientifically accurate. The analyses followed in the compounding of these waters are the recognized standard analyses of the natural spas and were made by such men as Strure, Bauer, Liebig, etc. All of the salts are analyzed for purity, and the finished product is subjected to a constant scrutiny in a splendidly equipped laboratory, the water being tested for each thousand siphons. The solutions are sent to the filling department and are introduced into large graduated vessels which are filled up to the mark with cold distilled water and thoroughly mixed with a stream of carbonic acid gas. Two samples are then taken, one from the top and one from the bottom, and sent to the laboratory for examination, no siphon or bottle being filled until the samples have been approved.

Mineral waters are bottled with the aid of special machinery. The bottles are thoroughly washed and then rinsed by reservoir rinsers. The filling machines are provided with valves and means for compressing and inserting the cork. The charged water is pumped into a reservoir at the top of the machine and from there it flows under pressure to the bottling machine which both fills and corks. In the case of club soda the bottle is seized by a pair of peculiarly shaped tongs which serve to hold the cork in position until it can be wired. The neck of the club soda bottle is not straight, but conical, so that the cork is expelled immediately on unwiring. The pumps have water lubrication, as it is not permissible to allow any aerated water to come in contact with grease.

The siphon is the most convenient means of dispensing carbonic or mineral waters. While quite an old invention, slight improvements are made from time to time. They consist of glass bottles to which a metal head, forming a draft tube, is attached. They are filled at a pressure of 120 pounds and the mechanism of the head is so arranged that when the lever is depressed the valve is opened and the liquid flows out by its internal pressure through a glass tube which extends nearly to the bottom. The valve is kept normally closed by a spring. In the plant which we illustrate the siphons are made on the premises, with the exception of the glass bottles, which are imported from Bohemia. The first step in the manufacture of siphons is to test the bottle. This is done by first heating the bottle filled with water to a temperature of 98 deg. The bottle is then placed in a carrier provided with a wire net. Temporary testing heads are screwed down on to the bottles, and they are then subjected to hydrostatic pressure of 350 pounds to the square inch, and the carrier is swung into a tank containing ice water. If the bottle stands the test without breaking, it is considered that it was perfectly annealed and safe to send out. The siphon head is now attached and the name of the maker is etched upon the glass with the aid of a sand blast. The internal working parts of the siphon head are silverplated, including the spring, in the electro-plating plant on the premises. The siphon head is of a composition and is kept bright by being buffed each time it is returned to the factory.



Siphon Filling Rooms.—Total Capacity, 20,000 Siphons Per Day.

MANUFACTURE OF CARBONATED MINERAL WATERS.

Special machines are used to fill the siphons. The siphon is inverted and placed at an angle in a forked rest. The lever is depressed as the valve is opened to allow of the influx of water which is being forced in by an adjacent pump. After filling the siphons and labeling them they are placed in a box ready for shipment to customers. Some idea of the magnitude of the mineral water business may be obtained when it is stated that this plant has a capacity for filling 50,000 siphons per day, and it requires 52 wagons to take them to their destination. We are indebted to A. P. Hallock, Ph.D., for courtesies in the preparation of this article.

Death of Dr. John E. Watkins.

The United States National Museum feels keenly the loss it incurred by the sudden death in New York city, August 11, of Dr. John Elfreth Watkins, who for many years was curator of mechanical technology.

Dr. Watkins received his academic education at Tremont Seminary in Norristown, Pa., and then entered Lafayette College, Easton, Pa., where he was graduated in the scientific course in 1871, taking the degrees of C. E. and M. S. For a year after graduation he served the Delaware and Hudson Canal Company as mining engineer, and then entered the employ of the Pennsylvania Railroad as assistant engineer of construction, being stationed at Meadows Shops, N. J., where he remained until 1873. On his recovery he was assigned to the Amboy division of the Pennsylvania road and served in various capacities during the ten years that followed. In 1873 he was appointed chief clerk of the Camden and Atlantic Railroad, and a year later was assigned to a similar office on the Amboy division of the Pennsylvania Railroad, which place he then held until 1886.

Meanwhile, having become interested in studying the history of the beginnings of mechanical arts in the United States, he was brought into close relations with the late Dr. G. Brown Goode, upon whose recommendation the then secretary of the Smithsonian Institution, recognizing his worth, invited him to become honorary curator of transportation in the National Museum, which place he accepted in 1884, and at once began to develop that part of the museum's collections which are now so valuable. Two years later he severed his connection entirely with the Pennsylvania road, in order to devote all of his time to the museum, and continued as curator until 1892.

Around the World in Fifty-Four Days.

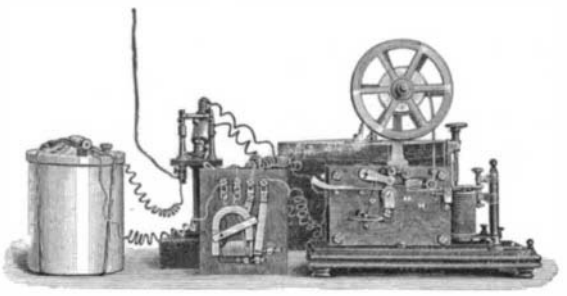
Jules Verne once wrote a story in which he described the adventures of a certain Mr. Phineas Fogg who, after many harrowing incidents, succeeded in traveling around the world in eighty days. On July 2 of this year, Henry Frederick left New York on the steamer "Deutschland." He returned at midnight August 26, after having completely encircled the earth in fifty-four days, seven hours and twenty minutes. To be sure, Mr. Frederick had one facility unknown at the time Jules Verne's story was writen, and that was the Siberian railway. Eighteen days were passed on the train from Paris to Dalny, China; two more were occupied in crossing the Yellow Sea. Japan was traversed in another two days. At Yokohama, Mr. Frederick missed a steamer by ten hours. That cost him seven days, for he was compelled to take a slow boat two days later, which spent sixteen days in crossing the Pacific. Landing at Victoria, he made the trip across North America in somewhat more than four days. In all that time the traveler slept in but one hotel, and that was in Yokohama.

A Georgia mail carrier has invented an electric whip which, according to Machinery, presents considerable novelty. The mail carrier drives a wagon with doors that could be closed in rain. In stormy weather he naturally disliked to open one of the doors in order to reach out and apply the lash to his horse, which, being an intelligent animal, naturally took advantage of this situation and always lagged in rainy weather. To overcome this propensity the Georgia Edison attached a pair of copper plates under the harness saddle and connected them by a wire to a hand-operated dynamo in the wagon. When the steed began to jog up and down, without making much advance, it was time to turn the dynamo crank, which gave the horse a very evident wish to get over the ground more rapidly, and almost any desired speed could be obtained, according to the number of rotations per minute given the dynamo armature. An apparatus is now contemplated, says the Atlanta Constitution, which paper has the distinction of first telling about this invention, for use on plows, whereby both the mule and plow hand shall be automatically shocked every few minutes. It is believed that such an attachment would find a tremendous sale all over the South, as by its use farmers could be very sure that no darkey would go to sleep between the plow handles.

GUARINI'S WIRELESS FIRE ALARM APPARATUS.

At Brussels on the 26th of July last, Emile Guarini carried out some practical experiments with a fire alarm device invented by himself, which possesses the peculiar characteristics of notifying the engine houses automatically without the intervention of a central station, not only of the existence of a fire, but also of the name of and position of the building in danger of destruction. The tests which he made took place in his laboratory. They were only the prelude to the series of experiments which he is about to undertake with the city for his field and the engine and truck houses for receiving stations.

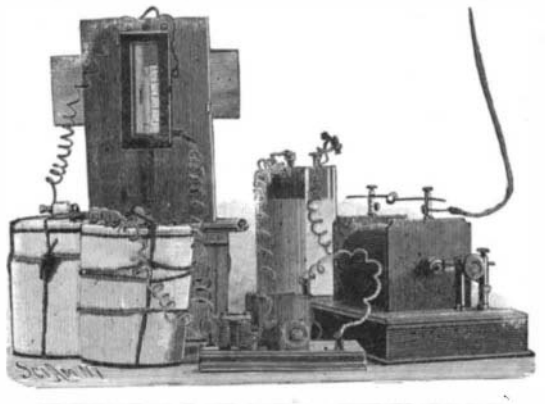
In one corner of his workshop was placed a structure representing the building in danger, which structure was fired. The fire was contained in a small brazier. Removed to the farthest extremity of the laboratory were the engine houses, or what represented them, provided with means of receiving notice of a fire. These



RECEIVER OF THE WIRELESS FIRE ALARM.

means consisted of a wireless telegraphic receiver with its accompanying antenna. Of Mr. Guarini's device the essential feature is a thermometer which is so arranged that it is capable of releasing a toothed wheel which serves to transmit the requisite information. When the flames, or perhaps better said, the heat therefrom, reach the thermometer the mercury naturally rises in the tube, and upon reaching the mark indicated by 42 deg. on the Réaumur scale it touches a small platinum wire inserted in the upper end of the tube and thereby closes an electric circuit including an electro-magnet. Thus excited the magnet attracts and holds its armature. This motion releases a toothed wheel which, by means of a weight or spring, is made to revolve, and, during each revolution, produces a series of makes and breaks upon a contact piece placed in its path. It may be well to state just here that this toothed wheel is not an ordinary gear wheel with teeth cut at regular intervals, but a wheel of peculiar construction, having irregular indentations, providing thereby irregular teeth or projections which, coming in touch with an electric switch or contact piece, are capable of making repeated connections and holding them for varying intervals, by which means an unlimited diversity of signals may be sent over the line and made intelligible at the receiving end. An induction coil is connected with this, and, being periodically excited by the electrical impulses induced by the toothed wheel, transmits, with the aid of its antenna, the necessary message, which in this case describes the exact location of the endangered property to the neighboring engine houses.

At the engine house, again, another antenna collects



TRANSMITTER OF THE WIRELESS ALARM.

the electrical impulses, excites in its turn a coherer, a battery is cut in, the current flows through, and starts a Morse apparatus which registers the message, while an electric gong calls the attention of the attendants to the signal received. The receiver also has a visible sign in the shape of an incandescent lamp, which glows when the alarm is sounded. The apparatus is tolerably simple, still it seems to be very complete, and to have been well studied out as to its details. Mr. Guarini states that the idea which he has elaborated and put into practical shape emanated from a certain Signor Mollo, a fire chief of the city of Naples.

To avoid calling out the force unnecessarily the transmitter is provided with an audible annunciator situated and operating in the building attacked by the fire. If the occupants, thus apprised of the danger, think they can successfully cope with the fire without the assistance of the fire department, they may easily break the connection and interrupt the transmission of the predetermined signal. Should the firemen have started, however, they will be notified on the way. For this purpose it is only needful to provide the engines or trucks with a receiver such as is employed by Marconi and attached to the war automobiles. The whole thing is feasible because such vehicles easily lend themselves to other uses.

Effect of Radium Rays Upon Frog Larvæ.

As the radium rays have been found to attack animal tissue and different organisms, causing destruction of the tissue and even death of various specimens, M. Georges Bohn thought it would be of interest to see whether a greater or less exposure to the rays would have an influence upon tissues in formation or upon animals in course of development. Among other specimens 80 larvæ of toads (*Bufo vulgaris*) and of frogs were exposed successively to the influence of the rays. They were placed for three to six hours in a shallow tank containing a thin layer of water upon which floated a tube with a small quantity of bromide of radium. The action of the rays on the specimens is strongly marked and brought out the following results, a certain number of free specimens being used for comparison. In the case of the toad's larvæ, normally the growth is very slow in the first ten days after hatching. He finds that 18 embryos, after exposure to the radium, undergo a diminution in their growth. The action is more strongly marked with frogs' larvæ. In the case of the embryos, the normal growth is more rapid than in the preceding. The embryos, which are still inert after hatching, rapidly acquire a caudal membrane and the gill-like appendages. Then on the eighth day the appendages are lost and the embryos become transformed into tadpoles. He used 38 embryos of different ages from 1 up to 8 days. Of these 9 died almost at once on exposure to the rays. For the remainder there are two cases. First, on the individuals of 8 days' growth the radium has an immediate action. The appendages disappear and the skin swells up in some places and becomes wrinkled, thus producing deformed specimens. Second, with younger specimens the rays do not have an immediate action, but regardless of the age of the larva when it is first exposed, the same kind of deformities are produced in a constant manner the moment it becomes transformed to a tadpole. The 29 deformed specimens which he obtained differed but little from each other. The younger the individual at the time of applying the rays, the smaller is the development of the tail, and the stopping of its growth acts upon the natatory membrane which normally is developed in the first few days. In all cases there is a shrinkage in the rear of the head and here the skin is wrinkled to a great degree. Some of these specimens live for 10 days. In the case of tadpoles exposed to the rays, while normally their growth is slow and progressive, 19 specimens underwent a diminution in growth. In these experiments it is clear that the rays act especially upon the growth of tissues and organisms, and when this is slow they cause a diminution in size, as with the tadpoles, or when rapid and accompanied by transformations (as with the frogs' embryos) they destroy the tissues and retard the growth or in other cases accelerate it, and this according to the region and the nature of tissues. A fact is brought out which is most interesting and bears upon one of the most fascinating problems of biology. The passage of the rays through the body of an animal for a few hours causes the tissues to acquire new properties, which remain in the latent state for long periods and then are manifested suddenly at the moment when the activity of the tissues increases normally.

The Current Supplement.

A most striking illustration, showing how a single-crown wooden face was attached to a four-crown cast-iron 55-ton engine-pulley, forms the subject of the front page of the current Supplement, No. 1444. Dr. J. W. Wainwright gives many an interesting historical bit of information about the apothecary. An ingenious portable electrical drill is described, the text being accompanied with several striking pictures. The Labyrinth of Crete has been made the subject of some very valuable archæological investigations, which are recorded in the Supplement in a well-written account. Some months ago mention was made in these columns of a new process of seasoning or vulcanizing timber invented by W. Powell, of Liverpool. The process is very fully described in the current Supplement. How the United States Geological Survey measures the velocity in river channels is told by H. A. Pressey, both by words and pictures. Sir William Ramsey and Mr. Frederick Soddy recount some new experiments in radio-activity and the production of helium from radium. Prof. Vivian B. Lewes, who is one of the foremost living authorities on gas illumination, treats of the future of coal-gas. "Fuels Other than Coal and Wood" is the title of a suggestive article.

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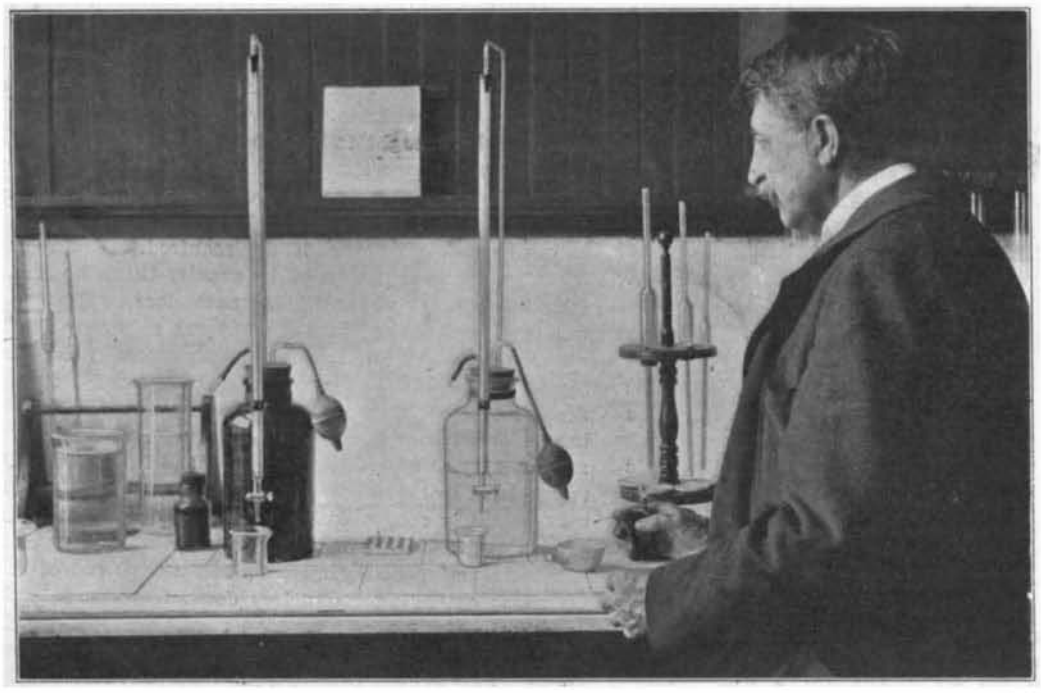
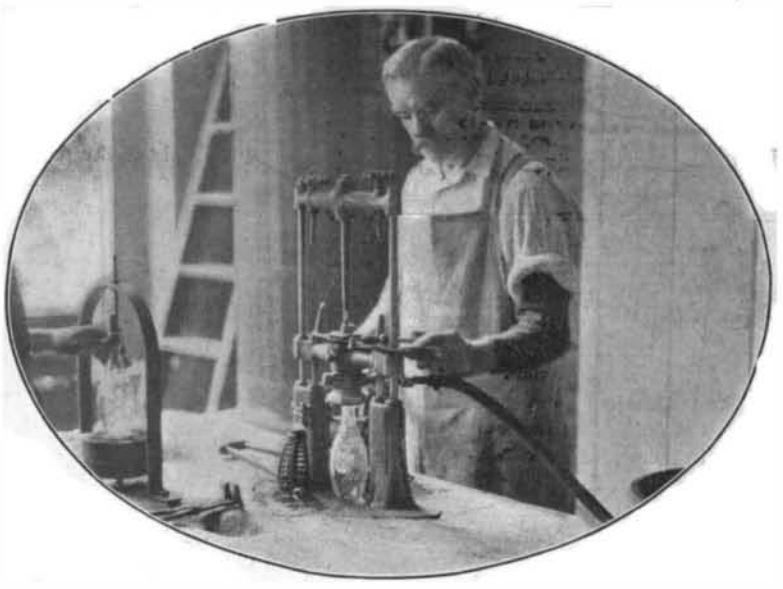
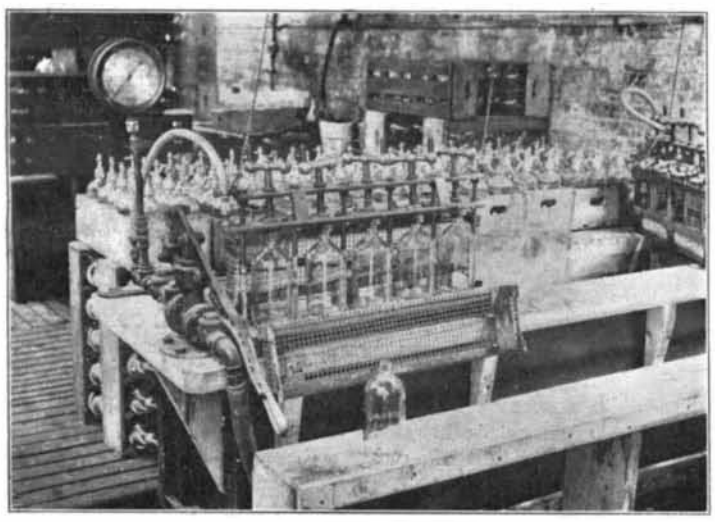


Testing Siphon Water.

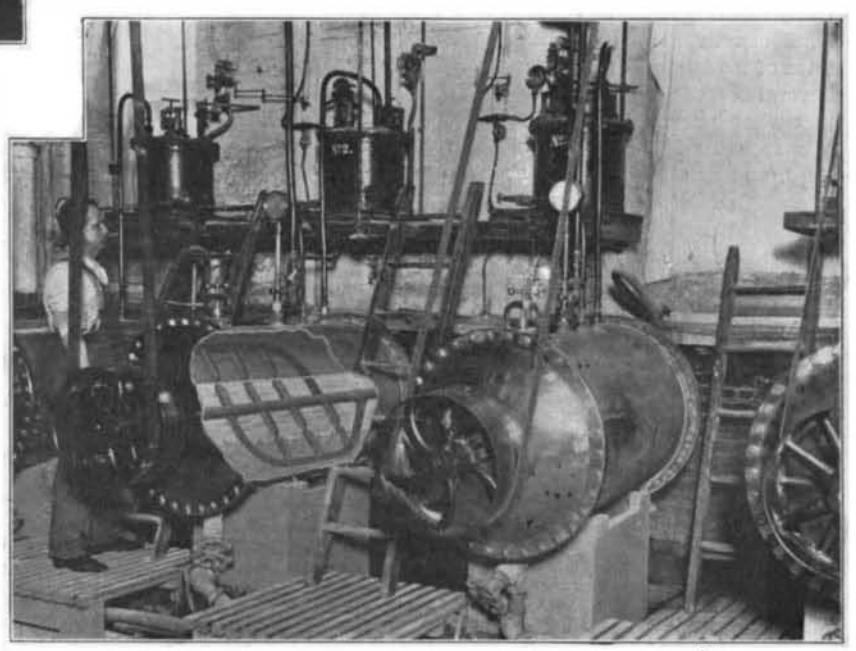


Filling and Wiring Club Soda Bottles.

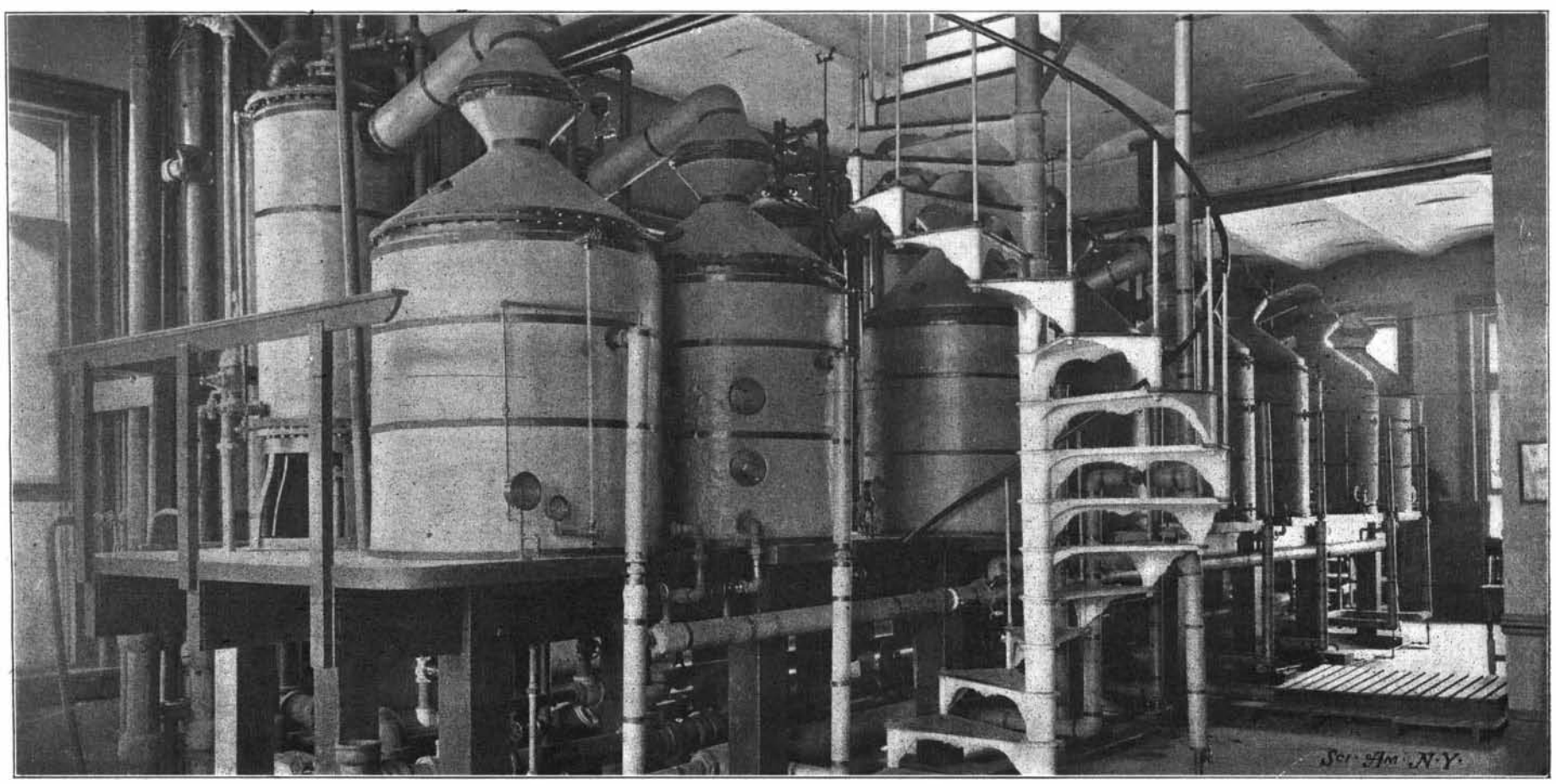


Testing the Siphons.

Section of a Siphon.



Generating the Carbon Dioxide Gas.



The Stills and Condensers.—Capacity 20,000 Gallons a Day.

MANUFACTURE OF CARBONATED MINERAL WATERS.—[See page 165.]