A NEW VACUUM PUMP, AND ITS APPLICATION IN THE MANUFACTURE OF ICE.

The apparatus which we represent herewith is a new pneumatic machine, or vacuum pump, which is destined, we think, to render genuine services in a large number of industries.

Fig. 1 and the following description thereof will sufficiently explain the mechanism and its *modus operandi:* A is a large pulley for transmitting motion to the working beam, B, and to the two pistons; C is a large pump chamber with double-acting piston; D is a small pump chamber with single acting piston; E is a conduit through which the vacuum pump sucks out the air contained in the apparatus; F is a conduit through which the air passes from the large to the small pump chamber; G, pipe for injecting water during the descent of the piston; H, orifice through which the injected water and the air are expelled; *a, a,* suction valves; and *b b,* force valves.

Did we wish to enumerate all the industries in which a vacuum is of great use, we should be obliged to get up a list that would exceed the limits of our article, so we shall merely cite some of the more important of them. These may be classified as follows:

1. *The Stearine Industry.*—Here the use of a vacuum under proper conditions permits of the distillation of fatty bodies at a very low temperature—say at 170° instead of 300°. Owing to this, the materials treated are not changed in character by an access of heat, and they thereby gain in density and whiteness, and the yield in stearine is larger, since the production of tar is greatly diminished.

2. *The Manufacture of Sugar.*—The evaporation of the water contained in beet juice is almost completely effected under the action of a high vacuum and at a low pressure; and the juice gives a much completer polarization and yields its product with a perceptible diminution in the quantity of molasses. This is the industry that, for the present, is to obtain the greatest advantage from the use of a vacuum.

3. *Petroleums.*—The distillation of these products with the use of a vacuum will give advantageous results through the easy production of a greater quantity of volatile oil and a greater yield of a superior quality of illuminating oil. The heavy lubricating oils forming the residue of such distillation will be of good quality, and almost totally replace the waste tar produced during distillation at high temperatures.

4. *Milk.*—The use of a vacuum for concentrating milk may lead to a perceptible improvement in the quality of the product as regards color and odor, as the evaporation of water occurs, under a vacuum, at an extremely low temperature.

5. *Varnish.*—In the composition of varnishes, through the use of special apparatus, a vacuum will permit of obtaining white products, of collecting the alcohol that is now lost, and of performing all operations rapidly without any danger of fire, thus leading to a difference in the rates of insurance that ought to pay for such an application.

6. *Filtration.*—A vacuum, combined with filtering apparatus, is capable of giving valuable results as regards the rapidity with which the operation may be performed.

7. *Alcohols.*—The use of a vacuum in the manufacture of alcohols, combined with condensing apparatus, will permit of obtaining a greater yield of 96° alcohol, and an article, too, that will not need to be rectified, since the distillation will be effected at a temperature at which no empyreumatic substances are carried over.

8. Finally, the *Manufacture of Ice* may be carried on

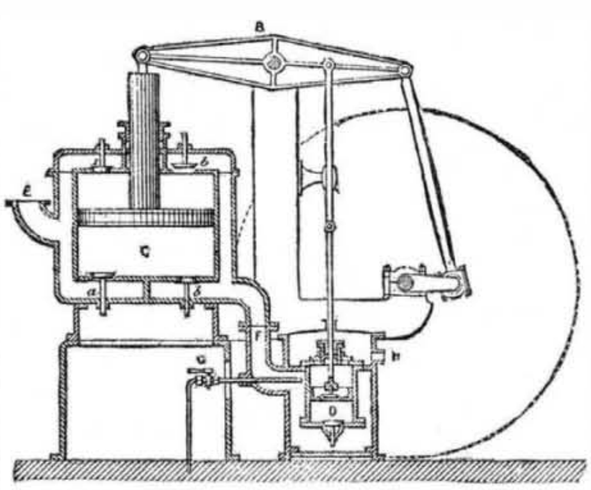

Fig. 1.—THE PNEUMATIC CO.'S NEW VACUUM PUMP.

through the congelation of water under the action due to a vacuum, and it is of such an application that we shall more particularly speak, since we have seen it carried out upon a large scale at Mr. Paul Briere's brewery at Savigny-sur-Orge. Our engraving (Fig 2) gives a general view of the large ice machine which has been put up at this establishment, and which is capable of producing from 12,000 to 15,000 kilogrammes of ice per day.

The air pump that we have already alluded to is shown in the background. This produces a vacuum (1) in a large horizontal cylinder, or *absorber,* 8 meters in length by 1·2 meters in diameter, containing a little more than half its capacity of 60° sulphuric acid, in which revolves a helix; and (2) in six vertical cylinders, each having 400 liters capacity. When the vacuum is at from 2 to 3 millimeters of mercury, the water contained in the reservoirs is slowly admitted into the cylinders. To this end, the cock is regulated so as to allow a flow of about from 6 to 8 liters per minute; and then the helix of the absorber is set running.

Under the action of the partial vacuum that exists in the interior, a certain quantity of water evaporates, and is absorbed by the sulphuric acid in the cylinder. In order to facilitate such absorption, the cylinder is traversed by a shaft provided with numerous paddles, which keep constantly stirring the acid, so as to renew and multiply the surfaces of contact with the aqueous vapor. This latter being absorbed in measure as it is produced, and the vacuum pump continuing to work, there results a depression of temperature that reaches about —10° in the cylinders. The water remaining in the latter is thus converted into ice. Into each cylinder there are introduced about 360 liters of water, and the blocks of ice removed therefrom vary between 300 and 320 kilogrammes in weight. It takes about thirty minutes to fill the six cylinders.

When once the blocks of ice are formed in the cylinders, the cocks that admit water are closed, and the ice is removed in the following manner: First, the valves that establish a communication between each pair of cylinders and the absorber are closed, so that the vacuum existing in the latter may not be lost.

Then the small valves through which the air enters the double jacket of the cylinders are opened, so as to re-establish an atmospheric pressure within the cylinders. The covers then open automatically, under the action of their own weight, and, finally, a jet of steam that is let into the double jacket of each cylinder loosens the blocks, and the latter then drop into tubs placed beneath. The workmen then break the blocks up with axes, and collect the pieces.

As we have already said, this machine is capable of producing from 12,000 to 15,000 kilogrammes of ice per 24 hours, in 6 or 7 operations that each gives about 2,000 kilogrammes.

The acid in the absorber, which in the beginning marks 60°, marks only 52° or 53° at the end of the operation. It is therefore emptied into a lead lined vat, and carried to a concentrator in order to be regenerated.

As soon as the absorber is empty, a vacuum is again created therein, and a communication is established between the absorber and the cylinder that contains the regenerated acid. While the ice is being made, the operation of concentrating the weakened acid is going on. To this end, the acid is passed from the vat into a heat recuperator, which has the form of a surface condenser, and contains 60 tubes. The hot and regenerated acid that descends from the concentrator circulates around the tubes, the cold acid becoming heated at the expense of the regenerated.

The concentrator consists of a vertical cast iron cylinder lined with lead, and containing 4 concentric leaden worms. The steam circulates in these latter at a pressure of from 3 to 3·5 atmospheres, corresponding to a temperature of from 125° to 130°. Under the action of this temperature and of the vacuum produced by a small pump at the side of the apparatus, the water evaporates.

In 6 hours it is possible to regenerate 6,000 kilogrammes of acid, a charge sufficient for the manufacture of 24 cylinders of ice. The vacuum machine, as a whole, requires a total power of 7 to 8 horses to start it, and 2 to 3 to run it.—*La Nature.*

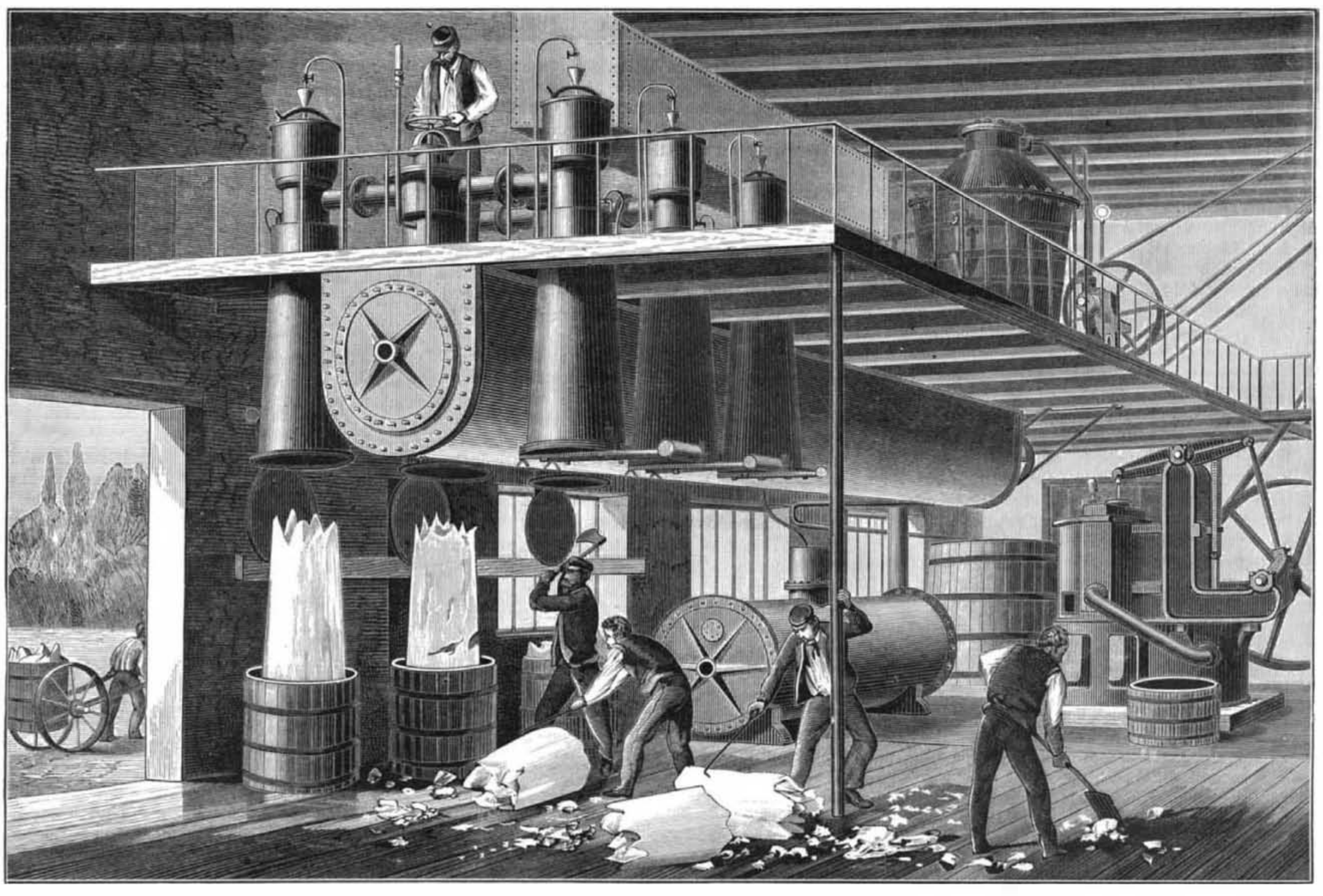

Fig. 2.—MANUFACTURE OF ICE BY MEANS OF A VACUUM AT SAVIGNY-SUR-ORGE.

Feeding Mice with Putty.

Having often noticed the white color of the dung of mice, as seen in buildings where the animals have little or no access to their usual forms of food, Prof. Storer (*Bulletin Bussey Institution*, ii., p. 264) followed the matter up, and found that the real source of the white mouse dung is common painter's putty, which is used not only for cementing the glass of windows, but also for covering the heads of nails, and for stopping cracks and holes. This putty is made by mixing ground chalk (whiting) with linseed or fish oil, and it is the oil in the putty which attracts the mice and serves them as food. Prof. Storer considers that the question of putty eating must have by no means an unimportant bearing upon the health of the community wherever water closets are fitted up in the manner often adopted, by fastening the leaden trap into the iron soil pipe by means of a putty joint. He was informed by plumbers that mice do eat the putty from putty joints, and that they cannot be prevented from doing so by mixing red lead or white lead with the putty. Prof. Storer confined mice in a cage, and fed them with an insufficient supply of oats, and with as much putty as they could eat in addition. Day after day three mice thus confined eat ten or twelve putty balls, three-eighths of an inch in diameter, besides their oats. To give figures, "besides their 3½ grammes of oats, the three mice ate daily during three consecutive days 12 balls of putty, weighing, all told, 20 grammes, and containing 16·7 grammes of whiting and 3·3 grammes of oil." That is to say, each of the mice swallowed every day and voided more than 5½ grammes of dry whiting. It is as if more than 50 pounds of dry chalk were to pass daily through a man of 150 pounds weight.

After the mice had become accustomed to eat large quantities of ordinary putty, various other mixtures of pigments and oil were offered to them. The results of many experiments may be thus summarized: Of red ocher mixed with oil, the mice ate a little at first, and then refused more. They refused putty made of three-fourths red ocher and one-fourth whiting, but would eat, not very freely, putty made half and half. Yellow ocher mixed with oil they refused at first, but were gradually brought to eat it by having fed to them putty containing more and more of the pigment. Powdered gypsum (with oil, of course) was eaten rather freely, plaster of Paris less freely, silica sparingly, and clay not at all unless mixed with whiting. Mixtures of oil with carbonate of baryta, carbonate of lead, carbonate of zinc, oxide of zinc, and slaked lime, all proved fatal to the mice, although in most cases the amount eaten was small.

Prof. Crampe, of Proskaw, Silesia found that the most effective of the poisons commonly employed for rats and mice was a paste made of precipitated carbonate of baryta with three times its weight of barley meal. Prof. Storer finds that mice can eat much more than the fatal quantity of either carbonate of baryta or white lead, provided they are mixed with whiting, the carbonate of lime seeming in some way to act as an antidote to the poison. He queries whether the protective influence of the lime carbonate, or some other analogous compound, might not be put to practical use in the case of ordinary paints—whether it might not be possible to "adulterate" white lead so as to diminish or do away with the colic of house painters. "The application of this idea would be beset with technical difficulties, but it might be studied nevertheless."

Detection of Oleomargarine.

Dr. Thomas Taylor reports to the Department of Agriculture that he has made a series of experiments with oleomargarine of different fats, using a variety of acids to ascertain what permanent change of color would take place by oxidation, etc. Of the various acids employed, sulphuric acid gave the most satisfactory results. The test is a very simple one. If a few drops of sulphuric acid be combined with a small quantity of pure butter, the butter will assume first an opaque whitish-yellow color, and, after the lapse of about ten minutes, it will change to a brick red. Oleomargarine made of beef fat, when treated in the same manner, changes at first to clear amber, and after the lapse of about twenty minutes, to a deep crimson.

That the changes in color do not arise from the action of the sulphuric acid on the artificial coloring matter (annatto) is certain, as I find that when annatto is combined with sulphuric acid a dark bluish-green color is produced, entirely unlike any of the changes mentioned.

Owing to the active corrosive properties of the sulphuric acid, in making these tests, a glass rod should be used in combining these substances.

Creeping of Rails.

At a recent meeting of the Engineers' Club at St. Louis, the paper for the evening was by Mr. J. B. Johnson, his subject being the "Creeping of Rails on the St. Louis Bridge." Mr Johnson said that on the St. Louis Bridge proper the rails had been known to creep 260 feet in one year, and on the bridge approach 400 feet. This creeping varied with the amount of traffic or with the weight carried over the rails. On the St. Louis Bridge the rails crept in the direction with traffic. These rails were supported from their base. The reason given by Mr. Johnson for the creeping was that the rail, being held fast on the extended ties, is caused to measure its length across the bridge on its extended flange whenever a heavy weight passing over it causes a wave in the rail. This wave has been known to raise the rail between the two trucks of a car three-eighths of an inch, and the creeping has been measured, and at times has amounted to one-half to three-quarters of an inch. If the rail is supported at a place above its neutral axis, the creeping will be opposite in direction to the traffic. This Mr. Johnson demonstrated satisfactorily with a circular track of hickory. There must be some intermediate point, Mr. Johnson argued, at which the rail would have no desire to creep.

LOUIS PASTEUR.

Since Jenner's great discovery of inoculation with virus for the prevention of smallpox, it has been the object of scientists to discover means for the prevention of other diseases in a similar manner. By means of the microscope, minute organisms, or microbes, were discovered to be the cause of many diseases of men and animals, and the question was to determine to what extent diseases could be prevented by inoculation of the diluted or weakened poison into the system for preventing the disease usually produced by this poison.

Louis Pasteur has made many wonderful discoveries in this new branch of medicine, but before that he was well known as a successful scientist in chemical and physical matters. He was born in Dole, in 1822, and was appointed teacher of chemistry at Besancon and then at Dijon, and finally was appointed Prof. of Chemistry at Strassburg in 1849. In 1857 he conducted the Normal School in Paris, and in 1863 was appointed Prof. of Chemistry at the Sorbonne. He was compelled to resign the latter position, as one side of his body became paralyzed; but he gradually regained his health sufficiently to be able to take up his chemical researches; and in order to enable him to give his full attention to the studies, the French Government has granted him an annual pension of 12,000 francs since 1874, which was raised to 20,000 francs recently.

In one of his first works, he discovered that crystallized organic substances, although having the same chemical properties, have decidedly different physical properties, specially in relation to the refraction of light. He made many valuable discoveries in relation to fermentation, and was able to prove that the process of fermentation, that is, the conversion of sugar into alcohol and carbonic acid, is due to the vitality of the yeast germ. In this matter the celebrated chemist Liebig was his opponent, but Pasteur's experiments were so numerous and new, and at the same time so absolutely exact, that his success was assured. He finally conceived the idea of making experiments to ascertain whether yeast germs, fermentation, mould, etc., could originate of themselves in fluids. His experiments proved beyond any doubt that this was not possible, and thus settled this question of long standing. He also discovered a method of preserving wine and beer by heating it for about thirty minutes to from 46° to 48° C., whereby the yeast germs are destroyed and prevent further decomposition of the liquid.

Since 1870 Pasteur has given all his attention to contagious diseases, such as anthrax, chicken cholera, and rabies of dogs. All these diseases are caused by parasites or microbes, and he claims that by inoculating part of the poison in small quantities and very much diluted into the system, a person is less apt to be affected by these diseases than those who have not been thus inoculated.

Toussaint previously made experiments with the blood of animals suffering from anthrax, but Pasteur has succeeded in raising anthrax bacilli in a drop of blood, and by preserving the germs upon certain substances, their strength as a poison was diminished to such an extent as not to cause any disease. Injections of this diluted poison protected animals to such an extent that very few suffered from anthrax where formerly entire herds were killed.

The latest experiments Pasteur has made are in relation to the rabies of dogs, and during the first months of this year he notified the Paris Academy that by inoculating dogs with microbe organisms they have been protected from the effects of bites by rabid dogs. The details of the results of these experiments are so well known that they need no further mention here.

The annexed cut, representing Louis Pasteur, was taken from the *Illus. Zeit.*

LOUIS PASTEUR.

Lindop's Improved Fire Escape.

This invention, recently patented by William E. Lindop, of St. Thomas, Ontario, Canada, provides for a compact and convenient arrangement of a coil of ribbon of spring steel in a small case, so that, for a single escape, it may be carried in the pocket, and then easily attached to the window of a building, and the descent of a person therefrom readily controlled, either by the person descending or by one remaining inside the window.

It is also so devised that the attachment may be conveniently sent back to a window, as desired, and carry means for facilitating the escape of others; but larger sizes are to be preferred for general use, as when built on a large scale firemen can be quickly sent to the windows of burning buildings. Of course the whole device must be of the best construction in this fire escape, and the work and materials necessary therefor of as good quality as would be required in making a bicycle or any such article.

A Gigantic Cylinder.

Messrs. Shorrocks, iron founders, Darwen, have just completed a gigantic cylinder for a paper mill at Hyde, near Manchester. It is 9 feet on the face, and 12 feet in diameter. It has been bored out inside, and is turned and polished like a looking-glass on the outside. The weight is 30 tons, independent of the 12 foot spur wheel and stand. It was drawn by two traction engines, and, according to the *Ironmonger*, is said to be the largest cylinder ever made.

[At the Dowlais Iron Works, England, they formerly had a blowing cylinder 12 feet in diameter and 12 feet stroke.—ED. S. A.]

Watermelon Oil.

Experiments have been made by M. Lidoff, with a view to defining the quantity of oil contained in the seeds of the *Cucumis citrullus*, a watermelon plant extensively grown in the South of Russia. According to a description of the process in the *Corps Gras Industriels*, the seeds are dried at a temperature of 266° Fahrenheit, after which the oil is extracted in a Tharn apparatus. By this method there was obtained a quantity ranging from 24 to 25 per cent of a lubricating oil, with a density at 64° Fahrenheit of 0·9298. It absorbs atmospheric oxygen very rapidly, an augmentation of about one-quarter per cent taking place within three days. M. Lidoff thinks watermelon oil suitable for culinary purposes, but fears that its extraction would be too costly to allow of its coming into general use.