DYEING IN FRANCE AND CONTRIBUTIONS OF MODERN SCIENCE TO THE ART.

BY E. R. MUDGE U. S. COMMISSIONER TO THE PARIS UNIVERSAL EXPOSITION OF 1867.

(Concluded from page 194.)

The advantages resulting from the recent improvements, by which the coloring matter of madder is obtained in a purer and more concentrated form, will be rendered more obvious by a brief statement of the usual processes in printing. These may be divided into three different classes: First, where the colors are fixed without a mordant, as in dyeing blue with indigo, either of a uniform tint, or where the whites are reserved by an application which prevents the contact of the dye upon the parts to remain uncolored. Second, where mordants are first printed upon the tissues, which are afterward subjected to subsequent operations of tinctures, as by immersion in the dying liquid, etc. This process, until very recently, has been necessary for all madder dyes. Third, where the mordants and coloring matters are previously combined together to form the color to be impressed, which is called a "color of application." In this last class of processes the printed tissues are suspended in a vessel filled with steam from boiling water, which produces the same effect as dyeing by immersion in a liquid bath, the colors combining directly with the fibers of the tissues. By means of the steaming process, the operator can print and fix at once an indefinite number of colors, and terminate by the two or three operations of printing, fixing, and washing, a work which formerly required many weeks when accomplished by the process of dyeing after the printing with mordants; almost all the coloring materials known could be fixed by the third process upon tissues of wool, silk, or cotton. The coloring matter of madder alone has not been isolated in sufficiently advantageous conditions of assimilation, that the process of fixing by steam could be applied to it. The discovery of the different purifications of madder has placed it in the power of the printer of tissues to apply the expeditious process of steam printing to the most permanent and useful of all vegetable colors. The most important use of madder as a color of application has been achieved only within a few months. Very beautiful fabrics printed by this process at two establishments, one in France and the other in Bohemia, were displayed at the Exposition. M. De Kaeppilin, referring to these fabrics, says: "It is evident that the long and difficult operations required for fixing the vegetable coloring material on tissues are now quite simplified, and that the new manner of fixing the coloring material of madder, all prepared and combined with the different mordants, being allied with the beautiful and simple fabrication of colors from aniline, will achieve for the industry of printing tissues its most beautiful conquest. Instead of the ancient steam colors, which in respect to solidity left much to desire, the madder colors, married as it were with the brilliant colors derived from coal tar and the solid and resistant mineral colors, like ultramarine and chrome green of Guignet, will replace the fugitive colors of the dye woods. The fabrication will be more perfect, and will reunite solidity and brilliancy of colors with the delicacy of execution which can be obtained only by machines which print mechanically."

It has long been known that certain species of lichen exposed simultaneously to the action of ammonia, moisture, and a moderate temperature, gradually acquire a deep purple color, and the property of dyeing wool and silk with pure and brilliant tints. The pasty and woody mass containing the coloring matter is known as cudbear. The coloring matter extracted by means of an alkali, and separated from the woody portions is known as archil, or *orseille*. A new kind of archil was introduced in 1856 by MM. Guinon, Marnas, and Bonnet, under the name of French purple, in the form of lime lake. It furnishes very fine and pure mauve and dahlia tints upon silk and wool without mordants, and mixes easily with other coloring matters, such as ultramarine, indigo, carmine, cochineal, aniline red, etc., producing the most varied and delicate tints. The manufacture of French purple, although at one time extensively prosecuted, has been greatly diminished in importance by the competition of the coal-tar purple.

In 1854, MM. Hartmann and Cordillet succeeded in fixing upon fabrics the green coloring matter of leaves. In 1851 and 1852 the famous Chinese green, called *Lo-kao*, was introduced. Subsequently, M. Charven, of Lyons, obtained the coloring principle of the *Lo-kao* from a weed indigenous to Europe, the *Rhamnus catharticus*, for which he received a gold medal. The Chinese green was especially admired on account of the beautiful green shades which the fabrics dyed with it assumed in artificial light. MM. Guinon, Marnas, and Bonnet discovered the means of producing at less cost shedes of green which preserve their character under artificial light by the use of Prussian blue with picric acid. It is a curious fact that, while the greens produced by indigo and picric acid appear blue in artificial light, the dyes produced by Prussian blue and picric acid appear green.

A remarkable and very beautiful amaranthine red was first commercially prepared from uric acid in 1856. This dye, called *murexide*, created a great sensation, but its use was of short duration, as a more vivid and more easily applied tint was about this time obtained from aniline, and the murexide was objectionable because the color, though unaffected by the sun, was destroyed by sulphurous fumes, as in the atmosphere of London, impregnated with sulphur from coal. This coloring material is peculiarly interesting from the circumstance that it is nearly identical in composition with the ancient purple derived from the murex. Professor Hoffman records, as he shared, the triumph which was felt in Liebig's laboratory when a few grains of this substance were first obtained in a state of purity, and the rapidity with which the scientific discovery was made practical in the arts. When the manufacture reached its culminating point, the weekly yield of murexide in one factory only amounted to no less than 12 cwt., a quantity in the production of which 12 tuns of guano were consumed.

The long-sought-for rediscovery of the Tyrian dye was hardly attained before it was replaced by a product of modern science. The year 1856 was remarkable in the history of dyeing as the epoch of the most complete revolution of the art. It was the period of the practical discovery of the first aniline colors. The property which aniline, a product from the hydrocarbons of the coal series, possesses of forming colored compounds, was indicated by Runge in 1856. This indication was followed by the discovery by a young English chemist, named Perkins, of the means of preparing commercially from aniline a coloring substance of great intensity of hue and permanency, which is known in the arts as the "Perkins violet." This was almost immediately followed by the commercial preparation in France, by Verguin, of the aniline red. The extraordinary qualities of these products, the wonderful facility with which they could be applied to wool and silk, and the freshness and vividness of their hues, stimulated the scientific and practical chemists in France and England to search for new compounds from the same source, and to cheapen the production of those known. The most important scientific results were obtained by the English chemist Hoffman, who discovered and prepared the colorless rosaniline, a base from which all the reds, beside many other colors, may be formed, by different reagents. The colors derived the hydrocarbons of the coal series are as various and as vivid as the hues of the flowers.

The aniline colors whose use in the arts has been fully established by practice, are:

1. The aniline, or Perkins violet, called also rosaline, indesine, mauve, aneleine, hamaline, and violene.
2. The aniline reds with a rosaline base, called also fuschine, azaleine, and magenta.
3. The blues of rosanaline, Lyons blue, blue *de lumiere*.
4. The rosaniline violets, different in hue from the Perkins violet.
5. Hoffman's violet.
6. Imperial dahlia.
7. Aniline green.

To these may be added an orange color, chrysaniline, and colors produced from the oxidization of aniline, but not directly applied; a green called emeraldine, a blue called azurine, and the intense aniline black, developed only on vegetable fibers.

The use of these colors gives a marked character to the dyed tissues of the present age. The great change effected by them was remarkably illustrated at the Exposition by a display of parallel series of wools dyed by the ancient, and the new or aniline processes. The aniline hues were predominant in the richly colored fabrics of the Exposition, and, adopting the figure of Colbert, that "color is the soul of tissues, without which the body could scarcely exist," we might say that these colors fix the physiological character of the fabrics of the present day. Among the wonders of modern science what is stranger than this, that the gigantic plants buried in the coal measures of the ancient world are made to bloom with all the tints of the primeval flowers, upon the tissues of modern industry?

Artistic reasons are not the only ones which have led to the prevailing use of the new dyes; economical reasons have had equal weight, especially in the woolen industry. One of the most remarkable characters of the coloring materials derived from aniline is the powerful affinity which they possess for materials of animal origin, or nitrogenized substances, and especially for wool, silk, albumen, gluten, and caseine. The affinity for these substances is so great that there is no need of any mordant. In the application to vegetable tissues, such as cotton, it is only necessary to animalize the fiber with albumen. These colors may not only be applied with the greatest facility in dyeing by immersion, but add vastly to the economy of printing mousselines or calicoes, as they may be used as "colors of application" in steam printing. Beside, all these colors are now sold commercially in a state of great purity, and very often in crystals. The colorist has rarely anything more to do than to dissolve the product in a suitable vehicle, and to put it in presence of the fiber, in the conditions in which it can adhere, which for wool and silk are extremely simple.

The great problem in the art which science has now to resolve is to give more stability of color to these magnificent products of modern chemistry. The chemist who has furnished many of the facts above given, M. De Kaeppilin, is hopeful that this will be accomplished. He says: "Some of these results have already been obtained; above all, upon tissues of wool and silk. It is evident that colors derived from archills, such as the violets and reds, are more fugitive than the Perkins violet or new violets from rosaniline of Pourier and Chappal; that the roses of safflower or cochineal are not more stable than the roses of aniline, and that aniline black is not only superior to all other blacks, but that it is wholly unalterable and of complete stability upon tissues of cotton."

Before closing this imperfect review of the relation of chemical arts to the woolen industry, it is due to American science to observe that the name of the lamented Dr. Dana, of Lowell, is most honorably mentioned by French savans among those who have rendered important service to the art of dyeing and printing tissues. The credit is awarded to him of the introduction of lime in the operation of bleaching for the purpose of saponifying the fatty matter contained in the crude tissues. He thus completed the great discovery of Berthollet of the bleaching qualities of chlorine.

GENERATION OF OZONE IN THE ATMOSPHERE.

BY C. W. HEATON, PROFESSOR OF CHEMISTRY IN CHARING CROSS HOSPITAL COLLEGE, ENGLAND.

As to the mode in which ozone is generated in the air, we have only probabilities to guide us. There can hardly be a doubt that it is formed to some extent by the agency of lightning, and it is possible that this is the sole mode of its production. Some writers assert and some deny that it is present in the oxygen evolved by plants under the influence of light, but though such a formation is probable enough, the evidence both for and against it, is at present inconclusive, and lastly, it is possible, though still unproved, that it may be formed during some of the processes of slow oxidation which are so common on our globe.

However it is formed, it is at least certain that ozone exists in the air, and that, though small in quantity, it must, from its extraordinary activity, have important functions to fulfill in nature. But this very certainty has, unfortunately, been a fruitful source of wild assumptions and mere speculative guesses, doing infinite harm to the progress of true knowledge. Some have asserted, and have attempted to prove by perfectly inconclusive reasoning, that ozone arrests infection, and destroys the germs of epidemic disease. It is highly probable that such is the case, and it is certain that its presence is incompatible with that of many noxious gases. But then it is *not* certain that epidemics are due to noxious gases, and if, as is more likely, they are propagated by spores, we have yet to prove that the minute trace of ozone in the air is capable of destroying those spores. We can no more assume it than we could assume that it killed birds. Even more vague, and much more improbable, is the floating notion that an excess of ozone in the air "does us good." Men talk of running down to the seaside "to get a little more ozone," just as if it were not possible that the little more ozone might do them harm instead of good when they got it. In large quantity it is certainly an intensely powerful irritant poison, and that it is useful in large quantities is the merest assumption. As to the notion of its assisting the process of blood oxidation, the probability is all the other way, for its energy would be much more likely to cause it to oxidize, and destroy the lung itself, than to permit it to pass quietly into the blood, and effect the work performed by the more gentle oxygen. The simple fact is, that we know next to nothing about this branch of the subject; and if, instead of guessing at random, we were to set to work to try to elucidate some of the obscurities by which it is surrounded, or, at any rate, were to wait until others had done it for us, we should act a much more sensible and modest part.

For the future there is every hope. The main elements of the inquiry have already been acquired, and a strong body of experimenters are at work upon it. The British Association has appointed a committee to investigate some of the moot points, and from the high eminence of every member of it, we may justly anticipate some important contributions to our knowledge.

Tanning---A New Process.

A process has been invented in England for preparing hides to receive more readily the action of tannin. After the hair and particles of flesh have been removed, and the hides have been properly cleaned by the action of lime, the first step in this new process is to place the hides in water sufficient to cover them. The hides are to be placed in separately, with the fleshy side upwards, and are to be sprinkled with bran in the following proportions:

Light hides, for uppers, etc., each skin....	6 ounces
Calf skins..............................	3 "
Sheep skins............................	4½ "
Heavy hides, for sole leather......... ...	14 "

In this vat the skins must remain until fermentation has taken place, which will be, in warm weather, in about two days, but in cold weather somewhat longer. After this the skins must be removed and scraped from any adhering particles of lime or other substances. When this has been done the skins are subjected to the action of mustard seed, which forms the distinguishing characteristic in this process. It is carried out in the following manner: A vat of proportionate size is filled with a sufficiency of water to cover the skins, and to this water there must be added for every hundred pounds weight of the skins, when dry, five pounds of ground Italian mustard seed, and five pounds of barley meal. When these ingredients have been thoroughly mixed with the water, the skins must be dipped therein, so that they may be perfectly saturated with it, and they must be left in this dip for the following length of time:

Calf, sheep, or goat skins................	24 hours
Light hides and kips..	36 "
Heavy hides, for sole leather............	48 "

When this time has expired the skins must be taken out and hung up to dry, but only partially, as when subjected to the next process they should still be in a damp condition. The dip which has just been described has a very powerful action on the skins; the combined action of the mustard seed, barley meal, and heat thereby generated, is to open the pores of the skins, and thus to render the remaining processes in tanning them by means of bark much more speedy than under any other methods hitherto known.

A New Alloy.—A new alloy, forming, we are told, a beautiful white metal, very hard, and capable of taking a brilliant polish, is obtained by melting together about 70 parts of copper, 20 of nickel, 5½ of zinc, and 4½ of cadmium. It is therefore, a kind of German silver, in which part of the zinc is replaced by cadmium. This alloy has been recently made in Paris for the manufacture of spoons and forks which resemble articles of silver.

The British Government and Inventors.

The relations subsisting between inventors and various branches of the government, needing and using the intelligence of inventors, have long constituted a topic of painful comment and incrimination. British law regards every inventor as an outlaw; as a man having no legal rights in any matter relative to the use of his invention by the government. It would be an insult to the reader's intelligence were we to debate the moral right and wrong of this decree. We only state what is the law, expressing, at the same time, our conviction that public opinion would never second or sanction the strict upholding of this, in any case of undisputed use and adoption by a governmental department of an invention originating with a member of the public. Not wishing to overrate the grievances inventors have complained of in the course of their dealings with the government, we are free to admit, that although the legal ruling is precisely as we have stated, yet the cases of inventors whose inventions have been adopted by the government, remaining totally unrewarded, are comparatively few. Usually some bonus has been conceded, but the manner of this assessment and award has been hitherto most unsatisfactory. Government, in these matters, has acted as though prompted by the desire to give an inventor the very maximum of trouble; to tire him out by all sorts of unnecessary delay, whereby in time his hopes and aspirations might be lowered to a convenient despair for inducing him to accept a trifle. Indications, we are gratified to state, are not wanting that Mr. Gladstone's administration is not insensible to the past injustice to which we have referred, and is resolved that inventors coming before governmental departments, and having their inventions ultimately adopted, shall be equitably treated in future. The first indication is seen in the terms of a recent announcement issued from the War Office, for the consideration of inventors, whereby various checks are imposed to the suppression of a valuable invention; first, establishing a more fairly constituted tribunal than heretofore for the assessment of value; secondly, defining the mode of payment, and indicating the precise time. In former days, if a man possessed an invention bearing upon warlike art, and wished to treat on behalf of the same with the government, his usual course of proceeding was the following: He made application either to the War Office, the Ordnance Select Committee, or the Admiralty. His letter of communication met a prompt response, accompanied with a printed statement of the terms on which alone the government would condescend to treat with him. He must defray all expenses; he must disclose all particulars; finally, he must trust wholly and absolutely to government for reward in the event of ultimate adoption. Now, the common opinion is (and it is one that, conscientiously, having arrived at belief through evidence within our own knowledge, we cannot gainsay) that, on many occasions, inventive particulars thus communicated to the War and Admiralty departments, have been turned to unfair account; that, by some means or other, those particulars have become known to members of the public service, "improved," ostensibly, at least, into discoveries of their own, to their sole advantage. If this did not happen, it readily might have happened. So powerful an incentive to profitably unfair dealing, without much chance of discovery, should never have been permitted. By the terms and wording of the recently issued memorandum, we are glad to see a check imposed on this contingency of unfair dealing. Inventors now are given to understand that their communications are not to be addressed to either of the war departments, but to one of the Under-secretaries of State, who takes upon himself the responsibility of laying them before the War Department, where due consideration is pledged. The government do not hold themselves responsible for any expenses an inventor may have occurred in the inceptive stages of an invention, but express readiness, under certain circumstances, to contribute towards expenses necessary to the development of an invention. The next point of importance in the recent memorandum is relative to the tribunal of assessment, which is to be a committee held in the War Office, a great improvement on the old mode of leaving this matter to the discretion of the legal heads of departments. Whether or not any civilian element is contemplated in these War Office committees of adjudication, the memorandum does not state; but if not, the machinery will be needlessly defective. Lastly, as regards time and mode of payment in behalf of inventions deemed worthy of acceptance and adopted, these matters—so important to inventors—are, by the memorandum, clearly defined. As soon as the value of an accepted invention has been assessed, the sum—under sanction of the Secretary of State—is to be inserted in the estimates, when, on being passed by the House (but not till then), the inventor will receive his award. The new *regime* may be said to have found its first application in the award to Captain Moncrieff; for, although government had come to a conclusion in respect to this matter, before the memorandum to which we have been referring was issued, yet the spirit of it is clearly seen in the terms and manner of Captain Moncrieff's award. Altogether, the aggregate sum receivable from the government by this gentleman, may be set down as some twenty thousand pounds. After paying him for the expenses of drawings, models, etc.,—a concession rather in advance, by the way, of the terms of the new convention—he is to have ten thousand pounds on the passing of estimates, and five thousand more at the date when his assistance may be no longer required by government in further developing his system. He is to be paid a thousand a year for such time as he has been already assisting the government, and for all future time until his services are no longer required. Then he is to receive five thousand pounds Altogether this is an arrangement more liberal—as we have already said—than the new memorandum, strictly interpreted, would warrant inventors to expect. All the better, is what we say; and if this liberality of treatment is to be repeated, all the better still. The English public, we are right. sure, will never uphold unfairness by the government to inventors who have advanced the interests or increased the power of any public department.—*The Engineer*.

Agricultural Implements.

Probably no department of invention has on the whole more munificently rewarded the genius expended upon it, or still offers greater inducements to inventors than that of agricultural implements. It is true that powerful and effective reapers, and threshers, and a host of minor inventions have been brought nearly to perfection, so far as anything human can be said to be perfect; but there remain very many agricultural operations to the aid of which machinery has not been yet successfully applied.

The annual address before the New York State Agricultural Society, delivered February 10th, by Thomas H. Faile, the retiring president, contained among much other interesting matter some statements of special interest to inventors.

He spoke in the highest terms of the beneficial effect upon both visitors and exhibitors of implements at the annual fairs of the society, bringing together as they do the manufacturers and those for whose benefit improved machinery is designed. He says "I think it a mistake to suppose that manufactures of agricultural implements attach any importance to the *cash value* of premiums. It is the opportunity to exhibit and make them known which they want, and this they get at every well conducted fair, whether State or county: in proof of which, I was told by an exhibitor of a small implement at the last fair, that he had spent over $30,000 in exhibiting and introducing it, and had been well compensated for his outlay by sales which he never could have made but for the fairs. The exhibition of machinery and agricultural implements was the crowning excellence of the best fair. The increased number of new machines, and the improvement of those long known for their usefulness, showed in a stronger light than ever before, the marvelous inventive genius of our people. The time has passed when mere hand work can make the cultivation of the soil remunerative, and it is only by the use of improved implements that success can be attained. Even in the remote parts of our country the scythe, the sickle, and the cradle, have been superseded by the mowing machine and the reaper, and by means of these and other agricultural implements, the fertile lands of the West have been brought into use, making Chicago the most important port in the world for the shipments of cereals.

"The different trials of implements—mainly agricultural—have resulted in such vast benefit, not only to farmers, but to the whole community, that another should not be long deferred. In ditching and digging machines especially, there is open a wide and very important field for improvement and invention; and when the vast quantities of wet lands, which could be reclaimed and made valuable by ditching, and the unavoidably slow work of the present method is considered, it seems to me that the society might do great good by offering an oportunity for a competitive trial of these important machines; more especially as it is now claimed that there is a rotary digging machine in Illinois which has been successfully operated.

"It has been suggested that a separate trial should be made of portable steam engines, sewing machines, etc., but it would seem that all such inventions can be more effectually tested by those whose interest it is to procure the kind best adapted to their purposes. I allude to manufacturers, especially those using sewing machines, who in preparing the various articles in their line, aim to have the best, and to whom $5,000, $10,000 or $20,000, is a small expenditure for ascertaining that fact. Hence I think that no premiums or certificates of merit should be given to such articles at our fairs. Nor do I think there should be any awards for pianos or musical instruments of any kind. In the great national exhibitions held in London and Paris, where the highest musical talent in the world was congregated, it was no doubt proper; but farmers are not supposed to be Mozarts and Rubinis, and a certificate of merit or superiority of one instrument over another is simply absurd, and leads to unnecessary trouble and dissatisfaction. As before mentioned, the opportunity to exhibit to such large assemblages as frequent our State fairs, is what the makers want, they knowing full well the advantages to be derived from it."

It will be seen here that the privilege of exhibition is regarded as a sufficient inducement to manufacturers of other than agricultural goods, at the annual fairs of the society, as a premium even when obtained would be of little service to makers of pianos and other articles not strictly pertaining to agriculture. While acknowledging the force of this view as regards piano manufacturers, we think the exclusion of sewing machines unwise. A premium on a sewing machine at a State agricultural fair is well worth competing for, especially as sewing machines are almost as common now in farmers' houses, as churns.

There can be no doubt that the annual fairs of this society have been a great stimulus to the demand for improved agricultural machines and implements, and have aided inventors in bringing their improvements before the public. If continued in the same spirit of liberality that has hitherto characterized their management, they will be still sustained by all classes of manufacturers and inventors; but a narrower policy may prove disastrous, unless careful discrimination is used in the exclusion of articles from the prize list.

Furnaces for Smelting Glass.

An improvement in the method of creating drafts in glass furnaces has been made by James Davison, of England. At present long caves are placed under glass furnaces, and large cones of brickwork above them, in order to get the sufficient amount of heat requisite for the perfect fusion of the materials used in glass making. Mr. Davison's invention does away with these expensive and inconvenient draft creators. He employs steam, which is generated in any suitable boiler, and which is injected into small flues, chimneys, or funnels, by steam pipes or jets; these he places in any convenient part of the furnace, and one or any number may be applied according to the size of the furnace, and the number of glass pots it may contain. In each flue or chimney the steam pipes or jets may be either fixed or portable; they are provided with stop cocks so as to regulate the supply of steam, and in this manner a draft is created and the heat of the furnace increased and regulated at pleasure. The principal features of this invention are, the application of steam injected into furnaces for the manufacture of glass, and the materials employed in that manufacture for the purpose of obtaining the necessary draft; but the flues may also be so arranged as to consume the smoke from the fuel.

TRANSPORTATION OF FRESH MEATS TO MARKET.

On page 323, Vol. XV., of the SCIENTIFIC AMERICAN, in a leading editorial, we discussed the above subject, offering some suggestions as to modes by which meats could be preserved fresh during transportation over long distances. We closed the article referred to with the following paragraph:

In the more immediate Western States, it is possible to construct cars so that animals may be slaughtered there, and the fresh beef delivered in a wholesome condition in this city. In the Southwest this plan seems at present impossible, and the only mode by which this object can be attained will be by boats constructed for the express purpose of carrying the slaughtered animals from the ports of New Orleans or Galveston direct to the Atlantic seaboard. This project seems to be a very difficult one, we admit, but science, well directed by capital, may yet accomplish the result.

Our suggestions were made with reference to the construction of refrigerating cars and boats for the purpose specified, and we now have the satisfaction to record that they have borne good fruit.

The New York *Herald*, of March 19th, says:

Yesterday a new invention, in the shape of machinery for making ice and performing the refrigerating process, was tested on board the ship *William Taber*, lying at the foot of Nineteenth street, East River, in the presence of a number of scientific and mechanical gentlemen, to whom invitations had been extended. The ship already named has been thoroughly fitted with this new apparatus for the preservation, during transportation, of fresh beef and other perishable food for a long period, and she will sail for Texas some day next week, to return with a large cargo. The properties and designs of this novel invention may be briefly stated as follows: The inventor has contrived a series of pumps, by means of which he obtains a pressure on the carbonic acid gas generated in the process of working, which was before obtained by the action of oil of vitriol on carbonate of lime. When these two properties are brought together they must, under this process, decompose. He has reduced the carbonic acid precisely in this way, and allows it to escape into bags. By the application of the pumps, which are surrounded with water, he reduces it to a liquid state. The first pump, under this pressure, carries 75 pounds to the square inch, the second 300, and the third is capable of 1,200 pounds to the inch, which pressure is amply sufficient to liquefy carbonic acid gas. Having reduced it to a liquid form, it necessarily becomes deprived of all its caloric, and the moment it becomes liberated it again assumes its gaseous form and takes caloric from all surrounding points. The inventor's first idea was to utilize carbonic acid gas for the production of ice. One of the principal features in the apparatus is an iron case lined with copper, and through which are copper tubes set in the top and running clear through. This case is surrounded with wood and well packed by other material to prevent it from receiving caloric from the outside. The tubes are filled with water, which soon becomes converted into ice. Another novel feature in this invention is that after the gas has performed its office of converting the water into ice once it is allowed to escape into gas again. It is now ready to be reliquefied and to go over and convert another quantity of water into ice. The expense is limited to the interest upon the machinery used, the cost of a given quantity of carbonic acid gas, and the cost of running a steam engine and apparatus to liquefy it and turn it into a gaseous form again. Fifty dollars' worth of carbonic acid gas, it is claimed, would make numbers of tuns of ice. The two great principles, then, in the mechanism of the affair, seem to be, first, the application of pumps to the liquefaction of carbonic acid gas; and second, the remaking of it into gas over and over again *ad infinitum*. On experimenting the inventor also found that the passage of a current of air through the tubes produced an intense degree of cold, and the idea at once occurred to him that he could, by means of a "blower," make a current of air available to cool a room of any given size, and in this he succeeded, as exemplified yesterday. The same current of air goes through the "blower" repeatedly. In a temperature of forty-five degrees, in a room sixty-six feet long, thirty-three wide, and thirteen high, in eight minutes the thermometer went below zero twenty-six degrees. With the aid of this machinery the ship *William Taber* is prepared now to carry from Texas to the New York market, it is claimed, 400 tuns of fresh beef. Through the agency of this process, it is also stated that all kinds of fresh meats, fresh fish, fruit and vegetables can be preserved for an indefinite time in a cold, dry atmosphere. The value of 400 tuns of beef in the New York market is about $96,000; the expenses of the trip to Texas is estimated at $10,000, which would leave the handsome profit to the inventors, whoever they may be, of $86,000. After the apparatus had been thoroughly tested, as above described, the gentlemen present partook of a handsome *dejeuner* on board the ship, during the progress of which the inventor performed some very interesting scientific feats, such as boiling an egg hard, making champagne cream, solidifying quicksilver and other things pertaining to the laboratory of the chemist, through the agency of carbonic acid gas and his refrigerating process.

THE third pumping engine for the Brooklyn Water Works, now being built, will be the largest and most powerful pumping engine in the world, with the exception of one in Cincinnati.

LUMBERING operations in Canada are nearly stopped by the extraordinary fall of snow during the past winter.