er number are in Lanarkshire and Fifeshire, in which counties valuable beds of fire-clay exist. The most extensive manufactory is that of the Garnkirk Fire-clay Company, situated on the Caledonian Railway line, about six miles east from Glasgow. The company was originally formed to work coal, but, finding that extensive seams of fire-clay existed on their property, they took to manufacturing that material, which now almost exclusively engages their attention. The principal seam of clay is 7ft. in thickness, and lies at the average depth of twenty-eight fathoms. Its quality is considered equal to that of the best Stourbridge clay. The manufactory covers upwards of six acres of ground, and is surmounted by thirty tall brick chimneys, which give it an extraordinary appearance. Raw material is brought in, and finished goods are sent out, by branch railways, the traffic of which never ceases, from one week's end to another. Two hundred tuns of clay, and about an equal weight of coal, are used every day. Upwards of 300 men and boys are employed by the company, and these are aided by three steam engines with an aggregate of 150 horse-power. This is exclusive of the power employed to bring the clay and coal out of the pits. The clay is of a dark color, owing to the presence of a small proportion of bituminous matter; but when that is expelled by the action of fire, only silica and alumina remain, and it is the presence of these substances in certian proportions that decide the value of the clay. As it comes from the pits the clay is entirely devoid of cohesion or plasticity; and in order to bring it into working condition it has to be ground very fine, and then mixed with water. Several powerful mills are used for this purpose. They consist of great iron rollers, which travel round a circular trough, and pass over the clay. Several hundredweights of material are operated on at once, the time for which the grinding is continued depending on the quality of the articles to be produced.

EXPLOSIVE COMPOUNDS FOR ENGINEERING PURPOSES.

NO. VI.

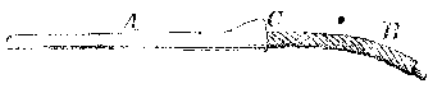
Concluded from page 274.

The second of the two principal opponents which gunpowder has to contend with is gun-cotton. This proposed substitute was discovered by Schonbein in 1846, since which time it has been greatly improved as far as regards manufacture, and attempts have been made in various countries to apply the material to purposes for which gunpowder hitherto had been alone used. In England, its manufacture on a large scale was commenced by Messrs. Hall, the gunpowder makers, at Faversham. An explosion, however, soon occurred at the works, killing a number of men, the cause being the spontaneous ignition of gun-cotton. This led to the abandonment of the manufacture on a large scale, and gun-cotton was apparently lost sight of until 1854, when Hadow published some results of his investigations into the nature of gun-cotton. In France, gun-cotton was made the subject of experiment as early as 1846, and its manufacture was carried on at the Government Powder Works at Bouchet, near Paris. Here, however, disastrous explosions also occurred—one in March, 1847, and two in 1848, several lives being lost. These disasters appear to have put an end until quite recently to experiments with gun-cotton in France. In Austria, where great attention has been paid to gun-cotton, Baron Von Lenk was commissioned to inquire into the merits of the material, and a manufactory of gun-cotton was established at the Castle of Hirtenburg, near Vienna. The material was applied for a while to cannon, but soon grew into disfavor, owing to its uncertainty of action. In 1862 an explosion occured in a magazine at Simmering, near Vienna, which caused the use of gun-cotton in artillery to be put a stop to; and in December, 1866, by order of the emperor, the use of gun-cotton by the Austrian artillery and crops of engineers was entirely prohibited.

Important progress has, however been made in the development and practical application of gun-cotton by Professor Abel and others, since its study was resumed in this country about six years ago.

Professor Abel has identified himself with the advancement of the gun-cotton question, and great credit is due to him for the light he has thrown upon that question by long and patient experimental research. Still greater credit is due to him for having discovered and perfected a method of treating gun-cotton whereby it is rendered non-explosive when burnt in the air, but in which the full energy is developed when fired in a close chamber. The method consists in reducing the gun-cotton fiber to a fine state of division or pulp, as in the process of paper making, and in converting this pulp into solid masses of any suitable form or density under a pressure of 18 tuns to the square inch.

The most recent feature in the development of the gun-cotton question is the rendering of the safety gun-cotton, just referred to, violently explosive when in the open air. This is effected by means of a detonating tube attached to a fuse, similarly to the method adopted by Mr. Nobel to explode dynamite, an engraving of which is here given copied from the *Mechanics' Magazine* of April 2d. It consists of a copper tube,



A, containing the fulminate. B is the ordinary mining fuse which is inserted in the tube. In firing the fuse is inserted in the tube, the opening, C, being nipped upon it with a pair of pliers. This tube is then inserted in the fuse-hole of the charge within about three-fourths of an inch of the charge and afterward fired. This safety gun-cotton, therefore, which will only burn in the open air if ignited by any ordinary means, will, it appears, develop all its deadly energy if fired under the same unconfined conditions, but with a special detonating fuse. In proof of this, some experiments were recently carried out at Stowmarket by Messrs. Prentice. The author appends a few particulars of these trials, which took place on January 22d. The first experiment consisted in placing a disk of gun-cotton, weighing about 1lb. 1oz., on the stump of a tree lately felled, and igniting it by an ordinary piece of miner's fuse. At the instant of ignition it was enveloped in flame, and moved about for the two or three seconds required for its combustion. About half the quantity was then placed on the same spot, and ignited by a small detonating fuse. A sharp, sudden report was heard, and the stump was found on inspection to be partly penetrated just where the charge had lain, while the twigs of the hedge close by suffered severely. The root of a large tree which lay on the ground was then attacked. A disk of gun-cotton, weighing about 1lb. 1oz., was placed in a hollow beneath it, a detonating fuse being inserted. The explosion shattered the old stump, and scattered its fragments in all directions. The next experiment was calculated to prove the question from a military point of view. A row of palisades, composed of trunks of trees, some 18in. in diameter, and all sunk 4ft. into the ground, was provided. A long tree trunk lay touching the foot of the palisade, and upon this 5lbs. of gun-cotton were laid. Wires communicating with a magnetic apparatus were affixed to a detonating tube, which was placed in contact with one of the disks of gun-cotton. Upon the explosion only one trunk was seen to fly away from the spot, and that proved to be the one upon which the charge had been placed; the palisades, although shaken, were comparatively unharmed. A charge of 15lbs. of gun-cotton was then placed against another part of the stockade, which was perfectly sound, and fired. The result was a general smash up, and a tumble over of all the trunks in numerous pieces; and so it ought to have been with such a charge as was employed.

If we compare the relative safety of dynamite and gun-cotton, there appears to be no difference between them. The only doubt upon Mr. Nursey's mind is whether, after long storage, any dangerous change may take place in either of the two substances. Mr. Nobel has endeavoured to answer this question with regard to dynamite, but the author thinks a year is scarcely sufficient time to determine this matter in such a comparatively recent discovery. So, too, with regard to the compressed gun-cotton. The author thinks a longer time must elapse before the new form of gun-cotton can be pronounced absolutely safe. The old gun-cotton was supposed to be safe in storage, but accidents at home and abroad have shown the contrary; and, however Professor Abel may now have eliminated the eliment of danger, as far as chemistry can, it is not for any one to say it is a reliable material until such time-tests have been applied as shall satisfy not only chemical science, but common sense. With regard to the question of relative powers of dynamite and gun-cotton, these appear also to be nearly evenly balanced; we may take it that for all practical purposes they are so. It would appear, however, to the author that dynamite was actually the stronger of the two, for, from his experience of that substance, he thinks that much less than 5lbs. of dynamite would have effected what 5lb. of gun-cotton failed to do at the palisade experiments—viz., to demolish it.

The most deadly explosives are at hand ready for work, but as harmless for mischief as so much sawdust or paper. They may be transported with safety, and played with by a child when unconfined; but when imprisoned they will tear down the hardest rock in liberating their gases. These are some of the marvels of the age in which we live, but which some new scientific discovery may eclipse before many years pass over.

The Senate Committee on Pacific Railroads.

"The report of the Senate Committee on Pacific Railroads favors two additional trunk railroads to the Pacific—one from Lake Superior to Puget's Sound; the other from Little Rock, in Arkansas, and from the terminus of the Kansas Pacific railway in Kansas, by the route of the thirty-fifth parallel, to San Diego and San Francisco. The report declares that the bill reported by the majority of the committee was intended to be the finality of legislation in aid of Pacific railways; that after having provided substantially two additional trunk outlets—one for the Northern States and one for the Southern States—at suitable initial points, it was intended to stop there all Congressional aid, and leave to private enterprise and State endowment the future construction of branches. The report shows at length, and with a large array of statistics, derived from the experience of the influence of railways in England, France, Belgium, Holland, and the United States, that they are the greatest of all modern agencies for the production of wealth and the development of trade and commerce. It demonstrates that the import and export trade of the principal countries in Europe are in precise proportion to the development of their railway systems, respectively; that the experience of Belgium, France, Austria, Spain, and Italy, shows that a tax on railway receipts is the best sinking fund thus far devised for the speedy payment of national debts. It also shows that two additional trunk railways to the Pacific are commercially necessary, demonstrating that a single line cannot do the work that will be thrown upon it; that additional lines, free from obstruction by snow, are needed to maintain uninterrupted intercourse; to prevent the evils of a monopoly; to avoid political discontent in the Northern and Southern sections of the Union; to bring the public domain into market; to increase immigration from Europe; to quadruple our yield of gold and silver; to save two-thirds of the cost of wagoning supplies to the 109 military posts in the Indian country, which now amounts to about seventeen millions a year; to reduce by one-half the number of troops maintained in the Territories by the greater mobility the roads will give the remainder, and to practically end Indian wars, which the report shows cost the country during the last campaign about one million dollars a week. The majority of the committee urgently recommend aid to the roads as a measure of immediate and lasting economy to the Government. The report proves that it is safe for the Government to aid them, without reference to the incidental advantages of doing so, by showing from the accounts of the Quartermaster's Department with the Kansas Pacific Railroad that upon an average use of 220 miles of the road its earning for work done for the Govrenment not only paid the interest on the bonds advanced to the road and provided the sinking fund to redeem them, but brought the Government in debt to the road. The report opposes grants hereafter of Government aid like that given to the Union Pacific and Central Pacific, in bonds directly issued, but advocates a guarantee of the interest of the mortgage bonds of the two additional trunk Pacific roads, to be issued to a defined and limited extent. It declares that they are military, commercial, and political necessities, and concludes with the averment that the people demand their construction, and do not, as has been alleged, participate in, or sympathize with, the recently raised outcry against Pacific Railway aid."

This is all very well. We are in favor of railways and other internal improvements, but it has become a very serious question and it is one in which "the plain people" are interested—namely, can these railroads be built, or can any public enterprise be carried on now without swindling? A few years ago we could answer this inquiry in the affirmative, but in these latter days there seems to be a job in every work of a public character. It is also charged that Members of Congress are in these things. Is it not, therefore, about time for us as a people to stop just long enough to find out whether we are not rushing on a little too fast? We fear that the country cannot much longer sustain such manifest disregard of honesty in public affairs.

Lumber of the Upper Mississippi.

The lumber product of the Upper Mississippi and its tributaries was very large last year, and it is estimated that the supply for 1869 will amount to six hundred and twenty million feet. Less than half this amount was cut in 1857, and yet the lumbermen of this region suffered heavy losses from the slight demand. Now, however, it is asserted, that the business is sure and very remunerative. The extension of the railroads in the adjacent States, and the construction of the Union Pacific, are assigned as the causes of this usual prosperity. A single lumbering firm in Minnesota is reported as owning over 100,000 acres of selected pine land. It is feared that the trees of this region will all be cut down, and that the land will remain desolate.

Amateur and Scientific Farming.

Mr. J. H. Hall, a member of the Farmers' Club and New York State Poultry Society, has purchased a farm on Long Island for the purpose of testing general questions of interest in agriculture. One of these is the value of artificial manures, the profitable growing of imported seeds from Washington, and the feasibility of raising poultry on a large scale, Dr. Pratterre, of the Eccelabeon celebrity, has kindly consented to aid him in the hatching of eggs by the hundred with his imported and improved machine.

THE eleventh exhibition of American manufactures, machinery, new inventions and works of art, under the direction of the Massachusetts Charitable Mechanics' Association, will open in Boston on Wednesday, September 15th. Faneuil Hall and Quincy Hall will be used as heretofore, and it is in contemplation to erect in South Market street a building several hundred feet in length to afford accommodation for the proper display of articles which have heretofore lacked proper space for an appropriate display. This building will be erected on iron pillars, and will not interfere with the trade or travel of the thoroughfare.

APPLICANTS FOR PATENTS want their claims examined more promptly. The Patent Office has got into a very lazy condition, and needs to be stirred up. Commissioner Fisher cannot do a better service at the outset than to devise measures to clean the docket of pending cases. Upon investigating the condition of the Patent Office in this respect he will find it very unsatisfactory. Examiners might, if they would, perform a little extra labor to bring up the back work of the Office.

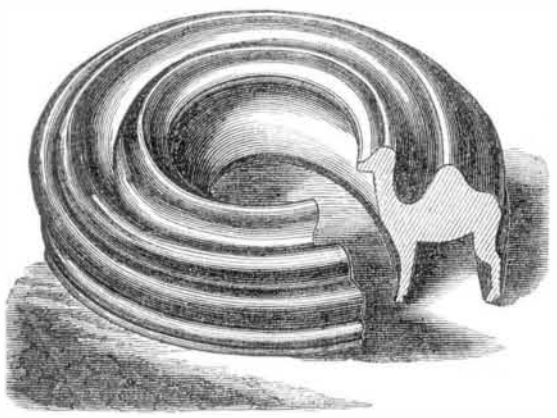
LIGHTING UP THE STOMACH.—We find the following curious statement in a Canadian paper: "M. Milliat, in France, introduces into the stomach, glass tubes of small caliber, connected with a strong battery, and containing the electrodes necessary for producing a brilliant galvanic light. Tumors or ulcers in the abdomen can thus be observed through the skin, and the interior lit up as when the feeble light of a candle renders the finger translucent.

SUNFLOWER SEED TEA—A REMEDY FOR SUMMER COMPLAINT.—A correspondent writes us that a tea made of the seeds of the sunflower, roasted like coffee berries, are an admirable remedy for all species of summer complaint. A half pint of the seed is sufficient. It should be remembered, however, that serious results often follow the too sudden stoppage of diarrhœa by astringents, and with this, as all remedies of a similar nature, caution should be used.

A TEXAS gentleman has received a quantity of silkworm eggs from France through the post. Some of the eggs hatched on the way, and the worms were living on their arrival.

Timber Beasts.

Mr. John R. Jackson, Kew, contributes the following curious article to *The Gardener's Chronicle*: That economic botany has a wide range of application the varied contents of the museum at Kew clearly illustrates. One of the most peculiar, and at the same time amusing of recent additions to that collection, is a series showing the mode of manufacture of children's toys as carried on in Saxony, and presented by Dr. Reichenbach. Everyone knows what a child's Noah's Ark is, and everyone is more or less acquainted with the orthodox forms of the representations of the beasts which it contains; and further than this we believe most of us have at some time asked ourselves the question, "How is it possible for these toys to be made, brought into this country, and sold at so low a price as they usually are?" But this question is partly solved by a glance at the collection at Kew. The wood used is the common white deal of carpenters, and the mode of manufacture is so ingenious that a description of it cannot fail to be of interest. The wood is first turned in a lathe in circular pieces, which look when entire very like circular picture frames. Cross sections of the proper width required are then cut out of these "frames" in the direction of the grain of the wood where a horse, a cow, a lamb, or a dog, or whatever animal has been designed in the lathe, presents itself. This will be more clearly understood from the accompanying figures. The section now has to be finished by hand; all it



requires, however, is to have the angles rounded and smoothed, and the tail, horns, etc., which are turned in separate pieces, attached; after which the whole is painted, and the animal is complete. In the case of an elephant, the ears, tusks, and trunk are all turned in distinct circular pieces, and sections are cut out in a similar manner to those intended for the body. This mode of manufacture is very ingenious, and in some degree explains the possibility of the production and importation of such large quantities of these toys for sale at such cheap rates. Since these specimens have been exhibited at Kew, they have attracted a large share of the attention of the numerous visitors who flock there.

The Golden House of Nero.

On that part of the ruins of Imperial Rome lying between the Palatine and the Esquiline Hills—a space which was more than a mile in breadth—Nero erected his "Golden House," as he called the new palace in which he fixed his abode. The vastness of extent and the varied magnificence of this imperial residence and its ornamental grounds almost surpass belief; and if the details that have come down to us respecting it were not too well authenticated to admit of doubt, they might be regarded as fabulous. Within its inclosure were comprised spacious fields, groves, orchards, and vineyards; artificial lakes, hills, and dense woods, after the manner of a solitude or wilderness. The palace itself consisted of magnificent buildings raised on the shores of the lake. The various wings were united by galleries each a mile in length. The house or immediate dwelling of the emperor was decorated in a style of excessive gorgeousness. It was roofed entirely with golden tiles, and with the same precious metal the marble sheathing of the walls was also profusely decked, being at the same time embellished with ornaments of mother-o'-pearl—in those times valued more highly than gold—and with a profusion of precious stones. The ceilings and woodwork were inlaid with ivory and gold, and the roof of the grand banqueting-hall was constructed to resemble the firmament. It was contrived to have a rotatory motion, so as to imitate the motion of the heavenly bodies. The vaulted ceiling of ivory opened and let in on the guests a profusion of flowers, and golden pipes sprayed over them the most delicate perfumes.

Stewart's New Model Dwelling.

We have already noticed the grand project of Mr. A. T. Stewart, of this city, to construct a model dwelling, designed as a home for worthy working women. The *Evening Post* gives additional particulars concerning the structure, which are worthy of attention. Mr. Stewart's purpose is to erect a magnificent palace of iron, somewhat resembling his store on the corner of Broadway and Tenth street, which will have stores on its ground floor, and sleeping and eating accommodations for fifteen hundred persons in the remaining stories of the building. The extent of the new structure will be 197½ feet on Fourth avenue, and 205 feet on both Thirty-second and Thirty-third streets. It will surround a court 100 feet square, and, consequently, every apartment will possess windows upon the open air, and ample consequent ventilation. The hight will be seven stories upon the Fourth avenue, in addition to the basement, and eight stories upon the side streets. The whole building will be painted white, externally and internally, and crowned with a Mansard roof of slate. It will be bricked behind the iron walls, and be thoroughly fireproof. The staircases will be of iron, and an elevator will be attached, which will transport luggage and residents to the various stories. A water tank will exist on the top of the house, and water will be in abundance upon every floor. The rooms will each be heated by a coil of pipes, affording means of regulating the temperature. Those for sleeping purposes will either be small, for single inmates, or eight feet by eighteen, for two persons. Others will be sixteen feet by eighteen, for four persons. All will be well furnished, and contain every essential convenience. The partitions will be of iron and brick. As little wood will be employed in the building as practicable. Bedsteads and tables will be of iron. The basement will contain the engine and heating apparatus, bathrooms, and storerooms of different kinds. In the back part of the ground floor, which will have no face on the street, and cannot be used for stores, the kitchen and laundry will be located. Above these will be the restaurant or dining room, and a large parlor for social purposes, elegantly furnished. To this a library and reading room will be added. The cost of the whole may exceed $3,000,000. A handsome interest upon this will be met, to a large degree, by the lease of the numerous stores below, leaving a very small sum to be paid for each of the rooms. The food furnished in the restaurant will be at cost, in addition to the expense of cooking, serving, etc., and it is calculated that an inmate will be able to live abundantly well, washing, rent, and food included-ed, for little more than $2 a week. The more numerous the household, the less the expense to each.

Hartford Steam Boiler Inspection and Insurance Company.

The following report of this Company's inspections during the month of March is made to its directors:

During the month 327 visits of inspection were made and 628 boilers examined—543 externally and 181 internally—while 47 were tested by hydraulic pressure. The number of defects in all discovered, 404. Number of dangerous defects, 63. These defects were as follows: Furnaces out of shape, 7; fractures, 116—34 dangerous; burned plates, 39—6 dangerous; blistered plates 57—5 dangerous; cases of incrustation and scale, 70—5 dangerous; cases of external corrosion, 36—1 dangerous; water gages out of order, 20; blow-out apparatus out of order, 11—1 dangerous; safety valves overloaded, 20—4 dangerous; pressure gages out of order, 38—5 dangerous; boilers without gages, 9; cases of deficiency of water, 7—4 dangerous; cases of internal grooving, 3.

The unusually large number of defects reported may be accounted for by the fact that considerable work for the month was done in mining and iron-working districts. The boilers of mines and iron works are usually urged to their full capacity and almost constantly, hence the opportunities for frequent examinations are less than in many and most other establishments. By dangerous defects we mean those that are liable to result in rupture or explosion at any time. Fractures are very common, and, as will be noticed, out-number other defects. These occur from various causes—over-pressure, burned plates, cold water on hot plates, and faulty construction.

The tendency of manufacturers to continue in use boilers of too limited capacity for their wants is the direct cause of many disasters. There is no valid excuse for this, for while the increasing business of a manufacturer demands additional machinery, he should remember that the boiler power adapted to his early beginning is ill adapted to present wants. This is, however, frequently overlooked, and a forty-horse power boiler is made to do the work of a sixty, or even more. This goes on until continual repairing becomes a nuisance or the boiler actually explodes.

Sufficient attention is not given to the feed water in rural districts. In many instances the water is gathered in ponds and contains much vegetable matter. This makes a deposit of greater or less thickness, which should be frequently removed if the manufacturer has not the means of filtering the water thoroughly before it is pumped into the boiler. Incrustation, deposit, and scale seriously interfere with the rapid generation of steam; hence, motives of economy should lead steam users to frequently clean their boilers.

In one instance, where insurance was desired, the engineer was requested to "blow out" the boiler, when he replied: "It must be pumped out for we have no place to 'blow it off.'" On examination it was found that the boiler had neither blow-out pipes nor hand holes. It had not been opened for more than two years. Is it a wonder that boilers explode?

The explosions during the month have been numerous and disastrous. Yet, while many of the boilers under the care of this company have been found in dangerous conditions, none have exploded. It may be well to add that on inspection all boilers found to be in an unsafe condition are regarded as uninsurable until thoroughly repaired.

A New Copying Ink.

A black copying ink, which flows easily from the pen, and will enable any one to obtain very sharp copies without the aid of a press, can be prepared in the following manner: One ounce of coarsely broken extract of logwood and two drachms of crystallized carbonate of soda are placed in a porcelain capsule with eight ounces of distilled water, and heated until the solution is of a deep red color, and all the extract is dissolved. The capsule is then taken from the fire. Stir well into the mixture one ounce of glycerin of a specific gravity of 1·25, fifteen grains of neutral chromate of potash, dissolved in a little water, and two drachms of finely pulverized gum arabic, which may be previously dissolved in a little hot water so as to produce a mucilaginous solution. The ink is now complete and ready for use.

In well-closed bottles it may be kept for a long time without getting moldy, and, however old it may be, will allow copies of writing to be taken without the aid of a press. It does not attack steel pens. This ink cannot be used with a copying press. Its impression is taken on thin moistened copying paper, at the back of which is placed a sheet of writing paper.

BEET ROOT SUGAR.

No. VIII.

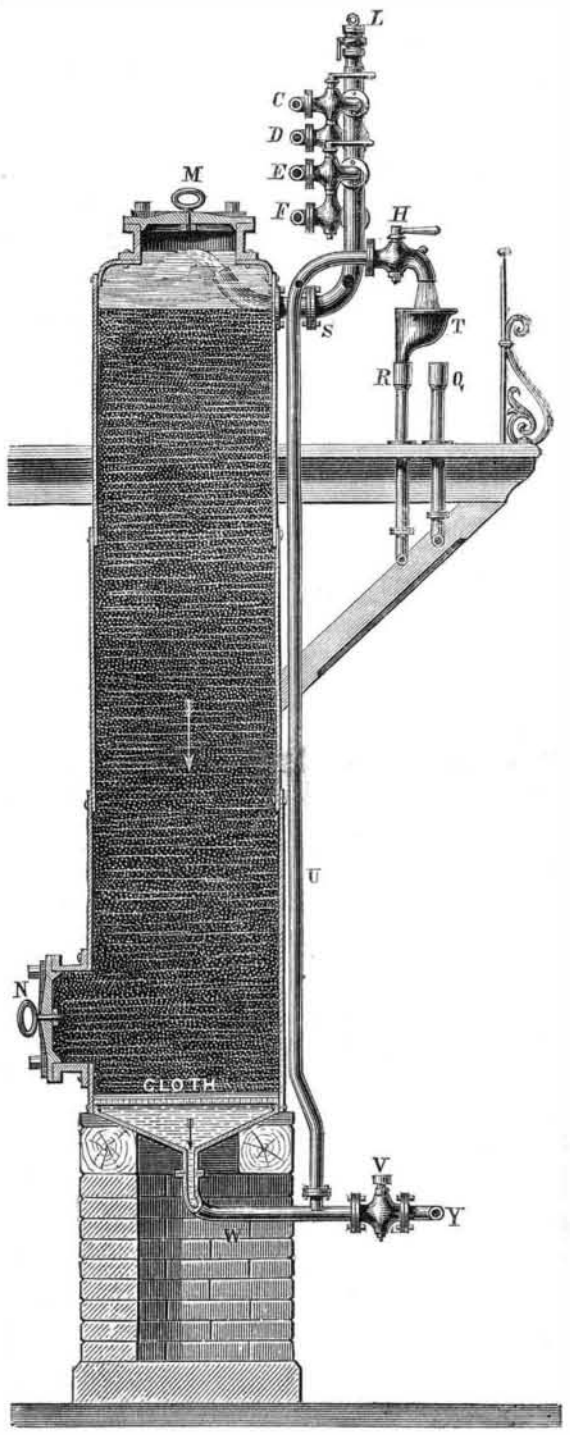
TECHNOLOGY.—PART V.

FILTRATION AND CONCENTRATION OF THE JUICE.

After leaving the carbonatation pans, the beet root juice, retaining still a certain proportion of both organic and inorganic impurities, is run into a tank or reservoir, from which it is conveyed into large filters, filled with granulated bone-black. These filters are upright cylindrical vessels, made of boiler plate, generally from 12 to 15 feet high, with an internal diameter of from 39 to 40 inches.

Several filters are always placed in a row, in close proximity to one another, forming what is called a filter "battery."

The following figure is a section through one of the filters in



such a battery. M is a cover, fitting very tightly on the top, through which the bone black is introduced. N is a man-hole for drawing out the spent bone black, and also for admitting a sieve, covered by a cloth spread carefully over it, which is introduced into the bottom of the filter before the bone black is admitted. S is a wide pipe for the introduction of steam, pure water, beet root juice, and sirups into the filter; this is effected by means of the pipes, F E, D C, which are in connection with S, through which the passage of either of these fluids is regulated at will by means of special cocks.

In order to preclude the possibility of mistakes being made by the workmen in the handling of these cocks, the pipes are superposed in the order of the density of the substances which are to be run through them, thus the steam pipe, F, is the lowest, next comes the clear water pipe, E, next that for the carbonatated juice, D, and uppermost of all, the pipe for conveying sirups, C.

The steam pipe, F, is connected with the other three by means of a smaller pipe, in order to permit of their being occasionally cleaned by blowing steam through them.

The reservoir for carbonatated juice is placed above the top of the filters; the higher the better, as it increases the hydraulic pressure, and forces the juice through the bone black with greater energy.

The pipe, S, is also fitted with a small connecting pipe, L, through which the air escapes from the filter as it is gradually filling with liquid The juice, after having traversed