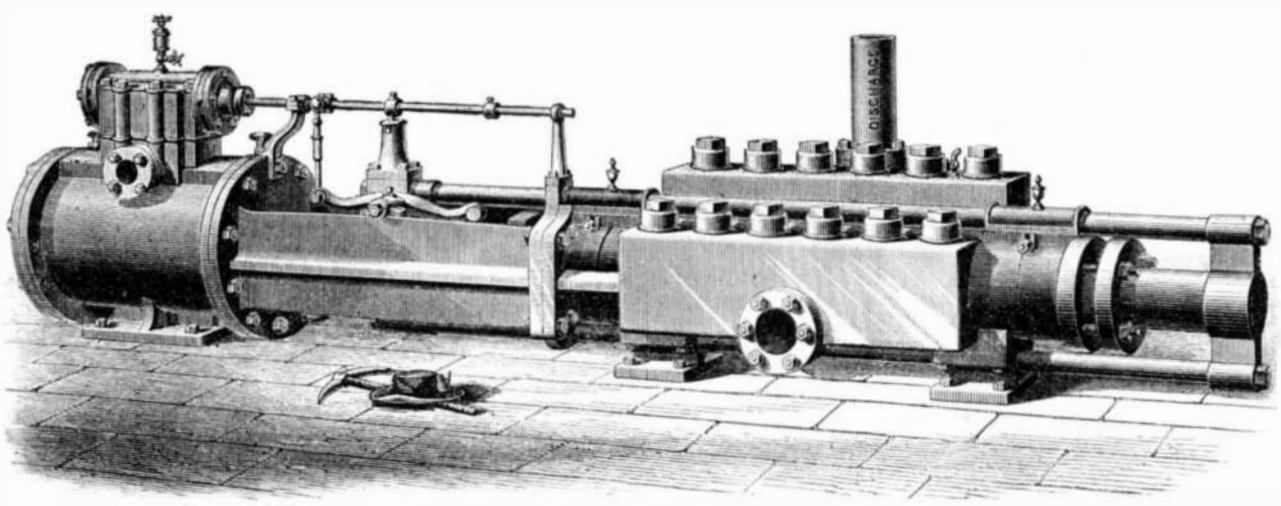
THE KNOWLES HORIZONTAL MINING PUMP.

An accidental interchange of the engravings illustrating our article on the Knowles steam pump, in our issue of January 8, exhibited a cut of a different style of pump from that intended to be described, in connection with so much of the description as relates to Fig. 6 The present illustration represents the correct double acting plunger pump referred to. The absence of joints at the water end is here clearly observable. The various parts are accessible, and there is a novel arrange ment of valves, by which not only the valve, but also the valve seat, is instantly removable by simply unscrewing the cap nut. These pumps are now working on lifts equal to 1,600 feet vertical column without causing shocks or pounds of any description. Full details regarding the manufacture and trial tests of these excellent machines are given in the article above mentioned.



THE KNOWLES HORIZONTAL MINING PUMP.

STEAM HORSE FOR STREET RAILWAYS.

Mr. S. R. Mathewson, of Gilroy, Santa Clara county, Cal., has recently devised a new motor for street cars, an illustration of which is given herewith. The following description, by the inventor, will explain its operation: "The design is to make a machine resembling a horse in form, so as not to frighten the horses on the streets. To this end the form shown is chosen. The motive power is steam, generated in a tubular boiler of from four to five horse power, located inside of the horse and forward of the cab. This drives a rotary engine of my own patenting, which is geared to the driving shaft of the machine. I also propose the use of gas as fuel, so as to do away with smoke. The steam is condensed in cold water carried in a tank of sufficient capacity on top of the cab. Gas is compressed in suitable tanks to a pressure of from 80 to 100 lbs. per square inch, and is used as fuel. The boiler is so constructed as to receive a supply of hot air to feed the flame, the gases from which, after passing around the boiler, are conducted around the engine to prevent loss by condensation. The water is forced into the boiler from the condensed steam chamber. The engine is provided with a brake capable of stopping the apparatus within a space of twenty feet, while under a speed of eight miles per hour."

The inventor points out that the engineer could easily control the machine, and also collect fares and perform other duties usually done by conductors. He claims that the cost of running the apparatus will not exceed one dollar per fifteen hours, that it may be very cheaply constructed, and that its use would be productive of a very large saving to street car companies. He also states that the weight of the machine will be from 2,800 to 4,000 lbs., and that it will run at from 4 to 20 miles per hour. A cow catcher is provided, and suitable devices arranged for attaching cars.

A signal bell is fixed above the horse's head; and a lantern in front serves as a head light to give warning of its approach, when the machine is running on dark streets at night.

For further information, address the inventor as above (P. O. Box 110), or Levi Doane, Esq., San Francisco General Post Office, San Francisco, Cal.

MATHEWSON'S STEAM HORSE FOR STREET RAILWAYS.

The Type Writer.

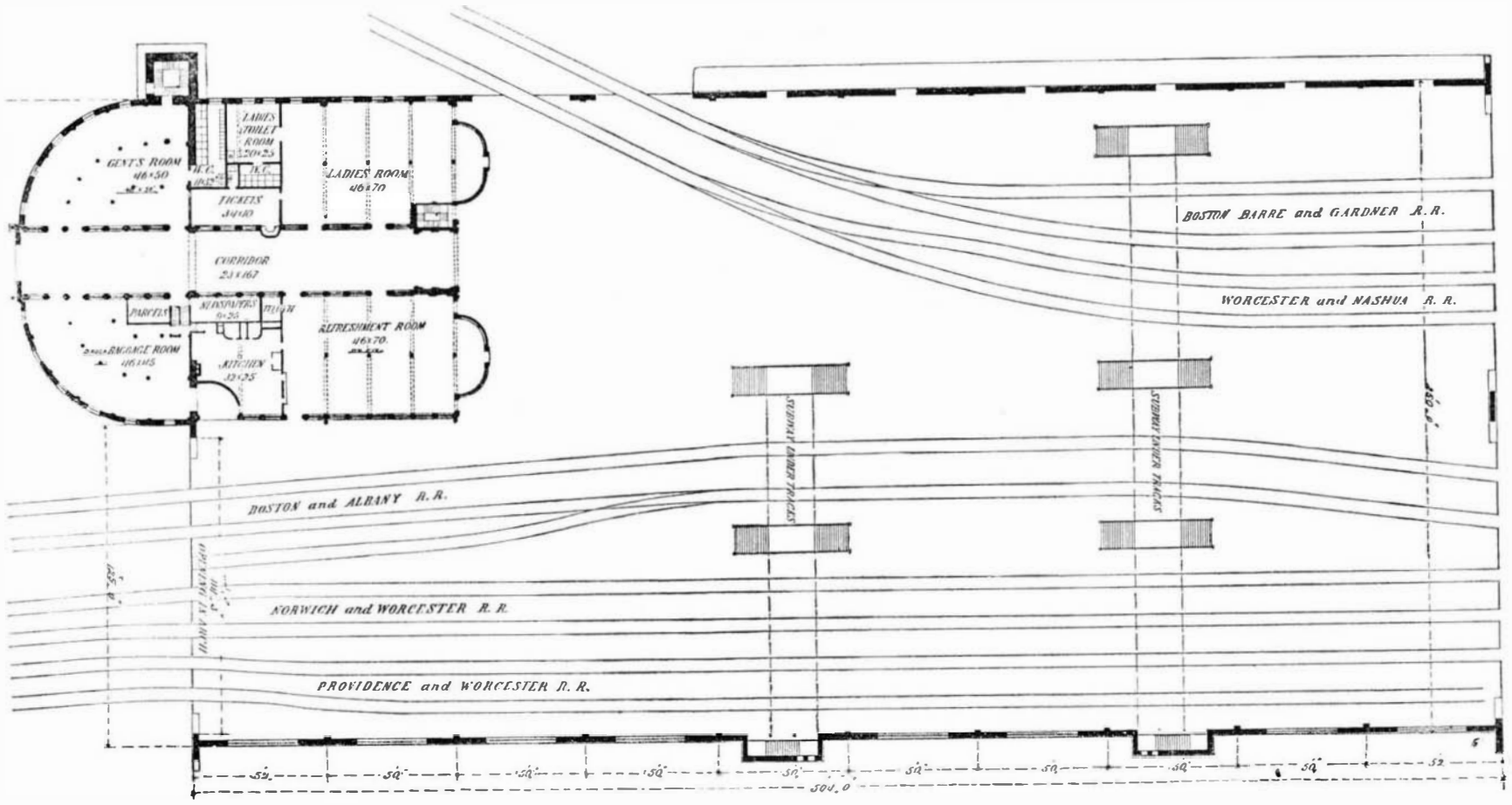
At a recent meeting of the Society of Arts, London, a machine was exhibited, intended to enable persons to write, or rather print, without using a pen. The *Journal of the Society of Arts* says:

The machine in appearance somewhat resembles an ordinary sewing machine, being mounted on a stand of the size and appearance of a sewing machine stand. In front there is a keyboard with the letters of the alphabet, numerals, etc., upon it; and on pressing one of the keys, a small lever bearing the corresponding letter is caused to strike against a ribbon saturated with a prepared ink, over which the paper is held on a roller. Each letter strikes in the same spot, but the roller with the paper moves a space forward after each letter, so that it appears on the paper in its proper place. The mechanism is very simple, the levers carrying the letters being actuated by a similar arrangement to that of a piano, and strung on a circular wire so that they all strike into the centre of the circle. By the action of a treadle, as soon as a line is finished, the roller is traversed back to its original position, and at at the same time it is revolved one tooth of a ratchet wheel, so as to bring a fresh line under the operations of the apparatus. The type is all small capitals, and the printing is perfectly regular and even. It is stated that, after a little practice, any person can work twice as fast as an ordinary writer, and that a skilled operator can gain a very much greater speed. The machine can be used for manifolding with the ordinary thin paper and carbon paper, some nineteen or twenty legible copies being obtainable. It is an American invention, and has been brought out in London by the Remington Sewing Machine Company.

[Our cotemporary is correct in stating that the improvement originated in this country. It is the invention of Mr. A. E. Beach, of the SCIENTIFIC AMERICAN, patented here in 1856, in which year the American Institute awarded its gold medal for the exhibition of the instrument at the Crystal Palace, this city. The invention is rapidly coming into use in all parts of the world. The original patent has expired. The machine as now made is very effective, and fully realizes all that is said above.—ED.]

Hydrated Cellulose.

It has long been remarked that, under the influence of acids, cellulose becomes extremely friable. Paper bleached with a too large excess of chloride of lime, and linen submitted to the action of sulphurous acid, which transforms itself into sulphuric acid, may by the least pressure be reduced to powder. M. Girard, after a series of elaborate ex



PLAN OF THE UNION RAILROAD DEPOT, WORCESTER, MASS.—[See first page.]

periments, concludes that this transformation is due to the fixation of an equivalent of water by the cellulose, and he has produced the hydrate synthetically. It is a white substance, very easily pulverized. M. Girard considers that this hydration of cellulose plays an important part in the economy of nature, and that the production of rotten wood, ulmine, and ulmic acid is always preceded by that of the newly discovered hydrate.

The Manufacture of Saltpeter.

The niter beds of Chili yield an inexhaustible supply of nitrate of soda or Chili saltpeter, but this compound is, unfortunately, unsuited for most of the purposes to which its analogue and near relative, nitrate of potash or common saltpeter, is employed in the arts, and especially in the manufacture of gunpowder. The immense deposits of potash salts at Stassfurt and Kaluss furnish the means of converting the inexpensive nitrate of soda into the highly important nitrate of potash. The following description of a saltpeter manufactory at Semmering, near Vienna, as given by S. Pick, will prove interesting as an example of the contrivances usually employed and the magnitude of the operations.

1. Raw materials: Chloride of potassium from Kaluss and Stassfurt, containing not less than 80 per cent of the salt, is employed. That from Kaluss is very pure and perfectly free from magnesium salts; it is also better to work, because it is not calcined so hard, while the Stassfurt salt often comes in hard lumps which are difficult to decompose. The poorest quality of Chili saltpeter contains 93 per cent nitrate of soda; generally the guaranteed 95 per cent is all there. It is kept in a magazine lined with asphalt, the floor of which has an inclination toward one side of 1 in 100. Along this side is a gutter, likewise covered with asphalt, which leads to a vat, where the lye is collected that drains from the saltpeter, and which is more abundant in winter. The sacks, from which this salt has been poured out, still contain 2·2 to 3·3 lbs. each of salt, and are washed out in vats connected with each other like a Shanks' apparatus, four constituting a battery. As soon as the lye, which is of a dark brown color, marks 42° B., or 1·41 specific gravity, it goes into the factory.

2. The manufacture: The factory is so arranged that the liquids shall flow down automatically as much as possible; hence the reservoirs for water and lye are at the top, somewhat lower down are the dissolving vats and refining and evaporating vessels, then follow the salt filters, the crystalizing pans, and the basins for lyes, from which they are pumped into the highest reservoir again. These basins are on the ground. The room where the crystalization takes place is also covered with asphalt, so that what spatters over can easily be collected.

The decomposition of the chloride of potassium and nitrate of soda is conducted in round cast iron vessels, 8 feet 4 inches in diameter and 6 feet 8 inches deep. They are covered with strong cast iron lids made of three segments and bolted together. A man hole in the lid, which can be closed, permits of the introduction of the raw material and lyes. From another opening a tube 6½ inches in diameter carries off the vapor, and conveys it under the double bottom of the mother liquor reservoir. Through the middle of the lid passes the shaft of the stirrer, which consists of three horizontal arms. The heat is communicated by a stout coil of copper steam pipe 2¼ inches diameter, making 8 windings quite near the sides and representing a heating surface of 107½ square feet. The joints are made tight with red red lead or plates of copper; caoutchouc, paper pulp, and lead lute last but a little while. To draw off the solution with the chloride of sodium formed, there is a cock of 4 inches opening, which can be blown out by means of a small steam cock attached near the top. Beside this, there are two open 1 inch steam pipes, opening into the bottom of the kettle on opposite sides, which serve to blow out the last portions of the salt and liquor at the end of the operation; and also, if the stirrers get fast and will not move in consequence of putting in the raw material too rapidly, they help to set it in motion. In case the heating worm requires repairs, the solution can be heated with direct steam from these pipes. These dissolving vessels are also employed for evaporating the lyes, and the course of the operation is as follows:

The apparatus is filled with lye which is evaporated to 50° B. (1·53 specific gravity.) During this time much chloride of sodium separates, and the lye, as soon as it becomes concentrated, begins to foam, but this is easily avoided by putting in some oil. When the lye has about reached the required concentration, and has fallen to the level of the first or second worm, decomposition takes place. The crude material is brought to the top of the apparatus by means of a rolling chair, in iron tilting carts and emptied into it through the man hole. The Chili saltpeter is put in first and then the chloride of potassium. It must be put in gradually, because, if it is thrown in too rapidly, it stops the stirrer. From 6,600 to 7,700 lbs. of nitrate of soda and the equivalent quantity of chloride of potassium are decomposed in one operation. After putting in the crude material it is boiled for half an hour; then the total contents of the boiler are drawn off into the filters belonging to each dissolving vessel. These are wrought iron vessels, 8 feet 4 inches square and 5 feet 4 inches deep. At the deepest point each has a discharge cock 3 inches in diameter, which has, like that in the dissolving vessel, a steam cock attached. About 4 inches from the bottom is a wooden bottom pierced with holes and covered with linen. It rests on strips of iron riveted to the sides. In the space between the two bottoms is a steam pipe to warm the filter before using and to keep the wash water hot. The solution remains in this filter 2 or 3 hours; the salt settles to the bottom, and the solution flows off clear into the crystalizing vessels; it has now a density of 1·63, or 56° B., at a temperature of 203° Fah. The salt which remains in the filter, and which still contains 12 to 20 per cent nitrate of potash, is next covered with lye from the dissolving vessel, which is filled with mother liquor and heated. In a short time it is drawn off, and has a density of 48° to 50° B., and is run with the other solution directly into the crystalizing vessels. For still further washing the salt, which still contains 6 to 8 per cent of saltpeter, those lyes are used which were obtained by the previous operation of washing the salt with water. These lyes are collected in a receiver which stands at the same hight as the reservoir for mother liquor. In the reservoir is a 6 inch copper pipe which conveys exhaust steam from the engine and raises the temperature to 176° Fah., and thus produces a not inconsiderable evaporation and separation of chloride of sodium. In this reservoir are received all the lyes which are saturated with common salt, but are weak in saltpeter, and have a density of 25° to 30° B. As a rule the salt is washed twice with this, and after the second washing it has a density of 35° B., and is put with the mother liquor for evaporation.

After washing with weak lye, the salt still contains 4·5 per cent of saltpeter. This residue of saltpeter is removed by rinsing it two or three times with hot water, and the solutions thus obtained are collected in the reservoir above described. After the second of these washings, the remaining salt is heaped up to drain; the dry salt is then removed from the filter, and the remaining inconsiderable wet residue goes through again with the next batch. The salt when finished contains 0·6 to 0·9 per cent nitrate of potash, say 6·5 per cent saltpeter and 6·5 per cent water. It is stored in a magazine lined with asphalt, where a good deal of liquor runs off and is collected in a buried reservoir. On account of the large amount of nitrate of potash, it is worked over, so that a considerable part of the saltpeter which was not washed out of the salt is recovered. The author found from 7 to 13 per cent in this liquor.

The solution of saltpeter, made from chloride of potassium and Chili saltpeter, flows, through half round wrought iron gutters provided with sieves, into the crystalizing vessels. They are all provided with mechanical stirrers of two different constructions, part round and part quadrangular.

The quadrangular reservoirs, formerly used for another purpose, vary from 8 feet 4 inches to 12 feet 8 inches in width and 10 feet 8 inches to 24 feet 7 inches in length; and they are 2 feet 7 inches deep. They are provided with pendulum stirrers, making about 12 oscillations per minute. These have the advantage of requiring but very little force, but need n attendant, say one man for all the vessels, to remove the altpeter attached to the sides of the vessels. It is also unavoidable that, on the bottom, where it is impossible to remove it, a solid crust of saltpeter should form, which does not permit the mother liquor to run through.

The round crystalizing pans are of wrought iron, 13 feet 5 inches in diameter and 2 feet 10 inches deep, and the bottoms are fastened by sunken rivets. They are provided with stirrers atttached to an upright shaft.

When cold, the mother liquor is drawn off; it flows, through cast iron gutters united by flanges, into an iron reservoir placed lower down, from which it is pumped into the reservoir on the top floor for evaporation. This reservoir is not heated by the escaping steam from the dissolving vessels alone, but also by the exhaust steam of the engine after it has passed through the lye used to wash the salt. The cold mother liquor should properly have a density of only 35° B.; usually it stands at 37° to 38°, especially in summer. This is because of the chloride of magnesium in the Stassfurt chloride of potassium, which collects in the mother liquor and increases its density, and also because a small excess of Chili saltpeter is used to make the decomposition easier. One hundred volumes of mother liquor contains:

Nitrate of potash	29·40	25·5	26·40
Chloride of sodium	25·72	14·2	17·18
Sulphate of soda	1·31	1 06	1·81
Chloride of magnesium	2 10	6·20	8·19
Nitrate of soda	——	19·6	7·19
Iodide of sodium	——	———	0 76

No. 1, a mother liquor of specific gravity 1·348 at 66°; No. 2, a mother liquor of specific gravity 1·395 at 54½°; No. 3, a mother liquor through which about 11,000,000 lbs. of Chili saltpeter had gone.

The crude saltpeter which crystalizes from solution still contains a considerable amount of chloride of sodium, from which it must be freed before refining. This is done by washing it with the lye resulting from rinsing the refined saltpeter, and which is likewise collected in a reservoir. After washing, it still contains 0·8 to 2 per cent of common salt. Recently this salt was dried and put on the market as a fertilizer; but notwithstanding its usefulness as such, its comparatively high price prevents it making a rapid inroad.

In order to free it entirely from chloride of sodium, it is refined. This takes place in one of the dissolving vessels, which is used exclusively for this purpose, the solvent being the wash liquor of the refined saltpeter. A solution is made of a density of 50° or 51° B., hot. This solution runs through the filter belonging to this dissolving apparatus, remains there two hours, and runs perfectly clear into the crystalizing vessels. As these are of iron, the saltpeter that crystalizes out of them has a yellow appearance; to prevent this 3½ ounces ultramarine suspended in water is mixed in the solution with each 10,000 lbs. of saltpeter. When cold, the mother liquor is drawn off, and may either be used to wash the crude saltpeter or evaporated as occasion requires.

The saltpeter that crystalizes out of this contains from ¼ to ½ of one per cent of common salt. A small amount, in solid lumps, adheres to the teeth of the stirring wheel; this is picked out and again refined, while the rest of the saltpeter is thrown on the adjacent filters and covered with water. These filters are of wrought iron lined with thin sheet copper, 5 feet high and 8½ feet long, have perforated double bottoms covered with linen cloth, and are provided with a discharge cock. The first rinsing is made in this way: the cock is closed, and enough water run in to completely cover the saltpeter; after a few hours, the lye is run off clean, and a second washing with a little water suffices to render the saltpeter perfectly free from chlorine. The washing is stopped as soon as the wash water shows a density of 10° to 11° B. The crystalization of the refined saltpeter takes place exclusively in the round pans above described, and from 10,000 to 11,000 lbs. of saltpeter is crystalized at once.

When liquor no longer drips from the saltpeter in the filters, it is dried, and then contains from 2 to 3 per cent of water. The drying vessel is a circular pan, 8 feet 6 inches in diameter and 10 inches deep. The cast iron bottom is planed on the upper surface and cast hollow with steam channels through it for heating it. The dried material is taken out through a hole in the bottom 6 inches square, which is usually closed by a slide. In the center of the drying pan is an upright shaft, protected by a ring from contact with the saltpeter to be dried. This carries a series of knives which are pressed against the bottom by means of springs; it also has a scraper, movable vertically to push the dried saltpeter towards the discharge hole; and finally there is a conical iron roller, covered with sheet copper, in a frame that turns with the shaft. This roller is to crush the larger balls of saltpeter.

When the saltpeter is ready for drying, it is conveyed in a tilting cart to the drying pans and dumped into them, while the stirrer is set in motion, the discharge slide closed, and the scraping plate raised up. The stirring knives, by their motion, spread the saltpeter evenly over the heated bottom, and at the same time prevent its burning, while the heavy rollers crush lumps that are caked together. When the saltpeter is perfectly dry, the discharge hole is opened a little way and the saltpeter falls slowly through into a shaking sieve, through which the powder alone falls into a wooden box, whence it is transferred by a copper spiral into a wooden trough, and is then carried by an endless chain elevator to the top floor and emptied into barrels. When the drying pans are almost empty, the slide is opened all the way, and the scraping plate let down so as to sweep the remainder of the saltpeter to the opening. It is impossible to entirely prevent its burning fast and forming crusts, and hence, every 10 or 12 hours, all the burnt saltpeter must be pounded loose. It breaks off readily in large plates. This apparatus, which is also employed in Stassfurt for drying chloride of potassium, has a large capacity; the four pans will easily dry 33,000 lbs. in 24 hours.

Besides this powdered saltpeter, it is also made in sticks, but only in small quantities. Its uses are very limited; it is principally in demand by metal workers, who think its crystaline form a guarantee of its purity.

Refined Chili saltpeter is also made in large quantities and is chiefly employed for pickling meat; it is mostly in large crystals. For this purpose Chili saltpeter is dissolved in the apparatus used for refining other saltpeter, to a concentration of 44° to 45° B., then filtered and crystalized in covered vessels protected on the sides from cooling. As the Chili saltpeter is, besides, very pure, the mother liquor can frequently be used for fresh solution.—*Polytechnisches Journal.*

Recent Balloon Ascent.

MM. Albert and Gaston Tissandier made a balloon ascent from Paris lately, and after a three hours' trip alighted near Illiers, about six miles from Paris. At 800 meters above the ground they entered a solid stratum of cloud 700 meters thick, the temperature being four degrees (centigrade) below zero. At 1,500 meters altitude they passed through a succession of ice crystals, a galaxy of little hexagonal stars, which danced round the car and sparkled in the sun. These did not exist in the lower stratum of cloud, but were suspended in the atmosphere over an expanse from 150 to 200 meters thick. The temperature here was at zero, and higher still it was at six degrees, the masses of white cloud below appearing like Alpine glaciers. Cumuli clouds were perceived overhead at about 2,300 meters altitude, but the aeronauts did not go higher than 1,700 meters, about 1 mile.

The Dutch Exhibit at Philadelphia.

The Dutch Government will show at the Centennial Exhibition a collective model illustrating the progress made by Holland in hydraulic engineering, and consisting of groups of models of the principal great reclamation and other works undertaken by the State. Among them will be shown the Haarlem drainage, the new canal, the Dordrecht steel bridge, the Kuilenberg railway, a new steam pump, copper models of sluices, relief map of the Zuyder Zee, etc. The objects are now being shown to the public before being packed for America.

SOUTHERN STATES AGRICULTURAL AND INDUSTRIAL EXPOSITION.—We have received a copy of the rules and premium list for this exhibition, which is to be opened in New Orleans on February 26, to remain open for ten days. The classes of goods in which competition is invited are very numerous.

THE artesian well at the Collier White Lead Works, St. Louis, Mo, has attained a depth of over 700 feet, nearly all of which depth has been through limestone. The drift is but slightly above the encrinitial limestone, and has passed through but little of either sandstone or chert. The boring commenced in the lower Archimedean limestone.