indicated horse power hour. The auxiliary machine working with the sulphurous vapor indicated 19 horse power—that is, an increase of 56 per cent and yielding, instead of 1 horse power, 1·56 horse power for the same steam consumption and reducing the steam consumption from 8·6 kilogrammes to 5·5 kilogrammes (from 18·96 to 12·13 pounds) per indicated horse power.

The experiments showed on the average that for every 15 kilogrammes (33·169 pounds) of steam passing through the main engine, 1 horse power could be gained in the auxiliary machine. Applied, therefore, to an ordinary single cylinder steam engine, exhausting into the air at high temperature, the percentage of power saved by this new device would be very much higher than the economy reached in these experiments, which, as has been shown, were made with a highly improved compound engine. From the average of these experiments, it may be broadly stated that given a fairly economical compound engine, using 7½ kilogrammes (16·5 pounds) of steam per indicated horse power hour, half an indicated horse power could be produced in the auxiliary machine for every indicated horse power developed in the main engine. Assuming an average vacuum of 60 centimeters (23·62 inches), corresponding to a temperature of 60° Celsius (140° F.), the saving of heat must be accomplished by using a liquid which can be vaporized to a high pressure at or below that temperature. Assuming, further the upper and lower limits of temperature within which the operation is confined to be 60° and 20° Clesius (140 and 67° F.), the pressure of the sulphurous vapor would range from 10·05 down to 2·35 atmospheres above open air pressure. A working pressure as high as ordinary steam boiler pressure is therefore readily obtained at a comparatively moderate temperature. Moreover, the volume of sulphurous acid vapor necessary to contain the number of heat units corresponding to the work to be performed is much smaller than the volume of steam which would be required for the same purpose. As the saving to be effected by the auxiliary engine depends directly upon the difference between the highest and lowest temperatures involved, the greatest gain will therefore be made either when the water in the surface condenser is as cold as possible or when the heat of the exhaust steam from the engine is at a maximum, as is the case with a single cylinder steam engine without condenser, which may be anywhere up to 212° F.

The expense of this improvement is practically all in the construction cost of the vaporizer, condenser, and auxiliary engine itself, and its economy may be realized from the fact that the exhaust steam from a 2,000 horse power central-station engine should furnish power to drive an additional 1,000 horse power engine, which can be connected as an extra cylinder to the steam engine or run independently, and thus increase by 50 per cent the power developed without adding a pound to the quantity of fuel consumed. When, in view of the present coal famine throughout Europe, it is remembered that the steam engine energy of Germany alone, afloat and ashore, is not less than 3,717,264 horse power, the commercial importance of such an improvement will be readily apparent.

The Telegraph at Victoria Nyanza.

The completion of the telegraph from the Indian Ocean to Victoria Nyanza puts the world in communication with the sources of the Nile. The telegraph line has been completed as far as Ripon Falls, which is the point where the White Nile leaves the lake. The people of Lower Egypt will not be able to tell what the water conditions of the Lower Nile will be for months in advance, so that they can regulate the quantity to be taken from the Nile for irrigation purposes. Information as to the state of the water in the Upper Nile would at times be worth millions of dollars to Lower Egypt. At present despatches from Victoria Nyanza will have to be sent by steamer to be put on the cable at Zanzibar. This will, of course, delay messages for several days, but five years ago, says The New York Sun, when the building of this line and the railroad alongside of it was commenced, the shortest time in which the news from the lake could reach Europe was about four months.

Electrical properties have been recently seriously damaged by storms. In Cleveland, Ohio, the street car lines were tied up for a day, and 8,000 telephones were put out of service and 4,000 miles of wire was down the day after the storm.

Filtration Plant for the Albany Water Supply.

The water supply of the city of Albany, which was originally obtained by gravity from certain reservoirs on small streams to the west and north of the city, was augmented in 1873 by taking water from the Hudson River through an intake in the river, opposite the heart of the city. In recent years the amount of water drawn from this source has greatly exceeded that obtained from the reservoirs above mentioned. At low water stages, owing to the tidal currents, considerable sewage is carried up-stream to the intake, and the sewage of the city was thus present in a very considerable amount in its own water supply. In addition to the local source of pollution the river received the sewage of Troy, Schenectady, Utica, Rome and many other towns further up the river. Under such conditions it is not surprising that the death rate in Albany was excessive.

As a result of the investigation by the Water Board made in 1896 by its superintendent, Mr. George I. Bailey, C.E., and by Mr. Allen Hazen, C.E., a report was presented in February, 1897, which recommended that the present intake be abandoned, a new one established at a point about two miles further up the river, clear of the local source of pollution, and a filtration plant established at that point. This important work has been carried through and forms the subject of the accompanying illustrations.

Source of Supply.—The Hudson River at the point of the intake has a drainage area of 8,240 square miles, the average annual flow of the streams amounts to at least 1,000,000 gallons per square mile per day, or over 8,000,000,000 gallons per day, while the minimum flow is only a small fraction of this amount. The minimum flow of the Hudson at Albany is about 1,060,000,000 gallons per twenty-four hours. This is about a hundred times the average amount of water taken from the river for waterwork purposes. The Hudson River opposite the filtration works flows in two channels which are formed by a long, narrow island. The main channel of the river, which formerly flowed between the island and the city has now been diverted to the other channel as the result of the construction of a dike by the United States government to improve navigation. The investigation of the water showed that that in the back channel was considerably better than the water in the main channel, and the intake was accordingly located in the former. The intake consists of a simple concrete structure in the form of a box with an open top covered with rails placed 6 inches apart, and from the box a 36-inch pipe leads to a well in the pumping station. Before going to the pumps the water passes through a screen with bars 2 inches apart. The centrifugal pumps at the pumping station have a guaranteed capacity of 16,000,000 gallons per twenty-four hours against a lift of 18 feet or of 12,000,000 gallons per twenty-four hours against a lift of 24 feet. The pumping station building, to a point above the highest flood level, is of massive concrete construction without any openings. Upon leaving the pumping station the water passes through a 36-inch Venturi meter, which records the quantity of water pumped, and is also arranged to show on gages in the pumping station the rate of the pumping.

Aeration.—After leaving the meter the water passes to the sedimentation basin through eleven outlets, which consist of 12-inch pipes stood on end, the tops of which are 4 feet above the nominal flow line of the sedimentation basin. Each of these outlet pipes is pierced with 296 ⅜ inch holes, extending from 6 inches to 3 feet 6 inches below the top of the pipe. The area of these holes is so computed that when 11,000,000 gallons of water per day are pumped, all the water will pass through the holes, the water in the pipes rising until it is just flush with the tops. The water is thus thrown out in 3,256 small streams and becomes thoroughly aerated. When more than the above amount is pumped, the excess flows over the tops of the outlet pipes in thin sheets, which are broken up by the jets, Although no observations have been taken on the Hudson River, experience with the Merrimac at Lawrence, where the conditions are in many respects similar, shows that since the water is at all times more or less aerated, and during the greater part of the year is nearly saturated with oxygen, aeration is not necessary. During low water, in the summer season, however, there is much less oxygen in the water, and at these times aeration is a distinct advantage. Another advantage of aeration is that it tends to remove the slight odor which is liable to exist in river water.

Sedimentation Basin.—From the outlets the water falls into a large basin measuring 382½×600 feet, which is located with its longer side approximately parallel to the banks of the river. The basin has an area of 5 acres, and is 9 feet in depth. To the overflow line it has a capacity of 14,600,000 gallons, and to the flow line of the filters 8,900,000, the reserve capacity being, therefore, 5,700,000 gallons. The basin, which is close to the river bank, is built largely above the natural surface of the soil. The embankments are made of the clay obtained in excavating the filters, mixed with gravel from the river, these materials being put down in alternating layers and well rolled. The outside of the embankment is covered with soil, the inside and bottom with 16 inches of puddle, which is protected from frost on the sides by a covering of gravel, above which is a rough bluestone pavement.

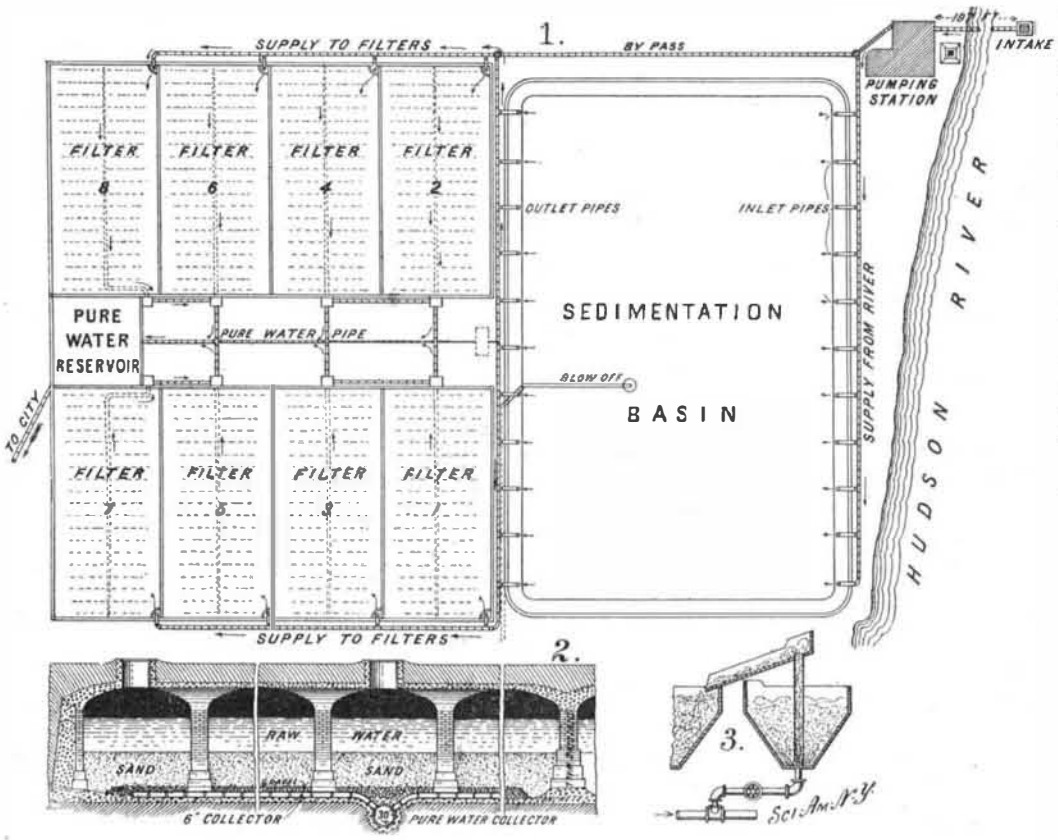
The water enters the sedimentation basin from eleven inlets along one side, and is drawn out from eleven inlets directly opposite. The floor of the basin is built with even slopes from the toe of each embankment to a sump, from which a 24-inch pipe leads to a large manhole in which there is a gate through which the water can be drawn, in emptying the basin.

The Filters.—The filters, which are built of masonry, are covered to protect them from the severity of the winter weather. The piers, cross-walls and linings of the outer walls, entrances, etc., are of vitrified brick, while all other masonry is concrete. The average depth of the excavation for the filters was 4 feet. The floors consist of inverted, groined, concrete arches, arranged to distribute the weight of the walls and vaulting over the whole area of the bottom. The bottoms were put in alternate squares, running diagonally with the pier lines, as shown in the accompanying illustration. The vaulting was designed with a clear span of 12 feet, a rise of 2½ feet and thickness of 6 inches at the crown. Above the vaulting there are 2 feet of earth and soil, grassed on the top. The tops of the manholes are carried 6 inches above the soil to prevent the entrance of rain water. The manholes of the filters are provided with double covers of steel plates to exclude the cold.

The Underdrains.—At the bottom of the floor of the filters between each line of piers, is a line of transverse 6-inch vitrified pipe collectors, laid with open joints, which connect with a main underdrain, laid beneath the floor of the filter and extending throughout its whole length, as shown in the accompanying plan. The main drains were put in before the construction of the filters was commenced. They are entirely surrounded with concrete. The main effluent collectors are 30-inch vitrified pipes reduced to 20-inches at the outlets.

Filter Gravel.—The gravel surrounding the under drains is of three grades. A coarse grade of gravel of from 1 to 2 inches diameter is laid immediately over the 6-inch drains; the second grade which is laid immediately above it is from about ⅜ of an inch to 1 inch in diameter, while the finest gravel forms a third layer whose grains are from 1/16 to ⅜ of an inch in diameter.

The coarse gravel entirely surrounds the 6-inch pipe drains and is carried slightly above their tops. The second grade fills up all the spaces on the floor to within 2½ inches of the finished surface of gravel; the finest grade being applied in a layer which is about



THE ALBANY FILTRATION PLANT.
1.—General Plan. 2.—Section Through Filter. 3.—Detail of Sand Washing Machine.

2½ inches deep. Above the gravel is placed a layer of sand 4 feet deep. The specifications for this sand require that it shall be clean, river, beach or bank sand with either sharp or rounded grains, that it shall be free from clay, dust or organic impurities. The sand has effective sizes averaging 0·31 millimeter.

Most of the suspended matters in the filtered waters are held by the top layer of sand which is removed from time to time. The dirty sand is washed and eventually replaced in the filters. Two ejector sand-washing machines, of the type shown in the drawings, are provided at convenient places between the filters. In them the dirty sand is mixed with water and is thrown up by an ejector, after which it runs through a chute into a receptacle from which it is again lifted by another ejector. It passes altogether through five ejectors, a part of the dirty water being wasted each time. The sand is finally collected from the last ejector where it is allowed to deposit from the water.

The cost of this filtration plant was for the sedimentation basin $60,000, for the pure water reservoir in which the filtered water is collected before going to the city, $9,000, and for the filters $255,000. The complete filters, including the piping, cost $45,000 per acre of net filtering area, exclusive of the land and engineering.

RESULTS OF OPERATION.—The filters were designed to remove from the water the bacteria which causes disease. They have already reached a bacterial efficiency of over 99 per cent. The disease directly traceable to the sewer-polluted waters of the Hudson was typhoid fever, the death rate from which in the city of Albany, had been large, the average number of deaths from this cause for nine years, ending 1898, being 85 per annum. During the first four months in which the filters were in operation seven deaths from this cause have been reported. For the corresponding time for the nine years ending 1898, the average number of deaths was 24, so that the filtration of the water has reduced the deaths from this cause in the ratio of 24 to 7. The St. Lawrence filtration plant has reduced the typhoid fever death rate from 11·31 to 2·54. The filtration plant of the city of Hamburg, Germany, was put in operation in 1895 and for the five years previous to that date the average typhoid fever death rate was 4·72, and subsequently to that date it has fallen to 0·72. The filtration plant of the city of Mount Vernon, N. Y., was opened in 1894, since which date the number of deaths from typhoid decreased over 76 per cent. The cost of operation of the whole plant, as shown by figures furnished by Mr. George J. Bailey, the superintendent of the works, was $6,165 for the period September 5 to December 25, of last year. This included the payroll, tools, repairs, supplies, etc. In this period 1,470,000,000 gallons were filtered, the average cost per million gallons being therefore $4.19. The average cost per million gallons of the operation of the pumping stations was $2.52, leaving $1.67 to represent the cost of operating the filters, including the laboratory work.

We are indebted for our illustrations and particulars to the courtesy of Mr. Allen Hazen, Assoc. M. of Am. Soc. C. E., who was responsible for the design and construction of the plant.

Death of Piazzi Smyth.

Charles Piazzi Smyth, Ex-Astronomer Royal of Scotland died on February 21. He was born at Naples, and was called "Piazzi" after the discoverer of Ceres who was the official astronomer of the two Sicilies. He was interested in science at a very early age, and in 1845 was appointed Astronomer Royal of Scotland. He tried for many years to get a new observatory and at last he resigned after protesting vigorously against the ways of officialdom. He then retired to Clova in Yorkshire where he devoted himself to the photographic study of the solar spectrum and of cloud forms. He is best known, however, by his eccentric views relative to the Great Pyramid. A controversy relating to this "paradox of a very high order" as De Morgan called it, led to his resignation, in 1874, of his Fellowship of the Royal Society. Among his views were that the Great Pyramid was erected under the eye of Melchisedec, according to a divinely inspired plan. Its interpretation, moreover, heralded the beginning of the millenium in 1882. The Israelitish origin of the Anglo-Saxon race and the reprobation of the decimal system of weight and measures were among his ideas.

A Music Library in Geneva.

A unique enterprise of certain music dealers in Geneva may be of interest to our readers. Dealers keep very large stocks of all kinds of classical and popular music, to all of which access may be had for a subscription fee of 50 cents a month, depending upon the number of pieces taken. Thus, three pieces may be taken for 50 cents a month or $2.40 a year, and twelve pieces of music at a time for $1.10 a month or $5 per year. This is a great boon to students who cannot afford to buy at will, and the dealers are being well repaid for their enterprise.

A NEWSPAPER is printed at Jacksonville, Fla. with the aid of acetylene gas as engine fuel

Science Notes.

The Ministry of Public Instruction in France encourages art by an annual expenditure of $3,600,000. This includes the support of the Ecole des Beaux-Arts and ten other state schools of fine arts.

The Italian government has brought forward a bill authorizing the purchase of all the pictures in the Borghese collection. The government valuation of $700,000 is a very low one and is not at all commensurate with the treasures it contains.

The excavations which M. Gauckler is conducting at Carthage, for the French government continues to produce remarkable finds. If the excavations keep on being as productive as they have been in the past, we may expect to see illustrations of "Salammbo" which will be archæologically correct.

An epidemic of typhoid fever has recently been traced to the use of celery grown on some sewage fertilized ground. As it occurred in an institution it was very easy to trace the cause. Owing to the peculiar nature of the stems it is very easy for them to become saturated with fertilizing material.

Women physicians have established themselves all over Russia and they have achieved a respected position. Some of them are employed by the government, and since last year are entitled to a pension. Many of them occupy positions as country physicians, school physicians, physicians for the poor and as surgeons for the municipal ambulance system, etc.

Wherever land is valuable for agricultural purposes the fact that wire fences take up little space is becoming more and more recognized. Stone fences are often 3 to 6 feet wide, and therefore, waste many acres of valuable soil on every farm. The zigzag fence waste a considerable amount of land. The hedge is also wasteful and they may profitably all be torn down and replaced by wire fences, for the crops which could be obtained from the area thus reclaimed would soon pay for the fence.

One of the Eastern novelties is a playhouse for children. It is 9 feet 6 inches in length, 6 feet 4 inches in width and 8 feet 9 inches in height. They are made of white pine and are painted with one coat of paint outside. They are provided with a door and windows which can be changed at will. The house can be built in an hour and taken down in twenty minutes, no nailing or carpentry being required. They are wind and waterproof and would undoubtedly furnish an excellent out-of-door study for an adult.

Sanitarians have virtually decided that street noises have an effect upon the health, and certainly the crying of "extra" newspapers has a bad effect upon many nervous people. We are pleased to note that an Englishman prosecuted a newspaper yeller for obtaining money under false pretences, as the words in which the blatant vender described his wares was not in accord with the news in the paper. In most cities it is against the law to call newspapers on Sundays and anything which will tend to make life peaceful will be warmly welcomed.

From a series of experiments carried on by Herr Müller-Thurgau on the effect on the growth of plants of an extra supply of nitrogen to the roots, he derives the following general conclusions: The roots are enabled to form an abnormally large amount of albuminoids when the nitrogen is presented to them in the form of a nitrate, but only if they can obtain a sufficient supply of sugar. This is manifested in the greater length and thickness of the roots, in their greater branching, and in the increased amount of protoplasm in their cells.—Bot. Centralblatt.

The hygienic exhibit for the Paris Exposition has been shipped, nearly every State contributing its quota. As we have no national department of public health the work was entrusted to Dr. Samuel W. Abbott, secretary of the Massachusetts State Board of Health, as special agent. The space was so very limited that with few exceptions books only could be shown. The exhibit includes maps, charts of vital statistics, albums containing photographs of municipal health work, plans of hospitals, circulars of State and local boards of health, etc. Samples of the product of private and public producers of antitoxins and vaccine lymph will be shown.

In France meat unfit for food and bodies of animals that died of disease are exclusively used for the manufacture of super-phosphates, says The Sanitarium. The meat is placed in a vat containing sulphuric acid which separates the resulting nitrogenous product from the fat. The dead animals are thrown whole into the covered lead-lined vats full of sulphuric acid. If they have died of anthrax or glanders they are cut up before being thrown in. In forty-eight hours the fat alone remains, and the animalized sulphuric acid, which is now so rich in nitrogenous substance is drawn off and sent through an undergound conduit to the superphosphate factory. Instead of the unsanitary method of burying such putrid substances directly in the ground they are effectually disposed of by the complete destruction of the injurious germs, and the product is available for the manufacture of valuable fertilizer.

Electrical Notes.

Electric traction will be used on the Berlin Elevated railroads.

An electric trolley will be laid betweem Milan and Varese, Italy.

The Metropolitan and District Railway Companies, of London, are about to work experimentally a line between Earl's Court and High Street by electricity. A third-rail is to be used, current being supplied at 500 volts.

A resident of Philadelphia has recently obtained a verdict of $15,000, through the instrumentality of the X-rays. The plaintiff was injured on a street railway car. Dr. M. K. Kassabian was the X-ray expert in the case.

The work of the signal corps of the army in the Philippine Islands has been excellent. The corps has handled an average of 2,500 dispatches each day since the American army landed at Manila, and the maximum was 4,000 on November 6.

Electric flatirons are used exclusively in many large laundries; their advantages are apparent. The heat can always be controlled so as to keep the iron at the right temperature thus obviating the danger of spoiling a finished dress by smut from an iron heated by gas.

The British War Office has been testing for the last two years a new electrical range finder. It was invented by an Australian. It will give the range and bearing of a fixed or moving object and will give information to any number of fortress guns attached by wire to the instrument.

The plans for the new Philadelphia Mint call for a large equipment of electrical machinery including fourteen 45-horse power motors for the coining department, sixteen 5-horse power cutting motors, six 25-horse power finishing motors; and one 5-horse power hydraulic motor. An electro-refining equipment is desired for the melting and refining departments.

The street car system at Frankfort is now electrical for the most part, and operations are being made for changing most of the other lines. Great precautions are taken to prevent accidents and should an overhead wire break an ingenious device renders it harmless. When necessary repairs have to be made, or when the Fire Department is at work, it is arranged so that the operation of the line can be interrupted for a certain distance.

It has been found that alternating currents of high frequency and low potential may be used to sterilize liquids. The objection to electricity for this purpose has always been that a current powerful enough to do any good would decompose the liquid, thus rendered useless. An apparatus has been devised for the treatment of wine which consists of a small tube through which the wine passes. Inside the tube there is a series of metal disks which are insulated and connected with the current. The speed with which the liquid passes through the tube can be regulated easily, and the current kills the microbes and tends to preserve the wine.

At a recent meeting of the American Society of Mechanical Engineers, the question of how small a tool it pays to operate with an individual electric motor, was discussed. Prof. Jackson stated that all large tools or machines, requiring from 5 to 7½ horse power and over, should be provided with individual motors, while smaller tools or machines requiring less power should be grouped and driven from a motor-driven shaft. These groups should ordinarily be arranged so that a motor from not less than 3 to 5 horse power is required and not more than from 10 to 15 horse power. Each industry includes conditions of its own which should also be taken count of. At the Baldwin Locomotive Works motors under 5 horse power are not used for any purpose.

Wiedemann has shown that the the temperature of a gas showing the ordinary vacuum phenomena is in general below 100°. He concluded that the luminosity is not a phenomenon of incandescence, but of phosphorescence. This conclusion has since been corroborated, but the experiments are complicated by the fact that the introduction of a hot body in itself reduces the discharge potential and increases the current through the tube. J. Stark introduces white-hot carbon filaments into the tube at various points, and keeps the current constant. If the filament is in the region of positive light, it reduces or extinguishes the light. If it is stratified, the filament cuts pieces out of the bright strata. A short positive column is totally extinguished by the filament. The negative light is enfeebled, but the luminescence of the walls is unaffected, thus showing that the cathode rays are not influenced by the presence of the hot body. The heating simply deprives the gas of its power of phosphorescence under electric charge. We know that a rarefied gas is ionized by heating, and must therefore conclude that an ionized gas does not phosphoresce under the influence of the electric discharge. This, again, indicates that the phosphorescence is a molecular rather than an atomic phenomenon.—J. Stark, Ann. der Physik.