wound to insure extra strength. Both the lining and its jacket are perforated to drain off the water, which escapes into annular channels provided between the jacket and the wire-wound casing. Provision is made, in case of an expansion of the guncotton charge, when the compression ceases, for permitting water to be absorbed by the guncotton instead of allowing the air to enter.

As soon as the guncotton is forced into the mold it is turned round, so as to come in line with the rams of the press. The lining and its jacket project slightly at one end and rests against the head of one ram, while an annular ring placed over the projecting lining and casing against the outer casing, rests against a corresponding annular ring attached to the head of the same ram. The guncotton is then compressed between the two rams. This operation completed, the rams are withdrawn, and the mold swung into alignment with the side ram, which forces it out onto a cradle.

There is one serious danger in connection with this process of hydraulic compression, which is, however, ingeniously guarded against. There is always the liability of a few fibers of the guncotton adhering to the side of the mold. The friction of the ram against the inside of the mold might ignite these particles when dry and detonate the entire charge within. To guard against such a possibility the head of the ram is grooved spirally, and at the bottom of the grooves are numerous fine perforations, through which water is forced, while similar orifices are provided in the face of the ram itself. This water acts as a lubricant and prevents particles of guncotton adhering to either the ram head or the mold, or if any fibers should so adhere they are kept in a wet condition. The great advantage of this system of manufacturing solid blocks of guncotton charges to fit any desired torpedo or shell is the saving of space within the missile. It has been proved that by this method about 15 per cent more guncotton can be contained within a specific area than with segment charges. Also, as the density is uniform throughout the block, detonation is far more perfect. According to results so far achieved, the cost of manufacturing is reduced by 25 per cent.

THE NEW YORK EDISON POWER STATION.

In few branches of steam and electrical engineering have the great advantages of concentration been so completely realized as in the mammoth power stations which are being built in the city of New York. The largest of these, at the present time, is the magnificent plant at the New York Edison power station which, when the whole of it has been installed, will have a maximum capacity of 125,000 horse power. A visit to a station of this kind teaches more in a half-hour regarding the remarkable advancement of the United States in mechanical and electrical engineering than can be gained in a whole day's study of the literature of the subject; for this vast aggregation of boilers, mechanical stokers, mammoth engines and generators, and all the thousand-and-one accessories with their endless devices for labor-saving, represents one of the very latest phases of our twentieth century development. With a view to making clear the general arrangement of the power house, we present, on our front page, a large sectional view through the engine room and boiler house, and also a diagram showing the means by which coal is taken up from barges in the river and carried to the 10,000-ton bunkers in the roof of the boiler house.

The power house, which occupies the block between 38th and 39th streets, First Avenue and the East River, extends 197½ feet north and south, and 272½ feet east and west, the western façade of the building fronting on the East River. A dividing wall extends longitudinally through the building, separating it into a boiler house 79½ feet in width and an engine house 118 feet wide. The boiler house is divided into four stories. In the roof of the building is a huge coal storage bin, capable of holding 10,000 tons of coal. The sides of the bin, which are carried on deep lattice girders, slope at an angle of 45 degrees to the floor, the weight of the structure with its load of coal being carried upon the side walls and upon two lines of columns which extend longitudinally through the building, as shown. The next two stories below are occupied by fifty-six Babcock and Wilcox boilers of 650 horse power, which are run at a working pressure of 175 pounds to the square inch. A most interesting feature of the plant is the arrangements for mechanical stoking. From the coal bin above, sheet-iron chutes lead down to hoppers which are placed on the fronts of the Roney stokers. From the hoppers the coal is fed by mechanical stokers onto the grate bars. The ashes fall from the grate at the rear of the furnace into bins located immediately below the floor of each boiler room. From the bins the ashes are led by chutes to ash cars which run upon tracks extending the full length of the basement.

One of the most spectacular features of the plant are the four great steel-plate stacks, each of which is 17 feet inside diameter, and extends to a height of 200 feet above the grate bars. These stacks are built of steel and lined internally with brick, the weight of each chimney being about 500 tons. The steel varies from ⅝ of an inch in the lowest portion of the chimney, to ½ an inch at its middle section, and ⅜ of an inch in the upper third. The lining of the lower third is of firebrick, and the rest of the chimney lining is red brick.

When every unit of this great plant is installed there will be sixteen Westinghouse-Corliss engines of 8,000 indicated horse power. Each engine will be direct-connected to its generator, and the units will be arranged down the building in two long lines of eight each. At present eight of the engines are installed and two are nearing completion. The other six will be added from time to time, as the business of the company calls for them. When running at 70 revolutions per minute, under 175 pounds steam pressure, the most economical capacity of each unit will be about 5,500 indicated horse power, but they will be capable of working up to a maximum of 8,000 horse power. The engines, which are exceedingly handsome specimens of the engine builder's art, are of the compound, vertical, three-cylinder type, with the high-pressure placed in the center and the two low-pressure cylinders on either side. The crank-shaft is built up in three forged sections with a 10-inch axial hole, which is reduced to 8 inches at the crank cheeks. The cranks are so arranged with regard to each other as to secure as even a turning moment on the shaft as possible. With a stroke of 5 feet at 75 revolutions, the piston speed is 750 feet per minute. The steam enters the 43½-inch high-pressure cylinder through a 14-inch throttle valve, thence it passes to a reheating receiver of about 4¼ times the displacement of the high-pressure and 7-10 the combined displacement of the two low-pressure cylinders. From the 75½-inch low-pressure cylinder the steam is led by 26-inch mains to the surface condensers, of which there is one to each engine. As shown in the drawing, they are located in the basement, each beneath its respective engine. Each of them contains 3,752 ¾-inch brass tubes, which give a cooling surface of 9,200 square feet. A point of interest in these engines is that they are the first engines of great size to be equipped with poppet valves, which were adopted because they lend themselves to the use of superheated steam. This form of valve lifts from its seat without any rubbing friction and, therefore, it does not involve those difficulties of lubrication which are often so troublesome when superheated steam is used. The low-pressure cylinders have double-parted Corliss valves. By means of a mechanical adjustment of the governor, which can be made while the engine is running, the speed of the latter can be varied at any time. In addition to this there is an electrically operated device for controlling the speed from the switchboard, for the purpose of synchronizing the alternators that are operated in parallel.

The fly-wheel is of cast steel in five segments, consisting of two arms and 72 degrees of the rim, which are joined by I-links, shrunk into pockets in the sides, the links being bolted to the hub. The generator armature is pressed onto the shaft beside the fly-wheel, and in addition to being keyed to the shaft, is bolted direct to the fly-wheel hub. The outer end of the generator shaft is supported by a heavy pedestal, as shown in our engraving. The total weight of the main shaft, which is 29 inches in diameter at the bearings, is 136,000 pounds.

We have spoken of the many labor-saving devices by which the operation of this vast plant is carried on expeditiously and at a minimum cost. Of these the most important is the system of bucket conveyors and elevators by which the coal is transported from the East River to the big storage bin. The coal is brought alongside the company's dock, opposite the eastern façade of the building, in barges, from which it is raised by a grab bucket operated from a cantilever conveyor derrick, and after being dumped into a screen, falls into an endless conveyor that carries it to the boiler house. Here it is unloaded into a vertical conveyor, by which it is taken to the roof of the boiler house and distributed through the length of the coal bin, which extends for 270 feet. A similar automatic disposal is made of the vast amount of ashes which is continuously being dumped from the ash pits of the boilers. The coal-handling apparatus is shown in detail in the sectional view in our front page engraving. For our information we are indebted to the engineers, Westinghouse, Church, Kerr & Co.

The University of Cincinnati has ordered from Alvin Clark & Sons, the famous telescope makers, a 16-inch refractor. The objective will be figured by C. A. R. Lundin, who has played so important a part in the success of the Clarks during the last thirty years. Ever since the death of Alvin G. Clark, Mr. Lundin has figured the large telescopes.

Correspondence.

George M. Hopkins.

To the Editor of The Scientific American:

In the death of Mr. George M. Hopkins science has suffered a great loss. By his pen and handicraft he had instructed a larger class than any professor in his lecture room and laboratory has the opportunity to teach. By his books and articles he reached many thousands and his printed words will still continue to inform and instruct multitudes to whom he will be only a name.

The leading characteristic of Mr. Hopkins' work was its genuineness. He printed nothing unless he had demonstrated its truth by actual experiment. His numerous designs of apparatus for the illustration of physical principles were all wrought out, mostly by his own hand, for he was a skillful mechanician, before they were given to the world. Many a time he came to me, saying: "I suppose you have always known this, or have always done this in this way, but I thought of it the other day, and wonder if it is new." He would proceed to show me some ingenious device which, so far as I knew, was novel. It certainly was original. It was in this way that his widely used "Experimental Science" was produced. Everything was tried before it was inserted. The book contains the results of his thinking and patient working for many years.

A controlling trait of Mr. Hopkins' character was his simplicity. In the scripture sense he was simple, a man without guile. He envied no one the most brilliant discovery. At the same time he desired to be protected in his own. The only person of whom in many years I ever heard him speak with impatience was one who had, as he thought, published without acknowledgement something he had obtained from him. His keen sense of honesty and fairness forbade such conduct.

Mr. Hopkins had numerous friends among scientific men of the vicinity in which he lived. For a number of years before the reorganization of the Brooklyn Institute upon scientific lines, there was in Brooklyn a club of men whose interests and occupations drew them together in scientific study. Of this club Mr. Hopkins was the sole officer, and the only one it ever had. The club ultimately became the Department of Microscopy of the Brooklyn Institute, he going with it into that organization. For several years he had been a sufferer from nervous disorders, and had been but little among his scientific friends. During this time he had, however, not been idle.

The suddenness of his exit from this life has terrors for some, but we are sure it had none for him.

A Personal Friend.

New Automobile Records.

On August 23 an automobile race was run on the Brighton Beach track under the auspices of the Long Island Automobile Club. The steam-carriage built by a Harvard student, George Cannon, naturally attracted the most attention. The record which it made of 1 minute 7 3-5 seconds for the mile, eclipses all records made by steam vehicles over any track or road. The best previous record for the mile on a track was held by T. E. Griffen, and was made at Chicago, the time being 1 minute 38 seconds. The best record on a straight-ahead course, was made by S. T. Davis, Jr., on May 31 of this year, on Staten Island, the time being 1 minute and 12 seconds. Cannon was barred from racing, but made his record in an exhibition mile. The other events, although interesting, did not result in the breaking of any records.

At Deauville on August 26, M. Gabriel, on a Mors car, beat the world's record for the kilometer, the time being 26 2-5 seconds, or 84 miles an hour. Not so long ago W. K. Vanderbilt, Jr., covered the same distance in 29 2-5 seconds, but his record was subsequently lowered by C. Jarrott to 28 1-5 seconds. Serpollet was the favorite for the race won by Gabriel; but the great Serpollet failed a hundred yards from the finish, when a steam joint gave away under enormous pressure.

Hezekiah Conant, who died a few weeks ago at his home in Central Falls, R. I., was an extremely useful and benevolent man. He had accumulated a great deal of money, and during his lifetime was noted for the generosity with which he made use of his wealth in order to help his fellows. In his early manhood he devised a number of minor implements which enabled him to cultivate his taste for invention, and in 1857 he designed and patented several mechanical improvements for the manufacture of thread of all grades, and ten years after he was at the head of a large business concern which bore his name at Pawtucket, R. I. This has been since consolidated with the Scotch firm of J. & P. Coats. The establishment at Pawtucket now covers about forty acres of land, and is valued at $4,000,000.

Electrical Notes.

It is proposed to establish a post office and signal station for Marconi messages about 110 miles west of the Lizard. A ship is to be moored at this point, fitted with a powerful searchlight and the Marconi apparatus. Situated, as she will be, in the very midst of the channel, distribution of orders sent from shore by owners of vessels in passing in or out, will be greatly facilitated.

The Société Nouvelle des Etablissements Decauville has devised a handy portable electric generator applicable for domestic purposes. It is convenient for lighting premises which cannot obtain the necessary current from central stations. The dynamo is driven by an oil or gas engine. The pipes delivering the liquid fuel, and those for the inlet and outlet of the cooling-down water, run under the flooring, at the foot of the engine. Adequately effective means are provided for the escape of the gases of combustion. The base-plate is cast in one piece, and is fitted with a two-cylinder engine, all the motive parts of which are cased in. Automatic lubrication is provided. The dynamo is mounted beside the engine, on the same base-plate. A compensating flywheel is placed between the engine and dynamo, forming an elastic coupling, which insures the independence of both the engine and dynamo shafts, and also regularity in the working. A noticeable feature of the apparatus is a contrivance for insuring fixity in the degree of light, whatever may be the number of lamps in service. The engine can be easily and quickly dismantled and transported, while it does not require much attention when running—two essential features of the invention. The cylinders are 3⅛ inches diameter. The oil to lubricate the mechanical parts is supplied from a hand pump, and the cooling water is delivered under pressure, a suitable tank fed by a pump forming part of the installation, to insure a regular supply. The generating capacity of these engines is sufficient to supply current for forty 16 candle power lamps. The switchboard contains an exciting rheostat, and is made for direct lighting. Machines of similar design are also manufactured for the lighting of building yards. For this purpose the engine is mounted on a four-wheel trolley to facilitate transportation from one point to another. The installation in this instance comprises engine, dynamo, water tank, pump and gearing, ribbed tubes forming a radiator for cooling, a tank for liquid fuel, another for the lubricating oil, a switchboard and a roll of cable for connecting the dynamo with the lamps.

M. Eginitis, in a paper read before the Académie des Sciences, describes a series of novel effects which he observed in the case of the spectra obtained by an electric spark passing between different metals. He finds that by introducing self-induction into the circuit the spectra are modified in a striking manner. In one case he used two poles of aluminium wire of 0.04-inch diameter, covered to within 0.1 inch of the ends with a small quantity of metallic sodium. The wires are connected to an induction coil and a spark is passed for a few seconds. By introducing into the circuit a series of solenoids, the self-induction may be given any desired value; the resistance of the circuit is kept constant at 3 ohms. Ordinarily the spectra of the spark contain the aluminium and sodium rays, but when the self-induction is increased the aluminium rays diminish in intensity very rapidly, while the yellow sodium rays become stronger. A small coil 2 inches in diameter with a few turns of wire shortens up most of the aluminium rays, and on increasing the self-induction they almost disappear; meanwhile the sodium rays become more and more brilliant and finally reach a remarkable intensity. In this case the sparks have a bright orange color, due to the vapor of sodium, and the poles are surrounded by a halo of considerable extent. The values of the self-induction which eliminate the aluminium spectra are greater when the distance between the poles is increased, but in general diminish as the capacity of the circuit is greater. Other experiments of a like nature were made using sodium or potassium in connection with platinum, iron, tin, and other metals. In some cases the elimination of the spectra of one of the metals is difficult and not always possible; this occurs, for instance, in the case of a sodium-mercury combination. The elimination may also be obtained without the immediate presence of another metal on the same pole. In one case the experimenter used one pole of platinum and the other of mercury, contained in a glass tube; here the platinum rays were eliminated while the rays of the mercury were reinforced. Sometimes the mercury rays presented a curious appearance. Each of the rays was divided into two parts of different intensity. The most intense portion corresponded to the mercury itself, and the ray passed briskly from one part to the other as if the spark-gap had been half filled with mercury vapor. It may be remarked in general that the metals whose spectra are diminished are those which give but a small quantity of vapor, while the metals whose spectra remain or are increased in intensity are very volatile.

Engineering Notes.

In many mountainous regions a steel rope railway constitutes the only means of transportation. On this slender support and suspended 2,000 feet in the air, freight and passengers are daily carried. One of these aerial tramways was recently built by A. Leschen & Sons Co., of St. Louis, Mo., at Ouray, Colo. The line is 4,200 feet long and runs up 2,000 feet to the mouth of a gold mine. The line consists of two stationary sustaining cables, securely anchored at each end. The loaded buckets run on a rope 1½ inches in diameter, while the empty buckets return on a 1-inch rope. An endless steel wire rope ¾ of an inch in diameter propels the buckets, an 8-foot sheave being used at the terminals of the line. The buckets are attached and detached automatically to and from the traction cable. The weight of the loaded buckets traveling down is sufficient not only to operate the tramway by gravity, but also to bring up supplies to the mine.

One of the New York Central Company's new tandem compound locomotives recently hauled a train of 108 loaded cars from De Witt to Albany in eleven hours. The 108 cars were loaded with 4,500 tons of freight. This is the greatest tonnage ever moved by a single locomotive on any railroad in the world. Some idea of the size of the load can be gathered when it is realized that 9,000,000 pounds of freight were moved. The engine was in charge of Philip Eberhardt, of Albany. The same locomotive has also drawn 100 cars over the division. In the 100 cars there were 4,200 tons. The hauling capacity of the locomotive is enormous. It drew fifty loaded cars up the Schenectady hill without assistance, an unheard-of feat among Central enginemen. The increased power of the monster is gained by the use of steam four times, that is one compound cylinder placed ahead of the other, hence its name tandem compound.

During the last ten years a great many mines have replaced animal haulage with compressed air motors, which lend themselves splendidly to the work desired. There are, in general, two systems—the low-pressure system, in which air is compressed to five or six hundred pounds; and the high-pressure system, with air pressure of 2,000 pounds and over. The former system can be used in large galleries or tunnels or drifts where the width is ample and the track is reasonably straight. This permits a large receiver on the motor, 30 to 40 inches in diameter and from 8 to 16 feet long, to be handled with ease. The high-pressure system is used where the drifts are narrow or the curves on a small radius, permitting only a small wheel-base on the motor. Large receivers are, therefore, impractical, and steel tubes must be used and charged with high-pressure air to get sufficient volume. Compressed air may be used cold on either of these motors, or the air may be passed to small tanks of hot water supplied to the motor at the charging stations. The air and hot water combination does almost double the work that cold air will do. These motors can carry sufficient air for any ordinary run desired and haul tremendous loads. Two miles and return, with fifteen or twenty loaded cars, is not an extraordinary effort, and from the general results obtained, the cost of haulage is from one-half to one-third of the cost of the animal power. The air escaping from the exhaust of the motor engines adds to the ventilating effect in the mine and the whole system harmonizes thoroughly with the power outfit in the average mine.—Cassier's Magazine.

One of the most ancient industries in existence at the present time in Europe is the production of zinc in Silesia. From the sixteenth century calamine was obtained in the manors of Beuthen and Jagerndorf; it was used in the local manufacture of brass, and it was exported to the countries adjoining the Oder and Vistula. During the 30 years war, when the workmen, mostly Huguenots, had abandoned the mines, this industry disappeared, and its exploitation did not recommence until the eighteenth century, when George de Giesche, a Breslau merchant, obtained in the year 1704 from his sovereign Leopold the privilege, for 20 years, to extract calamine in Silesia. The first zinc foundry established in Silesia was that of Lydagnla, which existed from 1809 to 1900. At first prices were very high, $21.75 per quintal. As the production increased, which in 1816 reached 20,000 quintals, prices dropped to $3.75 and in 1820 to $2.35. This year proved fatal to the high furnaces, some of which were obliged to shut up. At that time the article was exported to Asia via Brody and Russia. In 1820 the English route was employed for shipment to India, where it proved a powerful competitor to the Chinese zinc. This exportation gave fresh prosperity to the Silesian mines. Since 1830 the production has continued to increase. In 1837 there were 32 works, employing 1,091 workmen, in activity, and the production reached 207,707 quintals. At present it exceeds 2,000,000 quintals, and requires nearly 8,000 workmen. The exportation in 1897 amounted 496,004 double quintals, and in 1901 to 533,129 double quintals. The nominal price at Breslau is now from $3.25.

Science Notes.

After having vanished from view for more than a year, the planet Eros has been rediscovered. The planet was first observed in 1898 by Witt, of the Urania Observatory, Berlin, and given the name which it bears. Until 1898, as far as telescopes could show, Mars came nearer to the earth than any other planet, but after Witt's discovery it was found that Eros reached a point a little more than a third of the distance from earth to Mars. The honor of the rediscovery belongs to Professor G. D. Ling, of the Chamberlin Observatory, Colorado.

In the streets of Paris there may soon be installed a noval apparatus for rendering first aid to the injured. A model of the device was recently tested. According to reports which have been received from Paris, the contrivance resembles a lamp-post letterbox and contains a small medicine chest, folding stretcher, and is equipped with a telephone apparatus for communication with the nearest ambulance station. In order to obtain access to the box, a glass panel is broken, as in some fire alarm systems.

A curious astronomical phenomenon was observed in the South of England recently, a short time after sunset. From a bank of clouds hanging over the horizon to about 35 degrees, a clear pillar of light, about 5 degrees in width and perfectly cylindriform, shot up. It was distinguishable almost to the zenith, and was deep crimson in color on the horizon, dissolving to the sky color through orange as it ascended. This appearance was nearly stationary and perpendicular to the horizon, and what slight movement could be detected was with the sun, but the column remained perfectly upright. This remarkable light faded down rapidly in about eighteen minutes from the time when it began to decrease, although it had rather the appearance of being withdrawn below the horizon than fading, for the color did not decrease in intensity in the same proportion that the column decreased in size. This phenomenon was seen on an evening following one on which there was a vivid display of zodiacal light and Eastern night glow.

The report of the Parliamentary Committee which was formed some time ago in England for the purpose of investigating acetylene generators in the interests of public safety, has been published. Various types of generators, the greater proportion of which belonged to the automatic class, were examined, but the latter type are not recommended as being the most secure. In the automatic generators the object is the gradual generation of the gas as used, thus dispensing with the necessity of the gas holder. This principle of generation is claimed to be more advantageous and convenient than the non-automatic type in which the gas is evolved in a short time from a given charge of carbide, and has to be stored in a gas holder. The committee, however, point out that the advantage of the automatic type is emphasized only where skilled supervision and favorable conditions are assured, but the varied conditions of use, especially with unskilled labor, these advantages are completely nullified, while many automatic generators were condemned as being of too complicated design and deficient in constructional strength to be of practical utility. On the whole, having regard to the conditions of use which must often prevail, the committee have advised that a generator conducive to the greatest safety should comprise the following desiderata: Simplicity of construction and design, strength of construction, high efficiency as indicated by the yield of gas per pound of carbide, low pressure in generator, and facility of removal of the residue.

In the Popular Science Monthly Prof. Woodward discusses the progressive cooling of the earth and its relation to the length of day. Whether the day was formerly shorter than now, and whether it will be longer in future, depends upon the mass of the earth, for meteorological dust constantly falls upon the surface and increases the quantity of matter. Laplace concluded that there had been no sensible change in the length of the day for nearly 2,000 years. Repeating this calculation with new data Prof. Woodward finds that the day has not changed so much as half a second during the first ten million years after the beginning of the solidification of the earth's material. When the cooling of the earth is finally determined, the change will be marked. Prof. Woodward finds that the ratio of the change by day to its initial length is two-thirds of the product of the loss of temperature multiplied by its cubical contraction. If the primitive temperature of the earth, for example, was 3,000 deg. C. and if its cubical contraction was that of iron, the day will be finally reduced about 6 per cent; that is to say, about one and a half hours. In order to bring about so pronounced a change, an enormous lapse of time is necessary. About three hundred thousand millions of years, according to Prof. Woodward, are required for a 95 per cent contraction to take place. After the expiration of one million millions of years the length of the day will not be sensibly affected.