England and in the United States in a somewhat different form.

The rolling stock of the road consists of motor cars, electric locomotives, ordinary passenger coaches and freight cars. The motor cars have a seating capacity of 66, and are divided into first and second-class compartments. Each motor car has a hauling capacity of 20 tons at a speed of 36 kilometers (22.4 miles) per hour, on a 25-millimeter grade. The weight of each motor car is 32 tons. The body, which has a length of 16.3 meters (53½ feet) between the buffers, is carried on two bogie trucks separated by a distance of 9½ meters (30.1 feet). Each axle carries a motor of 60 horse power, with a speed of 600 revolutions per minute. The total weight of electrical equipment of the motor car is about 10 tons. Each motor alone weighs 1,500 kilogrammes (33,000 pounds). The electrical equipment of these cars, besides four asynchronous motors of 16 horse power, comprises two controllers; four variable resistances disposed transversely under the bodies between the bogie trucks; one controlling device for these resistances; four trolley loops; two sheet-metal boxes inclosing each four lead fuses, conveying current to the motors; one 18-kilowatt transformer to step down the current from 750 to 100 volts, for heating and lighting the car; one box containing fuses for the transformer; one compressor driven by a four horse power motor supplied with current at a hundred volts; one automatic circuit breaker for the motor of the compressor; six electric lamps for regular outside lighting; ten lamps for interior illumination; fourteen electric radiators for heating; six heat regulators; and one small switchboard carrying the switches controlling the radiators and the lamps, as well as the lead fuses of the motor of the compressor.

The three-phase motors employed have eight poles, with a fixed field magnet and movable armature. The winding of the field magnet comprises fifty-one turns for each phase. The resistance of the winding of a phase is 0.71 ohms. The winding of the armature comprises eight turns per phase, and the resistance of the winding for each phase is 0.0153 ohms. When the armature turns with a speed equal to that of the generating dynamo, the number of revolutions is 60 per minute. The four field magnets of a car are mounted in parallel in the circuit conveying the current. The four armatures are connected with four independent rheostats located beneath the car and regulated simultaneously by the controllers. These rheostats are used at the moment of starting. In order to cut out a motor the two corresponding circuit breakers are operated.

The trolley loops are of rather novel form. They consist of two frames placed side by side and carefully insulated from each other. That portion of the loop which is subjected to sliding friction is made of a highly polished brass tube triangular in cross section. By a single rotation of 120 degrees the surface of contact can be changed.

Each motor car is equipped with a Westinghouse air-brake as well as the usual shoe-brakes, which latter serve not only to check the speed on down grades, but to bring the car to a stop. In order to check the car on down grades, the motors themselves are used; for when the number of revolutions exceeds that required for perfect synchronism a braking action is obtained.

The locomotives employed for the haulage of freight trains are carried on two axles. Their weight is about 30 tons each.

The locomotives are provided with sills similar to those of steam engines. By reason of the comparatively large amount of space taken up by the two motors, which are each of 150 horse power, it was found impossible to mount them in the usual way. They were, therefore, disposed outside of the two sills. The method employed to transmit to the axle the movement of the common shaft of the two motors is original. Beneath the motor shaft, which is equidistant from both axles, is an auxiliary shaft, which carries two gears meshing with two pinions keyed on the motor shaft. These two groups of gears and pinions constitute a variable speed gear. The auxiliary shaft, which turns at the same speed as the axles, transmits to them the movement of the driving shaft by means of four connecting rods. Counter weights carried on the auxiliary shaft balance the rods and lessen the perturbations due to the inertia of the parts.

This arrangement of the motors may, at first sight, seem open to criticism. It must, however, not be forgotten that the locomotive is intended to be used for the haulage of heavy freight trains at fairly high rates of speed.

The speed of the motors is 300 revolutions per minute. Two changes of speed are obtained by cutting out one of the trains of gears.

With the motors developing a speed of 300 revolutions per minute, the normal speed attained is 33.6 kilometers per hour (21.6 miles) with a high-speed gear. By throwing in the other train of gears, the speed is reduced one-half. In this latter case double the load can be hauled. The throwing in of the gears cannot be accomplished while the train is in motion.

Each locomotive is equipped with two controllers similar to those to be found on the auto-motor passenger cars. Starting is effected by the interposition of resistances, which are cut out when the speed has risen to a certain point. The electrical equipment of these locomotives is almost exactly similar to that of the auto-motor passenger coaches.

The length of a locomotive from buffer to buffer is 7.8 meters (25.58 feet); the diameter of the wheels is 1.23 meters (4 feet); the total weight is about 30 tons, about 10 tons of which fall upon the electrical equipment.

Like the coaches, the locomotives are equipped with Westinghouse brakes. The air is compressed by a small pump driven by a four horse power motor. The starting resistances of the motors are inclosed in a cylindrical casing.

From all accounts the road has been very successfully operated at a comparatively low expense. The road is still another instance of the successful adaptation of the polyphase current to electrical traction.

THE BROOKS COMET OF 1902.

BY DR. WILLIAM R. BROOKS, F.R.A.S.

Announcement of the discovery of this comet on April 14 was duly made in the SCIENTIFIC AMERICAN. The writer was engaged in sweeping the eastern morning heavens with the ten-inch equatorial telescope of this observatory, when the comet was discovered near the northwest corner of the great Square of Pegasus.

It is a curious fact that this comet was found in the same telescopic field in which my comet of February 23, 1883, was discovered, that, however, being in the evening sky. This is, of course, simply a coincidence, and does not indicate that the two comets are identical, or indeed, have any relation to each other.

The appearance of this latest comet is well shown in the accompanying picture—a highly magnified telescopic view. The body of the comet was slender, tapering gradually to the coma, which had a minute stellar nucleus. The tail was narrow and slightly branching. The comet was fairly bright in telescopes of moderate power and an interesting object.

THE BROOKS COMET OF 1902.
Discovered by Dr. Brooks April 14.

Its path was diagonally across the Square of Pegasus, and at the time of discovery was moving toward the sun at the rate of three degrees daily.

The following elements of the comet's orbit have been furnished by Prof. Leuschner:

Time of passing perihelion, May 28.
Perihelion minus node, 274 deg. 30 min.
Longitude of node, 35 deg. 3 min.
Inclination of orbit, 71 deg. 50 min.
Perihelion distance, 0.5542.
Eccentricity, 0.3947.
Periodic time, 0.88 year, or a revolution about the sun in 320 days.

These data are to be regarded as tentative, but if approximately correct the above elements show this comet to be an exceedingly interesting one, having by far the shortest period of any known comet.

Encke's comet has a period of three and one-third years—the shortest heretofore discovered—and other short-period comets have periods ranging from five and a half to thirteen years; while this latest cometary addition to our solar system, should the above elements prove fairly accurate, performs its revolution in less than a single year.

The comet is at this writing lost to view in the sun's overpowering rays. It will emerge therefrom south of the sun, after which the comet should be well observed from the southern hemisphere.

According to statistics prepared by W. E. Nichols & Co., of New York, there are eighty-three banks in New York city, having an aggregate capital of $98,872,700, and thirty-seven trust companies of New York and Brooklyn, with an aggregate capital of $43,000,000.

Correspondence.

Volcanic Eruptions.

To the Editor of the SCIENTIFIC AMERICAN:

Volcanic eruptions are the absorbing topic since the terrible calamity on the island of Martinique. Their cause and prevention furnish interesting problems for discussion. It seems to be the consensus of opinion that "water" is the "spark" which explodes these awful mines. The question which presents itself is: Is not this explosive agent automatic in origin; being in fact the lake of water which is generally found filling up the crater of the so-called extinct volcano? Following an eruption as a rule the volcano continues more or less active for years. Then an interval of inaction succeeds; during which the bottom of the now inactive crater fills up and becomes impacted and waterproofed with the accumulating detritus of years. The rains of many years following this period gradually collect and form the crater lake. This lake during another lapse of years slowly percolates and weakens some spot in its bed until sufficiently enlarged to suddenly precipitate its contents in the subterranean depths below. This event may be accelerated by an unusual atmospheric pressure.

If the above hypothesis furnishes the true cause, the prevention naturally suggests itself to be the emptying and future draining of the crater through a tunnel which would prevent any large collection of water. B. S. P.

Savannah, Ga., May 19, 1902.

Lightning Effects.

To the Editor of the SCIENTIFIC AMERICAN:

Please give me an opinion through your paper on the following: On Friday night, May 2, a storm passed over our town, the lightning striking two trees, one with very peculiar results. A large red oak tree stood about 30 feet from a vacant house. The tree had a large slab torn from one side, the slab being about 25 feet long. The slab was broken into six large pieces and hundreds of small ones, some thrown a distance of 40 yards. One piece, 12 feet long, went entirely over the house; one struck a large tree near by; and the heaviest, 10 feet long and weighing about 70 pounds, struck against the closed shutters of a window, broke through shutters, sash, and glass, carrying all away clean; tore a large hole in the ceiling, then crashed into a window frame on the opposite side of the room. Now to the point. The timber doing the damage was a "stump piece," and had part of a root to it, the ground end having struck the house first. To do this it was thrown upward at an angle of about 35 deg., as the hole in the ceiling shows. My questions are these:

What force threw the timber? Was it steam caused by the heat of the lightning?

What caused the timber to fly upward?

Did the current run up the tree?

The force surely acted from below.

The tree has no marks above where the slab was torn off—is not shattered.

The lightning did not strike the house.

Gaithersburg, Md. S. A. LEHMAN.

[We must say we do not know to what the lightning owes its power to rend and split stones, trees, houses, etc.; not to steam in the case of dry articles, surely. That the electric current went from the ground to the cloud in this case seems certain. It does in many cases. Our professor in college said he always saw the lightning go up and never down. This is a mere result of habit of mind, since the flash is so sudden that no one can see it go in either direction, and any one may train himself to see it go in either direction. —ED.]

Standard Time-Signals by Electric Light.

To the Editor of the SCIENTIFIC AMERICAN:

For many years the time-ball has been generally accepted as the standard form of apparatus for giving time-signals to the public. In most of the principal seaports of the United States are time-balls which are dropped exactly at noon by telegraph from an astronomical observatory. The signals thus given are of great public benefit, and are especially valuable to shipmasters whose vessels lie within sight of the ball. A time-ball, as usually constructed, is about three feet in diameter, and can be seen with the unaided eye at a distance of about two miles. The care and expense involved in its maintenance are such that it is usually impracticable to operate it oftener than once a day.

In a letter published in the Boston papers in April, 1901, the writer suggested the use of incandescent electric lights for giving time-signals, and proposed that the lamps used to illuminate the dome of the Massachusetts State House be utilized for the purpose. It was pointed out that such lights can be readily seen at a distance of ten miles or more, and that if operated automatically by telegraph from an observatory, they could be made to give standard time-signals which