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 could hardly be surpassed for accuracy and effectiveness. Because of opposition on the part of the Sergeant-at-Arms the plan was never tried at the State House, but is now about to be carried out at the Harvard College Observatory. Signals will be operated simultaneously in Cambridge and in Boston.

Such is the facility with which the electric current can be controlled by automatic devices that, telegraphic communication with an observatory having been once established, signals could be given at frequent intervals, for example, every five minutes, during the evening, instead of once a day, as in the case of the time-ball. It is, of course, essential that the telegraphic signals, in order to be of value, should come directly from an astronomical observatory, as it is only at such an institution that the time can be determined and kept with the necessary degree of accuracy. Three distinct plans are possible under the proposed system, as follows:

1. The signal could be given once each evening at a prearranged hour as, for example, nine o'clock. The lights, which would be burning before the appointed time, would be turned off by hand at about fifteen seconds before nine. The controlling switch would then be connected with a telegraphic instrument operated from the observatory. At precisely nine o'clock a signal from the observatory would release the switch, causing the lights to flash into full brilliancy. This method, which is similar to that employed for the time-ball, would require the services of an attendant. It would have an advantage over the time-ball in that the radius of visibility would be much greater.

2. Auxiliary clockwork located near the lights could be made to turn them off a few seconds before the appointed time, and in so doing, connect them with the observatory instrument which would light them again at the proper instant, the entire operation being repeated at intervals of five minutes. By this plan the apparatus would be entirely automatic, and would require no attendant.

3. A specially constructed relay could be operated by the observatory circuit, causing a momentary interruption of the lamp current in response to every signal received from the observatory. Most observatory clocks give signals continuously, at intervals of one or two seconds, a pause preceding the sixtieth second to mark the minute. The Harvard signals, which have been extensively copied elsewhere, are given every two seconds, one beat being omitted before each minute, and twelve beats every five minutes. Thus, a person having the time within thirty seconds can correct his timepiece by waiting for the pause marking the minute. If the error of the timepiece is not known within thirty seconds but is known to be within two and one-half minutes, it is necessary only to wait for the long pause marking the fifth minute. Tests made at the laboratory of the Harvard College Observatory have shown this method to be remarkably effective; and it is probable that the signals to be established in Boston and Cambridge will be operated upon this plan.

It is evident that the new system is applicable to any number of lamps. A single lamp may be used for local purposes, in the street, or at the entrance of a public building, or several hundred lamps may be employed, giving a powerful light which can be seen for many miles. When the radius of visibility of such a light is considered in connection with the frequency with which the signals can be given, some idea of the efficiency of the system may be obtained. Moreover, it is not necessary that an expensive plant should be established especially for the purpose. The towers and domes of many large buildings are already illuminated for spectacular purposes. The equipment thus used could be utilized at trifling expense without materially altering their construction. A signal established at some point in New York harbor as, for example, on the Statue of Liberty, would be of inestimable value to the shipping interests, and would become a most striking and interesting landmark.

It may be argued that lights can never take the place of the time-ball, as they cannot be seen by day. Experience seems to show that the use of a standard time signal at midday is largely a matter of habit, arising probably from the old custom of ringing bells at noon. For most purposes almost any other time would answer equally well. The new system is not, however, designed to necessarily supersede the time-ball, but may, if desired, be used as a separate and supplementary service, having far greater efficiency.

WILLARD P. GERRISH.

Harvard College Observatory, Cambridge, Mass., May 23, 1902.

The Current Supplement.

The leading article of the current SUPPLEMENT, No. 1380, is devoted to a discussion of the occurrence and distribution of corundum in North Carolina and Georgia. The article is accompanied by four illustrations. Results of a most careful research in experimental phonetics are told by Prof. John G. McKendrick. The paper is one of the most important which has appeared on the subject of acoustics for years. The many illustrations presented do much to elucidate the text. Dr. Perrine concludes his interesting account of the power plants of the Pacific Coast. Striking illustrations accompany his description. Dr. Soper tells of the sanitary measures to be adopted after floods. The Hon. Carroll D. Wright writes interestingly of the use of statistics. The usual trade notes and consular matter will be found in their accustomed places.

THE MODERN USE OF ELECTRICITY IN PRINTING.

BY FRANK C. PERKINS.

It is certainly surprising to note to what extent electricity is now used in the leading printing establishments of this country, as well as in Europe. It is with a deep feeling of pleasure when one steps from the old-fashioned belt-driven pressroom into the modern, clean, bright, well-lighted, motor-driven pressroom of an up-to-date printing plant. The dark, ill-smelling, poorly-ventilated, dingy basement printing shop is now radically changed, it being noted that electricity has been the wonder worker, and is now supplying current for lighting the various departments with brilliant arc and incandescent lamps. The foul odors are dissipated and driven out of the workrooms by powerful electric fans and motor-driven exhaust blowers; the fast-flying belts which endanger life and limb, with the numerous countershafts and pulleys, have disappeared, and in their place are to be found separate motor-driven machines of every type and kind known to the modern printing trade.

In the typesetting room the electric motor is geared to the linotype machine, and the composition is accomplished with great accuracy and dispatch; the type-casting machines are operated by dust-proof electric motors, and direct-connected routers and metal saws are at work, saving power and economizing space and increasing the product in a given time. The electroplating branch has always been an important application of electricity in the printing industry.

In the pressroom the motors are connected to the various machines either by belting, by gears, or by being directly connected to the press, the latter being accomplished in many cases by simply removing the tight and loose pulleys, which were used for driving by belts from the main shafting, the motor simply being substituted.

The advantages of direct connection are many, including noiseless running, simplicity of construction, reduction of losses from friction, and slippage of belts, while the space in the pressroom required is less and the life of the motor is greatly increased, largely due to its slow speed. The automatic folders are frequently driven by the electric current, and the modern paper cutter is also operated in this way with great reliability and safety, it being possible to stop the cutting machine instantly if desired.

In the binding department there is probably as great a field for the electrically driven machine as any in the entire printing establishment. The embossing presses of the latest types, as well as the binding machinery, cutting machines, stitching machines, and graining machines, are electrically driven, producing a great saving in power, which is used only in proportion to the work done. It is not necessary to supply power for the whole plant when only one or more machines are working, as the moment the operator breaks the circuit the motor stops and all of the expense immediately drops off. With shafts, pulleys, and belting this is not the case, as there is a continual loss due to the friction in operation of same when there is no load, and the losses due to slip of belt are continually varying from month to month, due to variation of tightness of belt, arc of contact, and smoothness of the pulley faces. On account of the settling of floors and walls, the line shafting is bound to get out of alignment more or less, which also is a great source of loss. The entire belt transmission system is continually becoming clogged and covered with dirt, grease, and flying dust, while the motor-driven machines result in greater cleanliness, a saving in the cost of insurance on account of decreased danger from fire, and a greater amount of light, due to the entire absence of these overhead obstructions. Electric heaters are now being installed in many binderies, and electric motors can be adopted with great economy and many advantages by every printing establishment in the country, and there are a large number now fully equipped with this system of driving. The work of the printing press is bound to be more or less intermittent, which always results in a saving in motor-driven machinery, this being largely due in this class of work on account of the necessity for stopping to "make ready." It is also true that for the preliminary impressions the press must be run very slowly, and frequently started and stopped, and this cannot be so well accomplished by mechanical drive, although later the speed may be increased to a maximum limit, turning off thousands of impressions in a short time.

The Bureau of Engraving and Printing at Washington, D. C., is thoroughly equipped with electrically-driven machines operated by General Electric motors; and many of the leading newspapers and magazines have had their plants equipped with Lundell, Northern and Bullock machines, these types of motors having been extensively used for direct connection, as well as by gearing and belt driving, to most of the high-grade presses, cutting machines, routers, stitching machines, and other devices used in an up-to-date printing establishment.

It is not always the high speed of a press which produces the greatest amount of work, but the one which can be kept operating continuously at a comparatively rapid rate without a great number of stoppages, from various difficulties, a great amount of time being lost.

The breaking of belts and other faults due to bad power transmission causing delays require a greater speed from the press to make up, while a moderate speed under continual operation means greater economy, increased output, and less wear upon the machinery.

It is very easy in many cases to equip an old printing establishment with electrically-driven presses without discarding existing valuable apparatus. In these cases it is found very convenient and desirable to use a short, endless belt to connect the motor with the press, the standard press pulley being used, and no changes are required on the press. This method frequently allows placing the motor under the press, and no valuable space is thus occupied. The geared outfits and direct-connected outfits are, of course, the most substantial, the latter being really the ideal method, although the cost is considerably higher, as very slow-speed motors are required.

The direct-connected outfits have the armature of the motor attached directly to the driving shaft of the press without the interposition of gears or other transmitting mediums. The armature must, therefore, run at the required speed of the press shaft, which is usually very much lower than that of the ordinary electric motor.

The accompanying illustrations on our front page show several German direct-connected motors built by Schuckert & Co. of Nurnberg operating high-speed presses of the Frankenthal type.

The first cost of the motors for the geared and belted outfits are much lower than the direct-connected type, and the first cost of electrically operating with any type of motor is, of course, more than the old belting and shafting transmission. The advantages to be gained by the former over the latter, even at the added cost, are well worth the increased expense, on account of the saving of the great friction losses, economy of floor space, noiseless running, and greater reliability and safety.

The cost of equipping a printing plant is greater, as the use of the booster teaser, in addition to the motor, increases the expense of the electrical machinery by that amount; but as in the case of the advantages of the direct-connected, slow-speed motor over the high-speed belted or geared motor, the increased first cost is more than made up in the saving in current and other features.

Bird's Eye Maple.

What is bird's eye maple? That is a question which just now seems to be baffling not only people who use furniture made of this particular wood, but even woodworkers themselves. In a recent number of a woodworking magazine an article was published which stated that bird's eye maple was not a peculiar maple, but simply ordinary maple cut in a certain way. In a recent issue of the New York Sun that statement is refuted. It is there stated, on the authority of a woodworker, that bird's eye maple and curly maple are both cut only from the logs of the rock maple tree, *Acer saccharinum*, in which a beautiful lustrous grain is produced by the sinuous course of the fibers. This tree is not at all the common hard maple. It is a hard maple, but is full of little gnarls called eyes. Men looking for bird's eye maple logs go through the standing timber and pick out the bird's eye maple trees, paying for them from $30 to $50 a thousand feet in the woods. Ordinary hard maple logs are worth only from $6 to $7 a thousand feet. It would be impossible to cut a piece of veneer with eyes in it from a common hard maple log, and would be equally impossible to cut a bird's eye maple log, no matter how you cut it, so that it would not show the eyes.

The first sod of the new dock at Avonmouth, Gloucestershire, England, on which the sum of $10,000,000 is about to be spent, was turned on the afternoon of March 5 by the Prince of Wales. It is hoped that a portion of the American traffic formerly enjoyed by the port of Bristol will be recovered by the building of the new dock. In 1893 the corporation of Bristol presented a bill to Parliament asking for power to build a new dock at Avonmouth, large enough to accommodate at one time three of the largest Atlantic liners then afloat. After nine years of earnest effort, work has now begun.