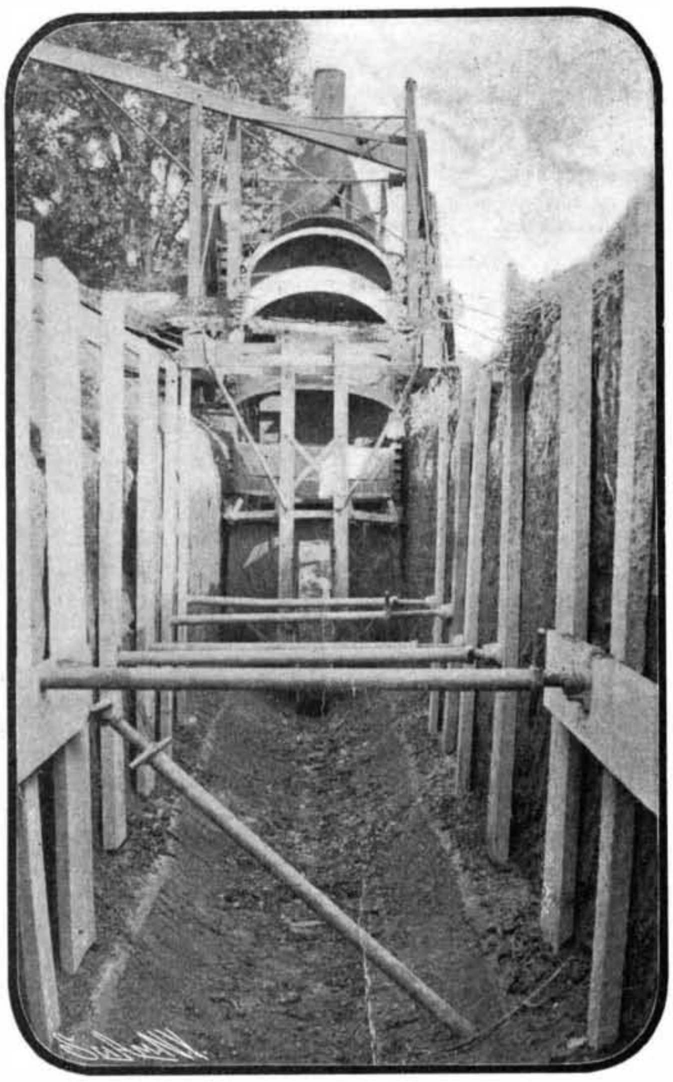
THE BUCKEYE TRACTION DITCHER.

BY FRANK C. PERKINS.

One of the most unique labor-saving devices recently brought out is the Buckeye traction ditcher, designed to cut trenches and ditches. By means of this machine tile trenches are dug entirely without the use of hand labor, and this is of great importance, as the time of year when this work must be done is frequently when it is practically impossible to find an adequate number of men available.

In order to do this class of work successfully a machine must be able not only to cut trenches while the earth is moist and soft, but it must work equally well when the earth is hard and dry. The Buckeye traction ditcher was designed by James B. Hill, a mechanical genius of Ohio, and it is said to be capable of successfully working in swamp lands; at the same time it is able to withstand the severe strains encountered in hard pan.

The rigid frame of a 54-inch machine carries the boiler, engine, and all of the necessary details which are required to furnish as well as transmit power to the excavating wheel, which is hung independently of the main frame, and works in a frame of its own which is supported by the wheel itself and also by a leveling shoe which slides along in the bottom of the trench, thoroughly leveling the little inequalities which are occasioned by the vibration of the machine and pebbles taken up from the bottom. The 54-inch wheel cuts a trench 54 inches wide and the 14½-inch machine cuts a trench 14½ inches wide, the latter width being used for 11-inch tile.



A Trench Dug by the Machine.

The boiler on this machine is constructed of flange steel of a tensile strength of 60,000 pounds per square inch and is equipped with mud and fire door rings. The engine is of the center-crank horizontal type, using the locomotive style of crosshead, and link reverse duplex engines are used on the large machines, while a single engine is used on ditchers cutting trenches 14½ inches wide. The engines are coupled to a steel crank-shaft the throws of which are set on the quarter—that is, 90 degrees from each other—the same as on a locomotive. The bedplates of the engines are riveted to a steel base plate and this is bolted to the main frame of the machine. The engines are coupled up with one feed pipe in the larger sizes, a single governor being employed, and both exhaust pipes are also connected into one.

The "business end" of this machine, the same as the bee, is at the rear. The excavating wheel is constructed of malleable iron and steel and the wheel proper consists of two circular rims held together at a proper distance from each other by the steel bucket-backs, which are riveted in place. In front of the backs and over them are the steel hoods or bucket-tops which hold the earth cut loose by the cutters.

The center cutters are placed in front of the hoods or bucket tops and the cutting edge of the center cutters is a half-circle in shape. A little ahead of the center cutters are placed the side cutters, two to each center cutter, one on each side of it. The cutters are all forged by trip hammers and are shaped over forming blocks which make them "flaring," giving them the proper angle for free cutting, giving them free clearance, so that their cutting edges alone come in contact with the earth.

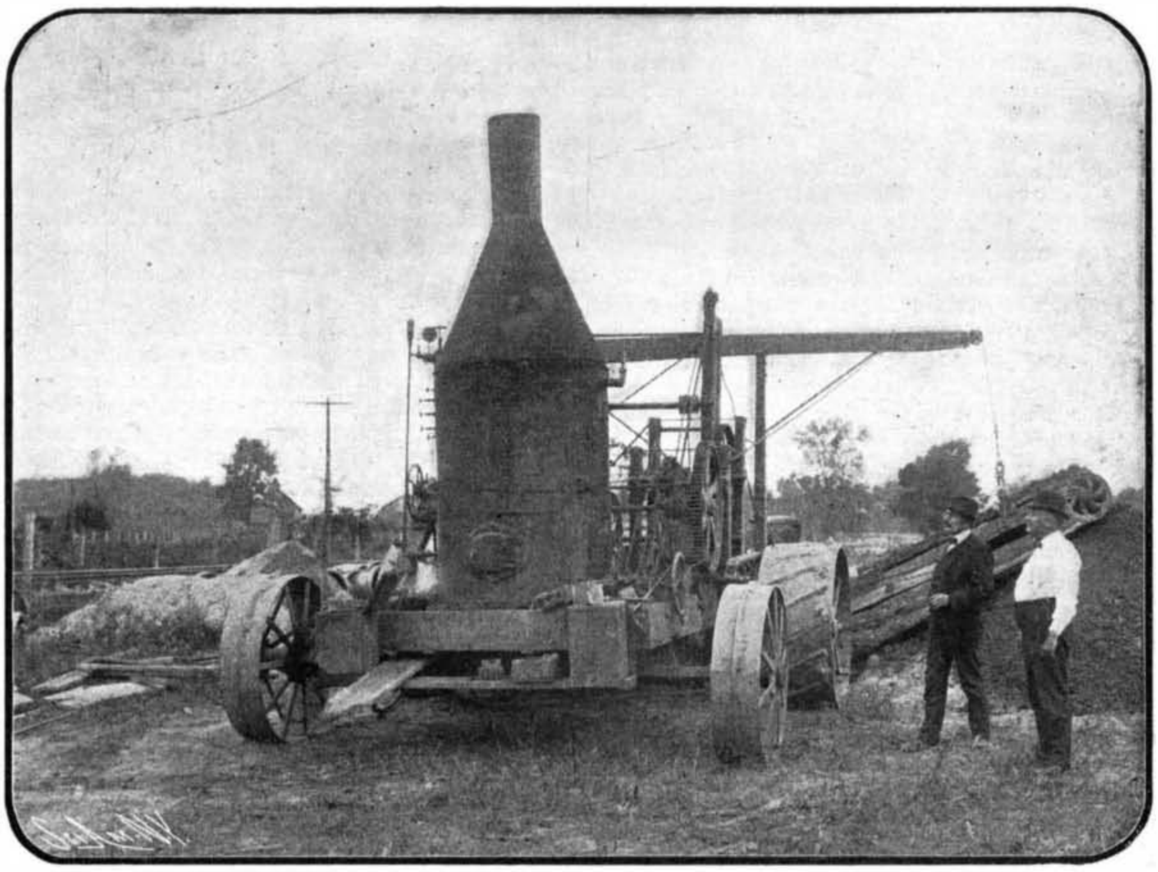
The cutters are held to the excavating wheel by bolts, two in each side cutter and four in each center cutter. These bolts are amply strong to hold the cutters to their work in the hardest earth. But they are just light enough so that they will shear off in case the wheel strikes quickly some solid obstruction which would break the machine. They are the safety valves of the machine, the same as wooden pins are safety devices on a grain drill.

The excavating wheel is driven directly above the point where the actual cutting is being done, and there is said to be no power lost in friction after it reaches the wheel. This is shown by the guide rollers that keep the wheel in position which are actually loose when the wheel is cutting. The power, it is claimed, is entirely expended in cutting and lifting the earth, and the side of the wheel opposite in going down counterbalances the part coming up. The driving of the excavating wheels is accomplished by means of two heavy sprocket wheels whose teeth engage with segments riveted to the rims of the wheel.

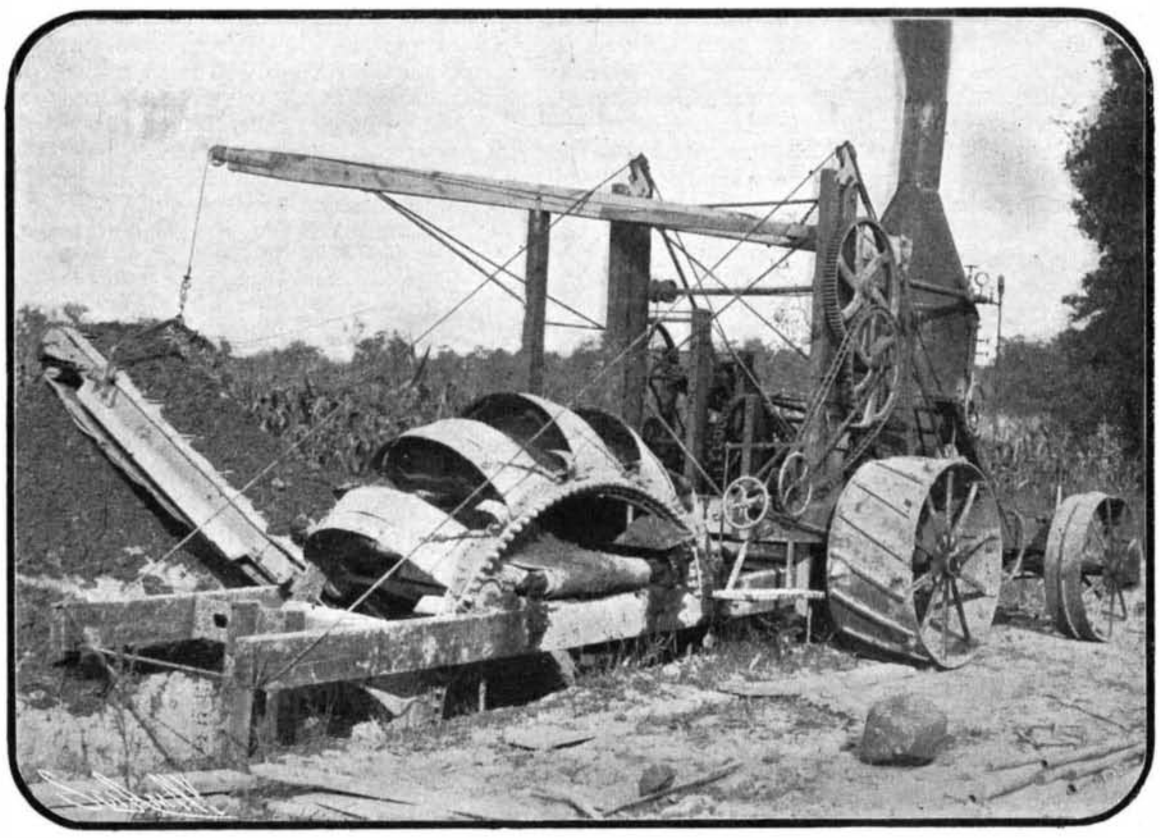
In places where the earth is inclined to be sticky, when just at the right (or rather wrong) consistency, the earth "sticks" to the sides of the buckets, in the small machines, so that it is necessary to provide a means of mechanically getting rid of the earth at the proper time.

Two cleaners have been provided which work automatically, one upper and one lower.

The upper cleaner is held in place by inverted V-shaped steel forgings which are clamped at one end or leg, and bolted at the other end or leg to the frame of the excavating wheel. This cleaner is constructed with three arc-shaped and diamond-pointed spades, which are bolted to the cleaner head and are of such shape and are spaced so that one is always in position for the oncoming bucket, which, as soon as the cleaner is reached, by its own action, forces the spade into and down toward the opening of the bucket, thereby positively discharging the material upon the elevator or "dirt-carrier" apron. This action brings another spade in position for entering and cleaning the next oncoming bucket.



Rear View of the Ditcher.



View Showing the Buckets of the Machine.

THE BUCKEYE TRACTION DITCHER.

This cleaner is controlled by friction collars, one of which is secured rigidly to the cleaner shaft and the other is a sliding connection and is held to the cleaner by a diaphragm-shaped spring.

The lower cleaner works quite differently and is constructed with but one cutting edge, and is forged from a bar of steel, arc-shaped to give it strength, and with two legs whose outer ends are hinged to the under and rear part of the excavating frame and just forward of the inside edge of the excavating wheel.

The driving mechanism consists of a train of gears, cut from the solid metal, which are held to their work and in position by malleable side-bars. These gears vary in width of face and also ratio of speed with the different size machines. The larger the machine, the wider is the face of these gears, and also the greater is the difference in ratio, as on a large machine there is much more earth to be moved, and also this earth must be carried further. The train of gearing spoken of, drives the cross-shaft, which carries the large bevel gear, which meshes into and drives the bevel pinion on the rear end of the elevator. Incorporated with the bevel gearing and forming a part of it is a friction disk. This frictional drive is necessary, because of the fact that when working in stony soil small stones sometimes become lodged in the sprocket chains of the elevator. Again, a large stone sometimes becomes wedged between the bucket backs of the descending part of the wheel and the outer edge of the elevator apron. In those cases the friction disk will slip and thus prevent the breakage of any part of the machine.

The operator stands or sits on his platform and by sighting over the guide toward the grade stakes he keeps the bottom of the excavating wheel on a true grade. As soon as the machine has traveled a few feet the rear shoe is then placed in position and clamped in place, after which the cables are taken off. The wheel is now carried at its rear by the rear leveling shoe and at the front by the chains or cables, as the case may be, which are controlled by the operator by means of the grade wheel.

This most interesting labor-saving device cuts to a perfect grade and it does it with a single cut at any depth up to its capacity from 4½ feet deep to 12 feet deep. It is said to operate rapidly, cutting at the rate of 3 lineal feet per minute at a depth of three feet in ordinary earth and greater or less depths at proportionate speeds.

THE COMPLETION OF THE NEW YORK SUBWAY.

Four years after the signing of the $35,000,000 contract for the construction of the New York Rapid Transit Subway, and approximately on the day set for completion, this great work will be thrown open for the use of the public. The event will be marked by considerable civic festivity, and rightly so, for the Subway will not merely bring instant relief to the millions who for the past few years have suffered intolerable crowding under the present inadequate means of transportation, but it is in itself, judged in comparison with other great engineering works of a like character, positively without a rival. Paris, Berlin, and Budapest have their subways; but in total length and carrying capacity they do not compare with our new system of rapid transit. Nowhere can there be found such a stretch of magnificent four-track road as extends from City Hall Park to One Hundred and Fourth Street, a distance of 6.7 miles, to say nothing of the 18 miles of three-track and two-track road that go to complete the system.

The section of the Subway that will shortly be opened represents the first contract, which was let four years ago for the sum of $35,000,000. The amount named was merely for the construction of the road. As a matter of fact, the equipment, which includes the cars, the electric signaling apparatus, and the great power station at Fifty-ninth Street with its various substations, scattered along the route of the road, cost $12,000,000 more, making a total expenditure of $47,000,000 that was necessary before the road could be thrown open to the public. The total length of the line is 24.7 miles. Of this 19 miles is underground, and 5.7 miles is elevated structure. Of the whole subway 6.7 miles is four-track, 7.4 miles is three-track, and 10.6 miles is two-track. There is a total of 5 miles of switches and sidings, and the total track mileage, that is to say, the total length of complete track with its two rails and ties, is 70 miles.

The power-house for the operation of the line is located at Fifty-ninth Street and North River. It is a huge building, the greatest of its kind in the world. It measures 200 feet in width by 690 feet in length. Centrally through its entire length it is divided by a wall which separates the engine-room from the boiler-room and coal bins. This coal bin, which is located immediately below the roof and above the boiler-room, has the enormous capacity of 25,000 tons of coal. The coal is fed by chutes directly down to the hoppers of the mechanical stokers, from which it is automatically fed to the furnaces. The ashes are dumped into the basement, from which they are carried directly to barges at the dock on the river front. Coal is brought in barges to the same dock, where it is unloaded by elevators and carried up by automatic conveyors to be dumped into the coal bins. Six lofty smokestacks are required for the boiler-room, and a novel feature is that the brick portion of these stacks terminates near the roof. The sub-structure of the stacks consists of massive steel towers of sufficient strength to carry the weight of the exterior brick stacks.

The character of the motive power and generators in the engine-room is similar to that at the Seventy-sixth Street power-house of the Manhattan Elevated Railways, the two systems, indeed, being connected up so that power may be drawn from each power-house for either the Subway or the elevated railways. The generators are driven by Allis-Chalmers compound engines of 8,000 rated horse-power, with a maximum capacity under 50 per cent overload of 12,000 horse-power. These engines are very similar to those at the Seventy-sixth Street power station, but are slightly more powerful and embody certain improved details. In this power station will be installed a separate set of generators for lighting the Subway which will be driven by direct-connected Westinghouse-Parsons turbines. The ultimate capacity of this huge station, when everything has been installed, will be 132,000 horse-power, thus making it the largest in the world.

From the station, the current will be distributed to sub-stations, located in convenient positions adjacent to the Subway, where it will be stepped down and transformed for use at the motors. There will be two classes of service, the express and the local, the former utilizing the two inside tracks of the four-track road and the center track of the three-track road, the other utilizing the two outside tracks. The express trains will be made up of eight cars, five of these being motor cars and three trailers. The motor cars carry 200-horse-power motors, one for each truck, making a total horse-power of 400 for the car, or 2,000 for the train. When we bear in mind that the crack express engines of our steam railroads have only about 1,500 horse-power at command, to haul trains that weigh twice and three times as much as these express trains in the Subway, it will be understood what a splendid reserve of power the Subway motorman will have at command. The expresses will start from City Hall and make stops on the four-track system at Fourteenth, Forty-second, Seventy-second and Ninety-sixth Streets. From there on, stops will be made as determined by schedule, the expresses using the center track of the three-track portion of the road, and it is probable that One Hundred and Tenth or One Hundred and Twenty-fifth Street will be the next alternate stopping places for express trains after Ninety-sixth Street.

The third track system extends from One Hundred and Fourth to One Hundred and Forty-fifth Streets, where the road passes beneath Washington Heights in a two-track tunnel. Emerging near Dyckman Street station it continues as a three-track elevated system to the end of the line. These express trains are to be run at a speed, between stations, of 45 to 50 miles an hour. They will be scheduled to run under two-minute headway with 45 seconds stop at the stations above named, the average speed, including stops, being 30 miles an hour. The average speed of the local trains, which will run under one-minute headway, will be 16 miles per hour, including stops. These respective speeds will give a running time of 15 minutes for expresses and 30 minutes for locals, from the City Hall to the Harlem River.

It is evident that with a train service so frequent and fast, particular care will be necessary to guard against collisions and other accidents. We present, on page 181, some illustrations showing the method of block signals and automatic train-stopping devices that have been installed. The block signal system is that known as the pneumatic-electric, whose principles of operation have been frequently described in this journal. The switches and signals are operated by compressed air, the valves of the operating cylinders being themselves operated by electric magnets that are controlled from the signal station. The blocks between stations and their respective signals, which latter are of the type shown in our illustration, are so interconnected and inter-locked that no two trains can possibly be in the same block at the same time. The signals are worked automatically by means of contacts that are operated by the passage of the train, each train setting its own protecting signals behind it as it passes into a given block. Thus far the description will apply to the automatic block-signal system as used on many of our steam roads; but in the Subway an additional precaution has been taken which should absolutely preclude the possibility of rear collisions. Opposite the signal, on the right-hand side of the track, is placed a trip which is thrown up when the signal is against the train, and lies down in the horizontal position when the signal is in the "go-ahead" position. This trip is so arranged that if a train overruns the signal when it is at "danger," it will open the train pipe, setting the brakes and at the same time automatically cutting off the power.

Several of our photographs give an excellent impression of the first-class nature of the work. The ties, the rails, and the ballast are of the highest type, the rails weighing 100 pounds to the yard and tie-plates being interposed between the rail base and every tie. The third-rail system is used, and we illustrate the method of protecting passengers and employes from contact with the third rail. This consists of a board which is firmly supported by means of brackets at a sufficient height above the rail to allow the contact shoe to enter between the covering board and the third rail, and travel in that position without striking the board. Ultimately it is the intention to place a vertical covering board at the back of the rail, thus completely inclosing it except on the side next the motors. Another of our illustrations shows a cut-off switch operated by hand which can be pulled down by the trainman, for the purpose of cutting out a section of the line upon which a temporary breakdown may have occurred. The Subway stations and the sections of the track that they serve have been so arranged that it will be possible to cut out the section of single track upon which a breakdown occurs, without interfering with the current in the other three tracks. This is an improvement over the Elevated system in which it is necessary to cut out all four tracks for purposes of repair. The circuits are so arranged that only a limited stretch of track is rendered dead by the opening of these switches, and there is no question that the period of interruption due to short circuits, etc., will be greatly diminished by this arrangement.

Another of our illustrations shows the type of ticket booth which is used throughout the system. It is of a simple construction that harmonizes fairly well with the general decorative features of the stations. An interesting feature from the engineering point of view, that we illustrate, is the point just beyond One Hundred and Fourth Street, where the two tracks that run to the Bronx diverge from the main line. The turnout is accomplished by gradually depressing the two inside tracks until they are at a sufficiently low level to pass beneath the easterly track of the westerly branch of the Subway. The two tracks are carried in a tunnel underneath the northwesterly corner of Central Park and continue in an underground tunnel and on an elevated structure to Harlem River and the Bronx. This division of the line is far from complete—the delay being due to the difficulty encountered in tunneling beneath the Harlem River. The connection between the north and south sections of the tunnel has recently been completed, and it should not be many months before trains can be run from the One Hundred and Fourth Street junction to the northerly terminus of the line at Bronx Park.

Life History of Radium.

The view that uranium is the parent substance of radium was advanced by Rutherford and Soddy on the ground that it is one of the few elements having a higher atomic weight, that it is the main constituent of radium ores, and that the proportion of radium in good pitchblende corresponds roughly with the ratio of activity of radium and uranium. An examination of a number of specimens of uranium salts purchased from seventeen to twenty-five years ago showed that these all contained a larger proportion of radium than the more modern specimens. This result is in accordance with the theory enunciated by Rutherford and Soddy, but may easily be due to modified methods of preparation. F. Soddy (Nature, 70, p. 30, May 12, 1904), states that a kilogramme of uranium nitrate was purified until the proportion of radium present was less than 10^{-12} gramme as tested by the maximum amount of accumulated emanation. At the end of twelve months the amount of accumulated radium was certainly less than 10^{-11} gramme instead of the 5×10^{-7} gramme calculated from the ratio of the radio-activities of radium and uranium. The quantity of radium produced was therefore less than one ten-thousandth part of the theoretical quantity, and this result practically settles, in a negative sense, the question of the production of radium directly from uranium. It is, of course, possible that intermediate substances might exist, and that radium would only be produced at a later stage, but there is no experimental evidence in support of this view.

The Current Supplement.

The current SUPPLEMENT, No. 1497, opens with an excellent article by Day Allen Willey on "Mechanical Cooperage." The article is accompanied by photographs taken in the largest brewery in the United States. An excellent discussion of superheated steam for locomotives in Germany tells what has been done across the water in a neglected branch of engineering. The English correspondent of the SCIENTIFIC AMERICAN writes instructively of irrigation development in Egypt. An ingenious spiral screw arrangement for levers is described and pictured. The prime minister of England, the Right Hon. A. J. Balfour, recently delivered a thoughtful address before the British Association for the Advancement of Science, which he entitles "Reflections Suggested by the New Theory of Matter." The attitude assumed by Mr. Balfour is one of interrogation rather than of conviction. The St. Louis correspondent of the SCIENTIFIC AMERICAN has three articles in the SUPPLEMENT. The first tells of the exhibit of New York State; the second of royal sleeping cars in 1842 and 1904 (this article being illustrated with a picture of the first sleeping car ever used, that of Queen Adelaide); and a model of the 10,000-horse-power alternating current generator.