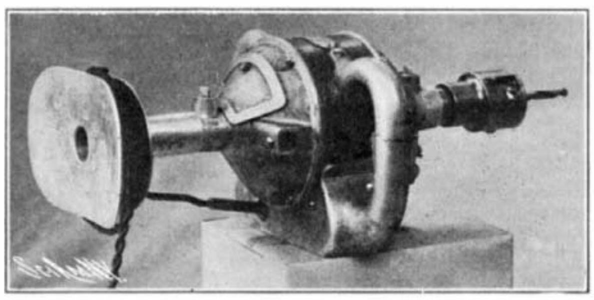
THE SIEMENS & HALSKE NEW ELECTRIC HAND-DRILL.

Siemens & Halske's new electric hand-drill does away with the inconveniences inherent to the drill with flexible shaft and, at the same time, has the advantage over the crank drill in being of greater efficiency although of sensibly the same weight. In other electric drills the motor that actuates the drill properly so called through a flexible transmission is generally established upon a portable frame. In consequence of such an arrangement the manipulation of the apparatus is relatively complicated, and the working parts are more difficult of access than practice necessitates. Moreover, the vibrations of the shaft render any accurate work very difficult. The use of the flexible transmission greatly reduces the efficiency, so that with an equal power the motor has to be larger. Finally, the flexible shaft and the frame of the motor are relatively costly.

In the new hand-drill illustrated, the mechanical and electric parts are united in a single apparatus. The current is led to the motor by a flexible cable that in no wise interferes with the mobility of the drilling machine. The arch of the electro-magnets of the motor is wrought iron. The core of the armature, as well as the poles, is laminated. The collars, handles, and center plate are of aluminium. In the posterior collar is formed an aperture, which is closed by an aluminium cover, which, when removed, permits of easy access to the collector and brushes. The interrupter is placed in the handle. Upon pressing upon this the motor is put in circuit, and, upon freeing it, is put out of circuit. The machine is made in two sizes for actuation by a continuous current of 110 or 220 volts. The smaller type is used for delicate work. It is capable of drilling holes of 0.24 of an inch in diameter, and has a net weight of 12 pounds and a gross weight of 33. The larger type, shown in our illustration, is capable of boring holes 0.64 of an inch in diameter and has a net weight of 21 pounds and a gross weight of 44. A lengthening piece for certain special purposes may be inserted by screwing it in between the collar and center plate. The method of using the machine is shown herewith.

The convenience and simplicity of this drill, along with the economic qualities resulting therefrom, will soon make of it an instrument indispensable in all shops in which drilling has to be done and in which electricity is available.

HOW THE ELECTRIC DRILL IS MANIPULATED.



THE ELECTRIC DRILL.

THE ORTHODIAGRAPH. AN APPARATUS FOR DETERMINING THE TRUE SHAPE AND SIZE OF INTERNAL ORGANS.

BY OUR BERLIN CORRESPONDENT.

The orthodiagraph, just brought out by the Berlin Allgemeine Elektricitäts-Gesellschaft, is a Röntgen apparatus allowing of the true image of any object being obtained in any desired position of the drawing plane.

Röntgen rays, as is known, are propagated from a point on the anticathode of the Röntgen bulb in straight lines radiating in every direction, and the image of a body projected on a phosphorescent screen or a photographic plate is a silhouette, the outline of which coincides with the places where the Röntgen rays touching the edge of the body strike the screen. This outline therefore is the periphery of the base of a cone, the point of which coincides with the luminous spot on the anticathode. As in any case the object to be projected is located between the Röntgen bulb and the screen, its image on the latter will be magnified, this magnification being the stronger the greater the ratio of the distance of the object from the image plane to the distance of the object from the Röntgen bulb. The image projected by a stationary Röntgen bulb, so far from recording the true dimensions of the object, will show the latter in a magnified shape apart from more or less considerable deformations.

There is only one possibility of obtaining the object in its true shape and size; the Röntgen rays touching the body and forming on the plate an image of its outline have to be made parallel and strike the plate at right angles. In other words, the projection from a centrum will have to be replaced by a parallel projection. Endeavors in this line have been made as far back as 1898; devices have even been invented allowing of such projections being obtained in the case of the objects to be projected lying on horizontal surfaces. The orthodiagraph, as above stated, is free from this restriction, allowing of projections in true shape and size being obtained in any desired position of the drawing plane.

The luminous screen, which also carries the drawing stylus, is rigidly connected with the Röntgen bulb by a U-shaped frame. This frame is made up of a number of jointed sections, which permit of any desired adjustment of the screen with the bulb. A rod extending from the screen is longitudinally adjustable in a split sleeve on the end of a tube lying parallel with the axis of the drawing stylus. The tube is provided with a telescoping member, on the projecting end of which a second split sleeve is adapted to slide. This sleeve is formed on the end of an arm which is thereby supported at right angles to the telescoping member. The clamp which holds the Röntgen bulb has ball-and-socket connection with a member which may be adjusted to any position along this arm.

When properly adjusted the propagating joint of the Röntgen rays should lie on an extension of the axis of the stylus. This may be approximately done by adjusting the bulb clamp and other members of the U-shaped frame.

In order to obtain perfect adjustment of the bulb, i.e., such an adjustment as would permit working with accurately perpendicular rays, the screen may be adjusted in one plane, by moving its supporting rod longitudinally in the split sleeve above referred to, and in a plane at right angles thereto by adjustment of the screen within its holder. By noting the shadow cast on the screen by the end of the stylus projecting therethrough, the operator can readily ascertain when accurate adjustment has been obtained.

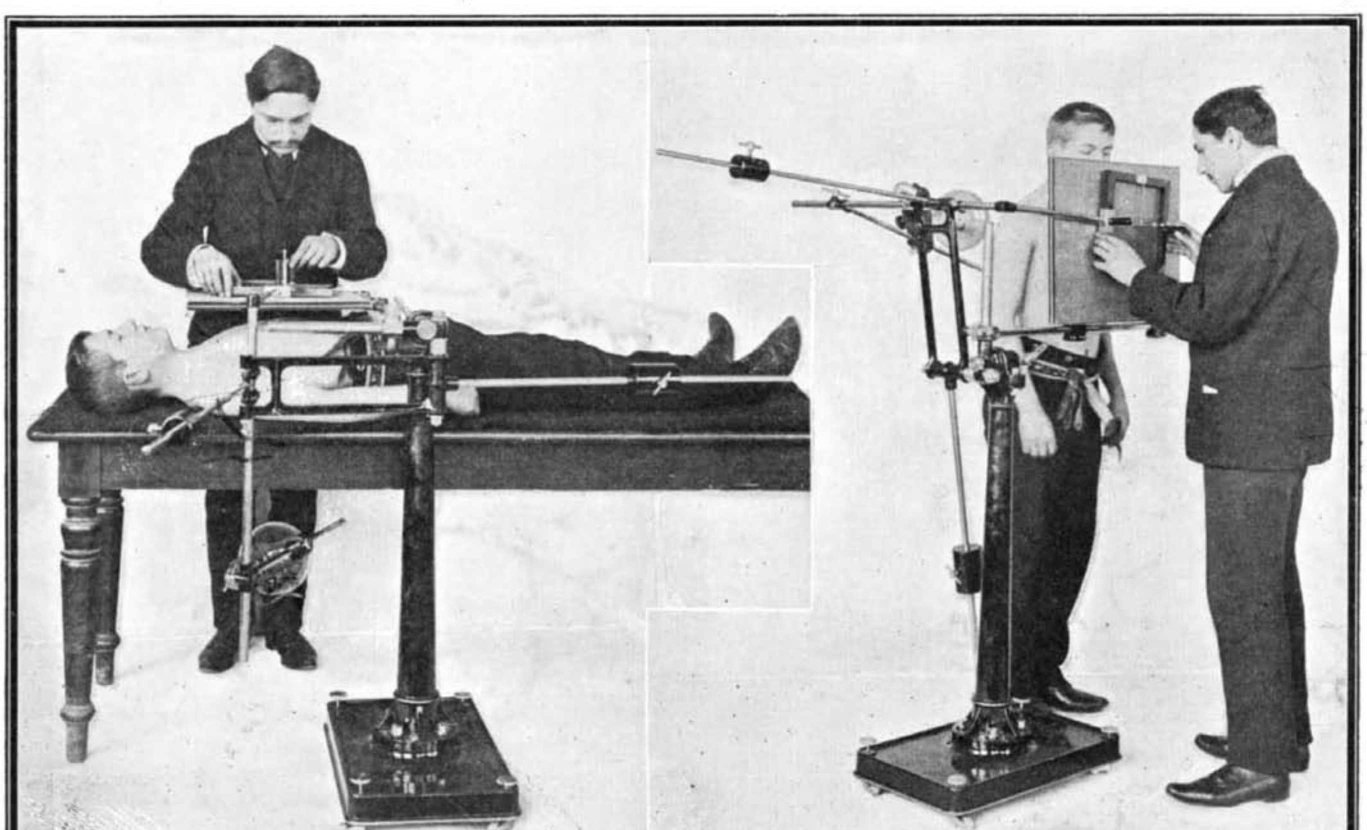
Parallel movement of the bulb with the screen is obtained by means of two levers, one pivoted to the other. A lever which supports at one end the U-shaped frame is hinged to a second lever, which in turn is pivoted to a bracket on the head of the supporting column of the apparatus. Each lever is provided with a counterweight movable along its outer arm, and these weights serve to hold the parts in equilibrium.

The bracket just mentioned also carries a rod to which by means of a universal joint the drawing frame is attached. The drawing frame is adapted to be covered with heavy bristol-board held therein by holders at the sides, and on this surface the drawing stylus is softly pressed by a spiral spring.

Now the whole system so far described is movable round the axis in the head of the main supporting column and may be clamped in any position by means of a milled nut; an additional fixing lever may be grasped to prevent this system from suddenly dropping on loosening the nut. At the same time, the accurately vertical and horizontal position of the system is indicated by a spring catch. The length of the supporting column is such that on turning the system round its axis into a horizontal position, the drawing plate will just be at a convenient distance above a person lying on an ordinary table about 30 inches in height. The heavy base plate is provided with four rollers allowing of the drawing apparatus being readily moved. By operating special screws these rollers may be removed and the apparatus placed on the points of the screws, which in addition will allow of the column of the apparatus being given an accurately vertical position even on oblique or uneven floors.

When a drawing is to be made directly on the body, the bristol-board is removed from the drawing frame, and a dermatograph stylus should be inserted into the drawing stylus instead of a pencil. The drawing frame is provided with three pencil holders or "plotters," as they are called, which are movable in the plane of the screen or that of the drawing plate and provided with scales in both coordinates; the position of a person with regard to the central ray may be thereby ascertained, so that on the examination being repeated, the same position of the person may be accurately secured. A fourth auxiliary plotter has been provided which slides on a scale projecting from the extended axis of the lower supporting lever.

In addition to reproducing the true shape and size of organs, the apparatus may be used advantageously to ascertain the depth of foreign objects. This can be done by meas-



THE ORTHODIAGRAPH, AN APPARATUS FOR DETERMINING THE TRUE SHAPE AND SIZE OF INTERNAL ORGANS.

uring the apparent diameter of the object when the Röntgen bulb is stationary and then ascertaining the actual shape of the body by means of parallel movement of the drawing stylus and the bulb. Now if $a\,l$ is the apparent length of the foreign body, $r\,l$ its real length, D the distance of the anticathode of the tube from the luminous screen, and d the distance of the object from the anticathode, the equation $d = \frac{r\,l \times D}{a\,l}$ will give the true distance of the foreign body from the luminous screen.

THE PENNSYLVANIA TUNNEL AT NEW YORK CITY.

Rapid progress is being made in the initial stages of the great engineering project by which the Pennsylvania Road is to secure a terminal station in Manhattan Island and through connections with the Long Island Railroad system. The work of clearing away the buildings on the four large city blocks that will be occupied by the passenger station is well under way, two of these blocks, over a third of a mile in total length, being ready for excavation. The shafts from which the work of tunneling will be carried through have been sunk; and before many weeks have passed the whole stretch of work from the portal in Jersey to the portal in Long Island will be covered with as big a force as can be crowded upon it.

The location and profile of the tunnel are shown in the accompanying diagrams. Commencing at the western approach to the tunnel, two tracks will enter the western end, known as the Hackensack portal, in the face of Bergen Hill, which runs parallel with the Hudson River. From this point to the portal which marks the exit on Long Island will be a distance of a trifle under six miles. The two tracks will pass through the hill in separate tunnels, which will extend to the Weehawken shaft, a distance of a little over one mile. On this portion of the work the tunneling will be of standard construction, but from the Weehawken shaft to the shaft on the western shore of Manhattan Island, a distance of about 6,000 feet, the two tracks will be carried in separate circular tubes of a construction hereinafter described. The line will descend from the Hackensack portal to its lowest point below the North River on a grade of 1.3 per cent, and at its lowest level the bottom of the tubes will be about 90 feet below mean high water of the North River. From this point, for a distance of 2,000 feet, the line will rise on a grade of 0.53 per cent, and then for another 3,000 feet it will ascend on a grade of a little under 2 per cent to a point between Ninth and Tenth Avenues on Manhattan Island. At the Manhattan shaft, going eastward, the tubular construction ceases, and the two tracks diverge into two triple, parallel tunnels, with three tracks in each—the main line and two sidings. The triple tunnels extend for about 1,100 feet, when they merge into a four-track, single-arched tunnel, which extends for 605 feet to the western end of the terminal station. The new terminal station will be the greatest structure of its kind in existence. It will extend from Seventh to Ninth Avenue, and from 31st to 33d Street, and will cover a great parallelogram measuring about 460 feet north and south by about 1,800 feet east and west. The details of the station and the architectural features have not as yet been made public; but the treatment will probably be a modified classic, or some style agreeable to such a monumental structure.

The portion of the tunnel thus far described is under the charge of Charles M. Jacobs as chief engineer. The portion now to be described, extending from the station to the end of the tunnel in Long Island, is under the charge of Alfred Noble as chief engineer. The latter division, which commences just east of Seventh Avenue, consists of two lines of three-track arched tunnels, one below Thirty-second Street, and the other below Thirty-third Street. This form of construction continues for 1,650 feet, when each set of three tracks merges into a double track carried in a concrete-arched tunnel for a distance of 2,400 feet. At Second Avenue the tracks swing to the left, and are carried in two concrete-lined tubes beneath the East River to East Avenue, a distance of about 6,000 feet; and from East Avenue to the end of the tunnel at Thompson Avenue, a distance of 3,700 feet, the tracks are carried beneath four separate concrete arches. The tracks descend from Seventh to Fifth Avenue on a 0.5 per cent grade, and from Fifth Avenue to the lowest point beneath the East River on a 1.5 per cent grade, from whence they rise on a 1.25 per cent grade to surface.

On the whole of the tunnel work thus outlined, that lies beneath the East River and the land, it is not anticipated that any conditions will be encountered that will call for special construction and present any obstacles to the smooth and uninterrupted prosecution of the work. The borings indicate that beneath the land the tunnels will be driven chiefly through rock, and under the East River through fine to coarse sand and gravel. In passing below the North River, however, it will be necessary, in order to avoid going to a depth which would involve heavy grades that would be expensive to operate, to carry the tunnel through a river mud and silt that are of such consistency that the question of the stability and perfect alignment of the tunnel calls for special study. Although the silt is sufficiently firm to preserve the tunnel itself in perfect alignment, it was considered by Mr. Jacobs that provision should be made for carrying the moving train loads independently of the tunnel shell. It was considered that if the heavy Pullman trains, weighing with their locomotives as much as 600 to 700 tons, were allowed to bear directly upon the shell of the tunnel, their weight and impact might produce a settlement and set up bending stresses that would result in fracture and leakage. The problem will be solved by driving a line of very massive cast-iron screw piles through the floor of the tubes, at 15-foot intervals, with their heads projecting within the tubes, and capping the piles with a system of heavy transverse girders and longitudinal stringers, upon which the track rails will be laid. The heavy load and severe impacts of the trains will thus be received by the piles, and should there be any slight settlement of the piles under load, the movement would not affect the tubes, which would serve their proper purpose as an envelope for the protection of the trains. The piles will be driven either to rock or to a bearing capable of sustaining a predetermined load without settlement. Of the 24,049 feet of cast-iron single-track tunnel, 12,174 feet will be reinforced with screw piles.

The cast-iron shell consists of bolted-up segments, each 30 inches in length and containing eleven segments and a key piece in each. The shell is 2 inches in minimum thickness, and the segments are flanged on all sides, the joints being planed and provided with five or six 1½-inch bolts, as the case may be. At stated intervals corresponding to the position of the piles, plates are cast with flanged holes, which are temporarily closed by a cast-iron block. After a certain length of the shell has been driven, it will be bulkheaded off, placed under pneumatic pressure, and the piles will be screwed down from the interior of the shell. The piles are 27 inches in outside diameter, with 1¼-inch thickness of shell, and they are made in 7-foot sections. The lower end of the pile is square, and is provided with one turn of a wide screw cast integrally with the pile, the outside diameter of the screw being 4 feet 8 inches. The pile is screwed down by means of a special hydraulic ratchet arrangement bolted to the head of the pile, and as one section is carried down, another 7-foot section will be bolted to it, the process continuing until rock or impenetrable bottom is reached. The core of mud inside the hollow pile will be excavated for a depth of 12 feet below the tunnel tube, and the space filled in with concrete. After the pile has been driven, the last section will be removed, cut to exact length, to bring it flush with the floor of the tube, and replaced and bolted. The upper end of the pile after it has been filled with concrete will be closed by a bolted disk. Above the cap of each pile will be bolted heavy transverse girders, and upon these girders, bridging the intermediate space of 15 feet, will be a pair of longitudinal girders, upon which the railroad tracks will be laid. By this method the weight and impact of the heavy trains will be borne directly by the piles, and the iron and concrete tube will have no other duty to perform than that of forming, as we have said, a protective envelope for the trains.

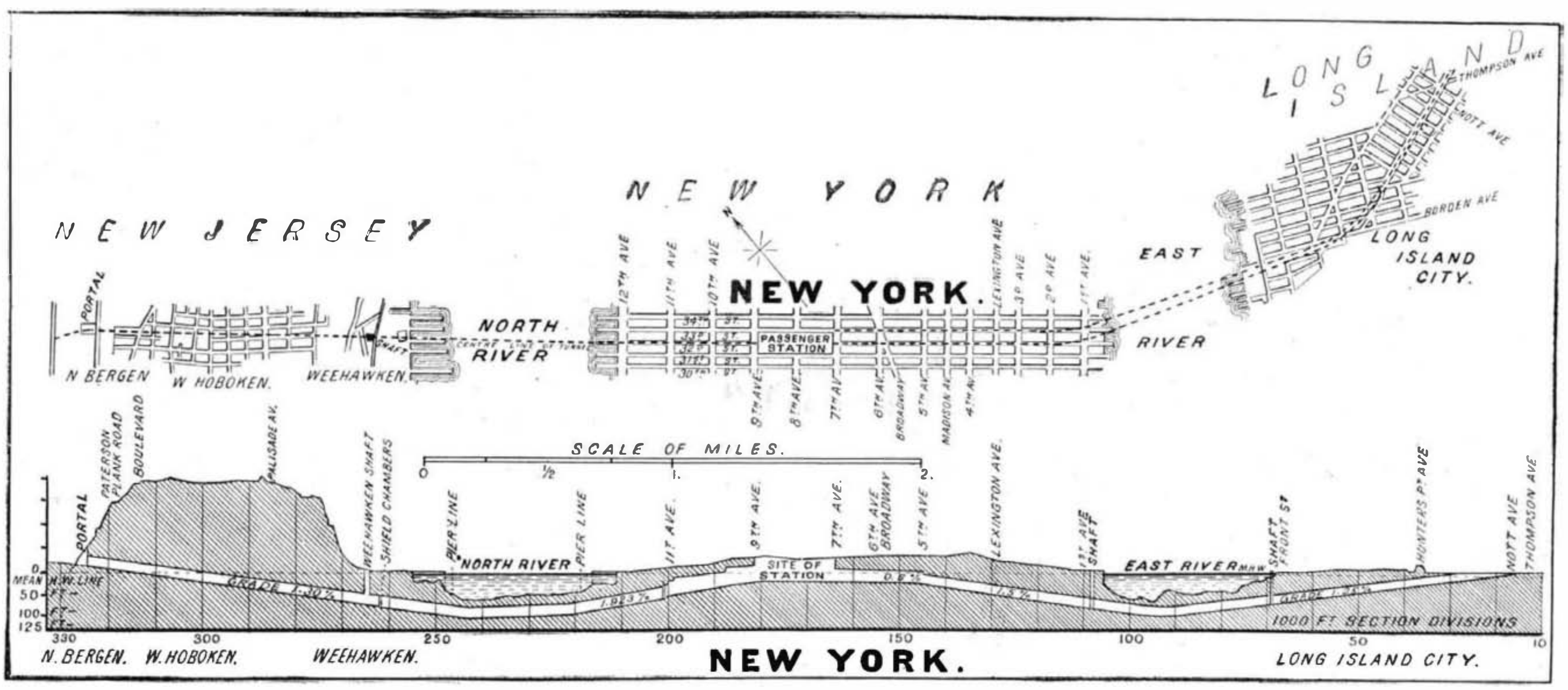


DIAGRAM SHOWING THE LINE OF THE PENNSYLVANIA TUNNELS UNDER THE HUDSON AND EAST RIVERS.

The tunnel, particularly that portion of it beneath the rivers, has been planned with a view to the prevention of accidents to trains, or mitigating the dangers, should an accident occur. In the first place, the sides of the tunnel are filled with a mass of concrete up to the level of the car windows. This will reduce the damage due to derailment or collision to a minimum, and will provide a means of egress from the tunnel in case of accident. Should a train be held in the tunnel for any reason, it would be possible for the passengers to climb out upon these footways, and escape by them to either end of the tunnel. Moreover, should a car jump the track, it would be impossible for it to slew out of line, and it is probable that the whole train could be brought to a stop before any more serious injury than the breaking of windows had been done. The electric cables will be carried in conduits and embedded, as shown in our engraving, in the concrete mass of these side benches. At stated intervals there will be refuge niches formed in the concrete for the use of employes, and, lastly, the whole tunnel will be thoroughly lighted from end to end.

Parisian Airship Fund.

The Municipal Council of Paris has appropriated an annual allowance for the encouragement of physiological research in connection with balloon ascents. The studies will especially be directed to the exaggeration of vital activity in high altitudes.