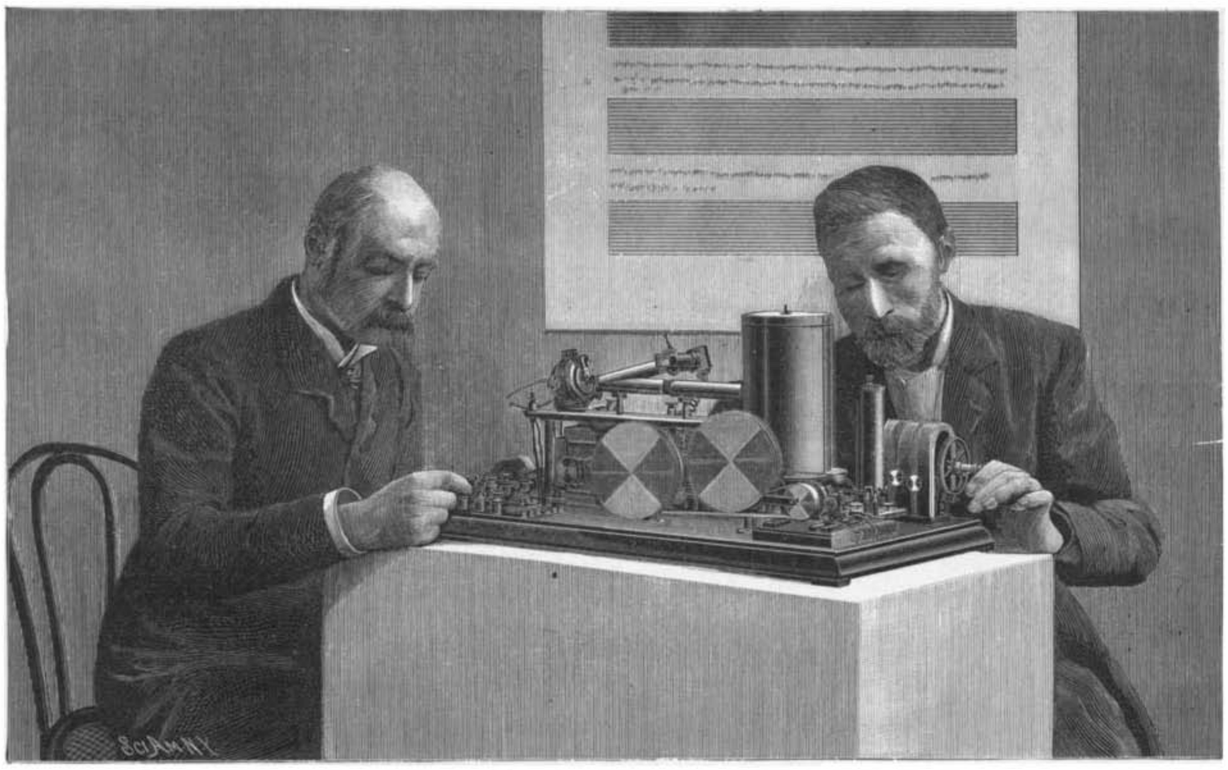
THE POLLAK AND VIRAG TELEGRAPH.

The recent invention by Pollak and Virág of a system of rapid telegraphy is destined, perhaps, to exert a vast influence upon our present methods of transmitting messages electrically.

Herr Pollak was formerly a telegraph agent in a small Hungarian city, and it was only during his leisure hours that he found time to study electric technology. In Virág, who was at the time an examiner in the Hungarian Patent Office, he found an earnest collaborator. Both men have devised various improvements on the electric telegraph; but of all their inventions none is more interesting than their system of rapid telegraphy.

In the system in question, a perforated tape is used, which passes around a wheel electrically connected with the telegraph line. The perforations of the tape are disposed in two lines, of which one lies above, the other below an unperforated central line. The upper line corresponds with the dashes, the lower with the dots of the Morse alphabet. Over the perforated strip are secured two metal brushes, one of which is connected with the positive, the other with the negative pole of a galvanic battery. These brushes, when depressed, will pass through the perforations, and, coming into contact with the wheel, will close the circuit and cause a positive or negative current to flow through the wheel to the receiving station, thereby swinging a mirror to the right or to the left as the positive or negative current energizes the electromagnet with which the mirror is connected. The light of a small incandescent lamp which falls upon this mirror is reflected to the right or to the left, according to the direction of the mirror's oscillation, and is concentrated to a point by a convex lens. This point of light falls upon a piece of sensitive paper, producing a series of lines which are located either above or below a central line, and depending upon which of the two brushes of the transmitter is forced into the perforated tape. The paper after having been developed, reveals characters above and below the central maginary line, which characters correspond with those of the Morse alphabet.


THE POLLAK AND VIRAG RAPID ELECTRIC AND PHOTOGRAPHIC TELEGRAPH SYSTEM.

The telegraph is said to be faultless in operation. Between 10 and 12 o'clock P. M. recently, telegraphic communication was opened between Berlin and Ofen-Pest. The Berlin instrument was operated by Herr Pollak; the Pest apparatus by Herr Virág. Representatives of the Hungarian, French, and American governments were present during the trial at the Pest station. A message of 220 words was transmitted in nine seconds, which corresponds with a speed of 88,000 words per hour. The development of the sensitive paper was accomplished in 4–5 minutes. The signs were sharp and clear.

Floating Stones.

Prof. Erland Nordenskiold, who is the son of the Arctic explorer, recently observed while engaged in scientific research in South Patagonia a most curious sight while rowing in the long and narrow channel of Ultima Esperanza on the southwest coast of Patagonia. He observed fragments of slate floating on the surface in large and small clusters. There were a great many of them, and at one cast of the net he gathered in 700 pieces. The stones had evidently drifted out from the beach, which was covered with similar fragments which had fallen from the slate cliffs. The surface of the stones was dry, and when it became wet the stones sank immediately. Their specific gravity was 2·71, while that of the water was 1·0049. It was found that small gaseous bubbles were attached to the undersurface of the floating stones, and these bubbles were also found on stones at the fringe of the beach, where they were being continuously washed into the sea when floating away. The greasy surface of the slate fragments undoubtedly helped to keep them afloat by preventing the water from coming in very close contact with them. Prof. Nordenskiold believes, besides the visible bubbles, they were surrounded by an envelope of gas supported by an insignificant coating of algæ, by which they were enveloped. The new strata they are now forming at the bottom of the sea may have a considerable admixture of these fragments representing a far distant geological age.

THE "OROGRAPH;" AN AUTOMATIC PROFILE RECORDER.

BY W. F. COFFEE, LONG ISLAND CITY,

The curious machine herewith illustrated was made for the engineering corps of the United States army, and is owned by a detachment of this corps stationed at Willett's Point, Long Island. It is essentially a surveyor's instrument, and is intended to take the place of the engineer's chain and level in the important work of making a profile of any road or stretch of country over which a surveying or reconnoitering party is passing.

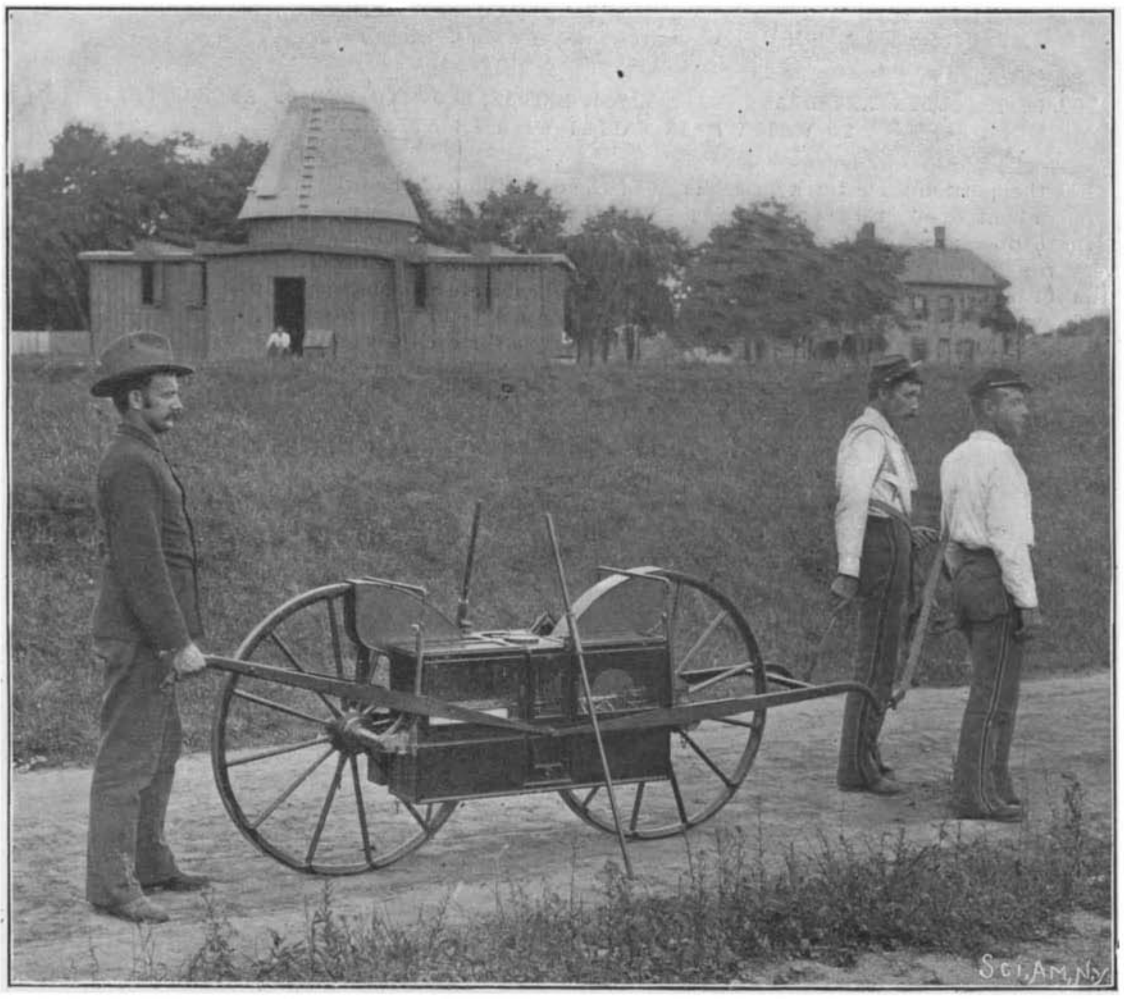
It will be known to most of our readers that the ordinary method of making a profile is to run a level through the country over a line that is laid out by means of the transit and engineer's chain, and take the levels at more or less frequent intervals along this line. These levels are then pricked off on cross-section paper, and a line joining them will represent the true vertical topography of the country along that particular route. Here we see two distinct operations, one in the field, the other in the office. They are both, of course, somewhat tedious and call for exercise of considerable care to prevent errors from creeping in.

The "Orograph" consists of two substantial carriage wheels, one following the other in a single track, supporting between them, and on one side, a box of mechanism, and on the other a sort of cistern. This cistern is 24 inches in diameter and ½ an inch deep. It is placed vertically and contains mercury. When in operation the "Orograph" must be held upright and not allowed to careen to either side.

As stated, the object of the machine is to draw upon paper an accurate profile of the ground over which it is rolled, thus furnishing the army engineers with all the results of a survey excepting the courses and general topography. The principles upon which the machine is constructed are those of the perambulator, operating in conjunction with a lever maintained continually in a horizontal position by floating upon a cistern of mercury. This lever is 24 inches in length and ½ an inch thick, with floats attached to each end, and has free motion in a vertical plane on a horizontal axis.

The principles upon which the reduction of surface distance to true measurement is accomplished are that, if the surface measure of any portion of gronnd be called radius, the true horizontal distance will be the cosine of the angle of inclination or grade of the surface, and the difference of level will be the sine of the same angle. In accordance with these principles an arm or crank is made to move in a slot, or elongated hole, in such a manner as to give it a motion corresponding to such sine or cosine. The machinery by which these principles are made to operate consists of a circular disk, revolving by connection with the perambulator with a velocity proportionate to the surface passed over, and of an adhesion wheel whose plane is perpendicular to the plane of the disk, and whose circumference is tightly pressed against, and so receives motion from it, the distance of its circumference from the axis of the disk being made to vary as the cosine of the inclination or grade of the surface passed over by the Orograph varies. This varying motion of one wheel against the face of another is effected by an arm from the axis of the horizontal lever, moving in a slot, which, together with a parallel motion, sustains the adhesion wheel against the circular disk from which it derives its motion. The adhesion wheel, moving according to the true horizontal distance, communicates motion by means of an endless screw and by ratchet-work to wheels which register all distances up to a hundred miles.

Another arm from the axis of the horizontal lever, moving in a slot perpendicular to the former one, varies the position of two adhesion wheels pressed against two circular disks in a manner similar to the former, but varying in proportion to the sine of the angle of inclination. The two adhesion wheels just mention


THE "OROGRAPH"—AUTOMATIC PROFILE RECORDER CONSTRUCTED FOR THE UNITED STATES ARMY.

ed both revolve in the same direction and with the same axes, and contain within these axes, one a male and the other a female screw. These screws are so arranged that if the adhesion wheels both revolve with the same velocity, by being kept at the same distance from the axes of the circular disks by means of a lever acting through the medium of the slot, the screws, although loose in the wheels, will neither advance nor recede, but a difference of level moving both the lever and the slot, and bringing one adhesion wheel nearer and the other further from the axis of the disks, and, therefore, causing difference in velocities, will make the screw which carries the pencil of altitude advance or recede as long as difference of level causes difference of velocities in the adhesion wheels and the screws which move them.

The arrangement by which the paper is made to pass under the two pencils (one to mark the surface and the other the base line and station) is at once suitable and ingenious. The two rollers upon which the paper is wound is kept tightly straightened by a tendency to motion in opposite directions, communicated to them through friction and from the main shaft, while drum rollers geared to the true horizontal motion deliver the paper under the pencils with the smallest expenditure of force.

The pencil of altitude moves an inch for every 50 feet change of level, and the paper is drawn under the pencils at the rate of an inch for every 500 feet in distance.

The true horizontal distance can be read to tenths of a foot, and the surface distance to every 10 feet. The machinery by which so many complicated movements are produced is substantial and well adapted for service, capable of adjustment in every part, and not liable to get out of order if well used. The cistern containing the mercury is entirely of metal and the frame work is securely trussed and bolted.

The perambulator wheels are made of the best material with steel tires, while the handles by which the "Orograph" is propelled and managed are hinged to the frame work near the center of gravity, adding much to the stability of the machine. The machine, which was very costly to construct, has been frequently loaned as an exhibit at scientific exhibitions. It was last on public view at the World's Fair in Chicago.

Our Copper Industry.

The rapid growth of the copper industry in the United States, and the large proportion which this country supplies of the world's copper, is shown by a German publication entitled "A Century of Copper." It shows that the United States has during the years 1891–1900 produced more than one-half of the copper of the world, while in the preceding decade it supplied about one-third of the world's production, and in the decade, 1871-1880, the portion supplied by the United States was only about one-sixth of the total. The growth of the copper production in the century has been very rapid, being in the first decade 91,000 tons, in the fifth decade 291,000 tons, and in the tenth decade, which ends with 1900, 3,643,000 tons, of which 1,963,000 tons is supplied by North America, a large proportion of this being from the United States. The greatly increased demand for this material is illustrated by the fact that, although the production has increased from 505,909 tons in the decade, 1885 to 1860, to 3,643,000 tons in the decade, 1891 to 1900, the average price has fallen only a little more than half, so that while the production has increased more than six-fold, it costs about one-half what it did.

While the world's production has increased with startling rapidity during the century, that of North America has by far outgrown all other parts of the world. In the matter of consumption figures are equally interesting. The consumption of copper in England, France, Germany and North America was 400,583 tons in 1899, against 268,447 tons in 1893, being an increase of about 50 per cent during the period under consideration, while in North America alone the production is given at 77,433 tons in 1893 and 162,000 tons in 1899, the growth being over 100 per cent during that period.

TRIALS have recently been made on the section of the London Metropolitan Railway which has been equipped electrically from Earl's Court to Kensington. The Board of Trade will pronounce upon the merits of the scheme.

THE TOWERS AND APPROACHES OF THE NEW EAST RIVER BRIDGE.

The new East River Bridge, whose progress has been considerably delayed by the lack of structural material, is now making very satisfactory progress. The great masses of masonry which form the cable anchorages at each end of the bridge are nearly completed, and the steel work of the two towers has been carried up to the level of the floor of the bridge. The false-work upon which the portion of the bridge between the towers and the abutments will be erected, has been put up, and unless there is further delay in the shipment of steel work from the rolling mills, it is likely that the towers and the shore span of the bridge will be completed some time during the summer.

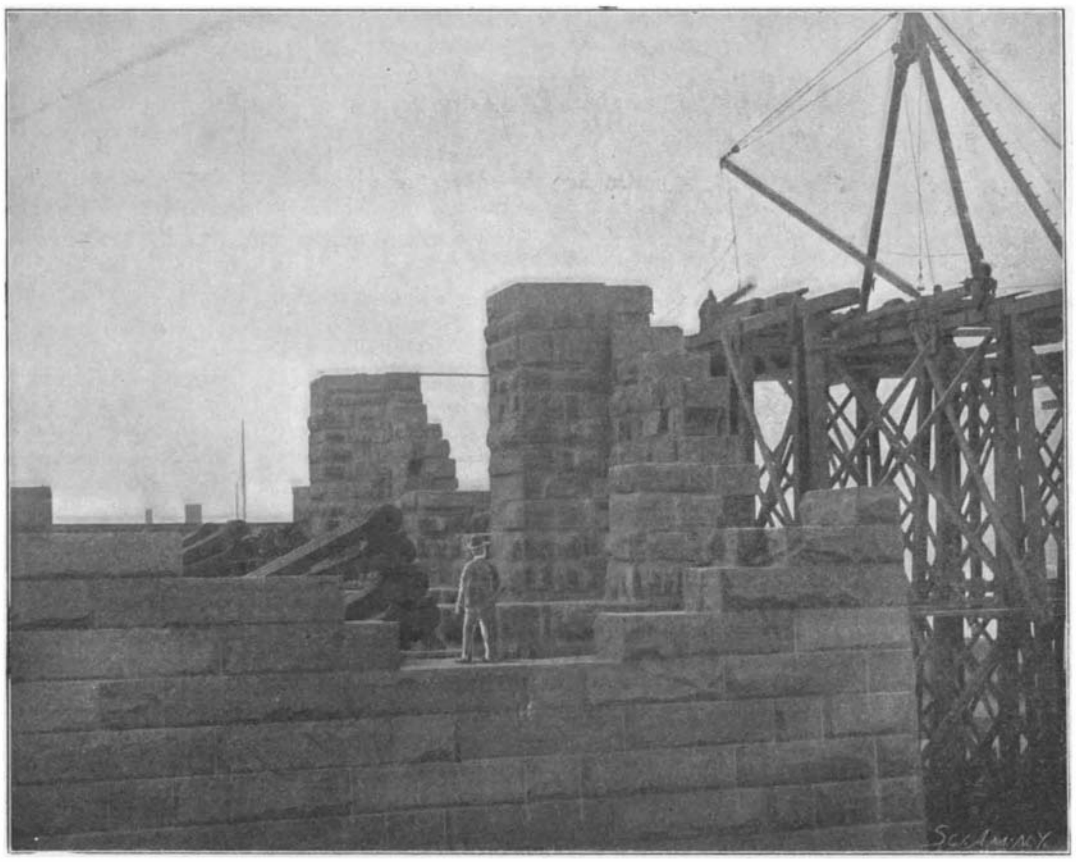
If not the handsomest, the new bridge will be at least the largest and stiffest of the notable suspension bridges of the world. Its entire length between terminals will be 7,200 feet; the length of the suspended span will be 1,600 feet, a few feet greater than that of the Brooklyn Bridge, while the extreme width of the floor between the outside railings of the bridge will be 118 feet. Provision will be made for four trolley tracks and two elevated railway tracks, all of which will be carried between the two stiffening trusses, 50 feet deep, which will run the entire length of the bridge from anchorage to anchorage. On the outside of these trusses, carried upon a cantilever extension of the floor-beams, will be two 18-foot roadways. Between the trusses and above the trolley tracks will be two bicycle tracks, each about 8 feet in width, and two 12-foot promenades, there being a promenade and a bicycle track on each side of the center line of the bridge, those on one side accommodating travel from Brooklyn to New York, those on the other reserved for travel in the opposite direction. The foundations of the towers, four in number, are timber and concrete caissons, sunk in every case until they rest upon bed-rock. Above these are solid masonry piers, two for each tower, the top course of the masonry being 23 feet above mean highwater of the East River. Upon each pier are laid four massive pedestal blocks of dressed granite, one at each corner. These blocks are not visible in our engraving as they have been boarded up to protect them from disfigurement during the erection of the towers. Upon the pedestal blocks are placed the heavy column pedestals, massive castings which measure 11 feet by 11 feet on the base and about 8 feet by 8 feet on the upper face; they are 3½ feet in depth and they are strengthened with a mass of intersecting 2-inch vertical ribs.

Immediately upon these pedestals are erected the four massive legs or columns which go to make up each half of the tower; they are square in section, measuring 8 feet on the side at the base, and tapering in the first 20 feet of their height to a square section measuring 4 feet by 4 feet, which they maintain throughout their full height. The massing of metal at the foot of the columns presents an interesting study. They are built up chiefly of ⅝-inch steel plates, stiffened by eight diaphragms which are disposed two on each inner face of the column. The columns throughout their full height, of over 310 feet, are built up of two thicknesses of plate, the total thickness of the metal at the base of column being 1¼ inches, and at the top of the column from 1¼ to 1½ inches. The two thicknesses are thoroughly riveted together and the stiffening diaphragms which are worked in at the base of the column are replaced in the upper 4-foot section of the tower by eight built-up Z-bars, two on each interior face of the column. The distance, transversely of the bridge, from center to center of the columns is 24 feet, and they are spaced 40 feet apart, measured in the direction of the axis of the bridge. The four columns of each tower are carried up vertically and parallel as far as the level of the roadway. This portion of the towers has been completed and the summit of the steel-work as seen in our engraving represents, approximately, the roadway level.

Above the roadway the towers will have a sharp inward batter, the inclination being 14 feet in a height of 215. The four columns are strongly braced together, the bracing being built up of heavy angles and tie-plates. Immediately below the floor of the bridge a system of massive lattice-bracing is run entirely around each tower, and extends also between the towers themselves. Similar lattice trusses will extend from tower to tower between the inner legs above the roadway. Additional stiffness and a pleasing architectural effect will be gained by the construction of a stiffening arch immediately below the roadway. The saddle castings, each of which is about 7 feet 8 inches in width by 19 feet in length, and weighs 32½ tons, will be placed immediately over the legs of the columns, a system of heavy column girders, 7 feet in depth, being interposed between the columns and the saddle castings. These girders will extend transversely from tower to tower, and will serve to give great rigidity at this point.

The erection of the towers is being carried on by means of timber false-work, whose construction is clearly shown in our larger front-page engraving. This false-work rests upon the masonry piers and is stiffened by being fastened to the tower itself and by a liberal use of wire cables with turnbuckle adjustments. The lighter material is brought to the tower over a trestle which is built out from the shore; while the heavier material, which in the case of the column footings weighed as much as 12 tons, and in the case of the bottom tapered sections of the tower, as much as 24 tons, was brought to the work upon lighters and picked up and placed in position by means of derricks, which at first were operated from lighters, but subsequently were rigged upon the top of the tower false-work.

Simultaneously with the erection of the towers, work is being pushed on the construction of that portion of the bridge which lies between the anchorages and the towers. Unlike the Brooklyn Bridge, this portion of the roadway will not be supported from the cables. The trusses at their inshore end will rest upon the masonry anchorages, but at the bridge they will be supported upon massive rocker bents which will rest by means of hinged bearings upon heavy girders built into the structure of the tower. Midway between the towers and the anchorages will be an intermediate tower upon which the trusses will rest by means of a combination hinge-and-roller bearing. The main span between the towers will, of course, be carried by the main cables, except for the first 100 feet or so at the tower, which will receive a cantilever support from that portion of the truss which extends from the main tower to the intermediate tower. Unlike the stiffening trusses of the Brooklyn Bridge, the new East River trusses will not be cut at any point, or contain any slip-joints, but will be continuous from anchorage to anchorage; moreover, they will not be anchored rigidly either to the towers or to the anchorages. As we have already pointed out, they will be provided with roller bearings at the anchorages and at the intermediate towers, and with rocker shaft bearings at the main towers; consequently, being higher at the center than at the ends, they will expand evenly and freely from the center toward the anchorages on either shore.



TOP OF BROOKLYN ANCHORAGE, EAST RIVER BRIDGE, SHOWING END OF ANCHOR CHAINS TO WHICH MAIN CABLES WILL BE ATTACHED.

IT is estimated that at the present rate of consumption there is pine enough in Northern Minnesota to last from thirty-five to forty years. With a reasonable conservation of the forests, the establishment of a Northern Minnesota forest park, and the adoption of forestry, systematically undertaken, as is now proposed, the Northern Minnesota woods should furnish timber and a revenue to the commonwealth for an unlimited time.