tending along the whole length of the north and south boundaries there are three thoroughfare tracks with double-track "Y" connections at each end to the belt lines. Bisecting the yard on an east and west line is a central through track known as "track No. 25." In the plan showing the general arrangement it will be seen that there are two sets of classification tracks, known as the "classification yards." The tracks in these yards are 2,400 feet long, and they extend the full width between the thoroughfare tracks. Midway between the two classification yards is an artificially-constructed gravity mound and on each side of it and parallel with it on the level plain are sets of receiving tracks which are from 1,600 to 3,200 feet in length. The gravity mound has an elevation at its summit of 21½ feet above the general level of the yard. For a short distance each side of the summit there is a grade of 1½ per cent, and then for a distance of 1,800 feet a grade of 0.9 per cent, which finishes in a grade of 0.5 per cent for a distance of 300 feet further, the foot of the gravity mound tracks being several hundred feet beyond the apex of the classification yards.

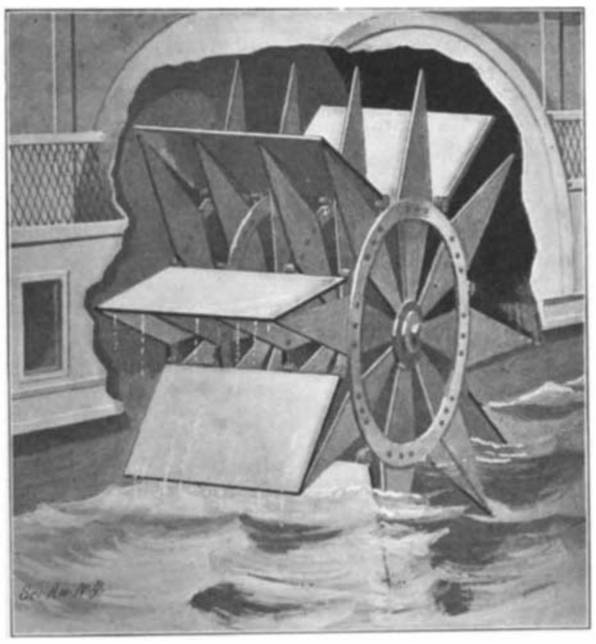
Running diagonally across the classification yards there are double ladders, and east and west of the classification tracks there are parallel overflow tracks which extend parallel with the classification ladders at the outer end of the classification yards. Parallel with the double ladder, at the inner ends of the classification tracks, are two tracks, the one next to the ladder being a "poling" and the outer one a "drilling" track. The double ladders, which connect by switches with each track in the classification yard, converge at a three-throw switch into the central track No. 25, already mentioned, which extends through the center of the whole yard. Consequently there extend over the summit of the gravity mound five parallel tracks with leader tracks and crossovers.

The object of the gravity mound is to allow the transfer of the cars to the various classification tracks to be accomplished by gravity and save a great amount of engine mileage which would be necessary if the cars had to be pushed onto the various tracks by switching engines. The method of operation is as follows: A train coming in at either end of the yard will be run into one of the receiving tracks, where the engine will be uncoupled and will take back a made-up train from one of the classification tracks, taking it out by means of the outer ladders of the classification tracks. One of the clearing yard switching engines will then couple onto the train, back up and push it over one of the drilling tracks, which we have mentioned above, as lying alongside the classification ladder. The drilling tracks and the whole V-point of the classification yard are on the grade of the gravity mound. As the train is pushed up to the summit, the couplers are disconnected at the proper places in the train, and as the cars go over onto the down-grade on the other side of the summit, they separate from the train and run down on the central track No. 25 to the three-throw switch at the apex of the classification ladder. Here they are switched to either side of the double ladder and finally into the desired track of the classification yard. Switching can be carried on simultaneously in both directions, that is, into both classification yards. The object of the "polling" track between each classification ladder and the drilling track is to allow an engine to assist the cars when a heavy wind is blowing against the grade or when there is snow upon the tracks.

The brakemen who ride on the cars down the gravity tracks are brought back by a light engine and car, which run to and fro either on the center track or on one or both of the tracks at the side of the classification tracks. The motive power of the yard will consist at first of six engines, four of them consolidations weighing 185,000 pounds and two of them six-wheeled switching engines weighing 120,000 pounds each. It is expected that from 5,000 to 8,000 cars can be switched and handled at this yard daily. For our illustrations and particulars we are indebted to A. W. Swanitz, chief engineer of the company.

A SELF-FEATHERING PADDLE-WHEEL.

The ordinary type of paddle-wheel encounters considerable resistance as it is submerged, and lifts no small quantity of water as it rises to the surface. As a result of these defects in construction, the engine must perform considerably more work than is actually required in propelling the ship. Mr. David W. Horton, of Petersburg, Ind., has designed a paddle-wheel which feathers itself both on entering and leaving the water,



THE HORTON PADDLE-WHEEL.

so that much of the power now unnecessarily expended is used in propelling the ship.

To the paddle-wheel shaft a series of parallel, radial, lozenge-shaped arms are secured. For the purpose of securing rigidity, a stay-ring is bolted to each circular series of arms at the widest part. Between the radial arms the paddle-blades are hinged to the stay-rings, in such a manner that they can be supported against the inclined face of either of the extending portions of the arms.

The paddle-wheels, as they successively pass the center of the wheel while it is rotating in either direction, will incline forwardly, and will thus be presented at or near a right angle to the surface of the water. The blade approaching the water will be submerged edgewise with a minimum of resistance. When fully immersed, the pressure of the paddle-blade and the immobility of the water when subjected to sudden impact, will rock the blade back until it impinges upon the arms immediately behind. The successive rearward movement of the blades will cause them to engage the water throughout their areas, when submerged, so that they will exert a maximum pressure. Each paddle-blade, by reason of its rearward inclination, will leave the water edgewise. Thus the paddle-blades are feathered while entering and leaving the water, and thus the tendency of ordinary wheels to lift a mass of water is prevented.

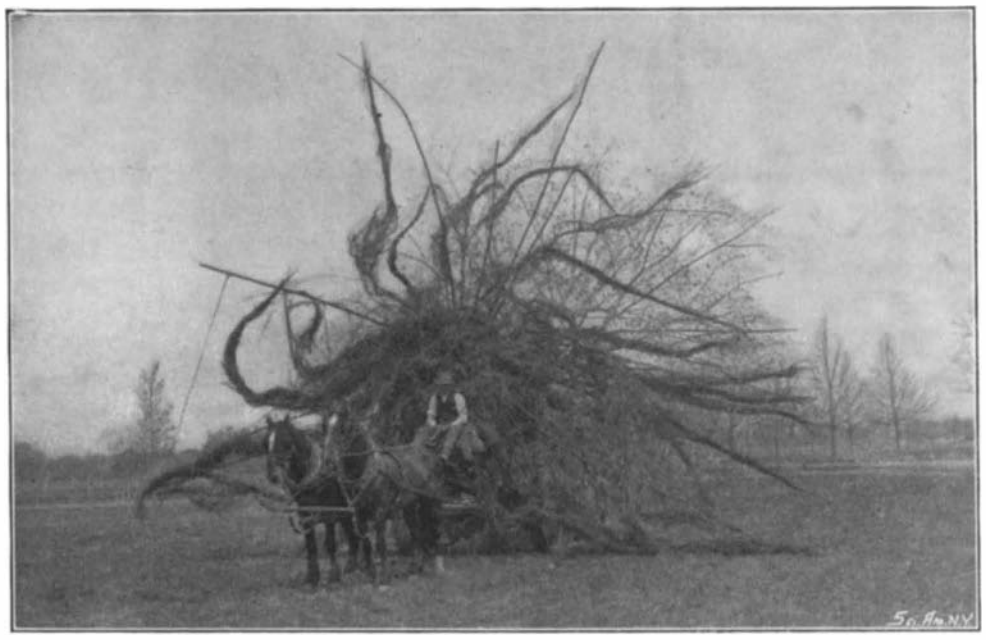
SCIENTIFIC METHODS OF MOVING TREES.

BY DAY ALLEN WILLEY.

The transferring of trees is at present so scientifically conducted that it is not necessary to wait ten or fifteen years for shade trees to grow for one's grounds or to ornament the landscape with large specimens of trees. In fact, parks and the surroundings of country seats can be made to order these days, the grounds about the residence being beautified and shaded while the home is being constructed. At a number of villages on Long Island can be seen fine specimens of forest growth ranging from twenty-five to fifty years old, moved various distances and replanted, yet are growing vigorously and to all appearances are in perfect health. They include such specimens as silver maple, Norway maple, beech, birch, linden, fir, hemlock and cherry.

Apparently it would seem impossible to transplant a tree fifty feet in height, with a trunk varying from one to two and one-half or three feet in diameter at the base, for even a novice realizes the extent of the roots which spread through a wide area of ground in all directions, yet the operation is being performed with complete success. What is known as a tree mover, the invention of Mr. Henry Hicks, of Westbury, N. Y., has been adapted for the purpose. In operating with this apparatus, the tree, if of 14 to 26 inches diameter of trunk, is dug by starting a circular trench with a diameter of 30 to 40 feet. An undercut is made beneath the roots with a light prospecting pick, and the soil picked out and caved down with a spading fork or picking rod, the points of which are rounded to avoid cutting off the roots. The lose dirt is shoveled out of the bottom of the trench and the roots are uncovered, tied in bundles with lath yarn and bent up, out of the way of the diggers. If the roots are to be out of the ground even for one day in dry weather, the bundles are wrapped in clay mud, damp moss and straw or burlap. When the digging has progressed within from 4 to 8 feet of the center, the tree is slightly tipped over to loosen the central ball, which cleaves from the subsoil near the extremities of the downward roots. On sand or hardpan subsoil this is at a depth of 2 to 5 feet. In deep soil it may be necessary to cut some downward roots. A ball of earth is left in the center from 5 to 12 feet in diameter, or as heavy as can be drawn by four to eight horses. This ball is not essential with deciduous trees, but it is easier to leave it than to remove and replace the soil. With fine-rooted trees like the red maple, it is difficult to pick out the soil, while with coarse-rooted trees, like the beech, in gravelly soil the ball drops to pieces.

In loading for removal, the cradle of the mover, which is pivoted above or back of the axle, is swung over to the tree, the trunk first being wrapped with cushions and slats. It is thus clamped to the cradle by chains and screws without injuring the bark. By means of a screw 9 feet long operated by a ratchet lever or hand-brake wheel, the cradle lifts the tree from the hole and swings it over in a horizontal position. Pulling in the same direction by tackle fastened in the top of the tree aids the work of the screw. After the tree is loaded, the roots on the other side of the axle are tied up to the perches. The front wheels are on pivots, therefore



ROOTS WITH 35-FOOT SPREAD BEING TRANSPLANTED AFTER BEING TIED TO BRANCHES.

LOWERING THE TREE INTO HOLE AFTER POLE AND SEAT ARE REMOVED.

the roots are not broken by the swinging of the axle. The roots are next drawn aside to put in the pole and driver's seat. Planks are placed under the wheels, and the mover is pulled out of the hole by tackle.

The hole to receive the tree is prepared with a layer of soft mud in the bottom, which partly fills the crevices between the roots as the tree is lowered into it. The weight of the tree is not allowed to rest upon and crush the downward roots, but is supported by the mover until fine earth is packed in. Soil is worked down between the center roots in the form of mud by means of a stream of water and packing sticks. The side roots are next unwrapped and covered at their natural depth. While the tree is horizontal, it is usually pruned, the outside being cut back 1 to 3 feet, cutting to a crotch or bud, and the remaining twigs thinned out about one-third. Hardwood trees and trees with few roots need the most severe pruning.

Until it is firmly embedded, the tree is secured by guy wires. Anchor posts are set slanting 4½ feet in the ground with a cross piece just below the surface. Two to six strands of galvanized steel wire are used, run from the posts through pieces of hose, around the tree and back to the post. It is twisted tight with two sticks turning in the same direction and moving toward each other. To prevent the sun from drying out the bark on the south side of the tree, the trunk is wrapped with straw, especially thin-barked trees, like beech and silver maple. By following the plan described, enough of the smaller roots of the tree are preserved to give it ample nourishment if it is transplanted in soil which contains fertilizing elements.

As already stated, Long Island contains a number of illustrations of landscape gardening which includes large trees transferred in this manner. The accompanying illustrations give an idea of some effects which have been produced. They depict various species which have been dug up, transferred on the movable vehicles a distance of from fifteen to twenty-five miles and reset. As will be noted, they have grown erect and in some cases more shapely than when in their original positions.

In spite of the details which accompany the work, a force of five or six men only is required to remove and set the largest trees, and the work can be accomplished in a comparatively short space of time. Consequently the owner of a plot of ground entirely destitute of trees can surround his residence with a grove of one hundred or more hardy specimens of the forest, arranged in artistic groups to suit his fancy, the operation representing but a few months from beginning to end.

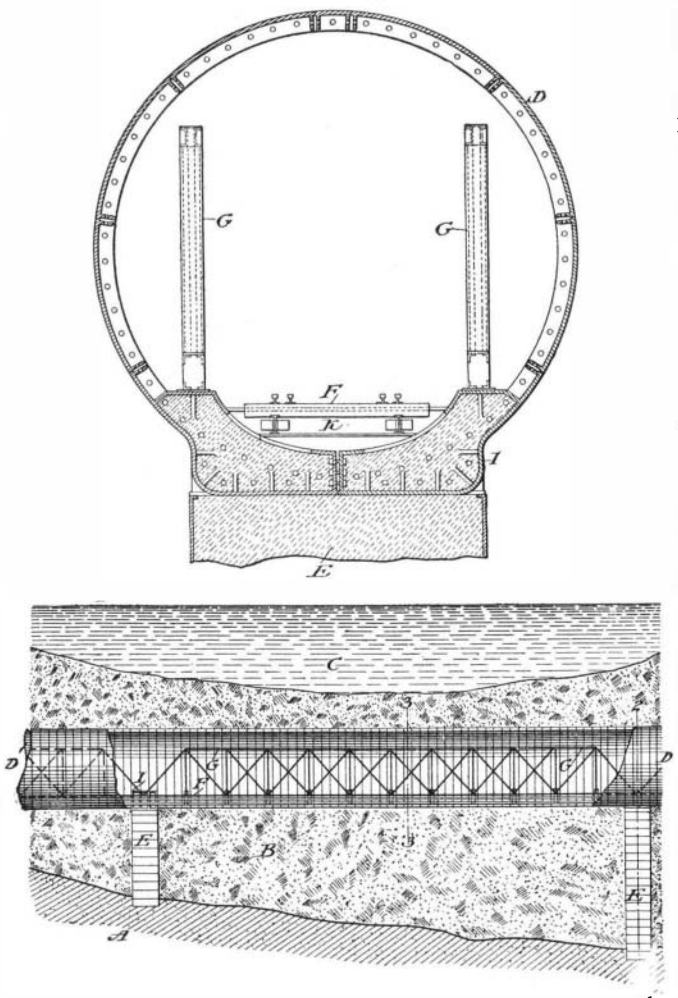
THE PENNSYLVANIA RAILROAD TUNNEL BRIDGE.

The accompanying illustrations are reproduced from the Patent Office drawings of the new system devised by Charles M. Jacobs, Consulting Engineer, for the construction of tunnels through silt and other loose material which is naturally ill-adapted to carry such structures. In driving tunnels through the ordinary run of material, such as solid rock, loose rock, cement, gravel or hardpan, it is sufficient either, as in the case of solid rock, to make an excavation larger than the gage required by traffic and line the excavation with masonry or concrete, or, as in the system so largely adopted in London tunnels, a metallic tube may be driven through the material. In case of any of the materials named, when once the tunnel is excavated, or the tube driven, the stability of the structure is assured for all time, as displacement, vertical or lateral, is impossible.

In driving tunnels beneath rivers where deep deposits of silt of varying consistency are encountered, it may happen that the silt is of such a semi-fluid consistency that when heavy traffic began to pass through the tunnel it would be in danger of throwing the tunnel out of alinement even to the extent of causing actual fracture of the same. The invention of Mr. Jacobs, while it was primarily designed to overcome the difficulties likely to be encountered in building the proposed tunnel beneath the North River, is, of course, applicable to tunneling operations under other rivers, or through swampy or saturated material, whose consistency is such as to threaten the permanence of the tunnel. In the case of the North River tunnel it would be possible, by carrying the tunnel to a sufficient depth below the river, to secure firm material, but this course would be open to the objection that it would involve heavier grades than are desirable for the economical and speedy operation of the line. Mr. Jacobs, therefore, determined to carry his tunnels at a higher elevation and overcome the objections due to the looseness of the upper strata of the river bottom, by giving his tubes sufficient transverse and lateral strength to perform the full functions of a bridge or girder, and support the bridge tube thus formed at stated intervals by means of piers carried down until they reach the underlying rock.

We present two illustrations, one showing a longitudinal view of the tunnel bridge, the other a cross-section. The tube may be built in the ordinary manner, of segments of cast iron, provided with internal flanges and bolted together. Within the tube and on either side of its longitudinal axis are steel trusses, the length of whose span would ordinarily be determined by the head room within the tunnel, an average proportion of length to depth being shown in the accompanying plan. The position of the piers, however, would ordinarily depend upon the configuration of the river bottom. These trusses could be incorporated with the structure of the tube by tying them to the shell by means of connecting plates at the flanges of the tube, and by means of castings, *I*, over the piers, which castings would support the bridge girders and also the tube. The piers, *E*, would be sunk from the tube itself by the pneumatic process, and they would be of any form of construction that was found most suitable. Probably they would be wrought iron shells filled with concrete after the plan followed so largely in bridge foundations. In this construction the truss would perform the work of carrying the moving load, or the truss and the shell might be so constructed and connected as to share in the work, or the shell itself might be so modified as to perform the double function of shell and bridge.

In due course we hope to publish working plans of this system as applied in the construction of the Pennsylvania-Long Island tunnel. Manifestly the



METHOD OF CONSTRUCTING BRIDGE TUNNELS UNDER THE HUDSON RIVER, AS PROPOSED BY CHARLES M. JACOBS FOR THE PENNSYLVANIA-LONG ISLAND TUNNELS.

most difficult problem will be the sinking of the piers; although we see no reason why this should not be satisfactorily and safely accomplished in spite of the very limited head-room available.

The Current Supplement.

The current SUPPLEMENT, No. 1,361, is begun by a most interesting article on Mexico, with eight illustrations. This is the first article of the series. In view of the Pan-American Congress which was held in the city of Mexico and the visit of the Mining Engineers to Mexico, this series will prove valuable. It is an abstract of a lecture delivered by Dr. W. P. Wilson, Director of the Philadelphia Commercial Museums. "Benzine Motor Cycle" describes in great detail one type of these interesting machines, and is accompanied by elaborate drawings. "Tubes with Sides and Without in Ship Resistance—An Example from Lord Kelvin" is by Marston Niles. "Behind the Wings in the Hoftheater in Dresden" describes how many novel stage effects are obtained.

Prof. Charles Wilson has announced to the Royal Society a new determination of the temperature of the sun, which, with due allowance for slight unavoidable errors, is placed at 6,200 degrees centigrade (11,192 Fahr.). If the probable absorption of the sun's radiated heat by its own atmosphere is allowed for, the mean temperature of the sun's body is placed at 6,600 degrees centigrade. Prof. Wilson started his calculations almost ten years ago.

Correspondence.

A Universal Language.

To the Editor of the SCIENTIFIC AMERICAN:

There will be a universal language, no doubt. It seems to be inevitable. It is also pretty certain that it will not be an artificial language. The failure of the attempts at language making *de novo* have been very conclusive on this point.

The next question is: What language will conquer the world? We may argue about this as we will. The fact remains that the English is *doing* this in a most convincing way. When other languages are brought in contact with English they fail to hold their own. It is common for foreign families in America to find themselves unable to make their children speak the language of the fatherland. This never happens with foreign-born children of English-speaking parents living abroad. The children hold the English with the foreign tongue, usually speaking both. The loss of the parents' native language by the children, in spite of most strenuous efforts, is a commonly known fact in America.

English is capable of stating facts and ideas more directly than other languages. This is constantly seen when newspapers and books are printed in several languages in parallel columns. English in nearly every case occupies the least space. The terse vigor of its every-day idioms makes it convenient and easy.

It can express every thought and every shade of emotion of the human mind that can be expressed in language. There may be words in other languages which some people think do not have equivalents in English, but the thought can be translated into English nevertheless. The thought is expressible.

For these reasons the English language is prevailing on its own merits. The growing power of the English-speaking peoples is another reason for its spreading use. This is aided by the fact that the peoples who speak English do not learn other languages with any facility.

ONE WHO SPEAKS ENGLISH ONLY.

Preventing Spontaneous Combustion of Coal.

A remedy has long been sought for preventing the spontaneous combustion of coal upon colliers and other vessels carrying large cargoes of coal, while at sea, but so far all the devices have proved futile. Coal always absorbs oxygen from the air, and always generates heat in consequence of the combination of the oxygen with the carbonaceous contents of the coal, and in the course of time spontaneous combustion ensues. Now, however, a system for preventing such conflagrations at sea has been invented by Mr. Thomas Clayton, of London, England. When the ship has been duly loaded, a quantity of sulphur dioxide gas is injected into the hold containing the coal. All possibility of an explosion or spontaneous combustion is thereby removed, and the hatches may be securely battened down. Some interesting experiments have been carried out to prove the practicability and efficiency of this invention. A chamber was filled with about 6 per cent of sulphur dioxide gas. A lighted torch was then thrust into it and was instantly extinguished. A long lighted torch was then slowly inserted in the chamber, and as it came into contact with the gas the fire was extinguished. A broad red-hot bar of iron was next inserted in the chamber, and a torch composed of straw dipped in naphtha was then placed upon the iron, but neither the naphtha nor the straw ignited. A broad red-hot bar of iron was inserted in the chamber and thrust into a bucket of naphtha. No explosion occurred. In fact, the result was similar to that achieved by plunging a red-hot iron into a bucket of water.

Hundredth Anniversary of Coal in America.

Arrangements were completed at Wilkesbarre on January 23 for the celebration of a notable anniversary, the one hundredth, of the burning of coal in this country, says the New York Tribune. This took place at the old Fell House, the experiment being conducted by Jesse Fell on February 11, 1802, and was witnessed by all the prominent men in town, word having been received from Mauch Chunk that the "black rock," so plentiful in the region, would burn and give heat. The occasion was made an important event, and the anniversary will be no less so. The old grate is still in existence, although it was twice stolen, once at the close of the Philadelphia Centennial, and again a short time later, and it is now in the same spot where it first held the glowing coal.

The artesian well at Grenelle, Paris, took ten years of continuous work before water was struck, at a depth of 1,780 feet, says The Engineer. At 1,259 feet over 200 feet of boring-rod broke and fell into the well and it was fifteen months before it was recovered. A flow of 900,000 gallons per day is obtained from it, the bore being 8 inches.