BEAUTIFYING THE ROADBED BY SODDING.

What an ideal roadbed should be, both for wearing qualities and appearance, is shown in four stretches of the main line of the Pennsylvania Railroad between Philadelphia and Pittsburg. Grassy banks sloping smoothly down, when the tracks are in a cut, are the features that strike the passenger's eye. It might be supposed that these sodded slopes are put there solely to please the eye, to make the Pennsylvania a good road to look at as well as to ride upon. This is a mistake—the grass is more useful than ornamental, and eventually it will mean the saving of thousands of dollars now spent on "maintenance of way."

"Water," said a prominent railroad official in a recent lecture, "is the greatest enemy of the roadbed." Water flowing down unsodded slopes causes erosion, washing dirt and stones into the ditch beside the track, and choking drainage. Perfect drainage is one secret of success in the maintenance of roadbed.

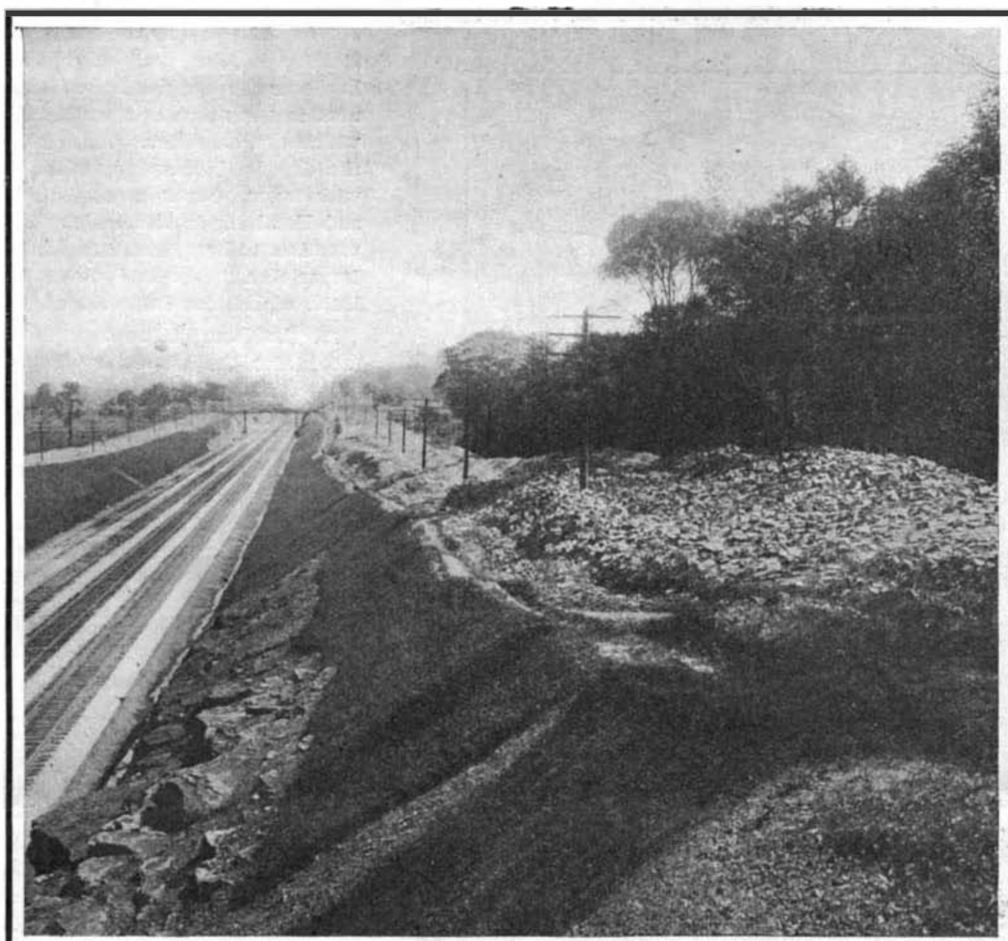
It was in the summer of 1905 that President Cassatt suggested the present improvement, in order to reduce the cost of maintenance as well as to make travel for the patrons of the Pennsylvania safer, more comfortable, and altogether more agreeable. He appointed a committee of engineers of the company to prepare plans for a roadbed with draining facilities as near perfect as possible, and the fifteen miles of new roadbed is the result of the committee's report. One of the two five-mile stretches of roadbed is near Lancaster on the Philadelphia division, and the other near New Port, on the middle division. The two shorter stretches, two and a half miles each, are on the Pittsburg division, one near Cresson on the western slope of the mountain, and the other about fifty miles east of Pittsburg, at Hillside.

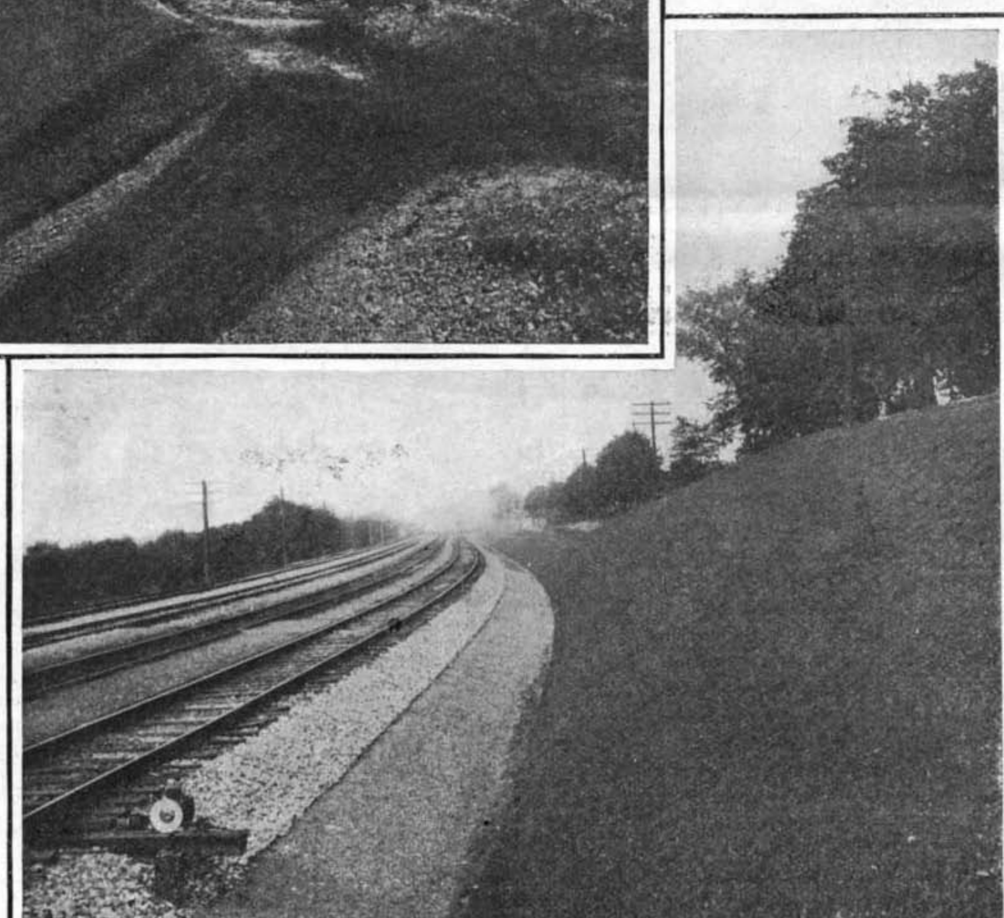
The Pennsylvania requires a ditch, ten and a half feet wide, on each side of a four-track road, and the bottom of the ditch must be three and a half feet below the level of the top of the tie. That means that there must be a decided slope from the lowest part of the roadbed to the ditch, so that water settling through the ballast will flow off rapidly.

The ditch itself is of ordinary soil, but the company has tried the experiment, in some places, of sprinkling it with oil to keep down both weeds and dust. Whatever method is adopted, the important object is to keep the ditch clean and unobstructed. It has been found that the sodded banks assist greatly in this. When it rains, the water pours down over them without bringing anything with it, and follows the ditch to the nearest outlet.

The cost of the improvement of even the fifteen miles has been very high. Seventy-three thousand cubic yards of new ballast were used in that short distance. This ballast was not to make the track more steady—the supply already there was sufficient for that—but to make the drainage perfect. The cost of sodding with blue grass was an even greater item. It was calculated by the engineers that sixty per cent of the entire cost was for cutting down and sodding the slopes.

The money will all come back, though, in saving of maintenance expenses. At present, work trains, crowded with laborers, have to be on the move all the time, for clearing ditches and putting in new ballast where it is necessary. In addition to the great cost of labor, the interference with traffic is a most important consideration in this constant overhauling.





BEAUTIFYING RAILROAD ROADBEDS AND PROTECTING SLOPES BY SODDING.

Antimony has a hardening effect when added to lead; a small quantity of bismuth gives the alloy the property of expanding at the instant at which it solidifies, the result being a perfect cast from the mold.

Engines Driven by Blast-Furnace Gas.

In order to show the great benefit which is obtained by operating low-carbon gas engines directly from blast-furnace gases we may cite some of the recent figures which have been taken from experiments made on the Continent, where many such motors are in use in blast furnaces for operating rolling mills and other machinery. In the blast furnace, the production of gas available for the engines is stated to be 2,700 cubic yards per ton of pig iron produced, making the necessary deductions for losses and for the quantity of gas needed for the reheating. The gas gives from 800 to 1,000 calories per cubic yard. This quantity of gas utilized in a steam engine, by burning it under the boilers, would give only an amount of energy available represented by 260 horse-power-hours, while in the case of motors which use the explosive force of the same amount of gas we find that the energy is three times the above amount. This is greatly in favor of the use of such engines, especially as they are now very reliable in their action and are built in large sizes. As the blast-furnace gas does not contain any products of distillation, but only a quantity of water vapor and dust which are easy to separate, the engines do not need to be cleaned as often as ordinary gas engines. With a good set of scrubbers for the gas, a motor can be operated several months at a time without needing to be cleaned. Seeing that the blast-furnace gas does not contain hydrogen, there is no danger of a premature explosion of the gas in the motor, even when working at a very high compression.

The native mass copper of Lake Superior has the highest electric conductivity of any known copper. A sample cut from the most compact portion of a mass, rolled and drawn into a wire of 0.104 inch diameter and annealed, gave a conductivity of 102.5 Mathiesson standard. Cathode copper, carefully deposited with a low current, and prepared in the same way, gave just as high a conductivity.

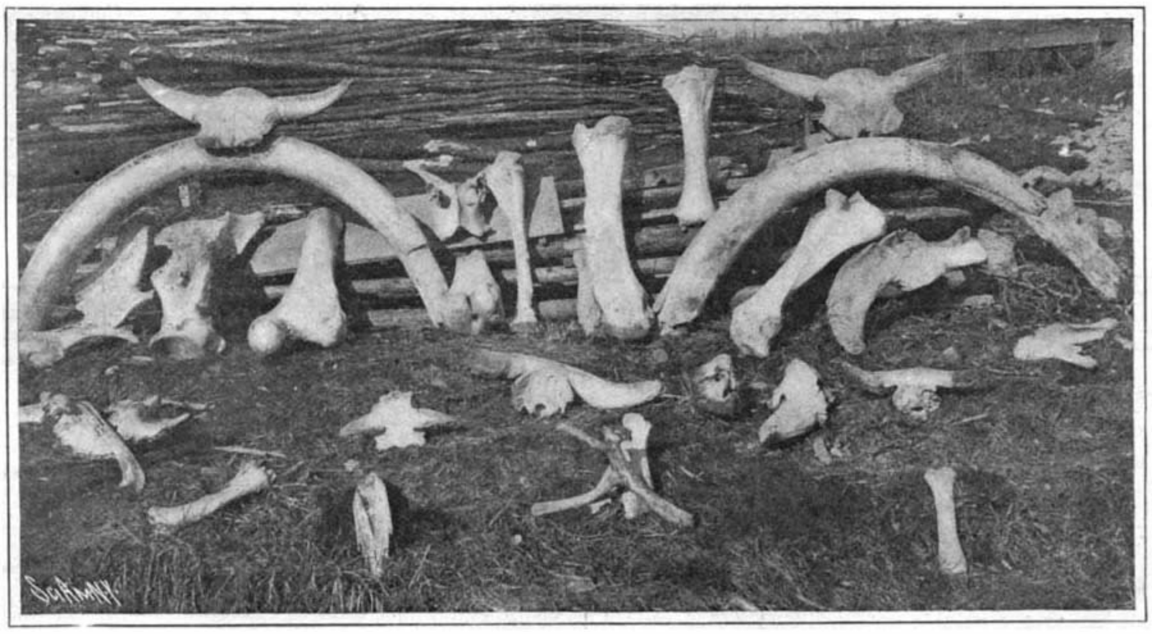
THE ANCESTORS OF THE ELEPHANT.

The ancestors of the elephants of the present day have become well known to palæontologists through the fossilized remains, and even frozen carcasses, which have been found practically all over the world. The two living species of elephant are the last survivors of a group generally known as mammoths or mastodons, which formerly spread over all the great continents and inhabited temperate and Arctic as well as tropical regions. Various species of these elephants or mammoths have been found in every country of Europe, in Asia and Africa, and in the western hemisphere from Alaska to Argentina. The remains of these giant creatures are so abundant in Siberia, that fossil ivory forms a fairly large article of commerce. The mastodons, distinguished from the true elephants principally by a less complete specialization of the grinding teeth, had an almost equally extensive range, but inhabited more especially the temperate regions during the Pliocene and Pleistocene epochs. Primitive mastodons lived in Europe and North America during the Miocene epoch. They were of smaller size than the later mastodons, and had small tusks in both upper and lower jaws. In some of the older species the upper tusks curved downward, and the lower ones upward, in a manner that indicates their origin from chisel-shaped incisors, like those of rodents. From this stage up to the present elephant a complete evolutionary series can be traced, but the earlier stages in the development of the Proboscidea are not known, though they are probably Asiatic. Mammoths have been found in the Arctic regions imbedded in masses of ice, which so preserved them that the flesh could be used as food for sledge dogs and even human beings. This preservation has enabled us to become familiar with the mammoth in every particular, even to the food upon which it lived, for quantities of this have, in certain instances, been found between the animal's jaws, or partially digested, in the s' ch.

Although the elephant can be considered an ungulate, nevertheless he presents such remarkable differences in the structure of the skull, that naturalists have given him an isolated position in the animal kingdom. The skull includes many prominent bones, and has numerous internal passages separated by partitions. The nasal bones are short, and the nostrils form an upwardly-leading duct. Compared with the size of the skull, the brain, although the largest found among the mammals, is exceedingly small and has strongly developed convolutions. As in the rodents, the teeth are composed of incisors and molars only. The modern elephants belong to the specially-created sub-class Proboscidea, which comprises only two varieties, and the elephant, therefore, stands alone in the animal world, a paradox in the natural systems based upon consanguinity or upon descent.

The first traces of pachyderms in any way related to the elephant are found in the Miocene period. In those days the climate of the temperate zone was subtropic, and together with the tapir, still found in Central and South America and in southern India, the dinotherium roamed the luxuriant forests of his habitat. Piece by piece the bones of this proboscidean have all been gathered, and show that he was an animal some 14 feet in height, with a trunk and long column-like legs. Most peculiar is the formation of the lower jaw, the forward portion of which is considerably elongated. This strongly-developed symphysis bends downward at right angles, and carries a pair of strong incisors turned backward, describing a curve not unlike that of the tusks in the upper jaw of the walrus. These tusks show in cross section a dense, concentric, radiating mass of ivory, the outer surface of which is sometimes circular and sometimes oval. The lower jaw of the dinotherium is unique among all mammalian jaws, and constitutes an especial differentiation of species. The resemblance between the molars of the dinotherium and the tapir is very strong, and from this resemblance Cuvier was led to conclude that the first discovered remains of a dinotherium were those of a tapir. The species is found in the middle Miocene strata of central and southern Europe and in the upper Miocene to the lower Pliocene in the same regions, as well as in the upper Miocene of southern Asia. In the mastodon the formation of the head was more elephant-like, while the body was longer and heavier than that of the elephant, with thicker bones. The cervical vertebræ were not so short, and consequently the neck was longer and more mobile. During the middle Miocene, mastodons inhabited central and southern Europe and north Africa, and during the upper Miocene southern and eastern Asia as well. The habitat remained the same for the entire Pliocene period, with which they disappeared, the cause of the disappearance being unknown, although it has been conjectured that man had a hand in the destruction of the genus. In North America the remains are first found in the upper Miocene, becoming more widely distributed in the lower Pliocene, and being found in the beginning of the upper Pliocene in South America. In both North and South America they are found even down to the Pleistocene period, but for some inexplicable cause they disappear with the first appearance of man. The geologically older forms of the genus Mastodon possess, besides a pair of huge auxiliary canines or tusks, a similar pair somewhat less markedly developed in the mandible. The mandible tusks are, however, not downwardly disposed as in the jaw of the dinotherium, but project forward with a slight upward curve. The mastodon molars resemble those of such suilline animals as the hippopotamus, but in the later forms the structure of the molar more closely approaches that of the elephant grinder until a complete transitional form is developed, occurring with a simultaneous retrogression of the symphysis together with the disappearance of the mandible tusks. The mastodons had a more compact dental enamel than any of the other mammals and were, on that account, good masticators, the food of the genus undoubtedly consisting of plants, reeds, and twigs of trees.

The later upper Pliocene mastodon when mature no longer had mandible tusks, the alveoli, or sockets, soon growing together after the milk tusks had disappeared. The molars in this species are characterized by alternating cusps in each half ridge. The Ohio species, called by the Indians "Father of Oxen," is better known and is generally recognized as typical. Of this species the most complete skeletons have been obtained from the banks of the Hudson, but large quantities of bones have been found in the salty bog soil of Big Bone Lick, Kentucky. The bones are very massive and the vertebræ long, while the upper tusks have a decided upward curve.



Mastodon Bones Found in American Gulch.

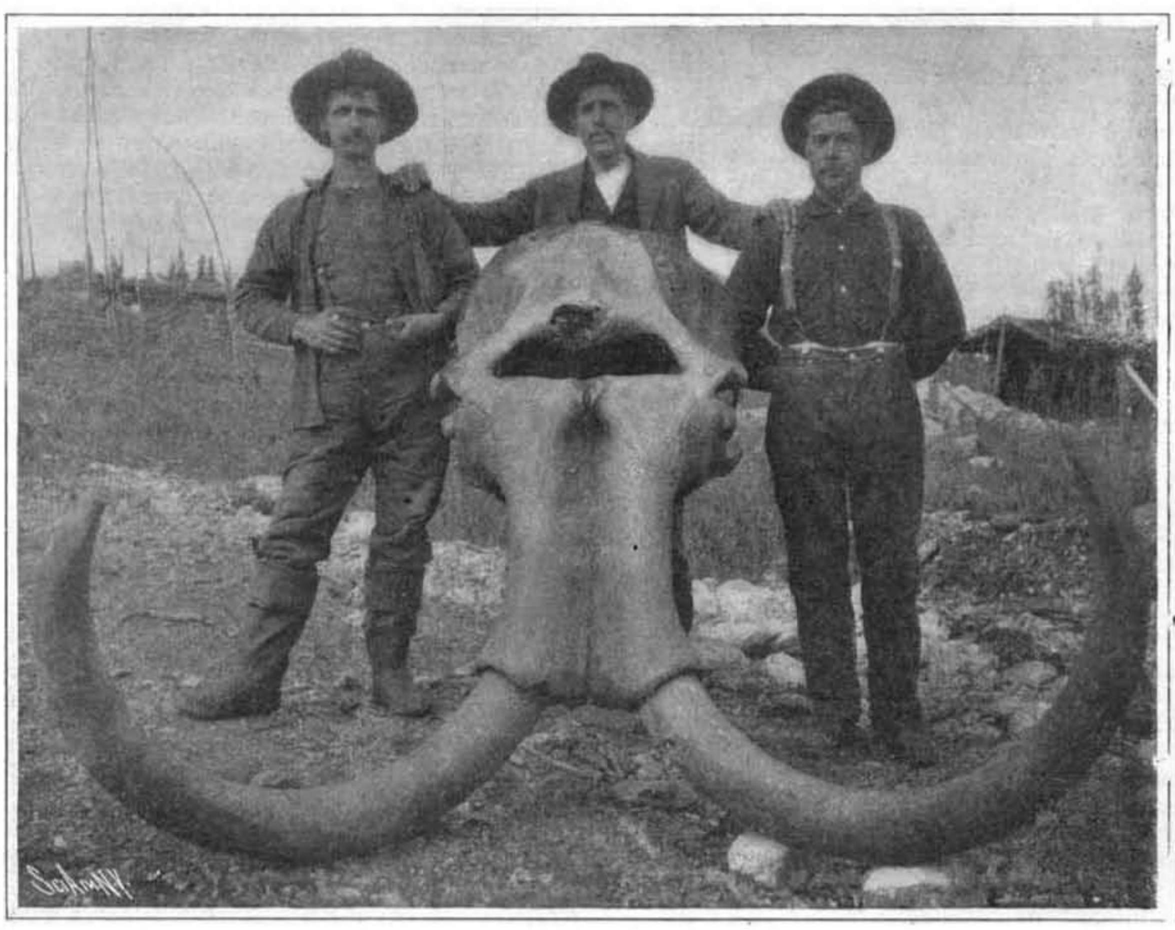
A transitional form between the later mastodon and the elephant is found in the stegodon. In this genus the lower incisors are lacking and the upper are enormously developed, while the molars consist of from six to twelve low convex transverse ridges, the depressions between which are usually filled with cement. The genus has four species, and it flourished from the Pliocene to the Pleistocene in southern India and eastern Asia.

The elephant evidently at some time migrated from his primeval southern Asiatic home. At the present time the last species inhabit southern Asia and the tropical regions of Africa, whither they migrated at a comparatively late period.

The list of vessels which have been engined in England with Parsons' turbines to date represents a total horse-power actually completed of about 280,999.

The Temperature at Which Water Freezes in Sealed Tubes.

Prof. H. A. Miers, F. R. S., of Oxford, and Miss F. Isaac presented an important communication on "The Temperature at Which Water Freezes in Sealed Tubes," before the recent meeting of the British Association. The authors had shown in 1905 that in a cooling supersaturated solution in which a few crystals were growing while the solution was being stirred, the refractive index rose to a maximum at a certain temperature and then fell suddenly; at that moment profuse crystallization took place. As the same solution inclosed in a sealed tube, so as to be protected from access of crystal germs, crystallized in a shower at exactly the same temperature, this seemed to be the temperature of spontaneous crystallization. Crystallization at a lower temperature could be produced only by inoculation of the solute—the nitrate, chlorate, chloride, sulphate of sodium, various alums, etc.—or of an isomorphous substance. The present sixty-eight experiments, Prof. Miers stated, had been made with water inclosed in sealed tubes which were continuously and violently shaken in a bath of brine, cooled by means of a refrigerating coil, and stirred by a wooden plunger of horse-shoe shape perforated with holes. The initial brine temperature ranged from + 9 deg. to —2 deg. C., and the rate of fall was about 2 deg. per hour. The tubes were of ordinary or Jena glass; some were newly made up, others had been used for weeks; the water was tap water, or distilled water, or pure water of conductivity 1.1 × 10^{-6}; the tubes were about half full, and the experiments lasted from seventy to five minutes each. All the tubes froze at temperatures between —2 deg. and —1.6 deg. C., the mean for all the experiments being —1.86 deg. C., and for the pure water —1.9 deg. C. The ice generally made its appearance at the bottom of the tube, and grew at first rapidly in fan-like crystals, and then in a cloudy shower. The authors concluded that —1.9 deg. C. was the temperature at which pure water froze spontaneously in the absence of solid germs of ice, and it was remarkable that, according to Pulfrich, this was also the temperature at which supercooled water possessed a maximum refractive index. The effect of friction had been studied by introducing glass, garnet, or lead into the tubes; the water then froze at —0.4 deg. C.



Mastodon Head Unearthed at a Depth of Forty-two Feet.

Length, 4 feet; width, 2 feet 4 inches; tusks, 7 feet 6 inches.

Mastodon Skull and Tusk Found in Quartz Creek, Yukon Territory.

THE ANCESTORS OF THE ELEPHANT.