The Tunnels of the Ancients.

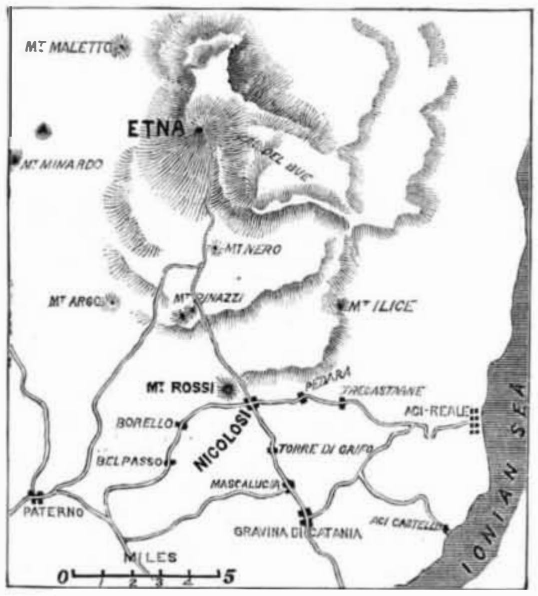
Leaving Naples by carriage, the road immediately leads through a tunnel three-quarters of a mile long, and cut right through a mountain eight hundred feet high. This tunnel is driven through a volcanic tufa. This tunnel of Posilippo, as it now exists, was cut through only twenty-seven years before Christ. Augustus Cæsar's great minister of public works, Marcus Agrippa, made the present tunnel, or he may have enlarged it from a smaller one that answered the commercial communications and necessities of the days before the Empire. This tunnel is to-day the great highway to the heart of Naples, as it has been for more than 1,900 years. The great Appian way ran to Capua, within thirty miles of Puteoli; thence this magnificent Roman high road, under the name of the Consular Way, was continued to Puteoli, and the then Consular Way pushed on through Neopolis, Herculaneum, Pompeii, Stabia, Nucera, Salernum, Paestum, down to Rheum. This tunnel of Posilippo was formerly called the grotto or tunnel of Puteoli. The ancients began their perforations at each end, and also from above, in two places equidistant from the termini of the tunnel. The guide-books, both Murray and Baedeker, tell that the shafts from above were made by Alfonso I., in the fifteenth century, which is altogether wrong. No less than four tunnels of Roman construction existed in the vicinity of Naples, and they, all of them, even the latest, rediscovered and open in 1842, have shafts from above.

The Romans were great road, tunnel, and bridge builders, and we have never yet given their engineers half the credit which we should for their great science and skill. Nowhere, not even in the city of Rome or on the Roman Campagna, are there so many evidences of their engineering skill as are to be found in the vicinity of Naples. At the recent meeting of the British Association of Science, held at Aberdeen, Scotland, Mr. B. Baker, an eminent British civil engineer, read a paper recalling certain engineering feats of the ancients. Mr. Baker says: "I have no doubt that as able and enterprising engineers existed prior to the age of steam and steel as exist now, and their work was as beneficial to mankind, though different in direction. In the important matter of water supply to towns, indeed, I doubt whether, having reference to facility of execution, even greater works were not done 2,000 years ago than now. Herodotus speaks of a tunnel eight feet square and nearly a mile long, driven through a mountain in order to supply the city of Samos with water; and his statement, though long doubted, was verified in 1882, through the abbot of a neighboring cloister accidentally unearthing some stone slabs. The German Archæological Society sent out Ernest Fabricius to make a complete survey of the work, and the record reads like that of a modern engineering undertaking. Thus, from a covered reservoir in the hills proceeded an arched conduit about 1,000 yards long, partly driven as a tunnel and partly executed on the 'cut and cover' system, adopted on the London underground railway. The tunnel proper, more than 1,100 yards in length, was hewn by hammer and chisel through the solid limestone rock. It was driven from the two ends like the great Alpine tunnels, without intermediate shafts, and the engineers of 2,400 years ago might well be congratulated for getting only some dozen feet out of level, and little more out of line. From the lower end of the tunnel branches were constructed to supply the city mains and fountains, and the explorers found ventilating shafts and side entrances, earthenware socket-pipes with cement joints, and other interesting details connected with the water supply of towns."

This tunnel of Posilippo is also a fine specimen of ancient engineering. Millions of human beings have each year, for nearly twenty centuries, passed through it. Roman chariots and other ancient vehicles have left their autographs scraped and scratched into the lining stone, and modern wagons and carriages still rub their hubs against it, leaving their traces for generations to come. Strabo wrote about this tunnel. Seneca described his passage through it. Petronius satirized it, and Petrarch, Boccaccio, Cappaccio, and more modern writers have told us their thoughts about it; and it seems good for a thousand years to come. Virgil's tomb is just above its eastern entrance, and his farms (where he wrote part of both the "Georgics" and the "Æneid") are over it.

ERUPTION OF MOUNT ETNA.

On May 17 an eruption of Mount Etna began, which, according to the latest dispatches from Catania, Sicily, is daily increasing in proportions, and now threatens destruction to a number of the villages scattered over the lower slopes of the mountain. Vast volumes of flame and torrents of lava are issuing from 11 of the smaller openings to the south of the main crater, and in the neighborhood of Monti Rossi. Earthquake shocks are constantly occurring. A stream of lava, in some places 200 meters broad, flowed toward the town of Nicolosi, advancing at the rate of 40 meters an hour. At last reports, it was within one kilometer of the town,



and has in all probability repeated the violence of former years. The adjacent country has been desolated over large areas, and the people forced from their homes. All the streams and water courses in the district have dried up, and a water famine prevails.

Mount Etna, or, as the Sicilians commonly call it, Mongibello, is one of the most celebrated volcanoes in the world. It is situated on the eastern seaboard of the island of Sicily. Its name signifies the burning mountain, and was known to the earliest classical writers, by whom it was invested with many legendary terrors. To them it was the prison of the fabled giant Enceladus. The flames were his breath, the thundering noises his groans, and, when he turned on his side, earthquakes were the vibrations produced by his ponderous frame. The ancients had very exaggerated notions of the size of the mountain, and computed its height at three and even four miles. As recently determined by the Italian Government, its true height is 10,868 feet. It must, however, be remembered that the cone of a volcano is far from constant in its dimensions, a diminution of more than 300 feet having been produced by a single eruption. The impressiveness of its elevation is due largely to the fact that it rises directly from the sea, while few of the interior peaks attain such a height above their respective plateaus. From the summit, the radius of vision gives an included area of 39,900 square miles. The circumference of the mountain is approximately 91 miles, and its area 480 square miles. The accompanying illustration represents Mt. Etna as seen from Catania, Monti Rossi and Nicolosi being on its southern slope. The map shows their respective locations.

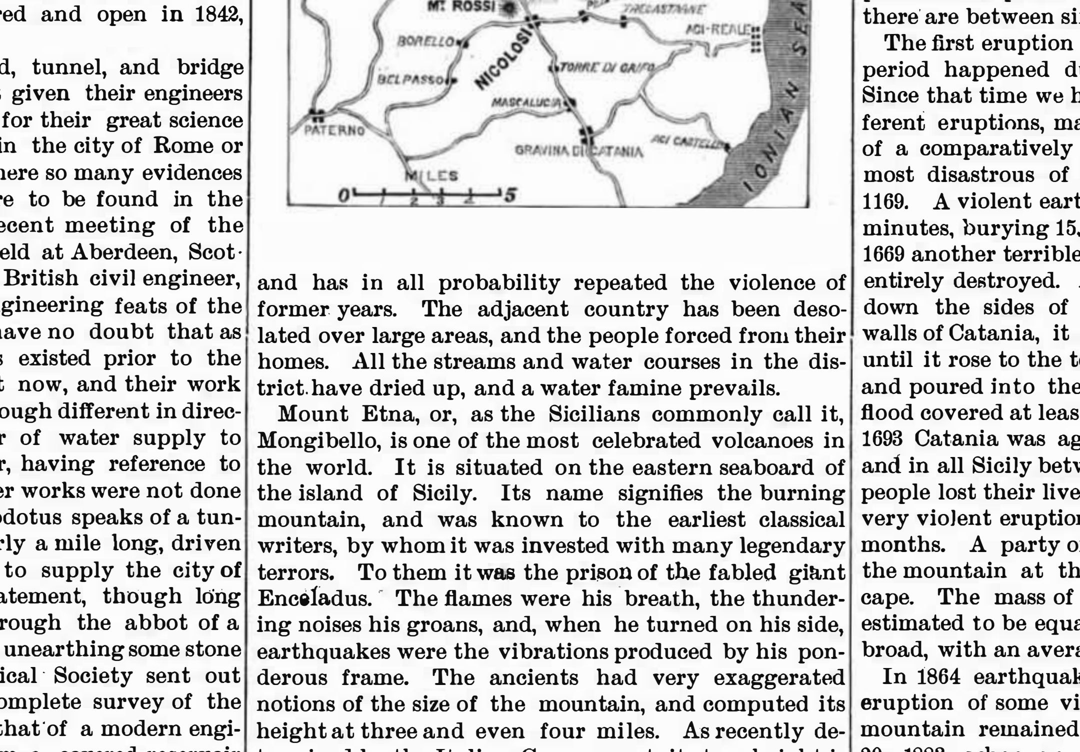
There are two cities, Catania and Aci Reale, and 63 villages on the mountain. In spite of its tragic history, Mount Etna is far more thickly populated that any other part of Sicily or Italy, no less than 300,000 persons living within its area. Its general aspect is that of a pretty regular cone with very gentle slopes. On the eastern side, the uniformity is broken by an oval valley, four or five miles in diameter, called the Val del Bue. It is bounded on three sides by nearly vertical precipices, from three to four thousand feet high, and is entirely sterile.

The mountain itself is divided into three distinct regions. The lowest of these, the *Coltivata*, is extremely fertile, and produces an abundance of semi-tropical fruits and grains. When decomposed, the lava makes a very rich soil. This zone covers the entire base of the mountain, and extends to an elevation of about 2,000 feet. Above this is the *Selvosa*, or woody region, which is covered with large forests. From its upper limit, at a level of 6,300 feet, to the summit is the *Deserta*, a dreary waste of ashes and lava. For a large part of the year this remains permanently covered with snow. A characteristic feature of Mount Etna is the large number of secondary cones scattered over its sides. There are at least eighty of these cones which possess some prominence. If one counts the monticules, there are between six and seven hundred.

The first eruption of the volcano within the historic period happened during the seventh century B. C. Since that time we have a record of seventy-eight different eruptions, many of which, however, have been of a comparatively harmless character. One of the most disastrous of the earlier eruptions was that of 1169. A violent earthquake destroyed Catania in a few minutes, burying 15,000 people beneath the ruins. In 1669 another terrible outburst occurred. Nicolosi was entirely destroyed. An immense stream of lava poured down the sides of the mountain. On reaching the walls of Catania, it accumulated without progression until it rose to the top of the wall, a height of 60 feet, and poured into the city in a fiery cascade. The lava flood covered at least 40 square miles of territory. In 1693 Catania was again destroyed by an earthquake, and in all Sicily between sixty and a hundred thousand people lost their lives. On the 26th of August, 1852, a very violent eruption occurred, which lasted for nine months. A party of English tourists were climbing the mountain at the time, and had a very narrow escape. The mass of lava ejected during this period is estimated to be equal to an area six miles long by two broad, with an average depth of twelve feet.

In 1864 earthquakes were frequent, and in 1865 an eruption of some violence took place. After that the mountain remained in a quiescent state until March 20, 1883, when an outburst occurred in almost the same locality as the destructive eruption of 1669. It created great consternation, but the phenomena ceased on the third day without causing damages. The present eruption occurs in almost the same part of the mountain, and were it not for the interval of time which has elapsed, could readily be considered a resumption of the hostilities then begun.

Geologically, Mount Etna is somewhat older than Vesuvius. Lyell states that its formation probably began in the newer Pliocene period.



1. Place of the Eruption. 2. Monti Rossi. 3. Village of Nicolosi.

ERUPTION OF MOUNT ETNA, MARCH 22, 1883.

Another Inventor Gone.

Mr. E. F. Loiseau, formerly of Philadelphia, and well known as an inventor of a practical method of making compressed artificial fuel, died in Brussels, Belgium, on the 30th of last April.

Mr. Loiseau was enthusiatic on the subject of compressing coal dust with adhesive substances for fuel, and he went abroad several months ago to erect machinery at some Belgian collieries for the manufacture of fuel from the coal waste. A short time before his death, he wrote home that he had been obliged to bury his machinery to prevent its destruction by the infuriated laborers, who objected to the introduction of his machinery in the mining districts.

THE latest invention in hat lining is a map of the city of London printed on silk, so that any stranger or gay young fellow may find his way home or see at a glance if cabby is taking him the nearest route to his destination.

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Steamers to Run Fifty Miles an Hour.

At a recent meeting in London of the Society of Junior Engineers, Westminster, a paper was read by Mr. C. Hurst, explanatory, among other things, of the power necessary to obtain a speed of 40 knots in steam vessels. Mr. Hurst explained that the power necessary to be introduced into steamers of light construction in order to obtain any required speed could not be determined by the old method of reckoning the resistance as proportionate to the midship section, but was to be ascertained by Reech's law, taking the actual speed and proportions of a first-class torpedo boat as the basis of comparison.

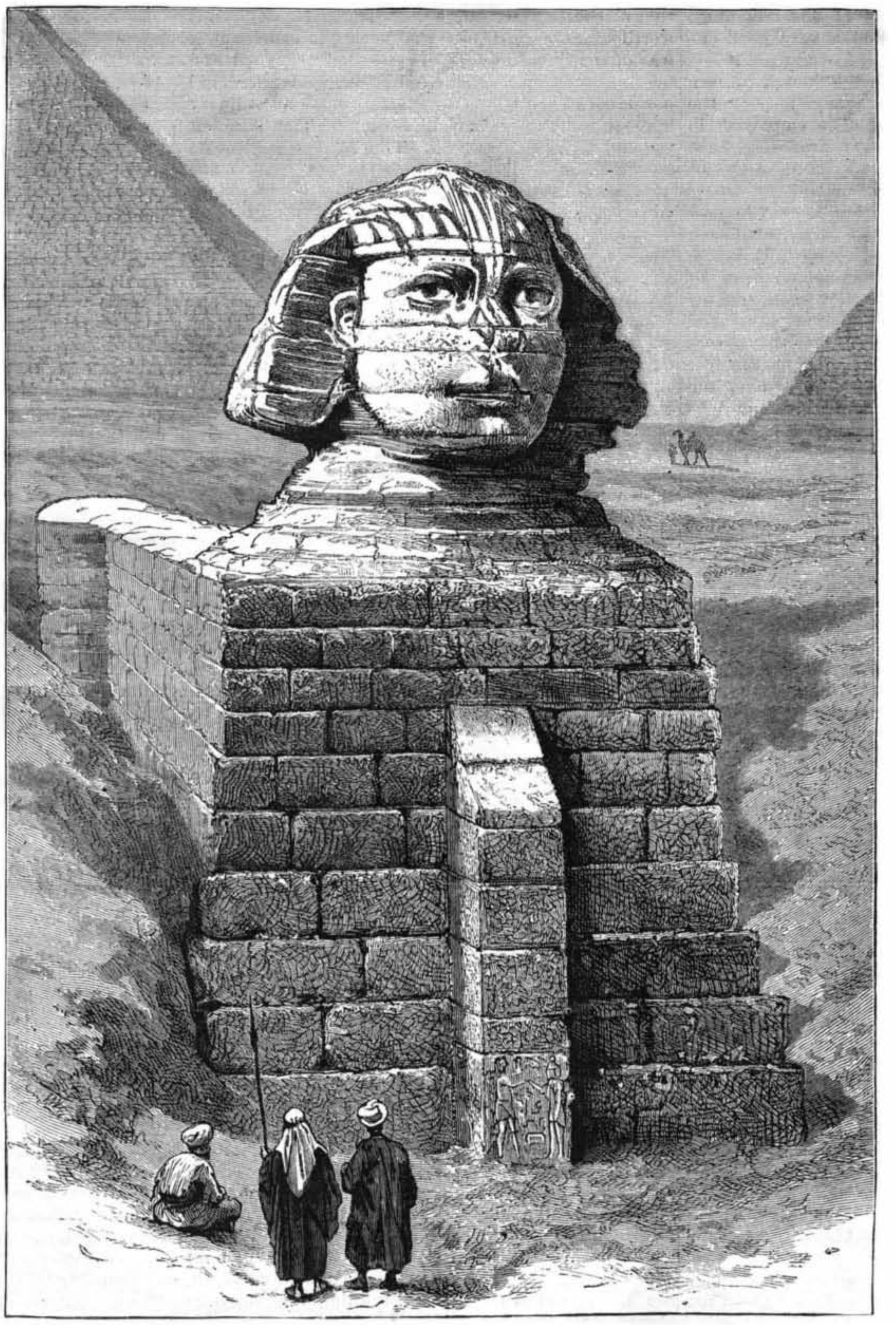
According to Reech's law, the speed attained by a model with any given power will illustrate the speed attainable in a large vessel having the same proportion of power, the speed of the large vessel being in all cases greater than that of the small in the proportion of the square root of the increased dimensions. Thus, if we take a first-class torpedo boat for our model, 110 feet long, 12 feet broad, and 6 feet 3 inches draught of water, and 52½ tons displacement, the speed, with 470 horse power, will be 21¾ knots, and these elements will enable us to determine what the speed of a vessel would be of the same form and of the same proportionate power, but three times larger every way. Such a vessel will be 330 feet long, 36 feet broad, and 18 feet 9 inches draught of water; her displacement will be 3^3 or 27 times greater, or it will be 52½ × 27 = 1,417½ tons. As each 52½ tons displacement must have 470 horse power, the total power will be 470 × 27 = 12,690 horse power. We shall then have two vessels in all respects identical, except that one is constructed on three times the scale of the other.

Although, however, the power is strictly proportionate in the two cases, the speed will not be the same, but by Reech's law the larger vessel will be the faster in the proportion of the square root of 1 to the square root of 3, or 1·732 times. If, then, the speed of the smaller vessel be 21¾ knots, that of the larger will be 21¾ × 1·732, or 37·6 knots per hour. If we take the larger vessel as four times the size of the smaller, the speed, with the same proportionate power, will be twice greater, or it will be 21¾ × 2 = 43½ knots per hour. The power necessary to attain this high speed will be 4^3 or 64 times 470 = 30,080 horse power. The displacement of the larger vessel will be 4^3 × 52½ = 3,360 tons, and the displacement due to the machinery will be 805·71 tons, taking the weight at 60 pounds per horse power, as in Thorneycroft's engines. The total number of horse-power required will be 470 × 4^3 = 30,080 horsepower. The displacement will be 134·4 tons per 1 foot of draught. The weight of the machinery will therefore increase the immersion by 5·9 feet; and if we take the weight of the hull as equal to the weight of the machinery, the draught of water with water in the boilers and the vessel ready for sea, except coal and stores, will be 11·8 feet, leaving a balance of 13·2 feet for coal and stores. If we take the consumption of fuel at 2 pounds per horse power per hour, the consumption of coal will be 26·8 tons per hour for 30,080 horse power; and if we take the speed of the vessel at 43½ knots per hour, equal to 49·4 statute miles, the time required for a voyage of 3,000 statute miles in length will be 3,000 ÷ 49·4 = 60·8 hours. Consumption of coal to be provided for will be 26·8 × 60·8 = 1,629·44 tons as total consumption for the voyage.

This weight of coal will depress the vessel 12·12 feet, which brings up the draught to 23·92 feet, leaving a margin of about 150 tons for extra fuel and for stores. The result of the whole calculation is to show that a speed of 40 knots, or thereby, is attainable on an Atlantic voyage with a vessel of moderate size and light construction and without any inordinate consumption of fuel; and it rests, says Mr. James C. Paulson, in the *Engineer*, with those who challenge the accuracy of this computation to show wherein it is erroneous, if they can. In merchant vessels advantage has not hitherto been taken of the quality of lightness for the attainment of high speed, and it is important that this essential condition should now be taken into account.

Calorific Power of Coal Gas.

The *Annales de Chimie et de Physique* recently contained a description, by M. Witz, of his experiments for determining the calorific power of coal gas. The method pursued was that of Berthelot, and consisted in the instantaneous combustion of an explosive mixture in a shell plunged in the water of a calorimeter, the elevation of the temperature of which could be exactly measured. A number of trials led to the determination, for a well-purified gas, of a calorific power of 5,200 calories per cubic meter of gas at 0° temperature and 760 millimeters pressure, saturated with aqueous vapor. This result was obtained from a gas mixed with six times its volume of air. Before passing through the scrubber and purifier, the same gas had a calorific value of 5,600 calories; so that it lost something by purifying. If the heat developed by the explosive mixture of one volume of gas and six volumes of air is taken as the standard for comparison, it is found that the same gas gives 5 per cent more heat when fired with 1·25 volumes of oxygen. With 11 volumes of oxygen, on the contrary, the calorific power is less by 4·6 per cent. It, therefore, decreases with dilution in oxygen. It is not so when gas is mixed with air. When diluted with 11 volumes of air, the calorific value is greater by 2·5 per cent. than when the gas is mixed with only 6 volumes of air. Thus the effect of the extra dilution is inversely to what might have been expected upon general principles.



THE GREAT SPHINX AS NOW CLEARED FROM THE ENCUMBERING SAND.

THE EGYPTIAN SPHINX.

For some months past, excavations have been carried on at Ghizeh, near Cairo, with the view of freeing the famous Egyptian Sphinx from the masses of sand which have gradually buried the monument. M. Maspero, the Director of the Boulak Museum, has superintended the operations, which have proved remarkably successful, and in a recent letter he states: "The result is beyond all my hopes. The face, raised fifteen meters above the surface, is becoming expressive, in spite of the loss of the nose. The expression is serene and calm. The breast has been a good deal injured, but the paws are almost intact. We have nearly reached the limits of the diggings of Mariette and Caviglia. The work now going on is in beds of sand, which have not been disturbed since the first centuries of our era." Later he writes: "The stones of the right paw are covered with Greek votive inscriptions, while the left have none—an indication that the piety of the faithful was called into play more on the south side."

Accordingly, M. Maspero thinks that there might have been direct communication between the Sphinx and the granite temple to the south, and that in the intervening space either an unknown chapel may be concealed or some group of statues, such as Mariette discovered at the Serapeum. Another important question to be solved by excavation is whether the Sphinx rests on a bed of rock or on a specially hewn out pedestal. Egyptian sculptors represent the Sphinx on a pedestal ornamented with designs similar to those on early sarcophagi; and if their representation prove true, there is a prospect, according to M. Maspero, of finding the door of a temple or a tomb on the eastern side.

In this case the pedestal may have been buried by the time of the Roman occupation, and the Ptolemies may have erected their monumental stair over the sand which covers it. This question will be decided when M. Maspero unearths the first steps. Our illustration is from a sketch by Mr. Charles Royle, Alexandria.—*The Graphic.*

The Mercurial Preventive of Phylloxera.

Prof. E. W. Hilgard, of Berkeley, Cal., in a note to *Science*, says: It appears perfectly practicable to protect vines planted in uninfested ground from attack coming from without, by surrounding the stocks with a sufficiently thick (eight to ten inch) layer of mercurialized soil, which, without obstructing or repelling the entering insects, will insure their being fatally poisoned before they can pass through it. This would leave the choice between grafting on resistant stocks on the one hand and the mercurial protection on the other, in the planting of new vineyards, the cost being (in California) about the same in either case; it would also serve for protection against threatened invasion, in the case of vineyards already planted, since, apart from the case of open soil cracks giving access to the vine roots, the stocks are the only known route by which the phylloxera reaches the root. Such are the presumptions created by our small scale experiments; how far the process will prove available in large scale practice remains to be determined by experience.

As regards, however, the treatment of ground and vines already infested, our experiments tend to show that the diffusion of the mercurial vapor is too slow, at the ordinary soil temperatures, to promise success; especially in the case of clay soils, which absorb and render inert a large amount of mercurial vapor before an effective excess can be obtained. It has been abundantly shown that the mercurialized soil exerts no unfavorable action upon the growth of the vine; and there is every reason to expect that an application once made will remain effective during the life of the vine.

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