affix themselves to the roots are submersion, sulpho-carbonates, and sulphide of carbon. Submersion, which drowns the insects, can hardly be employed, except in special localities, since we cannot always lead a sufficient quantity of water to the vineyard, to cover its entire surface, and to make up for the loss caused by evaporation during its stay thereon. As for sulpho-carbonates, the use of which was recommended by the illustrious chemist Dumas, their action amounts to the same as that exerted by sulphide of carbon, since, under the influence of the carbonic acid contained in the soil, they disengage all the sulphide of carbon that they contain. The use of them would be even more practical than that of the sulphide were they not dearer, did they not require a large amount of water to dissolve them, and did there not exist apparatus which permit of injecting into the earth without danger or previous practice definite quantities of sulphide of carbon. Thanks to the researches made at the instance of Mr. Paul Talabot, honorary director of the Paris-Lyons Mediterranean Company, by a committee consisting of Messrs. Magel, Gastine, and Cotta, and directed by Prof. Marion, agricultural technics is in possession of a very simple and easily performed method of insecticidal treatment through sulphide of carbon.

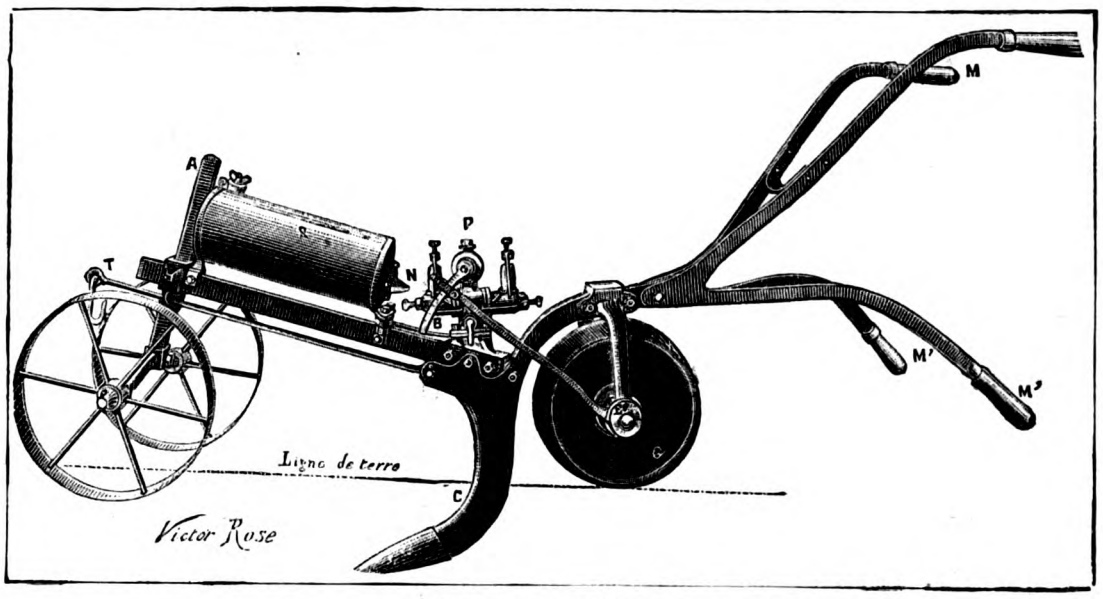
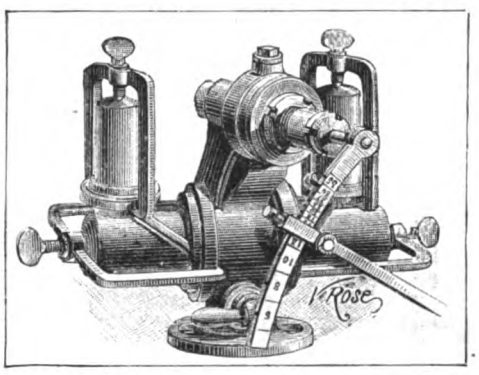
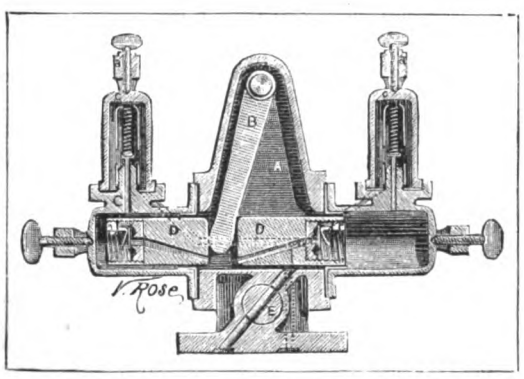


FIG. 2.—GASTINE'S TRACTION INJECTOR.

We may consider the soil as a porous body whose interstices contain air in permanent communication with the atmosphere, and which pours into the latter all the gases—carbonic acid and others—that are derived from the nutrition of plants or decomposition of organic matters. On another hand, sulphide of carbon is a colorless liquid heavier than water, and disengages vapors which, when mixed with even a small quantity of air, suffice to kill the phylloxera very quickly. Moreover, its evaporation is very rapid, and, as with ether, if we pour a few drops into the hollow of the hand, they quickly resolve themselves into vapor, and give a sensation of intense coldness. Therefore, if a certain quantity of the sulphide be introduced into the soil, it will immediately give off vapors that will be diffused, one after another, in the air that the soil contains, and all the insects found within its zone of action will be killed. This is the starting point of the method. There were, however, considerable difficulties to be overcome before it could enter into practice. Sulphide of carbon is a very inflammable body of disagreeable odor, and the vapor that it disengages forms a detonating mixture with air. If too large quantities of it are injected into the ground it may kill the rootlets, and consequently the vines; but if, on the contrary, the quantity be too small, the effect produced may be null or insufficient. It was necessary, besides, to invent an easily manipulated instrument that should permit of introducing definite doses of the sulphide to sufficient depths in the earth. Messrs. Marian and Gastine undertook to solve these difficulties, and we can boldly assert to-day that they have conquered them.





FIGS. 3 AND 4.—DETAILS OF THE PUMP.

It was also important to know how long the vapors of the sulphide should remain in the soil, and the extent of space that they covered from the point of injection. In principle, it may be granted that the sulphide diffuses itself more rapidly in permeable than in compact soils, that it spreads over a greater surface, and also that it flows more quickly in the atmosphere; but yet it was necessary to have accurate data. The researches made on this subject have shown that in grounds that have been tilled for some time, and that consequently have a high degree of permeability, we find scarcely a trace of sulphide twenty-four hours after injection. On the contrary, in sufficiently compact soil the vapors still remain for six or eight days after treatment, and their presence may be noted at more than three feet from the aperture of injection. On another hand, as these vapors are heavier than the air, they tend to descend into the soil, and their presence has at times been ascertained at a depth of over six feet below the surface. Under such circumstances, it will be readily conceived that by injecting given quantities of the sulphide into a vineyard, at distances learned by experience, the disengaged vapors will penetrate the entire soil to a sufficient depth to destroy the colonies of phylloxera that are affixed to the rootlets.

But one of the most difficult to do was to construct an injecting instrument. It was necessary, in fact, that such instrument should combine within itself a certain number of features that are difficult to associate, while at the same time it should be of sufficient delicacy to accurately gauge the quantity of sulphide to be injected. It was also necessary that it should be sufficiently strong to resist the shocks caused by the execution of the treatment itself, and that its mechanism should be so simple that the first comer could take it apart and put it together again after a few short and precise directions. Besides, its price had to be sufficiently low to put it within everybody's reach. Mr. G. Gastine has conquered these difficulties with rare ingenuity. He has constructed a *dibble injector* for ordinary treatment, and a *traction injector* for treating large vineyards planted in regular lines, and which in all respects leave nothing to be desired and have gained for him a goodly number of awards at agricultural and viticultural exhibitions. In order to explain the structure of these apparatus, we cannot do better than summarize what Mr. Gastine himself says about them in an excellent little book that all grape culturists ought to possess.

The dibble injector is a portable instrument consisting of a cylindrical reservoir that terminates in a perforating tube. Over the reservoir there are two handles that permit of grasping the dibble in order to insert it in the earth (Fig. 1). The reservoir contains a hydraulic pump designed for forcing accurately measured quatities of sulphide of carbon into the earth through the extremity of the perforating tube, which is provided for this purpose with a lateral aperture. The piston rod of this pump exceeds the reservoir in length. To operate the apparatus it is seized by the handles, the perforating tube is thrust into the ground by pressure both upon the handles and a pedal beneath the reservoir, and then the piston rod is shoved downward so as to force the sulphide through the extremity of the tube into the earth. When the pressure is removed from it the piston rod is forced upward through the action of an internal spring, and the instrument is thus primed for a new injection. Then the dibble is removed, and the aperture in the ground is closed with the foot or with a wooden bar having an iron head, and the same process is repeated for a new operation. The reservoir being previously filled with sulphide of carbon, the mechanism of the pump is so arranged that when the piston rises a definite quantity of the liquid enters the pump in order to be driven into the earth at the next operation, and so on. As the dibble is filled with sulphide, it is capable of serving for a large number of injections without the necessity of refilling it. As the quantity forced out depends upon the stroke of the piston, it is only necessary, in order to change the doses, to increase or diminish the length of the stroke by screwing special rings upon the rod.

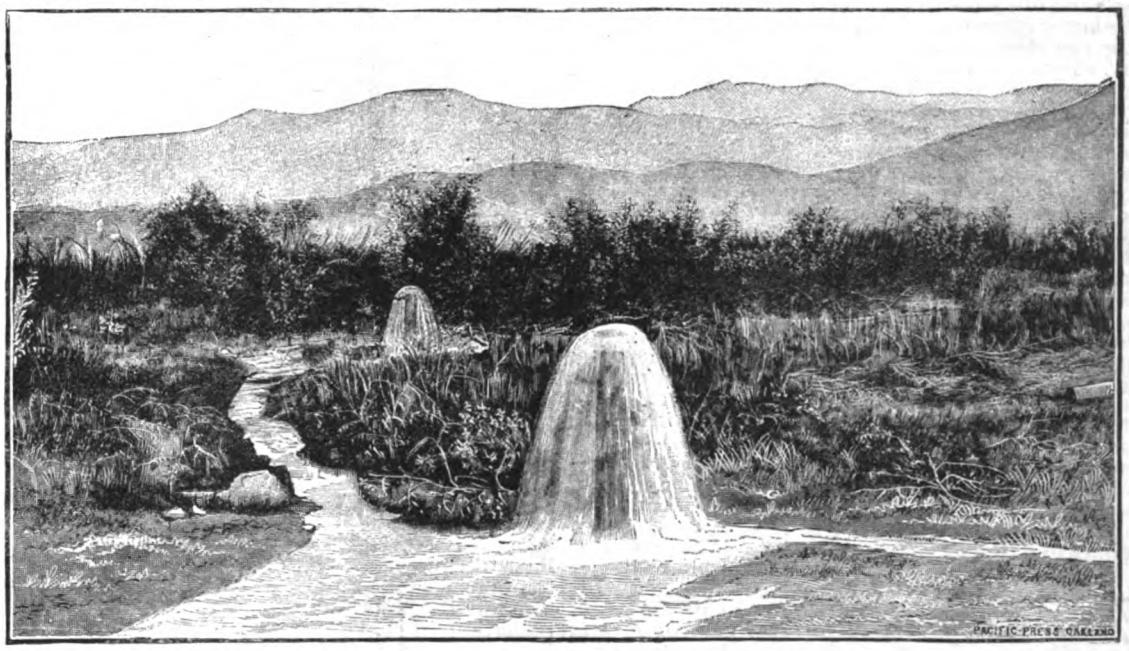
The traction injector (Fig. 2) is an assemblage of various peculiar pieces installed upon an apparatus similar to one of the plows used for light tilling. These pieces consist of a reservoir, R, placed upon the fore carriage of a colter, C, which is narrow and curved toward the front, and, finally, of a compressing roller, G, which closes the furrow made by the colter, and into which the sulphide has been forced. This roller also actuates the pump through the intermedium of an eccentric, E. An animal having been harnessed to the apparatus, the compressing roller revolves over the ground and sets in play the pump which is shown in detail in Figs. 3 and 4. At DD (Fig. 4) will be seen the piston, whose extremities contain small suction valves; B is a lever which moves the piston; A is the pump chamber; and E is the cock by means of which the entrance of the liquid into the apparatus may be cut off when it is desired to take it apart. The pump just described sucks the sulphide into the reservoir, measures the dose of it, and forces it, in *continuous injections*, into a groove back of the colter. The sulphide then enters the furrow made by the latter, and the compressing roller, in afterward passing, smooths the earth over the injected portion, and thus prevents all loss of vapor. This instrument is especially practical in that its motions are automatic, and that the circumstance alone of the traction exerted by the horse suffices to cause the entire apparatus to operate, without the driver having anything else to attend to than to keep the apparatus vertical by means of the upper handle, M. When the animal stops, all motion ceases, and the injection is interrupted. Moreover, these handles may be depressed and held by a bolt behind the frame, so that the driver can lift his apparatus and prevent the roller from bearing upon the earth.

It is positively to the facilities that these apparatus have furnished for the application of the method, as well as to the impulse given by a great railway company like that of Paris-Lyons-Mediterranean, which has at its disposal all the means of transportation, that must be attributed the rapid extension of the works undertaken since 1876, and their genuine success. A few figures will suffice to show the importance of these viticultural operations. Since the month of March, 1877, French manufacturers have delivered to viticulturists, for the treatment of phylloxerated vines, a little more than 26,400,000 pounds of sulphide of carbon. The principal works of Southern France have had to increase their production and erect additions. Manufacturing is now being carried on in the vicinity of the principal viticultural centers—at Marseilles, Narbonne, Bordeaux, and Lyons. Foreign countries have entered into the movement, and sulphide for anti-phylloxera treatment is being produced in Portugal, Italy, and Austria, and it is being employed in Spain, Germany, and Russia. It is permitted us to point with satisfaction to the success of this wholly French idea, which was emitted by Thenard and successively improved by Monestier, Allies, and the committee of the Paris-Lyons-Mediterranean Railway Company.—*La Nature.*

ARTESIAN WELLS AT POMONA, CAL.

No portion of the State has made such a rapid progress in the development of its natural resources as have Los Angeles and San Bernardino counties during the past few years.

In the fall of 1882, just two years ago, the Pomona Land and Water Company was incorporated for the purpose of developing and placing upon the market in small



ARTESIAN WELLS, POMONA, LOS ANGELES COUNTY, CAL.