SCIENCE

[Entered at the Post-Office of New York, N.Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

NINTH YEAR.
VOL. XVII. No. 414.

NEW YORK, JANUARY 9, 1891.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

THE OUTLOOK FOR APPLIED ENTOMOLOGY.[1]

GENTLEMEN,— You have made it the duty of your presiding officer to give an annual address,— a duty the less easy to perform for a new organization than for one which has a history behind it, and not facilitated by my absence in Europe at the time of your organization.

I had thrown together a sort of *résumé* of the results obtained during the year in economic entomology, more particularly by the entomologists of the different State stations, in the belief that this would be one of the most appropriate themes to present; but when I learned, from his circular of Sept. 15, that Professor Forbes intended covering substantially the same ground, and that it was expected of him as one of his duties as chairman of the committee on entomology of the Association of Agricultural Colleges and Experiment Stations, it became evident that what I might present in that direction would be substantially anticipating and repeating what we may expect and hope to hear from him. I will endeavor, therefore, to touch upon a few matters unconnected with station work.

Some Results from the National Department at Washington.

The hydrocyanic-acid gas treatment against scale-insects is becoming more and more common in California, and has to a certain extent superseded the use of washes, especially against the red scale (*Aspidiotus aurantii*). This is largely due to the fact that recent experiments, carried on through Mr. Coquillett, have resulted in a great cheapening of the process. The expense has been reduced to one-third, and the bulky machinery mentioned in my report for 1887 has been for the most part dispensed with. It has also been found that the use of the process at night is safer and more beneficial, in that it lessens the effect of the gas upon the foliage.

The repeated importation of scale-insects from Florida into California has attracted much attention. The species concerned are principally the purple scale (*Mytilaspis citricola*), the long scale (*M. gloverii*), and the chaff scale (*Parlatoria pergandei*). The fact that these insects must have been repeatedly imported into the State in past years without obtaining a foothold, has been used as an argument against a quarantine, and a great deal of discussion on the subject has been had in the California papers. From my own observations in the State, I am convinced, that, where the proper conditions of shade and moisture are obtained, there is no reason why these scale-insects should not obtain a foothold, but that they will probably die out in the hotter, dryer, and less shaded localities. An agent who was sent to Pomona to investigate certain newly planted orange-groves of Florida trees found, that while the trees were planted a year previously, and had been dipped, according to custom there, in a caustic solution, every tree examined by him bore a few specimens of the purple scale. The excitement on this subject in California has been fostered by the claims of rival nurserymen engaged either in the importation of Florida stock or dealing in varieties grown at home, and with so many contrary claims from persons prejudiced by their business interests, it is difficult to extract the truth. A rigid quarantine, not absolutely prohibitive, were wisest, for great injustice might be worked by absolutely prohibitive restrictions. Careful inspection and thorough treatment, if they could be guaranteed, would prove an effective safeguard, but it were unsafe to trust to them without rigid quarantine.

I have commenced a series of experiments upon the black scale (*Lecanium oleæ*), a species which, ordinarily occurring upon the olive, has long damaged citrus fruits in California. The horticulturist of the Wisconsin station, Mr. E. S. Goff, has modified the Nixon pump by adding a tube, so that kerosene may be drawn from one receptacle and a mixture of soap and water from another, thus forming a mechanical mixture in the act of spraying. This modification, at the request of Professor Henry, I have had tried in this series of experiments, and, although it is too early to state the results, it may be said that so little time and labor are required in preparing a stable emulsion, that this mechanical substitute will probably not come into general use. In this connection it may be observed that the formulæ recommended by some of our most voluminous writers are very misleading, and are calculated to produce only a mechanical mixture more or less unstable. The use of kerosene, temporarily combined with water or soap suds by mechanical means, dates from many years back. It was a favorite remedy of my friend Thomas Meehan, who urged it in 1871 in the *Gardener's Monthly;* it was experimented with by others; and I used it successfully in 1872 against an undescribed *Lecanium* on Austrian pine, as also against *Aphides* on the place of Mr. Julius Pitman of St. Louis, and in 1874 and 1875 against the congregated young of the Rocky Mountain locust. But the true and stable kerosene emulsion which now forms one of the most satisfactory and widely used insecticides, and which requires two parts of the oil to one of the emulsifying agent, violently churned until a stable, butter-like emulsion results, was the outgrowth of my efforts in the investigation of the cotton-worm, the milk having been first suggested in 1878 by the late Dr. W. S. Barnard while working at Selma, Ala., and the most satisfactory formula in 1880, from experiments which I had continued over two years by Mr. H. G. Hubbard on orange-trees.

A locust outbreak of some interest has occurred in parts of Idaho and Utah, and has been investigated by Mr. Bruner,

[1] Address of Dr. C. V. Riley at the annual meeting of the Association of Economic Entomologists, Champaign, Ill., Nov. 11-14, 1890.

the Nebraska agent of the division. The species involved proved to be *Camnula pellucida*, which has overrun a strip of country a hundred and forty miles in length by from fifteen to thirty in width, commencing at a point about thirty miles westward of Soldier, Idaho, and extending east as far as East River and Birch Creek. The people in these sections are quite willing to do whatever can be done to destroy these insects, but they need instruction. The country has been largely settled since the publication of the early reports of the United States Entomological Commission, and the new settlers lack experience in dealing with locusts; for fifteen years make great changes in the rapidly growing West. I have therefore in preparation a bulletin treating of the several species of locusts which are responsible for these frequent scares, and which will include, at the same time, a summary of the practical portions of the earlier reports of the Entomological Commission on *Caloptenus spretus*, long since out of print.

The army-worm proved injurious in several localities during the past year, particularly in Maryland and Indiana. The Maryland occurrence is of considerable interest, owing to the fact that the preceding year was one of unusual precipitation; and the outbreak of the insect was due rather to the extremely mild winter, which prompted the constant growth and development of the hibernating larvæ.

The notices in *Insect Life* and the *Entomologists' Monthly Magazine* of the damage caused by a new bark-louse to the gardens of Alexandria, Egypt, have attracted considerable attention, and Mr. J. W. Douglas has described the new depredator as *Crossotosoma ægyptiacum*. A study of Mr. Douglas's description and figures has convinced me that this insect is an *Icerya*, and that its spread is greatly to be feared, judging from our experience with *I. purchasi*. Moreover, three additional species of this genus have been brought to my notice during the year,—one occurring in Mexico on grape-vine; another in Key West, Fla., upon roses and other garden plants; and the third in the Island of Montserrat, West Indies, upon the cocoa palm, the banana, and a species of *Chrysophyllum*. These interesting and injurious insects have been investigated, so far as could be done, by correspondence; and full descriptions, with figures, will be published in the forthcoming number of *Insect Life*.

The sugar-beet industry, after a quarter of a century's vicissitude, has begun a substantial and permanent growth, especially in Nebraska. It has been found that the crop is speedily attacked by insects; and Mr. Bruner, being advantageously located for work of this kind, has, during the past summer, paid some attention to the insect enemies of this crop, and has already a list of sixty-four species, most of them being leaf-eaters and such as are commonly found upon various allied succulent plants, one of the worst being the garden web-worm (*Eurycreon rantalis*).

The Hop Phorodon.

One of the most interesting facts of the year has been the occurrence of the hop-fly (*Phorodon humuli*) in the extreme North-west, especially in Oregon and Washington, so soon after my note of warning as to the danger of its introduction to the hop-fields of that section, and the need of precautionary measures that might prevent such a calamity. The soil and climate of southern Oregon seem particularly adapted to the growth of the hop, as it is already the leading crop in Lane, Marion, Polk, and other counties.

There can be no doubt about the species, because Mr. F. L. Washburn, the entomologist of the experiment station, has given it some attention; and I have also received specimens from him and from Mr. A. Todd of Eugene, Oregon, as also from Mr. Giles Farmin and Mr. G. M. Stratton of Puyallup, Wash.

Mr. Washburn, from the fact that it has been noticed that hops were sometimes not so much affected in the immediate vicinity of plum-trees as some distance away, and from the further fact that some of the growers reported that they never saw the insect on the plum, intimates that there must be a different state of affairs in Oregon, so far as the life cycle of the insect is concerned, from that which prevails in the Eastern States and in Europe. Absolute and experimental proof of facts obtained after long and persistent investigation should never be lightly questioned. It is by no means a common experience that hop-plants in the immediate vicinity of plum-trees are not more affected than, or as much as, others at a distance; and this may depend on the direction of the wind, or on local circumstances, or on the variety of plum, whether wild or cultivated. I have examined in vain certain cultivated plum-trees for evidence of *Phorodon*, whereas I have invariably found it upon other varieties in the same vicinity. *Phorodon humuli*, in common with all other aphidids, preferably chooses, when migrating, certain genial days, and often fills the air, flying great distances. In perfectly calm weather the migrants settle almost everywhere; but they are easily affected by the least breeze, and are wafted in different directions. The invasion of a hop-yard may be from plum-trees miles away to windward.

Phylloxera.

The grape *Phylloxera* has continued to attract the attention not only of most European governments, but also of those of Australia and New Zealand. It continues its spread in France, having at last invaded the more valuable champagne districts. The last report of the Superior Phylloxera Commission of that country shows that about 240,000 acres have undergone defensive measures, submersion being employed in 72,000, bisulphide of carbon in 145,000, and sulpho-carbonate of potassium in 23,000. The work is practically at an end in such departments as Hérault, Gard, and Gironde, where the American resistant vines have most effectually been used; while the wine-growers of Algeria, Spain, Italy, Portugal, Hungary, Austria, and Switzerland, are all battling against it, and are all more or less aided by their respective governments.

The advent of the insect in New Zealand has been the cause of much writing and of much legislation there, and the government has been quite anxious to get the best and latest information on the subject. There is very little that is available in the way of published experience in this country, as my Missouri reports are now very difficult to obtain. I would repeat here in substance what I have recently written to Mr. F. D. Bell, agent general at London for New Zealand, because the demand for the information is continuous, and our own people are to a great extent unfamiliar with the facts.

During the more than twenty years' struggle in France against the species, innumerable remedies have been proposed, most of which have proved to be absolutely valueless. A few measures have been devised, however, which, under proper conditions, give fairly satisfactory results. These consist in (1) methods which avoid the necessity of direct treatment, comprising the use of American stocks and planting in sandy soils; (2) the employment of insecticides (bisulphide of carbon, sulpho-carbonate of potassium, and the kerosene emulsion); and (3) submersion.

It was early found in the history of this *Phylloxera* that most of the cultivated varieties of American grape-vines, as also the wild species, resisted or were little subject to the attacks of the root form (*radicicola*) of the *Phylloxera;* although the leaf-gall form (*gallicola*), which in point of fact does little if any permanent damage, occurs in greater numbers on many of our wild and cultivated sorts than on the European grape-vines, which are all derived from the single species *Vitis vinifera*, and which are so exceedingly subject to the attacks of the root form. This fact was first noticed in France by M. Laliman of Bordeaux, and later by Gaston Bazille of Montpellier, and was independently proved on a more extended scale by my earlier investigations in the United States. The use of American stocks upon which to cultivate the susceptible European varieties has resulted in an enormous trade in certain American seeds and cuttings, and now supersedes all other methods against the *Phylloxera*.

It was my privilege and pleasure to spend a week in August, 1889, among the world-renowned Médoc and Sauterne vineyards of the Bordeaux district in France. Here, by virtue of the rich alluvial soil, and the ease with which the chief vineyards can be submerged, the *Phylloxera* has made slower headway, and the opposition to the use of American resistant stocks has been greatest. Yet they have finally vanquished prejudice, and are, either from necessity or choice, rapidly coming into general use. When I say "choice," I mean that even where the French vines yet do well, and the *Phylloxera* is kept in subjection by other means, it is found that greater vigor of growth and increase in healthfulness and yield of fruit result at once from the use of the American stocks.

Without going into a lengthy discussion of the subject of wild American species, those of practical importance to the grape-grower are the following: *V. æstivalis*, *V. riparia*, and *V. labrusca*.

The varieties derived from *V. æstivalis* are of value for their fruit as well as for their resistant qualities, and, being easily propagated from cuttings, they are very often used as stocks. The most important varieties are Jacquez, Herbemont, Black July, and Cunningham.

The varieties of *Vitis riparia*, both wild and cultivated, are, on account of their special fitness, almost exclusively employed in France as resistant stocks, for which they easily take first rank. The varieties used are (1) the wild forms; and (2) the cultivated varieties, Solonis, Clinton, and Taylor. Of the cultivated varieties, the Clinton was one of the first vines tried for this purpose, and has been extensively used with fair satisfaction. The Solonis now ranks above it, but is valueless for any other purpose on account of the acidity of its grapes. In California the Lenoir, Herbemont, and Elvira have been used, but late experience shows that the wild *Riparia* is most satisfactory there, as it is in France.

The different varieties of *Vitis labrusca* are less resistant to the *Phylloxera* than those above mentioned. Certain varieties have, however, been grown successfully in France, and of these the Concord has given much the best results; but others, Isabella and Catawba for example, succumb there to the root-louse, as indeed they do in many sections of this country.

Of the many valuable hybrids obtained from the American species of *Vitis* which are serviceable as stocks, the more important are the Elvira, Noah, and Vialla. The last named, perhaps, of all the resistant varieties, gives the greatest percentage of successful grafts, and is admirably adapted for grafting on cuttings.

Early in the study of the subject it was found that the nature of the soil has a very marked influence on the success of the different stocks. The subject has been now quite fully investigated in France, and the latest researches are formulated by the Experimental School at Montpellier in the statement quoted below, which will be of interest as giving the various classes of soils, together with the American vines best adapted to each.

"1. New deep fertile soils: *Riparia* (tomentous and glabrous), *Jacquez*, *Solonis*, *Vialla*, *Taylor*, and *Cunningham*.

"2. Deep soils somewhat strong, not wet: *Jacquez*, *Riparia*, *Solonis*, *Cunningham*, *Vialla*, *Taylor*.

"3. Deep soils of medium consistency, new and not dry in summer: *Riparia*, *Jacquez*, *Solonis*, *Vialla*, *Taylor*, *Black July*.

"4. Light pebbly soils, deep, well drained, and not too dry in summer: *Jacquez*, *Riparia* (wild), *Taylor*, *Rupestris*.

"5. Calcareous soils, with subsoil shallow or granitic: *Solonis*, *Rupestris*.

"6. Argillaceous soils, white or gray: *Cunningham*.

"7. Argillaceous soils, deep and very wet: *V. cinerea*.

"8. Deep sandy fertile soils: *Riparia* (wild), *Solonis*, *Jacquez*, *Cunningham*, *Black July*, *Rupestris*.

"9. Light pebbly soils, dry and barren: *Rupestris*, *York*, *Madeira*, *Riparia* (wild).

"10. Deep soils with a tufa base and salt lands: *Solonis*.

"11. Soils formed of *débris* of tufa, but sufficiently deep: *Taylor*.

"12. Ferruginous soils, containing red pebbles of silica, deep and somewhat strong, well drained but fresh in summer: all the varieties indicated, and in addition *Herbemont*, *Clinton*, *Cynthiana*, *Marion*, *Concord*, *Herman*."

The accompanying table from the last report of the Superior Phylloxera Commission indicates better than words can tell the steady growth in the use of the American vines: —

Years.	American Vines Covered. Acres.	Departments.
1881	22,000	17
1882	42,700	22
1883	70,000	28
1884	131,909	34
1885	188,200	34
1886	276,900	37
1887	412,700	38
1888	536,900	43
1889	719,500	44

On the subject of direct remedies the value of the kerosene emulsion for this purpose has not been properly realized in France because of the relatively high price of petroleum in her grape-growing *départements*. A series of experiments which I made in 1883 showed conclusively its great value for this purpose, as it not only destroys the insect in all stages, but also stimulates root-growth.

In this connection I have recently had a series of experiments made through Mr. Albert Koebele's agency, in the Sonoma valley, California, to ascertain the effect upon the *Phylloxera* of certain of the resin-washes which proved so

valuable when used against the fluted and other scale-insects. The results have been quite encouraging, and the experiments have already shown that in the use of these washes we have a valuable addition to the underground remedies. Soaps were made by the use of bicarbonate of soda, sal soda, and caustic soda, each mixed with resin. In the earlier experiments the earth was removed about the base of the vine to a depth of six inches and for a diameter of four feet. Ten gallons of the mixture were poured into each hole, and found to penetrate from twelve to sixteen inches or from eighteen to twenty-two inches from the original surface of the ground. Most of the insects, as also the eggs, were destroyed to a depth of sixteen inches. In the later experiments the holes were made only about two feet in diameter; and nearly if not quite the same results were obtained with half the amount, or five gallons of the mixture. The plan which I have previously adopted for the application of insecticides to underground insects, of washing the mixture in with pure water, was tried with good success. Soon after the first application, five gallons of water were added, and five gallons more the following day. This would indicate that in the spring, when rains are frequent (occurring almost every day) in the Sonoma valley, only a small amount of the mixture need be applied, and the rains will do the rest, as examination has shown that up to a certain point each application of water intensifies and extends the action of the original insecticide. The best soap was made with bicarbonate of soda; but the results of that made with caustic soda are so little inferior, while the price is so much less, that the caustic soda and resin soap mixture is the one which I would recommend. The formula which was found preferable is as follows: caustic soda (77 per cent), five pounds; resin, forty pounds; water to make fifty gallons.

The soda should be dissolved over a fire in four gallons of water, then the resin should be added and dissolved. After this, the required water can be added slowly, while boiling, to make the fifty gallons of the compound. To this water may be added at the rate of nine gallons for one, making five hundred gallons of the dilute compound, sufficient for one hundred large vines, at a cost of only eighty-four cents, or less than a cent a vine.

Considering the effective way in which the ravaged vineyards of France have been and are being redeemed by the use of resistant American stocks, and considering the efficacy of some of the direct remedies discovered, it is passing strange that no disposition has ever been made of the premium of 300,000 francs offered in the early history of the trouble by the French Government. It cannot be awarded to any one person, but should be distributed among those whose labors and discoveries resulted in the several feasible and satisfactory methods of coping with the insect.

Introduction of Parasites and Predaceous Species.

The success which has attended the introduction from Australia of *Vedalia cardinalis* has been phenomenal. Indeed, few who have not kept in knowledge of the reports and the actual condition of things can appreciate the remarkable character of the results, not only because of the brief period required therefor, but because of the thoroughness of the work of the little ladybird, and the moral and financial benefit too range-growers which has followed in its wake.

The striking success of the experiment has served to fix attention not only of entomologists, but of fruit-growers and farmers, to this mode of dealing with injurious insects; and there is no question but that the cases in which the experiment may be more or less successfully repeated are numerous. Let us hope, therefore, that the moral effect will be as great as its practical effect in opening up means and ways in the future, as it should serve to remove the disposition to deride any expenditure having such results for its object. Many fears have been expressed, lest, after sweeping off the *Icerya*, the *Vedalia*, being so far as we now know confined to that species for food, should perish, and that the *Icerya*, preserved in some restricted places undiscovered by its enemy, would again multiply and become destructive. I firmly believe what I wrote in my last annual report as United States entomologist: viz., —

"We may hardly hope, however, that the last chapter in the story is written. On the contrary, it is more than probable, and in fact we strongly anticipate, that the *Icerya* will partially recuperate; that the *Vedalia* will, after its first victorious spread, gradually decrease for lack of food; and that the remnants of the fluted scale will in the interim multiply and spread again. This contest between the plant-feeder and its deadliest enemy will go on with alternate fluctuations in the supremacy of either, varying from year to year according to locality or conditions; but there is no reason to doubt that the *Vedalia* will continue substantially victorious, and that the power for serious harm, such as the *Icerya* has done in the past, has been forever destroyed. We have learned, also, that it will always be easy to secure new colonizations of the *Vedalia* where such may prove necessary, or even new importations should these become desirable."

During the year I have endeavored to return the favors received from Australia and New Zealand by sending there some of the natural enemies of the codling-moth; and from last accounts, though jeopardized by the action of the custom-house authorities, the experiment promised success so far as a species of *Raphidia* from California is concerned. I have also endeavored to introduce some of the parasites which attack the Hessian-fly in Europe, and which do not yet occur in this country. These efforts have been made by correspondence; for you will be surprised to learn that the restrictive clause in the appropriations to the Department of Agriculture for entomological work, which limits travelling expenses to the United States, is still maintained in the face of the *Vedalia* experience, where, by the expenditure of fifteen hundred dollars, many millions were saved. The maintenance of this restricting clause in the last appropriation bill, under these circumstances, is a travesty on legislative wisdom, and all the more remarkable because done by the Senate, in opposition to the House and the recommendations of both the secretary and assistant secretary of agriculture.

While there is much to be done in this direction in future, I cannot let this occasion pass without giving a note of warning. Success will only come in any particular case when exact knowledge is first obtained, and the most thorough scientific methods are then adopted; and we cannot too severely condemn every thing that savors of buncombe and ignorance. During the year, the press of the country has prominently heralded the fact that a gentleman from San Francisco, especially charged to study certain entomological matters in the East, found, while in Washington, the two-spotted ladybird (*Coccinella bipunctata*) feeding on "the spotted *Aphis*" right under the windows of the Division of Entomology of the Department of Agriculture, the inference intended being that the entomologist and his assistants were ignorant of the circumstance. Indeed, a writer in one of the California papers of recent date announced this dis-

covery under the sensational heading "Another Good Bug. — The Woolly Aphis has found its Sedan." How supremely ridiculous this sort of thing appears to the well-informed entomologist I need not tell you, but it may be well for the information of the public to say (as I have not alluded to the matter elsewhere) that a number of different species of ladybirds feed upon the woolly *Aphis*, and that it is a rule with the insects of this family not to be select as to the particular aphid they prey upon. *Hippodamia convergens* (the species referred to as the Sedan of the woolly *Aphis*) feeds, over nearly the whole extent of the United States, upon this particular *Schizoneura*, among others; and the fact that both the species referred to feed upon various *Aphides* is well known. That one of the species is also common upon the Pacific coast, and that its being carried there from the East is like "carrying coals to Newcastle," may not, however, be so generally known. All such efforts as this, carried on by persons unfit, from want of any special knowledge, for the mission, must invariably do harm, not only because of the negative results which follow, but because of the lack of confidence in such work which they will engender in the minds of our legislators.

I should not think of holding any one responsible for newspaper paragraphs; but in this case the party has substantially confirmed them in statements over his own name, and in interviews which (as announced) he has himself revised.

Method of using Bisulphide of Carbon against Grain Weevils.

The use of bisulphide of carbon against different insects attacking stored grain has greatly increased in this country since I first recommended it some thirteen years ago.[1] There is, however, considerable diversity in the methods of using it; and the recommendations of some of our writers have evidently been made with no sense of the fact that the fumes are heavier than air, and descend rather than ascend. Professor A. H. Church, in a recent number of the *Kew Bulletin*, records that he found that a pound and a half of the bisulphide is enough to each ton of grain. He advises that it be applied in the following way:—

A ball of tow is tied to a stick of such a length that it can reach the middle of the vessel containing the grain. The tow receives the charge of bisulphide, like a sponge, and is then at once plunged into the vessel and left there, the mouth of the vessel then being tightly closed. When necessary, the stick may be withdrawn and the charge (of one ounce to a hundred pounds) may be renewed.

The action of carbon bisulphide lasts, in ordinary cases, six weeks, after which period a fresh charge is required. The bisulphide does no harm to the grain as regards its color, smell, or cooking properties; and the germinating power of most seeds is not appreciably affected, provided that not too much is used, nor its action continued for too long a period.

The assistant director of agriculture of Burmah is reported to have used naphthaline instead of bisulphide in the following way, but I should not expect any thing like as good results from the naphthaline as from the bisulphide.

A hollow bamboo cylinder an inch and a half in diameter, with a stick fitted into the cavity, is pushed down to the bottom of the bin. The stick is then withdrawn, and a few teaspoonfuls of naphthaline powder is poured into the bamboo, which is then drawn out, leaving the naphthaline at the bottom of the bin. If the bins are very large, this should be done once to every ten feet square, and the application should be repeated every fifteen or twenty days.

[1] Farmers' Review (Chicago), March, 1879.

Insecticide Machinery.

A profitable hour might be devoted to the subject of insecticide machinery, but I must content myself with a few words. At a trial of such machinery at the Mareil-Marly vineyards during the late Paris Exposition, I had an excellent opportunity of witnessing the latest advances made in France in this direction; and it was extremely gratifying to note, that, with whatever modification of the power employed (and many of the machines were very ingenious), all other forms of spraying-tip had been abandoned for vineyard purposes in favor of modifications of the Riley or Cyclone nozzle. The superiority for most practical purposes, of the portable knapsack pumps of V. Vermorel of Villefranche (Rhône), France, was sufficiently evident. M. Vermorel has identified himself with the regeneration and improvement of French grape-culture in many directions, and is, withal, an enthusiastic student of insect-life. I spent a very profitable day with him last year both at the factory and at his home, where he has established a virtual experiment station in the midst of a fine vineyard on American roots, and with every facility for various fields of investigation, none of which are deemed more important than the work in entomology; for he fully realizes how much there is yet to learn of some of the commonest insects destructive to the vine, even in an old country like France. But in no direction has he accomplished as much good as in his work with insecticide and fungicide machinery. His sprayer with independent pump, his diaphragm pump (L' Eclair), and his reservoir with suction and force pump, are all admirably adapted for the purpose they were invented for, and may be obtained in France at a cost of from five to seven dollars, which is tripled before reaching this country, thanks to our present tariff system.

The Galloway Sprayer.—The last number of the *Journal of Mycology*, the serial publication of the Division of Vegetable Pathology of the Department of Agriculture, gives full description, with figures, of a knapsack spraying-apparatus for which the special merit claimed is cheapness.

The combination of a suction and a force pump with knapsack-reservoir has been frequently made in France, as illustrated by the apparatus styled the "Cyclone" of Vermorel; the Japy, Vigeroux, Nougès, and Perrin sprayers; and the sprayer of the society "L' Avenir Viticole." A number of pumps manufactured in this country of this style were mentioned or described in the "Fourth Report of the United States Entomological Commission." These, in general, are much inferior to the French pumps named, which are, however, modelled after those earlier and cruder forms. There are a host of other French knapsack spraying-machines, which differ from those mentioned by propelling the liquid by means either of air-pumps, diaphragm-pumps, or devices in which the pump is attached to the reservoir by means of a rubber hose.

In 1888 Mr. Adam Weaber of Vineland, N.J., brought out the Eureka sprayer, a very serviceable knapsack pump modelled after the French machines. The French sprayers will cost, including duty, shipping, etc., from eighteen to twenty-five dollars; the Weaber sprayer is sold for twenty-one dollars, which is but little more than the cost of manufacture; Professor Galloway's machine is sold for fourteen dollars, or from a fourth to a third less than the Weaber or the French sprayers.

In the first announcement of this pump in No. 1, Vol. VI.,

of the publication cited, and in the later full description, no statement is made of the indebtedness of the inventor to these older machines, except in the case of the original description of the lance and nozzle (*op. cit.*, vol. v. No. 2), where credit is given. This naturally gives the impression that the apparatus is novel in many or all of its features.

When compared with the French machines, the following facts become apparent:—

(1) The reservoir is practically identical with that of the Vermorel, Japy, and other French machines, and the opening for introducing the liquid with strainer and lid presents no new features.

(2) The pump is an ordinary double-cylinder (or hollow piston) force-pump, the hollow piston furnishing an air-chamber which causes the liquid to be forced out in a continuous stream.

(3) The lance and nozzle combination consists of the Riley nozzle fitted to a lance, and provided with a degorging apparatus, which also acts as a stop-cock modelled exactly after Raveneau's apparatus, and is practically the same as the Japy degorger and stop-cock, except that the action is reversed. In the latter (see *Insect Life*, vol. i. p. 265, Fig. 61) the spring normally closes the discharge orifice; and in the former the orifice is normally open, and is closed by the action of a lever in the spring.

That this modification of the foreign knapsack sprayers will prove a serviceable one for vineyard work, and by reason of its cheapness and availability come into general use, I have little doubt.

Strawson's Air-Power Distributer.

A new and distinct type of insecticide machine, the invention of Mr. G. F. Strawson, Newbury, Berks, England, has attracted no little attention, and has received numerous awards during the past two years at various agricultural shows in England, and has been very favorably noticed and recommended by competent judges. It was shown at the late Paris Exposition, and was thoroughly tested before a select jury, from which it received the highest praise, and was awarded a gold medal. I had occasion to study it thoroughly not only at Paris, but at the Royal Show at Windsor, and am under obligations to the inventor for courtesies and facilities afforded.

It will have, in common with all the heavier and more expensive machines, to contend with the more popular and less expensive portable machines. It has many advantages in the control of the volume and character of what it disseminates, and, with some modifications and adaptations for nether spraying, it would prove extremely serviceable in extensive fields of any crop that needs such spray, and where the rows are relatively straight and the plants low. The principle also is a good one, and practicable, with modifications, for many other uses.

The machine is called the "Strawsonizer," and is a pneumatic or air-blast distributer, and may be adapted to a variety of uses, such as broadcast sowing of grains, distribution of fertilizers or of disinfectants in cities, and of dry or liquid insecticides.

The machine is light, simple in construction, and easily operated by one man; the larger sizes being drawn by one horse, and the smaller by hand-power. It is constructed largely of wood, and is mounted on two iron wheels. The distributing power is obtained by a blast of air produced by a revolving fan worked by the travelling-wheels of the machine.

The essential part consists of a suitable receptacle or hopper, either for liquid or dry substances, from which the material is fed automatically and regularly to the blast generated by the revolving fan, the whole operated by suitable gearing. A receptacle for either dry or liquid material can be employed in connection with suitable nozzles or deflecting devices on all the machines; so that, with practically one apparatus, all the kinds of work indicated above can be accomplished.

For solids a metal spreader is used, while for liquids nozzles of the direct discharge type, but variously arranged to suit different requirements, are employed.

Very uniform and rapid work may be done with this machine in broadcast sowing of wheat, oats, and smaller seeds. These are distributed with great regularity over a track from eighteen to twenty feet wide, giving a rate of from thirty to forty acres per day. It is especially serviceable as a distributer of fertilizers (phosphates, nitrate of soda, lime, etc.) and all insecticide powders, which latter may frequently be applied in connection with the former substances.

Liquid insecticides are distributed broadcast at a rate of from one gallon upwards per acre, and, by the action of the powerful blast of air, are broken up into a fine mist, which spreads uniformly to a width of twenty feet. Nozzles for upright or lateral spraying would adapt the machine for work in hop fields or orchards.

A patent for the apparatus has recently been taken out in this country; but its manufacture here has not, so far, been inaugurated.

The one-horse-power machine for broadcasting grains, fertilizers, and either solid or liquid insecticides, with suitable receptacles and nozzles, is retailed in England for £30 sterling, or $150. If fitted with special nozzles for vertical work, £2 extra are charged. Hand-power machines are sold for £12 and £14. These prices would be even greater in this country, and would doubtless interfere with its adoption were it not that it combines the other advantages indicated.

(To be continued.)

THE CORK-INDUSTRY IN SPAIN.

THE cork-tree is found in Spain in great abundance in the provinces of Gerona, Cárceres, and Andalusia, especially in the provinces of Huelvas, Seville, and Cadiz, and, although in less quantity, in the provinces of Ciudad Real, Malaga, Cordoba, Toledo, and some others. The United States consul at Barcelona says, that, according to a calculation made by the administration of forests the extent of cork-forests in Spain is about 255,000 hectares (a hectare is equivalent to 2.47 acres), distributed as follows: 80,000 in the province of Gerona, 45,000 in Huelvas, 32,500 in Cárceres, 28,000 in Seville, 20,000 in Cadiz, 11,500 in Ciudad Real, and 9,500 in Cordoba. In the localities exposed to the north the cork is better than in those exposed to the south, and it is seldom found in calcareous soil, preferring always that of the felspar, this being found principally in the province of Gerona. It grows and develops in ground of very little depth, and sometimes in very stony ground. The leaves of the cork-tree are oval oblong or elongated oval, frequently toothed, and the teeth jagged; length, from three to five centimetres, and width from one and a half to two. The roots are strong, and spread considerably, and are frequently to be seen on the surface of the ground. It sometimes happens that the portion of root exposed to the air produces cork, while that which is buried produces scarcely any. The most common practice is to cultivate the plant by sowing, which is frequently done, especially in ground somewhat manured, making alternate furrows with vines. Up to their twentieth or twenty-fifth year the ground is cultivated as if it were a vineyard, rooting up at that age the vines on account of producing less fruit, and also on account of the cork-trees being fairly grown up, and no