SUCCESSFUL MANAGEMENT OF THE INSECTS MOST DESTRUCTIVE TO THE ORANGE.

BY PROF. C. V. RILEY.

The orange interest is assuming proportions in Florida and the Pacific Coast which few, not familiar with the facts, suspect. Yet no crop is more seriously affected with insect enemies, and successful orange culture is generally a question of their successful destruction. By far the worst of these are the scale insects (*Coccidæ*), a family most destructive to various fruit trees in all parts of the country, but especially severe on the orange.

Having recently presented to the National Academy of Sciences, at its annual session, some of the results of the investigations in this line now being made by the Department of Agriculture, I take this means of giving them publicity. The figures accompanying this communication will sufficiently illustrate the life-history and appearance of the particular scale-insect treated of. Fig. 1 shows the development of an allied species injurious to the apple; Fig. 2, the characters of the male, and Fig. 3, those of the female; while Figs. 4 and 5 show the general appearance of two of the orange species. In this connection it is not necessary to enter into the subject of classification, but it will be well to state that the species affecting the orange may be divided into two groups, namely, the naked species (*Lecaninæ*), and the protected species (*Diaspinæ*). The former are by far the least destructive. They seldom increase to an injurious extent, being far more easily affected by parasites, and more amenable to the action of simple insecticides.

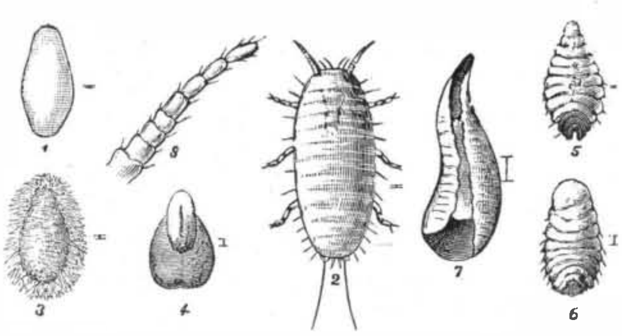

Fig. 1.—MYTILASPIS POMICORTICIS, Riley—1, egg; 2, newly hatched larva; P, its antenna; 3, do., after it is fixed and begins to secrete its covering; 4, scale showing larval and median parts; 5, female extracted from scale soon after losing members; 6, do., full grown; 7, ventral view of full formed female scale—all magnified, the natural size indicated (after Riley).

Of the scale-covered group three species are worthy of particular mention, and, in fact, comprise the only especially destructive species to the plant in Florida. They are: (1), *Mytilaspis gloverii*, Pack, (Fig.4,) which may be distinguished as the "Long scale." It is of a narrow, elongate form, and probably the most destructive and common.

(2.) *M. citricola*, Pack. (Fig. 5), which may be known as the "Purple scale," on account of its color. It is much like the former in form and in its work, and seems to prefer those trees which have very large oil cells, like the Tangierine, etc.

(3.) *Parlatoria pergandii*, Comstock—a small and more nearly circular scale, which so closely resembles the bark in color and general appearance that it is frequently overlooked by orange growers. From its resemblance to a lot of chaff it may be called the "Chaff scale." It affects the trunk and the larger limbs, and usually multiplies to such an extent that one scale is literally piled upon another, thus helping the chaff-like appearance. It is almost always associated with the others on the same tree, and while it is perhaps less injurious than they, except on very young trees, it is also the most difficult to exterminate, because of the fact that the ventral portion of the scale is continuous, and thoroughly separates the insect from the bark to which it is attached.

For the benefit of those who are unfamiliar with the characters of this family of insects, it may be, perhaps, well to say that, for practical purposes, their life may be divided into three principal periods: 1st. The period of *migration*, when the minute six-legged young are active, and crawl about rapidly over the tree—a period which lasts but a few hours, or, at the most, one or two days. 2d. The period of *growth*, during which the insect becomes fixed, losing its legs by the first moult, and assuming a more degradational character, and during which the protecting scale is excreted. The females undergo two moults, the cast-off skins assisting in the formation of the scale, while the males, existing parallel to the females up to the second moult, cast their skins a third time and assume an active winged form, vastly unlike that of the fixed, memberless female. This second period varies in duration with the season, and may extend from one to two months. 3d. The period of *incubation*, which includes the laying and hatching of the eggs, and which, like the preceding period, varies according to the season, but which is rarely entirely suspended even in winter in Florida.

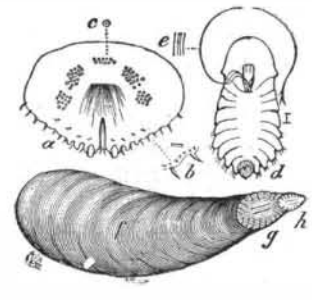

Fig. 3.—MYTILASPIS POMICORTICIS, Riley—showing female scale with its larval (*h*), median (*g*), and anal (*f*) parts; ventral view of female, *d*—the natural sizes in hair line; anal plate, *a*, with its secretors, *c*, and marginal points, *b*; and parts of proboscis, *c* (after Riley).

Now, it must be plainly seen that the best time to reach and destroy these insects is during the brief migrating period, and, were these periods at all well defined, it would be easy to watch for them and to destroy the insect by various very simple applications to which it is amenable in this unprotected state. But, unfortunately, this migrating period has no distinct and definite limits in time. For while it is short for the individual, it extends over a much longer time for the species. Even after the insects are settled, or up to the first moult, they are readily destroyed by various washes, and during the latter period of growth there are times, especially when the insect is moulting, that the body is partly exposed at the edge of the scale, and therefore when it is more easily reached with such applications. Hence, at almost any season of the year, individuals will be somewhat differently affected by one and the same application, since there is more or less irregularity in the hatching and moulting of the different individuals.

When the scale is once fully formed, however, few insects are more difficult to reach and destroy than these particular coccids; for the upper portion of the waxy scale is impervious not only to rains, but to acid and alkaline solutions, and resist even oils and bisulphide of carbon. The thinner ventral scale is, however, not proof against the more volatile oils and alcoholic solutions. They are least affected when the scales are thus fully formed and crowded with eggs; for experiment has shown that the eggs (and this seems to be a rule with all oviparous animals) have greater vitality and more fully resist the effects of insecticides than the parent insect. Consequently the periods of greatest resistance just precedes the migrating or most vulnerable period. The former or most resisting periods may be said to occur in February, May, August, and during the winter months; while the periods when the young are hatching in greatest numbers are the spring, or the latter part of March; the summer, during June and July; the fall, during September and October; and sometimes a fourth period, during any mild winter weather.

I will now condense the results of experiments carried on in this particular field, under my direction, very much as they have been reported by Mr. H. G. Hubbard, who, since last August, has been stationed at Crescent City, Fla., where he has done admirable work.

From what has been said of the nature and structure of the horny covering which protects the three scales, with which we are chiefly concerned, it will be seen that applications of solid substances are not likely to prove practicable, and that for cheap and effective remedies we must look to penetrating liquids. The cost of alcohol renders its extensive use impracticable. The volatile oils are, as a rule, powerful insecticides, but as they reach the insect from beneath, by penetrating the bark of the tree, and are all to a greater or less degree injurious to vegetation, their use undiluted can in no case be recommended. Some of the light oils, *e. g.*, naphtha, turpentine, etc., are extremely hazardous remedies, and experiments with them are known to have resulted in the destruction of the orange trees upon which they were applied. Experience has shown that of the different applications other than that to which I shall presently direct attention, and which transcends all others in value, the three following have proved most useful, as I have been assured by one of the most extensive orange growers, viz., the Rev. John F. Young, Episcopal Bishop of Florida.

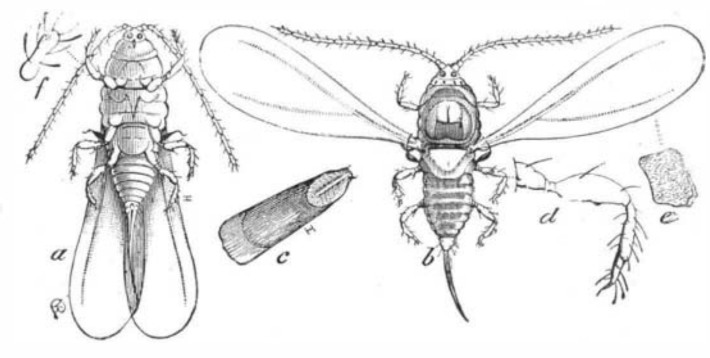

Fig. 2.—MYTILASPIS POMICORTICIS, Riley—*a*, male, ventral view, with wings closed; *b*, do., dorsal view, with wings expanded; *c*, scale, enlarged, the hair lines showing natural size; *d*, leg; *e*, portion of wing; *f*, antennal joint—greatly enlarged (after Riley).

1. One pound of whale oil soap to six pails of water, and a piece of copperas as large as a hen's egg. Dissolve at boiling heat, mix thoroughly, and apply cold.

2. Twenty pounds of quick (lump) lime and two ounces of sulphur; slake the lime in a kerosene barrel, and just before it is entirely slaked put in the sulphur. Stir thoroughly, and use cold.

3. Sixteen pounds of whale oil soap, four quarts of paraffine oil, four gallons of water. Put into an iron kettle, bring to a boiling point, stirring well. Of this solution use in proportion of one quart to four quarts of water.

Fig. 4.—MYTILASPIS GLOVERII, Pack.—2, scales on orange, natural size; 2 *a*, scale of female, dorsal view, enlarged; 2 *b*, scale of male, enlarged; 2 *c*, scale of female, with ventral scale and eggs, enlarged (from Comstock).

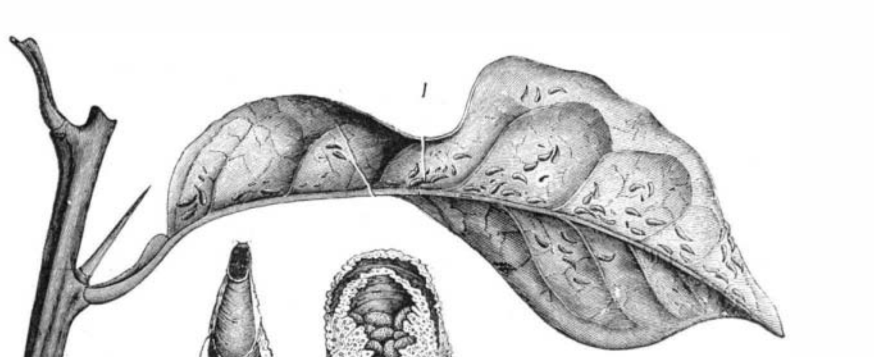

Fig. 5.—MYTILASPIS CITRICOLA, Pack.—1, scales on orange, natural size; 1 *a*, scale of female, dorsal view, enlarged; 1 *b*, scale of female, with ventral scale and eggs, enlarged; 1 *c*, scale of male, enlarged (from Comstock).

KEROSENE.—The value of this substance as an insecticide has long been known. Of all the light oils which I have tried, or of which I have any knowledge, it is the least injurious to plants of the citrus family. Refined kerosene, separated from the deadly naphtha oils, has frequently been used undiluted without injury. Crude petroleum will destroy the bark, and even the refined oil, if applied in the hot sunshine, completely defoliates the tree. Applied in the shade, at sun set, or in cloudy weather, I have never known any serious injury to result from its moderate use. The tree invariably loses the old and devitalized leaves, but young and vigorous growths, especially tender sprouts and budding leaves, are entirely unharmed by it. Nevertheless, so many cases of loss are reported that its use undiluted must be considered dangerous. In very fine spray, and with proper precautions, pure kerosene can probably be used with impunity, but all attempts to apply it in small quantities, with other liquids, by dashing them together, should be discouraged as dangerous, or at best unsatisfactory, since it is impossible in this way to insure an even distribution of the oil to all parts of the plant.

There is, however, a safe and ready method of diluting kerosene and similar oils, and of rendering them miscible with water. This method was first indicated by me in speaking of the cotton worm in the SCIENTIFIC AMERICAN for October 16, 1880, as follows:

"Nothing is more deadly to the insect in all stages than kerosene or oils of any kind, and they are the only substances with which we may hope to destroy the eggs. In this connection the difficulty of diluting them, from the fact that they do not mix well with water, has been solved by first combining them with either fresh or spoiled milk to form an emulsion, which is easily effected; while this in turn, like milk alone, may be diluted to any extent, so that particles of oil will be held homogeneously in suspension. Thus the question of applying oils in any desired dilution is settled, and something practicable from them may be looked for."

Whatever want of success in the attempts that have hitherto been made to emulsify kerosene has been solely due to the failure to appreciate the true method of combination and the consequent use of an imperfect and unstable emulsion.

Based upon the above quoted passage, attempts were made by Prof. J. H. Comstock, during his connection with the Department of Agriculture, to produce this emulsion, and in his last year's report to the Department, he makes it manifest that he fails to appreciate the importance of the discovery, or to successfully make the combination; for he produced nothing but such mixtures as required constant stirring in order to keep the oil suspended in water. Mr. Hubbard has had no difficulty whatever in making a perfectly stable emulsion, and the secret of so doing consists in the proper amount of churning; for the whole process may be comparable to butter churning, with the exception that the oil and milk, in any desired proportion, must be much more violently churned for a period varying, with the temperature, from fifteen to forty-five minutes. The emulsion, such as Prof. Comstock obtained, is in a few minutes produced in the form of a creamy fluid, in which finely divided particles of oil can plainly be detected.

In Mr. Hubbard's words: "This is as far as the process can be carried on by stirring, or by dashing in an ordinary churn. The product at this point will not bear diluting with water, and separates or rises at once to the surface. On continued churning the liquid finally curdles and suddenly thickens to form a white and glistening butter, perfectly homogeneous in texture, and stable. The whole amount of both ingredients solidifies together, and there is no whey or other residue. If, however, the quantity of the mixture is greater than can be kept in constant agitation, a portion of the oil is apt to separate at the moment of emulsification, and will require the addition of a few ounces of milk and further churning for its reduction. This kerosene butter mixes readily with water, care being taken to thin it first with a small quantity of the liquid. The time required to "bring the butter" varies with the temperature. At 60° F., half to three-quarters of an hour; at 75°, fifteen minutes; and the process may be still further facilitated by heating the milk up to, but not past, the boiling point. Either fresh or sour milk may be used, and the latter is even preferable. The presence of kerosene does not prevent or hinder the fermentation of the milk; on standing a day or two the milk curdles, and although there is no separation of the oil, the emulsion thickens and hardens, and requires to be stirred, but not churned, until it regains its former smoothness. Exposure to the air not only permits the evaporation of the oil, but also of the water necessary to hold the oil in emulsion, and the kerosene slowly separates as the emulsion dries up and hardens."

The churning can be done very satisfactorily through an ordinary force pump, such as the well-known aquapult, it being repeatedly forced from one vessel to another. If sour milk is used there will be no further fermentation, and when kept protected from the open air in a tight vessel, the butter endures for any length of time. The emulsion may be made of any desired strength, as the quantity of milk required to hold the oil does not exceed 10 per cent. Emulsions containing over 80 per cent of oil are, however, not readily held in suspension in water on account of their light specific gravity. Yet those containing less than 80 per cent of oil lose value as insecticides as the oil loses some of its power in becoming emulsified; in other words, the killing power of a diluted emulsion depends not so much on the amount used as on the percentage of the oil contained in it. The results of Mr. Hubbard's experiments, which have been quite extensive, lead him to recommend the following proportion for scale insects, though a smaller proportion of oil will doubtless answer for more tender and unprotected insects: refined kerosene 2 parts, sour milk 1 part—in other words, twice as much kerosene as milk.

Churn until the whole solidifies and forms an ivory white, glistening butter, as thick as ordinary butter at a temperature of 75° F. If the temperature of the air falls below 70°, warm the milk to blood heat before adding the oil.

In applications for scale insects the kerosene butter should be diluted with water from 12 to 16 times, or 1 pint of the butter to 1½ gallons for chaff scales; 1 pint of butter to 2 gallons for long scale. The diluted wash resembles fresh milk, and if allowed to stand, in two or three hours the emulsion rises as a cream to the surface. The butter should, therefore, be diluted only as needed for immediate use, and the mixture should be stirred from time to time. A wash prepared in accordance with the above directions will kill with certainty all the coccids and their eggs under scales with which it can be brought into direct contact. No preparation known will, however, remove the scales themselves from the tree, or in any way reveal to the unassisted eye the condition of the insects within. This can be ascertained only by microscopic examination of detached scales. Time alone, and the condition of the tree itself, will indicate the result of an application.

Kerosene, it is true, loosens the scales from the bark, so that for a time they are readily brushed off, but they afterward become more firmly adherent, and are very gradually removed by the action of the weather. Upon trees thickly infested, a large proportion of the scales are so completely covered up by the overlapping of other scales, or the webbing together of leaves by spiders and other insects, that the wash cannot be brought into direct contact with them, and they are only reached, if at all, by the penetrating action of the oil. This takes place gradually, and the number of bark-lice killed increases for some time after an application, reaching the maximum, in the case of kerosene, about the fifth day.

CRUDE OIL OF CREOSOTE dissolved in strong alkalies, or solutions of soap, forms a very effective remedy for scale insect. It may also be emulsified with milk in the same manner as kerosene. The undiluted oil is, however, exceedingly injurious to vegetation, and destroys the bark of orange and other trees. It is in fact a more dangerous substance than kerosene, and requires to be used with great caution. Solutions, emulsions, and soaps containing it should be very carefully mixed in order that no globules of free oil may be allowed to come in contact with the bark of the tree. Its action upon the scale insect is even more powerful than kerosene, but it does not destroy as large a percentage of the eggs. The effect upon the coccids is not immediate, as in the case of other insecticides, and for three or four days after an application very few of these insects die. At the end of a week, however, the bark-lice are found to be affected, and continue to perish in increasing numbers for a week longer. Even after the lapse of three weeks the destructive action of the oil is still appreciable. These facts lead me to suspect that the insects are killed, in part at least, by the poisoning of the sap upon which they feed. The visible effect upon the plant appears to confirm this view. Leaves upon infested trees begin to drop after four or five days, and the defoliation reaches a maximum during the second week. As is the case with kerosene, the effect upon the tree depends upon its condition at the time of application, but creosote is more severe in its action, and there is greater loss of leaves and infested branches. With care, however, an application of creosote may be made sufficiently strong to exterminate the scale without serious injury to the plant, and as new or vigorous growth is very slightly affected, recovery is rapid.

Simple as are the facts here presented in reference to this kerosene emulsion, and involving, perhaps, nothing scientifically novel, yet their practical value and importance are great and far reaching. I have for years been endeavoring to solve the problem of the safe and effective use of kerosene to plants, because of its well known superior insecticide qualities, and now that the problem is solved, the remedy will soon find universal application, not alone for the specific purposes here indicated, but for most of the insect ills that plants in general suffer from.

Cleaning Engravings.

It very often occurs that professional photographers have brought to them engravings to copy, and it generally happens that they are old, discolored, and stained in great patches about the color of gingerbread. Of all colors this is, photographically, most objectionable, and it is nearly impossible to obtain a passable result. If the engraving happen to be a valuable one the photographer, as a rule, is almost afraid to try and clean it, lest he should spoil it, especially with the receipts we find published in various receipt books. Only a short time ago I was looking over some of these books. One advocated chloride of lime, another hydrochloric acid, and agents of a similar nature. We all know the bleaching power of such powerful agents. With regard to the first named, I, for one, always shun it, as when once it gets in to any organic material it is very difficult to eliminate it again, and it is well known that if any of the lime compounds are allowed to remain the whole fabric, in the course of time, rots and drops to pieces.

I know many amateurs who like this kind of practice in copying old engravings, and are not aware that there is a means of cleaning and restoring them without the slightest possible risk; and, moreover, the plan I am about to propose is a very inexpensive one indeed.

Staining not only occurs in old engravings, but in modern ones we very often see parts of a picture stained sometimes through a knot in the back board, or the wood of the same being full of turpentine. All these markings can be removed. My plan is to get a dish or china tray a little larger than the engraving to be operated upon; if smaller there is a great risk of tearing and damaging the engraving. The bleaching agent is no other than Holmes' ozone bleach. The strength I prefer to any other is one part of ozone bleach to ten of water, well shaken up before pouring into the dish. A much stronger solution can be used—in fact, I have used it as strong as one to five of water; but the reason I use the weaker one is that I am of the opinion that the less of the agent we use the less we have to soak out of the paper afterward.

I immerse the engraving in the solution, face upward, avoiding bubbles. The only caution to be observed is that when the engraving is sodden with water it is somewhat rotten; so the less it is handled the better, though I have not the slightest fear in manipulating engravings of the largest size. Sometimes, if the engraving be only slightly stained, half an hour is quite sufficient, but when quite brown I have left them in for as long as four hours. With a stronger solution the time required is much less.

After all the stains are removed, and the paper has regained its pure whiteness, pour the solution out of the dish into a bottle (as this can be used over and over again—that is, several times until it becomes discolored, when it must be discarded), then fill up the dish with water, changing frequently for about two hours, or, better still, place it in running water. When sufficiently washed it can be taken out and blotted off and then hung up to dry, and, when perfectly dry, I find it advisable to iron on the back with a warm flatiron; but care must be taken not to have it too hot. When finished it will be as white as the first day it came from the press. The plan is very simple, and my advice is, try it.—*Wm. Brooks, British Journal of Photography.*

THE USE OF AMMONIA IN BAKING POWDERS AND ITS IMPORTANCE AS A CULINARY AGENT.

The recent discoveries in science and chemistry are fast revolutionizing our daily domestic economies. Old methods are giving way to the light of modern investigation, and the habits and methods of our fathers and mothers are stepping down and out, to be succeeded by the new ideas, with marvelous rapidity. In no department of science, however, have more rapid strides been made than in its relations to the preparation and preservation of human food. Scientists, having discovered how to traverse space, furnish heat, and beat time itself, by the application of natural forces, and to do a hundred other things promotive of the comfort and happiness of human kind, are naturally turning their attention to the development of other agencies and powers that shall add to the years during which man may enjoy the blessings set before him.

Among the recent discoveries in this direction none is more important than the uses to which common ammonia can be properly put as a leavening agent, and which indicate that this familiar salt is hereafter to perform an active part in the preparation of our daily food.

The carbonate of ammonia is an exceedingly volatile substance. Place a small portion of it upon a knife and hold over a flame, and it will almost immediately be entirely developed into gas and pass off into the air. The gas thus formed is a simple composition of nitrogen and hydrogen. No residue is left from the ammonia. This gives it its superiority as a leavening power over soda and cream of tartar when used alone, and has induced its use as a supplement to these articles. A small quantity of ammonia in the dough is effective in producing bread that will be lighter, sweeter, and more wholesome than that risen by any other leavening agent. When it is acted upon by the heat of baking the leavening gas that raises the dough is liberated. In this act it uses itself up, as it were; the ammonia is entirely diffused, leaving no trace or residuum whatever. The light, fluffy, flaky appearance, so desirable in biscuits, etc., and so sought after by professional cooks, is said to be imparted to them only by the use of this agent.

The bakers and baking powder manufacturers producing the finest goods have been quick to avail themselves of this useful discovery, and the handsomest and best bread and cake are now largely risen by the aid of ammonia, combined of course with other leavening material.

Ammonia is one of the best known products of the laboratory. If, as seems to be justly claimed for it, the application of its properties to the purposes of cooking results in giving us lighter and more wholesome bread, biscuit, and cake, it will prove a boon to dyspeptic humanity, and will speedily force itself into general use in the new field to which science has assigned it.

The Sultan of Turkey.

A correspondent of the New York *Herald*, writing from Constantinople, gives a variety of interesting information concerning the political situation and material progress of Turkey, including personal particulars relating to the Sultan. The writer says:

"The United States is the furthest off and can help him (the Sultan) more than any other nation in developing the vast resources of Turkey. The Sultan reads regularly the SCIENTIFIC AMERICAN, which he has translated into Turkish, and General Wallace, our worthy representative in Constantinople, is higher in favor with the Sultan than are any of his European colleagues."