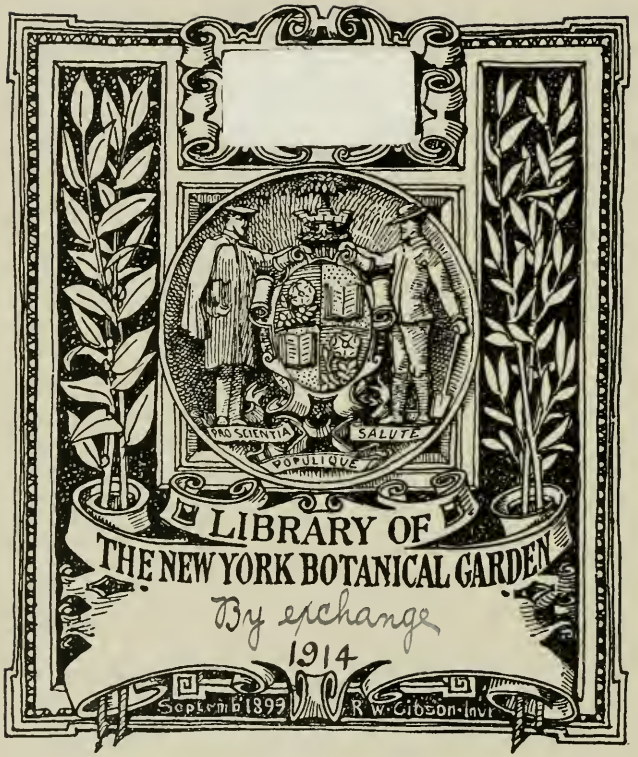
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VOLUME III No. 1

THE MONTHLY BULLETIN

Work of the cherry fruit saw-fly, *Hoplocampa cookei* (Clarke), on young cherries. Natural size. (Photo by E. O. Essig.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA JANUARY, 1914

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STATE COMMISSION OF HORTICULTURE

January, 1914

THE MONTHLY BULLETIN

VOLUME III No. 1

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 28, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

FRIEND WM. RICHARDSON, SUPERINTENDENT OF STATE PRINTING

SACRAMENTO, CALIFORNIA

1914

EMERGENCY CONVENTION

(ONE DAY ONLY)

TO CONSIDER

INSECT CONTROL WITH SPECIAL REFERENCE TO THE CITRUS MEALY BUG

TO BE HELD AT

CHAFFEY HIGH SCHOOL, ONTARIO, CAL., FRIDAY, JAN. 30, 1914

The following men will take part on the program:

Geo. G. Laidlaw, President West Ontario Citrus Association of Narod, Ontario; **Dr. A. J. Cook,** State Commissioner of Horticulture, Sacramento; **C. C. Teague,** Manager Limoneira Co., Santa Paula; **G. Harold Powell,** Manager California Fruit Exchange, Los Angeles; **R. S. Vaile,** Horticultural Commissioner Ventura County, Santa Paula; **R. C. Allen,** Manager Sweetwater Fruit Co., San Benito; **L. B. Barnes,** Manager San Diego Fruit Co., Chula Vista, Cal.; **J. A. Prizer,** Entomologist San Diego Fruit Co., Chula Vista; **H. A. Weinland,** Horticultural Commissioner San Diego County, San Diego; **Wm. Wood,** Horticultural Commissioner Los Angeles County, Los Angeles; **Roy K. Bishop,** Horticultural Commissioner Orange County, Santa Ana; **S. A. Pease,** Horticultural Commissioner San Bernardino County, San Bernardino; **R. S. Woglum,** Expert Bureau of Entomology, U. S. Dept. Agriculture, Whittier; **Harry S. Smith,** Superintendent State Insectary, Sacramento; **E. O. Essig,** Secretary State Commission of Horticulture, Sacramento.

Nearly all of these men have had personal experience in the control of the citrus mealy bug and can speak with authority upon this subject.

All fruit growers interested in the control of citrus insects are urged to attend, as the matter presented will be of great value to all interested in this great citrus industry.

One and one third railroad rates on the receipt certificate plan. Be sure and obtain receipt certificate when you buy your ticket to Ontario or Upland.

THE MONTHLY BULLETIN

FROST PROTECTION IN THE LIMONEIRA LEMON ORCHARDS.

Address, State Fruit Growers' Convention, San Jose, Cal., December 2-4, 1913.

By J. D. Culbertson, Assistant Manager Limoneira Company, Santa Paula, Cal.

Introduction.

What I shall say about protecting orchards against frost injury will be nothing more than the story of how this problem has been met in the past by the Limoneira Company of Santa Paula and how we are preparing to meet it in the future. Mr. C. C. Teague, vice-president and general manager of the company should have been here to tell this story himself, and most certainly would have been, had not a very important and unexpected water rate hearing before the State Railroad Commission demanded his presence at home.

No attempt will be made to avoid repeating statements made previously on the platform and in the press by Mr. Teague and myself. Our main purpose is to give you our experience in a fifteen year struggle to save our orchards from frost damage, hoping that someone may profit thereby, just as we have profited.

Early Frost Fighting.

Fifteen years ago, the Limoneira Company had one hundred acres of six-year-old lemons frozen to the ground and two hundred acres more frozen back to mere skeletons. English walnuts were substituted for the lemons on the one hundred acre tract, but on the two hundred acres where the trees were not hopelessly frozen, steps were taken at once for their protection. Fifty-six coal baskets per acre were installed, each basket holding about twelve pounds of coal. Several years later this equipment was doubled, making one hundred twelve baskets per acre, or one basket to each tree. With this protection serious damage to trees was always averted, but again and again the loss of fruit, both large and small, was so great that the need of still more and better protection was self-evident.

Beginning of New Era—The Oil Pot.

The "Briquette," made of compressed shavings and hard asphaltum, was tried experimentally but made altogether too much soot, regardless of its possible merits. Several hundred dollars were spent four years ago equipping five acres with the sheet iron smudge pots for burning the well known loose wood shavings saturated with heavy crude oil. Selecting a suitable night, a test firing was made on this five acre tract equipped with these smudge pots, together with another five acres some distance away similarly equipped with coal baskets. Careful thermometer readings, cost estimates and soot factors, all considered together, convinced us that this smudge fuel was not superior to the coal. A year later, in the fall of 1910, impressed by the successful use of the oil pot in the deciduous orchards of Colorado, Oregon and California, and because the introduction of slop distillate for fuel promised a less dense soot and freer burning than that obtained from crude oil,

the company accepted the offer of an oil pot agent who desired to send us five hundred one-gallon "lard-pail" pots, free of cost, on condition that we give them a thorough trial, and burn in them twenty-four gravity slop distillate.

In reporting to the gentleman who had sent us the pots, under date of January 20, 1911, we wrote as follows: "On Saturday morning, December 31, 1910, at four o'clock the temperature had fallen to 29 degrees in the area where we had the one gallon oil pots distributed one pot per tree. We immediately fired all of the pots, and at the same time fired fifty-six coal baskets per acre on other tracts nearby where the temperature was the same. When the oil pots were lighted, the temperature rose from five to six degrees in less than thirty minutes and remained practically stationary till sunrise, while the fifty-six coal baskets on the other areas sufficed merely to hold the temperature where it was, allowing considerable ice to form in the leaves and on the surface of the fruit."

Not once in twelve years had it been possible to raise the temperature six degrees with the coal baskets. If a one-gallon pot of oil per tree could do it within thirty minutes after lighting, and maintain it there for four hours, the possibilities of a larger pot and more oil per tree were indeed promising. Still there was the soot question. On four different nights that year low temperatures necessitated lighting the five hundred sample oil pots, but so few of the lemons were seriously affected by the soot—possibly because of dry nights followed by winds—that our greatest fear regarding the practicability of the oil pot was, for the time, somewhat dissipated; so much so, in fact, that with such positive evidence of what we had accomplished and could accomplish with oil in case of an emergency, the entire two hundred acres of orchard commonly subject to frost visitations, was equipped with ten thousand two-gallon oil pots, one pot to each two trees, in addition to the one coal basket per tree already in use. It was the plan, however, to use the coal under all ordinary conditions, holding the oil in reserve for extremes. You see, we still feared the soot. The coldest ten acre tract was equipped with eighty-four of these two-gallon oil pots per acre, and, to make a more thorough test of the cost, efficiency, and problems connected with handling oil, and to satisfy ourselves more fully as to possible damage from soot, we decided to use it exclusively in protecting this area, which we did successfully although the pots had to be lighted on sixteen different nights.

So severe were most of the frosts that frequently we were obliged to use the oil, in addition to coal, throughout the other protected areas, as well as where we had planned to use the oil only. On several nights the leaves and fruit were dripping wet with dew, and as the soot accumulation on the fruit under such conditions is excessive, the spring of 1912 found us with a lot of very sordid looking lemons indeed. The lowest temperature recorded in the orchard was 23 degrees, lasting but a few minutes, and due to an extremely sudden drop at the very moment when the lighting of the pots was in progress. The eighty-four two-gallon pots per acre within a few minutes raised the mercury to thirty-four degrees, while with the fifty-six oil pots per acre, supplemented with an equal number of coal baskets in the other sections of the orchard we easily maintained a temperature of 32 degrees and higher. Except for a little damage to outside rows, the crop was saved.

Removing Soot from Fruit.

As I stated before, the fruit everywhere was badly sooted, but, realizing as we did that without the oil pots our carloads of sooted lemons would have been carloads of frozen lemons, we set ourselves lightheartedly to the task of washing them clean, even though we did not know how to do it. After numerous experiments with soaps, solvents, etc., we adopted the method developed by the late Mr. A. F. Call, and others of Corona. This was with hot water at a temperature of 110 degrees and Gold Dust in the ordinary lemon washing machine, starting in the morning with from three to five pounds of the Gold Dust to each one hundred gallons of water, adding an additional ten per cent of Gold Dust hourly during the day. But as a most important preliminary to this we found that an instantaneous bath in cheap kerosene just before dumping the lemons into the washer seemed to dissolve and absorb the soot in such a way that the soap wash was far more effective. This combination gave excellent results.

Comparative Costs of Coal and Oil as Fuels.

In the mean time a careful comparison of the cost of oil protection with that of coal protection, including equipment, interest, deterioration, fuel consumed, and labor required, gave oil the advantage. The equipment and store of fuel required about the same initial investment, but in handling a cold night it developed that seven cents' worth of fuel in the oil pot gave twice the efficiency obtained from nine cents' worth of coal. This was readily explained by the fact that even under superior conditions of combustion a pound of coal can not be made to give off more than about half as many heat units as the same amount of oil. A smaller labor cost was also an extra item in favor of oil.

With the factor of efficiency and cost so plainly and unmistakably in favor of oil, it is easy to understand why from the day when the sooted lemons first came from the washer clean and uninjured, we have firmly believed the oil pot to be the most effective, the simplest, cheapest, and therefore the most practical equipment for frost prevention.

Firing in the Winter of 1912–1913.

When congratulating ourselves on the successful results of our "firing" during the winter of 1911–12, we could not forget the strain and anxiety of those twelve consecutive nights when we fired from one hundred to two hundred acres each night. Would the oil and coal last till morning? Would the temperature fall so low that the equipment could not save the crop? Could we get enough fuel from outside sources if the siege continued many days more? It was evident that where a quarter of a million dollars' worth of fruit was at stake, the margin of safety was still too small. Before another winter ten thousand more oil pots were installed on the cold areas, each pot holding three gallons, so constructed that the combustion was much improved and the size of flame subject to some regulation. Higher areas, never known to freeze were at least partially equipped against the possibility of still severer frosts.

Thus it happened that when the coldest winter California citrus orchardists have ever known came upon us one year ago it found our

coldest areas protected by one three-gallon oil pot and one twelve-pound basket of coal to each tree, and fuel in storage sufficient to fill every pot and basket about three times. We felt reasonably sure that we could handle any temperature that might visit us. How little we suspected that California—sunny California—could ever be so cold! Between November 1, 1912, and March 27, 1913, we put the torches to the oil pots on twenty-nine different nights—one night out of every five. It is said that every man's success may be measured by the extra work he does. Just as surely was our success due to the extra ten thousand three-gallon oil pots, for wherever they were installed only the exposed margins of the orchards gave evidence that the frost had been there. On January 6, 1913, before the evening twilight had faded from the west, our oil pots had been burning half an hour. We began firing at 30 degrees. The temperature was falling at the rate of one degree every seven minutes. How low it might have gone we shall never know, though one thermometer just a few rods above the firing line on the warmer ground registered 19 degrees for several hours. Neighbors reported varying temperatures as low as 12 degrees. First one half of the pots were lighted, followed by half of the coal. This held the mercury nearly 31 and 32 degrees. At 9.40 p. m. the second half of the oil pots were fired and a little later the first half extinguished, while there was still a little oil in them. We did not want to find ourselves with half of the pots altogether empty in case of a still more severe drop in the temperature. At the same time eight tank wagons with eight men to each wagon stood ready, and as fast as the pots were extinguished, the men carried oil in from the ends of the rows refilling every pot. This refilling continued all night. Twelve thousand gallons of oil was thus distributed. Other teams hauled out forty tons of coal which men with boxes carried down the rows replenishing thousands of the baskets while they burned. In the meantime a special train from Los Angeles was bringing half a dozen cars of oil to fill the reservoirs that were now nearly empty. When at four o'clock in the morning the last stray basket and every pot had to be lighted and kept burning full blast till sunrise, we realized again that it was the extra twelve thousand gallons of oil and the extra forty tons of coal hauled out and distributed steadily all night long in darkness and dense smoke by men who had worked all of the day before—it was this extra fuel and this extra labor so willingly given, as well as the extra ten thousand oil pots and the special trainload of oil, that saved full two hundred carloads of lemons on two hundred acres of orchard.

Costs of Firing.

To the manager of the Limoneira Company, Mr. C. C. Teague, is due the entire credit for the foresight and timely conviction that led to the installation of the generous equipment and abundant store of fuel that made possible this hard earned victory. Did it pay? Was it worth while? The total equipment used in the entire winter's campaign, including coal baskets and basket stands, oil pots, oil storage reservoirs, tank wagons, torches, and all accessories, cost, when new, only $13,800.00; the 150,000 gallons of oil always in storage cost $4,500.00, and 300 tons of coal, $3,600.00, making a total of $21,900.00. This

averaged $109.50 per acre for the investment. The actual expense items were as follows:

Labor	$10,574 75
Oil consumed, 180,000 gallons at 3 cents	5,400 00
Coal burned, 150 tons at $12.00	1,800 00
Miscellaneous	338 20
Six per cent interest on plant	828 00
Twenty per cent deterioration	2,760 00
Six per cent interest on coal and oil in storage	486 00
Total	$22,186 20

Estimating as above that two hundred cars of lemons were saved on the two hundred acres protected, the average cost per car was $110.93, or the same amount per acre. The ordinary cost of producing a carload of lemons is more than $500. We have met all expenses and paid fair interest in dividends to stockholders out of this year's earnings.

Losses in Unprotected Areas.

Even though we saved much, our loss was still severe. Fifteen hundred twenty-year-old lemon trees on "safe" ground above and immediately adjoining the protected area, lost all of their fruit and foliage and all of the smaller branches; ten thousand trees five years old were frozen to the ground and twenty-five per cent of them later reset; while another ten thousand of the same age lost crop and much of the fruit wood. These areas had never suffered before. Our lesson was severe enough to teach us that frost protection is as much a part of our industry, and as necessary in almost every part of the orchard, as irrigation or any other operation. And like the great nations advocating international peace, we have come to believe that invincible equipment guarantees the surest "peace" of mind and most certain security in time of "strained relations."

Adequate Equipment.

The man who tries to handle a low temperature with inadequate equipment is like that gentleman who came running down to the dock with his ticket in his hand just as the gang plank had been hauled in and the ship already some twenty-five feet away. His anxious friend aboard saw him coming and shouted excitedly, "Jump! Ikey, jump! I think you can make it in two jumps!" We have been in Ikey's position too often and know well enough just how he felt.

And now a word as to our present equipment—an equipment that we believe sufficient to handle a temperature as low as 12 degrees, possibly lower. Instead of having only two hundred acres fully equipped the area is increased to five hundred acres. The coal basket and the oil pot of the lard-pail type and the open top have been hauled from the orchard and discarded. Each tree is protected instead by a new pot holding seven gallons of oil. It is a pot that can be regulated so as to burn at any desired rate from one pint to one gallon per hour. It will burn any grade of petroleum from asphaltum to engine distillate or kerosene—and burn it to the bottom of the pot. It is not a smokeless pot, but promises to make less soot than any of the types used last year. It can be set with draughts all adjusted so that when firing is necessary the operator with one hand removes the hood cover and with the other instantly touches it off with his torch. We believe that with proper care it will last from six to ten years.

Care of Pots.

Every pot is thoroughly inspected for holes or other defects when taken from the car. It is then dipped in asphaltum paint before sending to the field. This asphaltum paint is a very effective protection against rust. It has been our observation that rust will deteriorate an oil pot more rapidly than the firings in the orchard, and it is our regular practice after every siege of firing, be it for one night or a dozen, to send men through the orchard with paint and brush to retouch every spot where the protecting coat has been burned off. The shiny coat of lacquer that covers the pot when it comes from the factory will not last long when exposed to the weather, and we believe it an extremely wasteful practice to allow pots to stand in the field with no other protection. The making of the asphaltum paint is a simple matter. Heat fifty pounds of broken asphaltum in an iron tub or kettle until thoroughly melted. Remove a safe distance from the fire and stir into it five gallons of stove distillate, being careful that it does not boil over. This will be a little too thick for dipping purposes, but can be diluted to any desired consistency with engine distillate. The cost of dipping each pot is about one cent.

The Latest Oil Pot.

While not recommending any particular pot, we do not hesitate to say that in our opinion the greatest advance step ever made in oil pot construction has been the introduction within the last year of the "down draught" tube, either perforated or slit in such a way that an ample supply of air is always available at the surface of the burning oil. And the positive control of this air supply means great economy in oil consumption and a cleaner flame, and makes available if needed the last heat unit contained in the heavy residue that unavoidably accumulates in the bottom of the pot.

It might be mentioned here that when this pot is new the first attempt to light it will probably result in failure and possibly serious delay, unless a loose wad of excelsior be crowded into the mouth of the tube. This will become saturated with oil and make possible instant ignition. After a little soot has accumulated about the openings the excelsior may not be necessary.

Assembling the Help.

At the first suggestion of danger the regular night watchman will call several patrols who will go, each one to a different part of the orchard, and report to headquarters over our newly installed telephone system the temperatures in his section. All of the temperatures will be charted as they come in, each thermometer's readings separate from the rest. At every telephone station are a number of torches and an extra supply of distillate to refill them. At a temperature of 33 degrees, if the night is threatening, the men will be assembled ready for lighting the pots. As most of them are in dormitories close at hand this requires but a few minutes. The telephone will enable us to know the temperature at all points every few minutes, and as the mercury approaches 30 degrees in any section a firing squad will be sent at once to that point with orders to light the pots immediately if there is no change for the better. In like manner, by means of the telephone, any squad may

be transferred from one section direct to another without the loss of time required in returning to headquarters. Organized in this way, we hope to do more effective work than ever before, and at the same time make it much less arduous for the men.

Firing Early Important.

If any one point should be impressed on the mind of him who has an orchard equipped for frost protection, or is contemplating such equipment, it is the supreme importance of *firing early*. "Of all the words of tongue or pen the saddest are these—'It might have been'." The bitterest memories that linger in our minds in connection with our years of fighting frost are of the nights when, hoping to save a modicum of paltry fuel, we waited a few minutes too long. Every chapter in our experience has borne testimony that once the latent, reserve heat becomes exhausted from air, fruit, tree and surface soil, the task of raising and holding a temperature is not only far more difficult and expensive, but in nearly every case accomplished only after irreparable damage has been done to small fruit especially, and often to the entire crop and tree. If you let the thermometer fall below 30 degrees you are taking the reckless gambler's chance, unless perhaps it be just a short, sudden drop during the last few minutes before sunrise. Whether your equipment be heavy or light, we firmly believe it should be brought into action on all occasions if the mercury falls below 31 degrees, and then used just freely enough to keep the temperature above 32 degrees, putting out part of the pots, cutting down the flame, or adding to, as the case may require.

First Cost and Maintenance.

The following figures representing our total investment on five hundred acres may be of interest.

50,000 oil pots (including several thousand of last year's pots)	$50,000 00
2 steel storage tanks, capacity 5,000 barrels each	4,885 89
2 cement reservoirs, capacity 100,000 gallons each, equipped with pump	3,000 00
5 miles of 3-inch and 4-inch pipe line	6,375 03
35 tank wagons and trucks	4,315 00
150 spout pails for filling pots	300 00
200 torches	200 00
50 thermometers	150 00
4 miles of telephone system	750 00
350,000 gallons of oil in orchard at 2½ cents	8,750 00
500,000 gallons of oil in storage at 2⅛ cents	12,500 00
Total	$91,225 92

Reduced to the basis of one acre, the investment is:

100 pots	$100 00
Storage space for 1,240 gallons of oil	15 77
Pipe line	12 75
One tank wagon to 14 acres—per acre	8 63
Pails—one to 3½ acres—per acre	60
Torches—one to 2½ acres—per acre	40
Thermometers—one to ten acres—per acre	30
Telephone	1 50
Oil in pots—700 gallons at 2½ cents	17 50
Oil in storage—1,000 gallons at 2½ cents	25 00
Total	$182 45

These figures are almost staggering, yet, if ample protection is to be afforded areas annually visited by low temperatures, we believe this is

not too high for the average estimate for initial outlay. A ten acre tract will require about the same investment per acre as a larger area equally cold. On this investment the annual interest, deterioration, and maintenance expense, aside from any operating expense, is of no small consequence:

6 per cent interest on total investment	$10 94
15 per cent deterioration on $100.00 worth of pots	15 00
6 per cent deterioration on balance of equipment	2 40
Estimated maintenance—handling, painting, filling, etc.	5 00
Total	$33 34

This is what it will cost us per acre annually just to be prepared, without even once lighting the pots. It may seem like costly insurance, but instead it is a most profitable investment. The cost of properly caring for an orchard—irrigating it, cultivating it, fertilizing, pruning, fumigating, spraying, planting the cover crop, feeding the work animals, meeting repair bills and taxes—all taken together frequently amounts to several hundred dollars per acre yearly. It is not merely a question of whether or not the end of the year will show a profit. With such expense accounts the grower can not afford to lose his crop even if it takes every dollar of profits and more to save it. The danger of a deficit is far more serious than the possible lessening of the profits. Of course, there is a limit beyond which profitable growing of fruit on cold areas is impossible, but where, in ordinary years, little or no protection against frost is necessary, given other suitable conditions, this problem can be as successfully and profitably met as any of the other problems such as pumping irrigation water, or fumigating for insect pests.

Conclusions.

Fellow Horticulturists—and this most certainly includes you, Mr. Chairman,—my purpose has been not to give you too many figures and details, but rather to tell you the story of what we have done, and to tell it in such a way that you will believe in the practicability of frost prevention as thoroughly as we believe in it. You will have no difficulty in finding out all of the little details of how to do it, if you once really believe that it has been done successfully, that it has paid, that it can be done by yourself or any one else, and that it will pay you or any other man just as certainly as it has paid us.

THE HOME OF THE FARDH DATE.

PAUL B. POPENOE, West India Gardens, Altadena, California.

At present the Fardh* date is the highest priced sold on the American market, with the exception of a very small quantity of Deglet Nûrs from Algeria or Tunisia, and a negligible quantity of Majhûls from Morocco. To ascertain how severe a competition it was likely to offer to the rapidly growing date industry of California, to investigate the methods used in its culture, and to secure offshoots of this and any other valuable varieties, the West India Gardens of Altadena directed me to pay a visit to Oman, during the trip which I made to the Persian Gulf in the winter of 1912–1913, in company with my brother, F. W. Popenoe.

The results of my investigation may be summed up as follows: Production of the Fardh date is not likely to be much increased, and California can certainly produce much better dates; therefore she need fear no serious competition from the Fardh. The methods used by the native cultivators of Oman are the most intelligent and skillful employed by any Arabs with whom I am familiar, but they do not equal those of my own countrymen, although their use of manure and water illuminates several points of interest to us. Methods of packing and handling the crop are inferior. As regards offshoots, I secured 100 of the Fardh, and enough of the fourteen other best varieties to make up a total of 575, which are now growing in Coachella Valley.

Production of Fardh dates is practically confined to Samaîl Valley and its continuation, Amân Valley, 50 miles inland from Masqat, the capital of the little dominion of Oman, a principality which is nominally independent, but subject to British influence, and which occupies the eastern apex of Arabia, jutting out into the Persian Gulf. There are many other good date-growing regions in Oman, but the Fardh, according to the natives, does not flourish in them. I can testify from personal knowledge that it is not cultivated on the coast, the so-called Batînah, where date plantations extend for several hundred miles; whether it be the prevailing winds, the humidity, or some soil condition that is inimical to this variety, I do not know, but native testimony, and past experience with this variety in the United States, certainly justify the supposition that it is rather delicate. At any rate, to see the Fardh, one must go to Wâdî Samaîl, and I made the three days' trip in company with the American consul at Masqat, Homer Brett of Mississippi, as a guest of the Sultan of Oman, on his own camels and with his own bodyguard.

Samaîl valley lies at the foot of the Green Mountains (Jabal Akhdhar) rising to a height of nearly 10,000 feet, which shelter it from the desert. It is eight or ten miles long and a third as wide, running northeast and southwest, with its opening toward the sea. It is surrounded by high hills, forming a perfect basin, but through the seaward gap blows a wind, in the winter months, that is frequently destructive. Humidity is considerable, for the mango, banana and papaya are found in the

*This is the correct spelling, although "Fard" is the usual trade name. The word is classical Arabic, meaning "apportioned"; modern Arabs usually spell it in a slightly different way, meaning "separated" and claim that this refers to the way the dates are disposed in the bunch.

valley: their presence also indicates plainly that the locality is practically frostless. According to native testimony, it is not so hot as at Masqat, and this I believe; but during the summer months, when the dates are ripening, the sea breeze stops and gives place to a current of air from the mountains, which must be very warm and dry. The temperature is then doubtless higher than on the coast, but less felt because of the lower humidity; and it is this alone, I suspect, that really makes the successful cultivation of the palm possible.

The soil is a light, sandy loam of unlimited depth, containing many loose stones. There are practically no traces of alkali, either in it or the water, which is brought down the valley for some miles in a cement conduit, in order to prevent its absorption in the stony bed of the stream. There were at least 200 inches of water running down the bed during my visit in what must be one of the dryest months of the year—October. I saw but one conduit entering the oasis, and this was carrying 200 inches; the natives said there were several more like it, in which case the total water supply available to Samaîl must be about 1,000 inches minimum. Certainly there is no lack of it; and although it is distributed on a communal basis, each man getting an amount proportionate to his land, I was told one could obtain an additional supply, even in midsummer, by paying a slight fee to the community.

Brought down the stony bed of the valley for many miles in a covered cement conduit close to the surface of the ground, the water gets thoroughly heated. I found it 91 degrees F. at noon, where it entered the upper limit of cultivation, while in a shaded lateral several miles down the valley it was still 80 degrees; the temperature in this lateral did not fall below 76 degrees, even in early morning—and the nights were cool. The natives do not attribute any particular virtue to warm water for irrigation, but I think, nevertheless, that this constant supply of water warmed to such a temperature must have an important bearing on the cultivation of the palm in a district which has the natural disadvantages of humidity and sea breezes. My belief is strengthened by the observation of several small oases irrigated by hot springs, during my ride to the valley; they were all remarkably healthy and vigorous, and from them the first dates are sent to the Masqat market, at the beginning of the season.

Nor is there any stint in the supply of this warm water to the palms, for the best plantations get a bountiful irrigation once a week, fifty-two times a year. The growers had never heard of our theory that water applied at the time of flowering makes the fruit set scantily; or that irrigation should be suspended when the dates soften, to prevent them from becoming sticky or souring.

In fertilizing the soil, the cultivator is as generous as with water, for those who can afford it put two bags of cow manure around each palm, twice a year, and no one considers himself a successful planter if he does not enrich the soil at least once a year, whereas most Arabs consider their duty is done if they apply a donkey-load of straw and refuse to the palm once in two years. The plantations also get a fair amount of cultivation, because subsidiary crops are largely grown, garden truck and various forage grasses being used. Alfalfa is usually grown in separate fields, the natives not knowing its nitrogenous value.

Propagation is, of course, solely by offshoots, and this is the only

Arab community I know which roots them in nursery rows, as we now do in California. Large Fardh offshoots are scarce and bring as much as $1 each, while a sucker weighing not more than six or seven pounds can be had for twelve cents. They are set in deep holes, "because they grow bigger;" all Arabs consider that the top layer of earth is prejudicial to offshoots, because of its hardness. Winter is considered the best time for planting; fall will do, but spring and summer will not. The nursery rows are often between the palms of a plantation, and the offshoots are left there for a year or more—sometimes three or four years—when they are transplanted, also in winter, to fill up gaps or start a new orchard. A Fardh palm in its prime is valued at $50.00 or more; one shaykh held his three-acre plantation at $10,000.00. Palms are set about twenty feet apart, nearly always in regular rows. The gross return from even a good palm, however, is seldom more than $1.50 or $2.00 a year.

The Fardhs ripen about the first of September, but long before this the crop has been bought on the trees by Indian money lenders, who advance funds to the proprietors in their hour of need, earlier in the year. These brokers pick the crop and transport it to Mattrah, the twin city to Masqat, where they auction it to the agents of exporting houses. Transport from the garden to the coast costs about $6.00 for one bihar of 200 maunds, each containing a little less than nine pounds. Pickers can be had for seven or eight cents a day, payable either in cash or dates, as the employee selects. The upkeep of gardens is usually put in the hands of a caretaker, who is paid by the choice of one bunch from each palm at harvest time, and his lien on this is a prior one which the money lender must respect.

Fardh dates of average quality are worth little more than a cent a pound at the time of the harvest. If the pickers want payment in dates, for instance, they regularly get one maund a day, while at auction sales in the valley in 1912 the price for ten maunds (about eighty-eight pounds) was $1.10, on the average. The crop that year was good, but overproduction seems to be a danger, for the crop in 1911 was even better, while in 1906 it was so heavy that the dates could not be sold, and were sometimes left to rot on the ground.

On the other hand, practically all the available land is under cultivation at present, in Wâdî Samaîl. There are extensive plantations of the Fardh in Wâdî Amân, the name given to the upper course of the stream which passes through Samaîl. How extensive they really are I do not know, as I did not visit them, but Arabs said one might travel all day without coming to the end of the plantations, which are, however, scattered, and not a solid area as in Samaîl. Take it all around, it looks as if an increased market was badly needed by the Omanis, and that no material increase in production is likely, if indeed possible.

At Mattrah the dates are packed, by wasteful and unattractive methods, for export to New York, which takes practically all the Fardh output that is not consumed locally or in the gulf. The firms engaging in this export business are Hills Brothers Company, Arnold, Cheney and Company, Birdsong and Brothers, and Suffern and Company, all with their headquarters in New York. Much of the trade is carried on in chartered steamers, which make the trip to New York direct in less than a month. Exports to New York in 1911 were 3,882,008.5 pounds, valued

at $154,662.42, according to consular invoice; for preceding years the value of the annual shipment to New York was as follows: 1910, $94,082.00; 1909, $40,771.00; 1908, $59,036.00; 1907, $105,011.00; 1906, $131,058.00.

Probably this fluctuation in the exports is due more to fluctuation in the amount of the crop, than to variation of the American demand, which is fairly steady, because the Fardh date is the only one imported in any quantity by the United States which can be bought in fairly presentable condition. Its tough, firm flesh allows it to come on the table intact, while the superior Halâwî and Khadhrâwî of Busreh have been so squeezed out of shape by the packer that they do not look presentable, no matter how good their flavor may be.

Aside from its packing quality, the Fardh can not be considered a first class date: its dark color and strong flavor disqualify it at once. We can produce much better dates in California, and can pack them in a way that defies competition, both because of superior methods, and because we are close to our market. I do not see, therefore, that California need in any way fear the competition of the Fardh date.

But there are better dates in Oman, even though they are not exported. Local taste, indeed, quite disdains the Fardh. One expert named to me the five best Oman dates, in order of merit, as Khalâseh, Khanayzî, Naghal, Hilâlî and Qush Zabad; the order is a matter of individual taste, but it will be noticed that Fardh is not on the list.

Certainly the Khalâseh has no rival as the preëminent date of the region, but its scarcity is such as to make it almost unobtainable. I found that it grew in Wâdî Samaîl, but could obtain no fruit there—my next door neighbor had two bags, but they were destined to a rich Arab of Zanzibar, who depended on getting his annual shipment of Khalâseh dates from home;* so I could not get any of them. On my way back to Masqat I stopped for lunch with a cousin of the Sultan, who brought out as a rare treat a dish of "'ajweh," of date paste, made from this superlative variety, and there I had my first taste of it—a taste that was by no means disappointing. On my departure from Oman I commissioned a reliable and experienced man to secure such offshoots as I wanted and sent them on to Busreh, and I particularly urged him to secure every possible offshoot of the Khalâseh. He was able to find a hundred. Later I got 400 more direct from the date's home in the province of Hasa, farther up the gulf on the eastern coast of Arabia, and I thus have reason to hope that it is introduced on a sufficiently large scale to give it every chance of success in California.

Taken as a whole, the great value of Oman dates to California is in their early maturity, for the first rutab or soft, fresh dates appear in the market of Masqat about May 15th; but the field is also notable for its long season, since Khasâb or Hilâlî rutabs can be had up to November 15th or even later. There are thus fresh dates in the market for six months, while at Busreh the season lasts scarcely more than three, and as far as its commercial end is concerned, occupies but forty days. The introduction of early ripening varieties is one of the most desirable

*Zanzibar was colonized by natives of Oman, who were the great slave traders of the last century, and for years the island formed an integral part of the Kingdom of Oman. The explorer W. G. Palgrave mentions that even half a century ago there was a regular exportation of Khalâseh dates to Zanzibar. At present an attempt is being made, under the auspices of the British government, to establish the variety in that island, offshoots having been shipped from Oman for the purpose.

things for California, since in the Deglet Nûr and other North African sorts we already have plenty of late ones; and I know of no region which offers so many interesting dates, from this point of view, as does Oman. Doubtless they will not bear quite so early in California, but if we can get a number of choice varieties that bear in July, or even in August, it will put a different aspect upon our date culture, and will enable us to get a large part of our crop on the market when it is empty—before the Babylonian dates can possibly arrive and lower prices by their cheapness, and long before the French could possibly get their well-packed Algerian Deglet Nûrs in our shops. It is this idea I kept in mind when selecting the varieties of offshoots I wanted in California.

The following list enumerates, in alphabetical order, all the varieties which I could find in Oman—a field which has practically never before been investigated by any student of date culture. I was obliged to get most of my descriptions at second-hand, however, and I can not pretend that these are wholly satisfactory, since an Arab usually thinks of a date only in its fresh stage, and has but two colors to describe it—red and yellow. In transliterating Arabic names, I have followed the system universally adopted by English-speaking scientists, namely, that consonants should be pronounced as in English, but vowels as in Spanish or other continental languages. Where possible, I have added the English meaning of the name, but many of these are uncertain, the etymology of the modern Omanis not agreeing with that of the classics.

Date Varieties in Oman.

Abû Sabrîn, "The Father of Patience," a large, red, rutab date—that is, one which is eaten in its soft, fresh condition. On maturity it turns dark brown and is sometimes cured, when it keeps fairly well. Ripens in midseason, is of good quality and fairly common. The palm bears very large clusters. Not in California.

Amânî Hajîrî, a date from Amân Valley, which I secured in a boiled form* in the Masqat bazar: it is the only palatable boiled date I have ever tasted. In addition to this variety, I was told that there were Amânî Awâbî, Amânî Rustak and Amânî Mawal, all quite different, but I am not at all sure that these are not trade names, rather than the names of true botanical varieties. Amânî Hajîrî is a large date, rusty brown when boiled, with a dirty grayish tinge. Length, 1 5/16 in., breadth 1 1/8, widest at base, tapering gradually to blunt apex. Flesh 1/8 to 1/4 in. thick, seed of medium size, greenish brown, practically no fibre observable; seed 15/16 in. long, 5/16 in. wide. Flesh very sweet, dry and easily granulated: no trace of astringency. Not in United States.

Bahalânî, named after the town of Bahala, an early and very large rutab, noted as a heavy bearer. Not in United States.

Bakala (name of a village), a small, yellow rutab, said to be very early in ripening but bearing only a few bunches. Rare. Not brought to America.

Bû Ma'an, "The Flowing" (?), a very broad date, about 1 1/4 in. long, yellow, dry. Early, rare; a shy bearer. Not in United States.

Bû Nârinjâ, "Father of the Orange," because of its color; also sold

*For preservation in this form dates are picked when still hard, boiled in water with salt, and then dried in the sun. They will thus keep indefinitely and can be shipped and handled easily, but the flavor is usually astringent. The consumption of boiled dates is principally in Persia and India.

boiled in the Masqat market, when it is locally known as Sakkarî, "Sugary." A small date but one of the best soft dates of the region, so much like Khalâseh in appearance that attempts are often made to sell it under that name. Ripens in latter part of August and bears well; a common variety. The dates are great favorites as rutab, but also keep well.. As a soft date, it has a tender, light brown skin, small seed and no fibre; flesh light golden brown in color, caramel consistency but sticky if not properly cured. Flavor mild and sweet. Boiled specimens which I obtained were 1¼ in. long, ⅝ in. wide, broadest about base, tapering gradually to rounded apex. Color dark chestnut brown. Flesh ⅛ in. thick, fairly soft, dark café au lait color, some fibre, cavity large and loose seed, ⅞ in. long, 5/16 in. broad, flavor in boiled form bad. Has not yet fruited in California.

Burnî, "The Sweetmeat Jar," according to the Omanis, and this etymology is perfectly legitimate, but half a dozen others have also been given by experts, and the name is so confused that it is even a question whether it should be spelled Burnî, Barnî or Birnî. Apparently there are several varieties under this or similar names. The common Burnî of Masqat, as I saw it, is a dry date similar to Naghal, and of unique appearance. Fruit 1 11/16 in. long, 11/16 in. wide, basal half of almost uniform width, tapering thence to blunt, flattened, sometimes depressed apex. Basal half a dead, yellowish gray, apical end light chestnut brown, the division of colors being very distinct. Seed cavity large and large seed loose in it, with considerable fibre. Flesh thin but more tender than that of the ordinary dry date; keeps indefinitely. Seed 1 in. long, ¾ in. wide, usually some fibre adhering to it. The date requires chewing and has a rich, full, but not cloying flavor with slight trace of bitterness. It is often sold on strings like necklaces, in the Masqat bazar, at the rate of 30 for one cent. Ripens midseason, bears moderately; not a common variety; can not be considered of first quality, but is decidedly interesting on account of its great size and double coloring. Introduced to the United States last year. The Bureau of Plant Industry introduced a date to the United States under this name in 1902, which is entirely different, and is described by Fairchild as follows: Light colored, about the same size as the Fardh but thinner. Season, July. Formerly exported to America but found to be a poorer keeper than Fardh and now not in demand. Scarce. (S. P. I. No. 8755.)

Burshî, "The Curved Dagger" (Hind.) according to modern etymology, but the classical meaning is "speckled." A small, fat, yellow, dry date, valued because it is very early in maturing. Common and a moderate bearer. Has not yet fruited in California.

Busrîyyeh, sometimes called Qush* Busreh, both names alluding to its origin, in Busreh, the great date-growing center of Turkish Arabia; but if it is one of the varieties now recognized at Busreh under another name, I do not know which one. It is a yellow, dry date of medium size, ripening late in the season; bears scantily and is rare. Not in United States.

Bû Sukhûn, "The Father of Heat," a long, slender, yellow date,

*Qush (spelled in various ways) is the Oman equivalent of the more common Deglet or Degal: a variety of adventitious origin and usually, but not always, of second quality. Sometimes it means merely an inferior seedling, as does the word Deglet or Degal.

ripening in midseason; largely eaten as rutab, but also keeps well. A very shy bearer, but the dates are, by some, considered superior to Khalâseh; they are so full of sirup that it exudes all over them and a bunch has to be brought down from the palm in a basin. Scarce; not introduced to California.

Fardh, "The Separated," according to modern etymology, the natives declaring that this refers to the way the dates are disposed on the bunch; but the variety is more than a thousand years old, and the ancients spell its name in a different way, which means "The Apportioned." It is the principal commercial variety of Oman, and in Samaîl Valley probably makes up two thirds of the plantations. A small, very dark brown date, 1¼ in. long, ¾ in. wide, broadest near middle, but tapering little until its blunt apex. Flesh ¼ to ⅜ in. thick, sticky but of firm consistency, russet brown in color. Skin fairly thin and tender. Seed small, ⅝ in. long, ⅜ in. wide, tight in cavity; little fibre. Flavor sweet with a rather strong after-taste. A small date, but if packed properly has dry skin and perfect shape. The palm is probably rather delicate, although offshoots are not considered so in Samaîl. It is said that it will bear two bunches the third year after planting; its ordinary yield at maturity is from 100 to 150 pounds. The first shipment of Fardh dates for New York was sent from Masqat on September 9th this year—hence the variety can not be considered an early one. I believe that no imported Fardh has yet fruited in the United States, although some good fruit has been produced by seedlings, in a few instances.

Firâdhî, a rare variety whose name is from the same root as the preceding. It is small, red turning black; a shy bearer. Ripens same time as Fardh, and may have originated as a seedling of the latter. Not in United States.

Habâb, "Dewdrops," a variety almost identical with Khasâb, but a little smaller. Ripens in October, yields scantily and is very rare. Not imported.

Halâwî, "The Sweet," the well-known Busreh date, is grown in Oman to some extent.

Harmî, "The Women's Date," a small, slender rutab, yellow turning to red; midseason; rare. Not imported.

Hilâlî, "Moonbeams," from its color; the latest date of the region, usually eaten only when fresh, and in that condition the most delicious I have ever tasted. Fruit 1¼ in. long, 1 in. wide, broadest just below apex, which is very broad and blunt. Color golden yellow, shading to straw at the base. Flesh soft and delicate, melting, golden yellow in color, thick. Seed small, slight amount of fibre. A rather scarce variety and a shy bearer. Sometimes boiled. Has been tested in United States and found to be successful.

Hilâlî Makrânî, a variety from the Makrân coast of Baluchistan, resembling Hilâlî save in color. Fruit reddish brown with purplish bloom, 1⅝ in. long, 1⅛ in. wide, broadest just above base, apex slightly pointed; skin rather thick and tough and inclined to blister. Flesh light in color, 5/16 in. thick, sticky but with caramel consistency. Seed cavity large but little fibre. Seed a little less than an inch long, ¼ in. wide, color of an unroasted coffee bean; small. A date of good characteristics save for its late maturity and a slight heaviness of flavor.

Ripens about October 1st; scarce; yield average. Not in United States.

Hushkiar—so far as I know, a meaningless word, and although it was given me by natives in that form, I think it may be a corruption of Qush Khiyâr, the Cucumber Date. Similar to Khasâb, ripening about October 1st, rutab but cures fairly well. Bears heavily. Fairly common and of passable quality. Not in America.

Jabrîyeh, "Producer of Happiness," a large (short and fat) yellow rutab, ripening October 1st. Common and a fairly heavy bearer. Not in United States.

Khalâseh,* "Quintessence," the most famous date of the Persian Gulf region, and easily the best. Scarce in Oman—there are probably not more than 1,000 palms in Samaîl Valley, out of a total of more than a quarter of a million. It has proved a shy bearer there. Ripens about September 1st, and the fruit brings twice the price of Fardh. The following description is of specimens obtained directly from Hofhûf, in Hasan, the principal home of the variety: Form oblong to oblong-ovate, slightly widest at or near center, rounded or slightly flattened at the base, rounded to broadly pointed at the apex. Of firm, solid consistency, keeping shape excellently. Size medium, length $1\frac{3}{8}$ to $1\frac{5}{8}$ in., breadth $\frac{3}{4}$ to $\frac{7}{8}$ in. Surface slightly sticky, rather smoother than the average, with a delicate satiny sheen. Color light orange brown with a tinge of ruddiness or deep reddish amber. So translucent that the outline of the seed can almost be seen. Bloom slight, bluish-gray. Skin firm but quite tender, adhering closely except for an occasional small fold or blister, loosely wrinkled indiscriminately but not deeply so. Flesh firm and solid but very tender, caramel-like in consistency, of delicate texture, $\frac{1}{4}$ in. thick, reddish amber in color and entirely free from fibre. Seed oblong-elliptical, slightly pointed at both base and apex, $\frac{3}{4}$ to $\frac{7}{8}$ in. long, $\frac{1}{4}$ to $\frac{3}{8}$ in. broad, broadest near center, smooth, gray-brown in color, ventral channel almost or wholly closed. Flavor delicate, but deliciously bringing out the characteristic date taste. Fruit grown on or near the seacoast is much inferior. Has been introduced to the United States several times, but not yet fruited.

Khanayzî, named after a tribe of Arabs, according to the modern belief, although the classical signification is "Little Stinker." A common soft date which is considered one of the best general purpose varieties, and is eaten rutab, boiled or cured. Dark reddish brown in color, and closely resembles Khasâb in appearance. Ripens shortly after midseason; its yield varies greatly. In United States has not yet fruited.

Khanayzî Halâwî, "The Sweet Khanayzi," a long, slender, red rutab, turning almost black as it matures; distinguished from the genuine Khanayzî only by being a little longer, and by ripening two or three weeks earlier. A very rare variety, the fruit of which is eaten as rutab only. Not in United States.

Khasâb, "The Abundant Producer," a common variety and the latest of the season except Hilâlî. Bears heavily, but only if given good care.

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*This is the spelling accepted among educated men at present. The vulgar often call it Khalâsî. Palgrave, who was a great linguist, but sometimes careless, spelled it Khalâs: a wrong spelling in view of the meaning he himself says it bore, of "quintessence." The correct classical spelling would be Khulâseh, and this is sometimes heard from scholarly men even at present.

The fruit $1\frac{1}{4}$ in. long, $\frac{7}{8}$ in. wide, almost oval, both ends blunt. Color when rutab is a beautiful carmine, when dried chestnut brown, almost black at apex. Flesh 3/16 in. thick, dark brown, seed cavity large and considerable fibre. Flesh pleasantly tough, flavor rather coarse. Seed small, $\frac{3}{4}$ in. long, $\frac{1}{4}$ in. wide, loose in cavity. Usually eaten rutab, but if properly cured will keep two years. In United States, but has not fruited, so far as I know.

Madrûkî or Madrukî, vulgarly Madlûkî or Maldûkî, "The Early Ripening," a large, round, yellow date, very sirupy. Ripens midseason; eaten as rutab or preserved in bags. Fairly common. Not in United States.

Masûlî, "The Dripping," an important date in local commerce, particularly on the Batînah coast, and ranked fairly high by the residents. Fruit small; light to very dark chestnut brown in color, $1\frac{3}{8}$ in. long, $\frac{5}{8}$ in. broad. Flesh $\frac{1}{8}$ to 3/16 in. thick, light russet brown in color and semi-translucent. Seed fairly large, $\frac{3}{4}$ in. long, 5/16 in. broad; some fibre. Skin rather tough. Flavor not well defined: indifferent but not unpleasing. Said not to pack well, and I only saw it in bags. Ripens late in season, keeps well, bears heavily; highest priced of any date on the Batînah coast (where all dates are inferior). Not in United States.

Mubsalî, a very popular date with the natives, although its name seems to mean that he who eats it should be accursed. It is a very large, yellow fruit, maturing midseason, and does not ripen on the palm, but falls while still green. It is only eaten after being boiled. Begins to bear at an early age and produces heavily; its fruit sells for almost twice as much as that of the Fardh. Not in United States.

Musbalî Batînâhî, a special variety grown on the Batînah coast, and usually called simply Batînî; inferior. It is $1\frac{1}{2}$ in. long, $\frac{7}{8}$ in. broad, widest at or near the middle, but varying in this respect. Apex blunt. Color (boiled specimen) a dark, caramel brown, flesh lighter in color, $\frac{1}{8}$ in. thick; seed cavity very large, seed rather large and loose in it; very little fibre. Seed $\frac{7}{8}$ in. long, $\frac{3}{8}$ wide, brown. Flesh soft and yielding, instead of hard and brittle as with most boiled dates; flavor sweet and reminiscent of molasses, with little astringency, but not at all nutty. Not in United States.

Murzibân, "Foul Tongue," in the modern dialect, probably referring to the color of this yellow rutab of medium size, ripening in September. Trees scarce, yield light, keeping qualities poor. Not in United States.

Muznaj, "Thirst Producer," a name often corrupted to Meznag, Mejnaz or even Bznag. A common variety which bears heavily in May or early June, and is eaten as rutab. A long, slender, yellow date. Has not yet fruited in the United States, I believe.

Naghal, "The Bastard," a popular date because very early; usually eaten rutab but also dries well. Long and slender, reddish-yellow in color; scarcely distinguishable from Burnî except by its smaller seed, according to some native authorities. A common variety; bears well; but has not yet fruited in California.

Naghal Hilâlî, a common date, fairly long, and broad. Ripens in early October; bears moderately; eaten either fresh or cured. Not in United States.

Narjîlîyyeh or Narghîlîyyeh, "The Cocoanut Date," a small slender fruit, red turning black, soft but keeps well. Midseason. Very rare; not brought to United States.

Nashaûh, "Unirrigated," a very common, small, yellow, dry date; ripens early and bears well. Not in United States.

Qush Bala'aq, a name of unknown origin, but the variety is of great antiquity; even a thousand years ago the lexicographers cite it as the best date of Oman. At present, although common, it seems little esteemed. It is short, fat, yellow, spoils quickly, ripens midseason, bears heavily. Not in United States.

Qush Batâsh, "The Outspread" (?), a slender, very dark brown or black date much resembling Muznaj in appearance, ripening in June. Rare. Yield rather heavier than the average. Eaten fresh. Brought to the United States, but has not yet fruited.

Qush Farfara (name of a town), sometimes called the Farfara Fardh, being almost identical in appearance with the latter date, but ripening a month earlier. Said to be slightly inferior to Fardh in flavor, but for sale and export they are mixed together indiscriminately. A very common variety, of average yield; the fruit is noted for its keeping qualities. Has not yet had time to bear in the United States.

Qush Handhal, "The Bitter," a slender date of medium size, eaten rutab, cured or boiled. Yellow to brown in color, and of fair quality. Noted for its very heavy yield. Not in United States.

Qush Hasâs, "The Indigestible" (lit., "rumblings of the belly"), a small, yellow, dry date much esteemed by the Arabs in spite of its name. Ripens in September, coeval with Khanayzî, Khalâseh and Qush Zabad. Common; bears well. Introduced to United States last year.

Qush Minhî, "The Forbidden Fruit," a short, yellow rutab which can not be preserved. Ripens early; a shy bearer; and the size of the dates on the bunches varies greatly. Not common. Not in United States.

Qush Mundhuf, "The Cleansed" (?), a long, slender, yellow rutab, which can also be kept for two years if cured properly. A good bearer, but not common. Not in United States.

Qush Musfah, "The Desert Date," or "The Juicy," or "The Broad," a short, fat, red one turning nearly black when ripe. A common date of mediocre quality, ripening early in October. Bears and keeps fairly well. Not in United States.

Qush Mûza, "The Banana Date," similar to Khasâb but larger and of poor quality. Ripens midseason. Scarce; yield light. Not in California or Arizona.

Qush Na'îm, "The Date of Comfort," a long, slender, black rutab, maturing in midseason; will not keep. Common; yield average. Not in United States.

Qush Sabkhâ, "The Alkali Land Date," a large, long, yellow date with bad flavor, eaten only boiled. Rare and a notoriously shy bearer. Not in United States.

Qush Shahm, "The Meaty," a long, yellow rutab ripening in June or earlier; bears an average yield of dates of good quality, which are said to keep well. A scarce variety in Samaîl but more plentiful on the Batînah coast. Introduced to California only last year.

Qush Sûâ, "The Valuable," a long, slender, red date, turning almost black when fully ripe. Common, early and keeps fairly well, but a shy bearer. Not in United States.

Qush Tabak, "The Fat Boy," a fairly long, broad date, reddish yellow in color, but very rare. Eaten only as rutab; matures in September; yield light. Not in United States.

Qush Zabad, "The Butter Date," very small, but one of the best soft dates, ripening in midseason; the yield is said to be heavy. Fruit 1 7/16 in. long, 15/16 in. broad, broadest near base and tapering very slightly to blunt apex. Color reddish brown; skin tender and color of café au lait when it blisters. Has a tendency to stickiness, but this can be obviated by proper handling, as the flesh has an excellent caramel consistency, and is ¼ in. thick. Seed small, ¾ in. long, ¼ in. wide, tight in cavity, some fibre, but soft and not noticeable in eating. Flavor mild. A common variety recently brought to California.

Sarnî, a small, yellow dry date, almost round in shape, ripening in the latter part of August, according to some informants, while others declared it matured in June. There may be two varieties of similar name. The palm is common and bears an average yield. Has not yet fruited in America.

Zâd, "Food," a long, white rutab, turning yellow on maturity, but not keeping well. Broad in proportion to its length. Midseason; scarce. The dates are highly esteemed, and when sold bring the top market price. Not in United States.

In addition to the foregoing, I heard of the following varieties, but could not get descriptions of them:

Khamrî ("The Vinous"), Qush Minûma, Hawan and Salânî, early varieties on the Batînah coast; Shabrut, Mahaldî, late varieties in the same region; Hasmî and Sarashî, probably also confined to the Batînah coast, which produces immense quantities of inferior dates, and supplies a large part of the local trade, and that to Southern Arabia.

I could not learn definitely of any varieties of male palm distinguished by name, although I suspect that such exist. The Arabs there have the idea, which has lately been gaining ground in California, that the influence of male pollen on the resulting fruit is direct and important, and, therefore, that the choice of a male should not be left to chance. In general, the Oman males are merely classified as to whether they suffice for the pollination of 100, 200 or 300 females.

ESSENTIALS IN THE MANAGEMENT OF CALIFORNIA SOILS.

Address, State Fruit Growers' Convention, San Jose, Cal., December 2–4, 1913.

By Charles B. Lipman, University of California, Berkeley, Cal.

In soil fertility, as in everything else in our little world, things do not stand by themselves but are mutually dependent on each other; and, moreover, like everything else in the universe these several factors, which by proper ordering of their functions regulate the degree and permanency of soil fertility, move in cycles. I dare say, if it were not running counter to the established etiquette of horticultural meetings, that I might entertain you far better with some of these fascinating

journeys of material things in their several cycles than by recounting to you the bearings on horticultural practice of certain fundamental findings of science gleaned from studies of the cycles of plants and soils, which are, however, not absorbing enough in themselves to be considered a reliable antidote to that tendency to slumber which overtakes most men seated in a nice comfortable lecture hall. However, I am constrained to follow not only the inexorable decree of conventionality, but also to remain more or less faithful to the implied promise which lingers sadly in the subject of my talk.

Why We Have Deep Soils in the Arid Region.

It is a weakness inherent in the human flesh, especially in that of the human of scientific attitude of mind, to attempt the discovery of the underlying causes of things and to try to use these causes as foundation stones upon which to erect the structure which regulates man's relations with such things. To this weakness the soils scientist is no stranger, and he who has to deal with California soil conditions can not, without paying dearly for his neglect, ignore the cause of the formation of our justly celebrated deep soils which gives us the key to our modern conception of rational soil management in the arid region. The institutes and meetings in this State are legion in which I have attempted to expound this interesting fact to which I refer, and yet I have armed myself with the necessary temerity to broach the subject once again to this larger and more representative audience of horticulturists in the hope, which I trust is not vain, that it will bear repetition and may to some here even be wholly new. This important fact to which I have just made such cryptic reference is the manner in which *clay* is formed and how such clay formation differs in arid and humid regions, the meaning of which terms I shall assume you are familiar with. Clay is largely formed from two of the most common and widely spread minerals of the earth's crust, namely potash and soda feldspars which are respectively compounds of aluminum with potash and silicic acid and of aluminum with soda and silicic acid. Now potash and soda in these two feldspars are easily leached out of them under the action of rain and other forms of water which descend upon the earth, the aluminum silicate being practically insoluble, remaining behind, and that is *clay*. So that clay constitutes the residues of the feldspars (particularly those named) from the action of weathering agencies. Carrying the argument one step farther it must follow that the largest amount of clay must be formed where leaching and weathering agencies attacking the feldspars of soil material are most active and potent.

In turn, the leaching and weathering agencies, owing to the large amount and even distribution of precipitation characterizing the humid regions, must be most potent there. Therefore clay must form there most rapidly, and conversely clay can only form slowly in arid regions such as ours, because the leaching agencies are only at work here during a very short period of the year, and even then the total amount of precipitation is usually far below that of the Eastern States which we take as an example of the humid regions.

Why the Rate and Extent of Clay Formation Are Important in Regulating Soil Depth.

But as one of the well beloved instructors of my undergraduate days was wont to remark this is "all porch to my house." Admitting the interesting reactions just described which contribute respectively to the slow and rapid formation of clay substances in the arid and humid regions, how does that affect the depth of our soils and therefore those radical differences which distinguish them so sharply from soils of the humid region? Well, that is easily enough answered. Clay is a substance of great binding or cementing power besides being possessed of many other striking characteristics of the utmost importance in soils. But if that is true we should expect that the soil particles would be more slightly cemented in the arid than in the humid region, and that the spaces between the particles which admit of an easy flow of air and water would be larger. As a matter of fact our expectations come true. In soils in which clay forms more slowly the particles are much less cemented than in those in which clay forms rapidly. Therefore, soils of the former type must be looser and must partake, when considered by and large, of more of the sandy soil structure than of the clay soil structure. Here also our reasoning serves us truthfully and field observations confirm it. But why, you will ask, does a greater or lesser amount of cementation or binding of the soil particles through more or less clay formation so markedly influence the resulting soil structure? The answer to that question is also very simple. It determines to a very considerable degree the amount of air which can be held by a soil, and still more markedly the amount of air which can penetrate into the greater depths thereof. Yet, again, you may ask how does this difference in air penetration account for the striking differences observed between soils of the humid and arid regions? In just this way. Air makes possible the proper activation of three of the essential agencies to successful and healthy plant growth, viz. (1) proper root development of plants, (2) proper development of the denizens of the dark recesses of soils in numbers and efficiency—the bacteria, fungi and others, and (3) the proper oxidation and solution of soil minerals which are used as plant food. In just such measure, therefore, as air is admitted to the soil depths will conditions therein, other things being equal, be made congenial for the development of these powerful agencies in the regulation of a plant's development. Moreover, in just such measure as we contribute by artificial means to the greater or lesser penetration of air into the soil depths do we contribute to the greater or lesser efficiency of the agencies named; in the former case augmenting, in the latter, defeating the purposes to whose end the natural agencies described above are operating. From the foregoing remarks we should expect, therefore, that in soils of the arid region, owing to slow clay formation, the interests of many generations of plants are best subserved, because deep root development is made possible, not only for the reason that the roots themselves can obtain the necessary air supply, but because the other agencies named, and which are concerned in large measure with the welfare of the plant, are also made to operate efficiently. Conversely we should expect but a poor activation of these agencies in soils of the humid regions in which clay forms

rapidly, and thus poor conditions for air penetration, and, therefore, for deep root development must obtain.

Why Are Deep Soils Superior to Shallow Soils?

After being thus made acquainted with the causes contributing to the formation of our deep soils, your next question doubtless will be "Why do we value deep soils so highly?" To reply simply, I must say—for purposes of making possible a deep and large root development on the part of the plant. I must also add that in its turn the deep and large root development of a plant is advantageous because it places at the disposal of the plant so much more area from which to draw its food and water, and since so much more surface is available as a source of food and water supply, the fertility of the soil is not only greater but more lasting. To emphasize this point I must also say that plants can only take their food up in solution from the water films surrounding the soil particles, and it is only reasonable to expect that a plant which has twice as many water films as another to draw on, because of its superior root development, should obtain its food and water with greater ease and have twice the amount at its disposal. A deep root development, therefore, makes possible under our climatic conditions the utility of the greater depth of the soils which we own as much as the surface; and by making the surface soil more lasting in its fertility and placing a more adequate supply of food and water at the plant's disposal, serves as one of the greatest blessings of him who grows crops for profit.

What Do the Foregoing Principles Teach for Soil Management?

The six most important considerations in California soil fertility which flow directly or indirectly from the principles just considered are:

1. Deep plowing of our soils.
2. Prevention of formation or breaking up of plowsole.
3. Irrigation in deep furrows.
4. Deep incorporation of manure and fertilizers.
5. Frequent summer cultivation.
6. Green manuring and the maintenance of the humus and nitrogen supply.

I shall take up now a brief consideration of the first five factors and consider the sixth by itself this evening.

Deep Plowing.

The functions of deep plowing in soils are: First, to aerate the soil at greater depths, thus making it possible for weathering and bacterial and root action to augment the supply of available plant food; second, to create a larger surface for catching and holding rain and irrigation water. The importance of these two functions of deep plowing to the maintenance of fertility in California soils can not be overestimated. The second function named is of particular interest to us because of the disastrously dry seasons of the past two years. There is doubtless many an orchard in the State in which two inches of rain water saved by a deeply plowed soil as against a like amount lost by a similar soil plowed shallow has spelled the difference between profit and loss during the past year. It is thus by throwing open a much larger surface of

soil particles for catching rain and irrigation water that deep plowing acts as one of the most potent methods of moisture conservation which we can employ. And it accomplishes this great service for us in addition to making possible the more active bacterial development at great depths in the soil, the more rapid weathering of the soil minerals, therefore increasing the available plant food supply, and the much deeper root development of plants—the paramount importance of which, especially in our soils, has already been duly emphasized. Who can say truthfully, in view of these arguments, that it is possible to over-emphasize the importance of deeply plowing California soils?

As to the proper depth to plow under different conditions, I want to say that in the orchard it may vary from eight to ten inches, depending on the nature of the soil and other circumstances regulating tillage operations on the ranch. The greater depth is to be preferred. There is no necessity for changing suddenly from a shallow to a deep plow depth. It will suffice gradually to attain to that condition recommended by plowing an inch or two deeper every succeeding season. Moreover, with such methods of plowing pursued, but one plowing a year will suffice to render the soil one of proper air and moisture conditions.

The Prevention of the Formation of Plowsole.

Plowsole in soils is produced through either plowing at the same depth year after year or through the washing of fine clay and silt into the soil by irrigation water or rain. When it is due to the silting up of irrigation furrows, it is known as an irrigation hardpan, but it produces the same effects as plowsole. The latter is thus a hardened, more or less impervious layer of varying thickness found between four and eight inches in depth below the surface of the soil. If in an old orchard in which poor methods have been employed it may attain a thickness of six or more inches. Air passes through the plowsole layer only with the greatest difficulty and water likewise can percolate but slowly through it. If this condition is allowed to continue for any length of time in a soil, the roots of plants will soon find conditions in the soil depths uncongenial to their development and so will the beneficial soil bacteria. The result will be that the roots will tend to come to the surface for more air, warmth, and available plant food, and we gradually produce from a naturally deep soil an artificially shallow one.

Plowsole should be broken up with a subsoil plow if it is already formed. Three or four furrows between two rows of trees will improve conditions markedly. If the plowsole is thin it may be broken up by means of an ordinary deep plowing with a moldboard plow. To prevent the formation of plowsole change the plow depth from year to year, and break up the compacted and silted bottoms of irrigation furrows instead of merely covering them with loose dry soil.

Irrigation in Deep Furrows.

The foregoing remarks anent the prevention and breaking up of plowsole and irrigation hardpan have for their principal purpose the more adequate aeration of the deeper soil layers so as to make in them more congenial conditions for the development of plants' roots, and to prevent the massing of the feeding roots at the surface of the soil where both the food and water supply may soon become insufficient to

properly sustain them. A similar purpose attaches to irrigation in deep furrows. By means of the latter but little of the irrigation water wets the surface, most of its descending into the greater depths of the soil in which in turn it is more adequately distributed in all directions. By thus insuring better water as well as air conditions in the deeper soil and a relative lack of water at the surface a double encouragement will be offered the root to ramify deeply and widely in the soil, thus insuring to the plant a better, larger and more lasting source of food and water for vigorous growth.

No fears need be entertained as to the effects of subsoiling or deep plowing on trees growing in soils which have always been plowed shallow. The writer's experience in the field has taught him that trees do not even suffer a temporary setback as a result of subsoiling, and thus the alarming condition usually predicted when the fibrous roots are cut is a specious one.

Deep Incorporation of Manures and Fertilizers.

With respect to manures and fertilizers which are the carriers of plant foods to the roots, the same rule holds as for the air and water supply above discussed. In fact, their fate is dependent in so large a measure on the fate of the soil water that it is difficult to consider the two apart. It must of course follow to the reasonably minded that if it is desirable to encourage the distribution of most of the soil water considerably below the surface of the soil, the fertilizers must be placed in its vicinity in order to insure their decay, transformation and availability. We are constrained, therefore, to recommend consistently that manures and fertilizers be deeply incorporated in the soil. The presence of this plant food in the greater soil depths will thus be another incentive to deep root penetration, the importance of which has been emphasized above.

Frequent Summer Cultivation and the Conservation of Soil Moisture.

One of the most valuable precepts for agricultural practice flowing from the development of that interesting branch of soil science called soil physics is the conservation of soil moisture by means of mulching. Perhaps nothing else in our farm practice can be said to be attended with such striking results as the mulching of soil for the purpose of moisture conservation. Among the numerous investigations on the subject those of King for Eastern conditions and Hilgard and Loughridge for California conditions have clearly shown why mulches are effective, to what extent they are so, and have worked out the best methods of their application. The principle of the mulch of course consists merely in having something on the surface of the soil which will act as a blanket and prevent the dissipation of soil moisture as it is brought to the surface by a combination of physical forces, the exact nature of which we do not as yet understand. It follows, therefore, that the best mulch must be the one which is cheapest and the most feasible to employ in soil management, and at the same time one which is very efficient in moisture conservation. There are only two materials which could possibly answer to such description under ranch conditions. They are the straw mulch and the dust mulch. By the first we mean mulching with a thin layer of straw on the surface soil, and by the second the covering of soil by a thin layer of air dry soil thoroughly

stirred by means of cultivating implements. In experiments with the two kinds of mulches it was found that the straw mulch is much more efficient than the dust mulch as a moisture conserver, but it was looked upon as not a feasible method for large tracts of land because of the expense involved in the purchase of straw and because of certain practical difficulties it presented in soil management for some crops which are at once obvious to him who is conversant with methods of crop production. From very recent experiments of fruit growers in this State I am inclined to class straw mulching with dust mulching as a thoroughly practicable method, and particularly for orchard conditions even on a rather extensive scale. Not only can we conserve more water by using the straw mulch, but we can conserve the humus of the soil by decreasing the rate of oxidation of organic matter, and we can also eliminate other mischief to the soil which constant cultivation with heavy tillage implements, necessary in preserving an efficient dust mulch, is bound to entail. Considering, further, that we are in part at least compensated for the additional cost of the straw mulch not only by water and humus conservation but by actual addition of humus when from time to time the straw is plowed under, it is not at all unlikely that under many of our orchard conditions the straw mulch may supersede the dust mulch in large part. The straw used should preferably be that from legumes, such as lima beans, and have the merit of cheapness, efficiency as a water and humus conserver and as a valuable material for humus formation and nitrogen addition. While bean straw has possessed all these properties in recent years, I fear that in some localities its cost is becoming prohibitive.

But we can always fall back on the old reliable dust mulch which under all conditions is feasible and destined to remain perhaps forever the most widely used method of mulching which we know. Without going into the details of experiments carried out in this State to show the proper methods and the efficiency of dust mulching, I may inform you as I have said to some of you on other occasions that as between three and six inch cultivation or mulch depths in our orchards the six inch depth proved the more efficient; but since its use involves certain practical difficulties I recommend that at least a five-inch dust mulch be maintained on the soil's surface to conserve the moisture. This dust mulch must be frequently stirred if it is to act most efficiently, for even in its dry and apparently fluffy state the soil material is heavy enough to pack of its own weight and thus establish the passages again by which water may ascend to the surface and may evaporate and be lost. In experiments on this point it was found by Loughridge in this State that cultivation twice a week saved the most moisture. This, however, would cost too much to make the moisture conservation pay for its use. Cultivation once a week, however, could be used and made to pay well for the moisture thus saved. In such dry seasons as the past two have been in this State moisture is the limiting factor in crop production and every tenth of one per cent of it saved by cultivation means on the average two tons of water saved per acre for only one foot in depth. Need I emphasize more strongly the necessity of very frequent summer cultivation under our orchard conditions when there can be no doubt that the use of the method would have made the difference between

success and failure in many of our unirrigated orchards during the past year.

Light tillage implements should be employed in cultivation and mulch production wherever possible. Heavy disk implements with the more numerous horses employed all assist in plowsole formation. The ordinary tooth cultivator of the Planet Junior type with one or two horses is far to be preferred, especially on our sandy soils.

MEALY BUG PARASITES IN THE FAR EAST.

By Harry S. Smith, Superintendent, State Insectary.

The following brief report on some work with beneficial insects is submitted in anticipation of the more complete account of the trip to the Orient because of repeated requests from our growers for information regarding it.

At the outset I wish publicly to express my appreciation to the Imperial Department of Agriculture of the Japanese Government, and to the Bureau of Agriculture of the Government of the Philippines for the most cordial way in which they assisted me. Every facility from assistants to insectaries was placed at my disposal, to say nothing of the valuable professional advice on local conditions, which was so freely accorded me by the entomologists of the two governments. The Japanese entomologists are very clever in manipulating and shipping live insects, and the success of the trip, so far as obtaining Japanese insects is concerned, is due largely to their skill.

Just what the final outcome of the work will be no one can foresee. We can only collect and attempt to introduce into California the enemies of our various pests, and then let nature take her course. *The* important thing is to give the newly introduced insects as nearly an ideal (i. e., to the parasites) environment as possible. After that has been done we can only wait.

In inaugurating a new and active program for the insectary, beginning with the spring of 1913, it was decided to turn our attention first and most forcibly toward introducing the enemies of *Pseudococcus citri.* This insect, which has been the source of so much worry and loss to the citrus growers, seems to be proof against artificial means of control such as fumigation and spraying. Natural enemies at this time seem to be almost the only chance. I do not mean by this that there is danger of the mealy bug ruining the citrus industry, or even approaching that; but until the pest is controlled it will continue to be a severe drain on the finances of certain of the citrus growing sections. By reason of this fact the decision was early reached to direct our first efforts toward the subjugation of the citrus mealy bug.

In Japan there is found a mealy bug which has been known as *Pseudococcus citri.* Doctor Kuwana tells me that it differs in some respects from our *P. citri,* and may not be the same species, although it is very similar. In that country the mealy bug is never a pest of any importance. A few trees of the Satsuma orange in the vicinity of Okitsu were found slightly infested with mealy bug, and in this place three promising enemies were found: One is a ladybird, the name as yet unknown to me, resembling in a general way, *Cryptolæmus mon-*

trouzieri, but less than half as large. The larva, too, is very similar, being covered with white waxy excretions. Two other enemies are a small metallic blue Encyrtid and a Proctotrypid, both parasitic wasps, or *Hymenoptera*, which lay their eggs in the very young mealy bugs and emerge from the half-grown insect before its eggs are deposited. We now have a good breeding stock of these in the insectary and hope to get them established.

In the Philippine Islands many species of mealy bugs occur, some very abundantly, but in the seven weeks spent there by the writer, *Pseudococcus citri* was not encountered. There is, however, a somewhat similar species which occurs on the citrus trees of the archipelago, but which was not found to be common at the time the writer was present, September and October. When I first arrived in the Philippines the little black ladybird, *Pullus fuscatus** was feeding upon this mealy bug in considerable numbers, but it gradually grew scarcer and scarcer until during October it was not to be found. Another ladybird, *Aspidimerus orbiculus*, which occurs there, does wonderful work on the mealy bugs of the Islands. This was the most generally distributed enemy, the larvæ being practically always present whenever *Pseudococcus* was found, feeding voraciously upon the eggs and newly-hatched insects. This species was first discovered to be of possible economic importance by Mr. George Compere, and has been brought to California in considerable numbers. Whether or not it will withstand the somewhat colder winters of California, remains to be seen, but it would seem as though it should thrive at least in the mild climate of the coast counties in the south, where the citrus mealy bug is at its worst. In these islands there also occurs a wonderful predaceous butterfly, *Spalgis substrigata*,* a very important factor in the control of mealy bugs. While I did not find this insect to be widespread in Luzon, it was quite common in certain localities, especially at Singalong, where my laboratory was located. A single larva of this butterfly would frequently clear an entire twig of mealy bug larvæ and eggs. The adult is one of the familiar "Blues" or Lycænids, about three quarters of an inch in wing-spread. It deposits its eggs singly on the leaf or twig of plants infested with the mealy bug. They are quite small, somewhat flattened and of a greenish-yellow color. The larvæ are grayish, with a short thick hairy covering. As they feed upon the mealy bugs the waxy coverings of the latter are thrown back, stick to these hairs and within a short time the larva is indistinguishable from the mealy bugs, excepting when in motion. When full grown the larvæ are between one half and three quarters of an inch in length. Pupation takes place upon the leaf and the pupa looks exactly like the head of a monkey, eyes, mouth, nose and all. The pupal period lasts approximately two weeks. Several specimens were brought to Sacramento in a living condition, but so far no eggs have been deposited. This type of insect is very difficult to breed in confinement, and it may be that we will have to rely upon importing in larger numbers and releasing the adults directly into the orchards.

Of the chalcid flies there are two species, but neither compares with the ladybird or butterfly in efficiency in its native habitat. Whether they will breed upon our citrus mealy bug has not yet been determined.

*Determined for me by Mr. Schultze, Philippine Bureau of Science.

There are two wonderful little true flies or *Diptera*, of the genus *Diplosis*, which do great work against the guava and *Hibiscus* mealy bugs in the Philippines. These, during the maggot state, feed upon the eggs and young of their hosts. The two species have quite different habits. The larva of one has the peculiar faculty of being able to jump for a considerable distance when disturbed. The purpose of this jumping is evidently to assist the larva in getting to the ground for concealing itself in the soil beneath the leaves, where it pupates. The other species, curiously enough, does not have this jumping habit, and pupates beneath a silken web on the stem in the vicinity of the mealy bugs. I believe these insects exert a very considerable influence on the abundance of their host. They seem to be quite generally distributed in the Islands.

Several other enemies of the mealy bug are found in the Orient, but they are, for the most part, of minor importance. Still others will undoubtedly be discovered as the work progresses, and many which were of little importance this season may prove to be very effectual during other seasons.

To show the occasional abundance of enemies of the mealy bugs in the Philippines, I found on one occasion a stem of the Rain tree (Acacia) three and one half inches long by one fourth inch in diameter, infested with *Pseudococcus*, on which were feeding fourteen ladybird larvæ, one larva of the predaceous butterfly and eighty-five larvæ of the little *Diplosis!* Needless to say, this tree was soon freed from its pests.

In the vicinity of Manila a number of parasites of *Saissetia hemispharica* were obtained in the hope that they would attack its relative, the black scale, in California. This they seem to do in the insectary, but we have not yet tried them in the field. One Pteromalid attacks the eggs of the scale in much the same way as does our *Scutellista cyanea*. Two others, Encyrtids, attack the young scale before eggs are laid. One of these is very efficient, and, attacking the young scale, is exactly what we most need in California. The third has proved to be occasionally secondary, and will probably not be introduced.

Tentative arrangements have been entered into with the Imperial Department of Agriculture of the Japanese Government, and the Bureau of Agriculture of the Government of the Philippines, whereby they will co-operate with us in our attempt to introduce the natural enemies of California pests. It is our aim to introduce into California every natural enemy of the mealy bug which shows the slightest indication of being of importance in the control of that pest. During the next two years it is hoped that we may be able to work thoroughly the Mediterranean region of Europe and north Africa, where, according to the observations of Doctor Silvestri and Mr. Woglum, the citrus mealy bug is apparently rendered innocuous by natural control. At the same time the work in Japan, and to a lesser extent, in the Philippines, will be continued. While there are many natural enemies of mealy bugs to be found in the tropics, it is from Japan and the Mediterranean region that we will obtain our best material. Insects from these countries are much more likely to find our climate agreeable to them, and it will prove much less difficult to ship living insects in good condition from these countries than from the tropics.

It will be at least months before any of these new enemies can be released in the field. A great deal of painstaking labor is necessary to work out in minutest detail their complete life history. This work is carried on in insect-proof rooms at the State Insectary and every precaution taken that no insect escapes until its habits are thoroughly known. After it has been demonstrated that an insect is a desirable one to release, it is necessary to breed large numbers of them for colonizing. It is our plan first to establish the insects in what we consider to be the most favorable locality in the State for its existence. After that is thoroughly done we will begin its distribution.

All this work requires time and we respectfully urge that we be not asked for colonies of these new parasites until such time as the public is notified that they are ready for distribution. We hope for some measure of success, but the problems of parasite introduction are so complex that no man can foresee just what the final outcome will be. Compere's energetic collecting in the Orient and the observations of Woglum and Silvestri in the Mediterranean region showed that the field in promising, and so long as the means are placed at our command, we propose to persist until the natural enemies of the mealy bug are either established in California or the fact is demonstrated that they can not exist here.

THE WHITE GRUBS.

By A. J. Cook, State Commissioner of Horticulture, Sacramento, California.

Grubs are the larvæ of beetles and almost always have six legs, though the larvæ of weevils, or snout beetles, are, like dipterous larvæ—maggots, without legs. White grubs are dirty white, live in the earth,

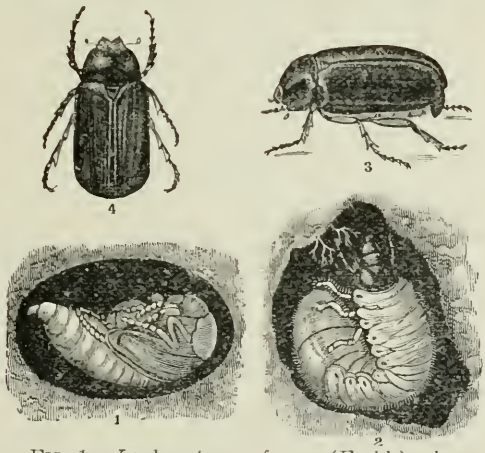

Fig. 1.—*Lachnosterna fusca* (Frohl.) showing the various stages in the development of the white grubs. 1, pupa; 2, larva; 3 and 4, adult.

usually curled up, possess a brown head and strong jaws—mandibles, feed on roots of various grasses and other plants, and as adults, or imagoes, are beetles. They belong to the family *Scarabæida*. The beetles of this family are robust, with five-jointed tarsi, and lamellate

antennæ. Such antennæ have the few terminal joints expanded into leaves which may be closed to form a head.

These beetles are of two types. The beetles of the first are usually broad, often as broad as long, and they feed, as larvæ, on ordure of privy or stable. The tumble bugs are examples. These do no harm. The others are usually more elongated, a few much longer than broad. These are plant eaters, feeding on the roots of plants, as larvæ, and on foliage of plants, shrubs and trees, as imagoes. Some of these are enormously destructive, as the rose chaffer, *Macrodactylus subspinosus,* of the East. The various May beetles of California and the East are also serious pests. These devastate the lawns and meadows and work havoc in strawberry beds and with other vegetables. The common one in California is *Ligyrus gibbosus*, a plain dark brown beetle, which ruins lawns and strawberry plants. I had frequent calls for aid against these pests, both at Pomona College and since coming here. In Michigan the common May beetle, *Lachnosterna fusca*, was an egregious destroyer, both in meadows and lawns, and the chief insect enemy of the strawberry.

These beetles lay the eggs in May and June, the grubs feed on roots of grass for two or three years, pupate in an earthen cocoon, and come forth as imagos in May. As adults they are often so numerous, feeding on foliage of trees, as to remind one of a swarm of bees. The rose chaffer of the East is often fatal to various rosaceous trees and shrubs.

Control Measures.

Selecting grasses or plants distasteful to the beetles is always wise. In case a meadow is seriously attacked, it best be plowed and superseded by some other crop. If a lawn is badly attacked, the same method may be followed. A clover lawn is not attacked. Often the roots are so destroyed that all the grass can be swept off, leaving the earth entirely bare.

Carbon Bisulphide.

This ill-smelling inflammable, very volatile liquid is one of our most effective insecticides. It has a very wide use. It is too expensive for field use against these white grubs, but may often be very satisfactory on lawns. To apply this make holes in the earth about three feet apart and six inches deep with a crowbar or iron rod. Into each hole about one fourth of an ounce of the liquid is poured, after which the hole is quickly filled with earth, which is pressed down with the foot. The volatile liquid quickly pushes out in all directions and kills all grubs in its path.

In handling carbon bisulphide we must always remember its inflammable nature and carefully keep it far from any fire. It is one of the best specifics against pests in stored grain.

THE CHERRY FRUIT SAWFLY.

Hoplocampa cookei (Clarke).
(*Dolerus cookei* Clarke.)
(*Hoplocampa californica* Rohwer.)

Order—Hymenoptera. Family—Tenthredinidæ.

By E. O. Essig, Secretary, State Commission of Horticulture.

Summary.

1. The cherry fruit sawfly is a native of California and other Pacific Coast states and has been known since 1883 in the Suisun Valley, Cal.

2. Considerable damage to young cherries has been done in various sections by the larvæ of this insect and occasionally, at least, control measures may be necessary.

3. The presence of the insect may be told by the small round holes bored in the young green cherries, many of which soon drop to the ground.

4. The larvæ are small, white and average about one fourth of an inch in length. The adults are four winged insects, black with brownish or reddish appendages, about one eighth of an inch long.

5. Control measures have not been thoroughly perfected but two applications of arsenate of lead at the rate of 4 to 5 pounds to 100 gallons of water, the first application to be made shortly before the blossoms open and the second about ten days later, have proven effective. Fall plowing is also recommended to kill the larvæ and pupæ in the soil while a distillate-oil emulsion and nicotine spray is recommended to kill adults at time of egg-laying.

6. The insect has been reported as occurring in the Suisun Valley, El Dorado and Nevada counties, California, and at Medford, Oregon, where it is confined to a very small area.

7. The orchard fruits attacked are cherry (sweet and sour), prune, plum, peach and apricot (the peach and apricot only occasionally).

Fig. 2.—Work of the cherry fruit sawfly, *Hoplocampa cookei* (Clarke), on young cherries. Natural size. (Original.)

History.

The cherry fruit sawfly was first reported in the year 1883 by Matthew Cooke,[1] who found the larvæ as damaging fruit of the cherry in the Suisun Valley. The insect was named *Dolerus cookei* by Warren T. Clarke,[2] who made observations of its work in the Suisun Valley during the years 1905 and 1906. Both of the first reports were brief because little was then known of the life history. In 1911, Mr. S. A. Rohwer named the species *Hoplocampa californica* from specimens received from Suisun, California, March 10, 1910, collected by R. W. Brancher.[3] The life history and all obscure points relative to this insect were definitely cleared up by Mr. S. W. Foster in Bull. No. 116, Part III, Bur. Ent. U. S. Dept. Agrcl., Jan. 31, 1913, entitled "The Cherry Fruit Sawfly."

On May 6, 1913, specimens of young cherries infested with the larvæ of the sawfly were received from Mrs. Hattie Buffington from Nevada City. Mr. J. E. Hassler, County Horticultural Commissioner of El

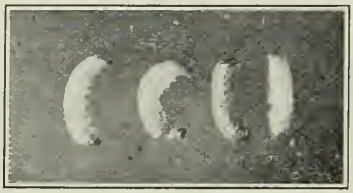

Fig. 3.—Larvæ of the cherry fruit sawfly, *Hoplocampa cookei* (Clarke). Enlarged. (Original.)

Dorado County, forwarded similar specimens to the writer on May 11, 1913, from Placerville, California. Though the insect has been long known to exist in the Suisun Valley the only other records of its existence come from Mr. P. J. O'Gara, Medford, Oregon, until those received by the writer from Nevada and El Dorado counties. These widely recorded infestations indicate clearly that in all probability the insect is more or less commonly distributed from central California to southern Oregon and infests native fruits not yet discovered.

Damage.

Considerable damage has been done to cherry crops in the Suisun Valley according to Mr. Foster, who reported 80 per cent infestation in April, 1909. On the Buffington place in Nevada City there were only three or four cherry trees and practically all of the fruit was rendered worthless. Two trees belonging to Mr. Hassler have been severely infested for two years (1912 and 1913), the injury having never been noted until 1912. Nearly every cherry was ruined.

Mr. P. J. O'Gara reports more damage to prunes and plums than to cherries at Medford, Oregon, and has been conducting spraying work for three years.

[1]Inj. Ins. of Orchard, Vineyard, etc., pp. 137-138, 1883.

[2]Can. Ent. XXXVIII, pp. 351-352, 1906.

[3]Tech. Ser. No. 20, Pt. IV, Bur. Ent. U. S. Dept. Agrcl., p. 143, May 27, 1911.

The insect has not spread rapidly to any extent in the Sacramento Valley, so control measures have not been very urgent. However, a true understanding of the life habits and control may prove of great benefit in checking any outbreak which may occur in the future.

Work.

The injury to the fruit is very noticeable as shown in Figs. 2 and 4. *i* and consists of one or more clean round holes bored into the fruit to the kernel, which, if soft, is devoured, as well as much of the meat around it. If the kernel is hard only the meat is eaten. In many cases half or more of the fruit is eaten away. The work shows quickly upon the young fruit, which soon becomes discolored and falls to the ground. The attacks usually continue until the fruit is nearly matured but cease before ripening begins.

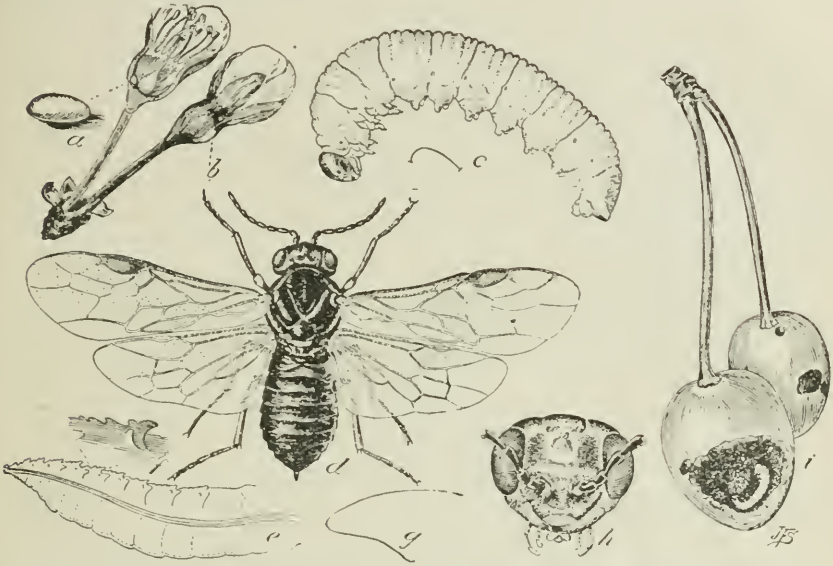

FIG. 4.—Stages and work of the cherry fruit sawfly, *Hoplocampa cookei* (Clarke): *a*, egg; *b*, position of egg in cherry blossom; *c*, larva; *d*, adult sawfly; *e*, saw of ovipositor; *f*, serrations on ovipositor; *g*, sheath of saw; *h*, head of adult; *i*, infested cherries. *a*, *c*, *d*, *e*, *f*, *g* and *h* enlarged. (After Foster, U. S. Dept. Agrcl.)

Description and Life History.

According to Foster the females appear in the spring just about the time the Black Tartarian cherries are beginning to bloom. The eggs are whitish, some shiny, somewhat kidney shaped, being 0.5 mm. long and 0.3 mm. wide. They are usually deposited in the sepals of the flowers (Fig. 4, *b*) or in the upper portion of the calyx cup, always on the blossoms just before the petals open. The insertions are made by the sharp ovipositor and the eggs are well buried in the plant tissues. In the valley egg-laying begins about the middle of March. The eggs hatch in about four or five days, though the time often varies from three to six days. They are ordinarily hatched about the time the petals fall. Usually but one egg is deposited in a single flower though this is by no means a fixed rule. Soon after hatching the young larvæ eat

their way into the young cherry and work upon the tender kernels where they feed from two to four days or until the fruits are eaten out or withered. They then seek new cherries and repeat the same process, though the time required to destroy the second is about twice that of the first. The third cherry is usually also destroyed by each larva, but in this case the kernel is too hard to be eaten so that only the portions around it are consumed, which often includes nearly or over half of the fruit. There is little evidence of the attack upon the first cherries but the entrance holes are plainly seen in the second and third series.

The writer is not aware if these records hold true with regard to the work on the prune, plum and other hosts or not, the complete life history not having been recorded in the localities where these fruits are attacked. The larvæ reach maturity in from twenty-two to twenty-six days and are then yellowish-white with head, tip of abdomen and legs darker yellow, and eyes black. They have three pairs of well developed legs near the head, six pairs of small prolegs back of these and one pair of larger prolegs at the posterior end of the body. The body is usually curved almost to the shape of a letter "C" and is very plainly wrinkled (Figs. 3 and 4, *c*).

As soon as full grown the larvæ leave the fruit and enter the ground to a depth of from three to seven inches for pupation. The pupæ are dark brown and are enclosed in thin cocoons which are oval in shape and from three eighths to one fourth of an inch in length. The pupæ remain in the ground until spring and the adults emerge in March to begin egg laying as soon as the well formed blossom buds appear.

The adults are mostly black with light reddish brown or yellowish appendages. A portion of the head is also reddish. The females measure 3.5 mm. while the males are 3 mm. in length. They have four well developed wings, as shown by the illustration of the female (Fig. 4, *d*).

Control.

Mr. P. J. O'Gara has had more experience in the control of this insect than any other person. In reply to a communication addressed him relative to the control of this pest he writes:[1]

> "Regarding the matter of the control of the cherry fruit sawfly, *Hoplocampa cookei,* I may say that we have used both the tri-plumbic and Pyro arsenates of lead. Of course, the tri-plumbic lead is much safer under moist climatic conditions, but, so far, we have seen no injury resulting from good Pyro lead.
>
> I have been working on the control of this insect for the past three seasons and find that to fully control it from two to three applications of lead arsenate at the rate of 4 to 5 pounds of arsenate of lead to 100 gallons of water may be necessary. However, as a rule, two good applications have been sufficient. The first application should be made shortly before the blossoms of the cherry or related fruits open; the second about ten days later, or when the petals have mostly fallen. If a third spray must be applied, it should come just after the shucks have fallen. Because of the fact that a single larva may destroy from three to four fruits, it is evident that with proper spraying the insect may be prevented

[1]Medford, Oregon, May 18, 1913.

from entering the second or third fruit after emerging from the first.

In some spraying tests this year, but very few infested fruits could be found on thoroughly sprayed trees, while check trees were practically denuded of fruit."

In addition to spraying, Mr. Foster recommends two or three thorough cultivations at picking time to destroy the larvæ entering the soil for pupation and hibernation. He also suggests a 3 per cent distillate-oil emulsion to which has been added nicotine sulphate at the rate of one part to 2,000 parts of water. This should be applied to the trees in the early mornings when the adults are on the trees but very sluggish.

Two internal parasites were reared from this insect by Mr. Foster which would indicate that parasites are responsible for its not doing greater harm every year.

Distribution.

This insect was first reported in the Suisun Valley, Solano County, by Matthew Cooke in 1883. It has since been reported as occurring in the same locality by a number of investigators. Mr. Foster, in a letter to the writer under date of May 13, 1913, states:

"Relative to its distribution and occurrence in California, I have found it very prevalent in Solano County, also have found a few specimens in Contra Costa County, in Napa County, one specimen from Yolo County."

In addition the writer has received specimens of the larvæ infested cherries from Nevada City, Nevada County and Placerville, El Dorado County.

P. J. O'Gara reports it prevalent in some parts of Jackson County in the Rogue River Valley at Medford, Oregon.

Food Plants.

In California the fruit most commonly attacked is the cherry. Clarke also reports the eggs being deposited in the calyx of the plum.[5] In Oregon, O'Gara has found the insect more destructive to prunes and plums than to the cherry. He also records both sweet and sour cherries, prunes, peaches and apricots.

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[5]Can. Ent. XXXVIII, p. 351, 1906.

GENERAL NOTES.

REPORT OF RESOLUTIONS COMMITTEE.

State Fruit Growers' Convention, San Jose, Cal., December 2–4, 1913.

Freight Rates.

WHEREAS, The Railroad Commission of the State of California, has filed before the Interstate Commerce Commission of the United States, a complaint in regard to the shipment of deciduous fruits, alleging:

First—That the minimum carload weight is excessive, unjust and unreasonable.

Second—That the refrigeration charge on these shipments is excessive, unjust and unreasonable; and

WHEREAS, This complaint is in line with, and an endorsement of, a complaint filed by or at the suggestion of the freight rate committee of this association; therefore,

Resolved, That we, representatives of the California Fruit Growers' Association in state convention assembled at San Jose, December 2–4, 1913, heartily endorse the action of the State Railroad Commission and urge them to use all possible means to secure a favorable decision.

Standardized Fruit Pack.

Resolved, That it is the sense of this convention that we should have a state-wide standardized pack of all fruits for interstate shipment.

Delegates to Commonwealth Club.

Resolved, That the invitation of Mr. Isador Jacobs of the Commonwealth Club, that this association name fifteen delegates to attend the meeting to be held in San Francisco about January 15th, be accepted, and the delegates named.

Taxation.

WHEREAS, It is the general opinion that our present tax system is antiquated, unjust and unfair, in that it attempts to compel all local taxing bodies to tax all property at the same rate; and

WHEREAS, The irrigation districts of the State now have, by law, the right to exempt improvements from taxation; and

WHEREAS, The state legislature by a majority of two thirds of each house, has submitted to the people a constitutional amendment which will give to each county, city and town the same privilege now enjoyed by irrigation districts; and

WHEREAS, The State Convention of the Farmers' Educational and Co-operative Union, held in San Jose last week, unanimously endorsed this amendment;

Now, therefore, we, the fruit growers of California, in annual convention assembled, do hereby commend the action of the legislature in submitting to the people this amendment providing for home rule in taxation, and we urge all our members to do all in their power to secure its ratification by the people in November, 1914.

Insect Pests and Parcel Post.

WHEREAS, Many plants, seeds and fruits are transported through the mails and the danger of introducing plant diseases and injurious insects is serious, notwithstanding much aid secured from the postal authorities by the State Commission; therefore,

Resolved, The postal authorities at Washington be requested to further aid in protecting the fruit industry of the country, and that the matter be referred to the legislature committee for further consideration.

Table Grape Standardization.

WHEREAS, The State Board of Viticultural Commissioners has called to the attention of the forty-third Fruit Growers' Convention, the serious injury to the table grape growers, brought about by the picking and marketing of sour, immature, unpalatable grapes; and

WHEREAS, The fruit growers of California are desirous of enlarging the markets of all California deciduous fruits, and conserving the reputation of California for honest dealing;

Resolved, That we approve the purpose of this investigation by the State Viticultural Commission; and in order to assist in remedying this condition, by legislation, standardization or otherwise, we request Dr. A. J. Cook, State Commissioner of Horticulture, to appoint a committee of three fruit growers or shippers, to confer with the secretary of the State Board of Viticultural Commissioners, and to report progress at the next State Fruit Growers' Convention.

The resolution offered by the State Board of Viticultural Commissioners is in line with the hope of every thinking grower and shipper in attempting to better conditions surrounding the shipment of table grapes, but the methods advocated to bring this about have been tried for several years and have failed. In the opinion of your committee the time for decisive action has come, and we recommend that the whole subject be referred to the committee on legislation, with the request that they formulate a bill defining the percentage of sugar that table grapes shall contain before they shall be deemed suitable for shipment, and that the committee present this bill at the next session of this body for its consideration.

Commission of Horticulture.

Resolved, That fullest endorsement be given to our State Horticultural Commission, for the efficient quarantine service maintained in this State and along the Mexican border. The menace to California's greatest industry which represents more than a half billion dollars demands the continuance and every possible strengthening of this valuable service;

For its successful campaign for a federal quarantine which was all too tardy in its enactment and only made a possibility because of vigorous work by this State and especially by the Horticultural Commission of this State;

For the methodically arranged library and documents, and especially for the collection of mounted insects and instruments which are of great educational value to county horticultural commissioners and fruit growers;

For issuance of bulletins and circulars free to fruit growers of the State.

And especially for the work being done by the State Insectary in the collection and distribution of beneficial insects. We trust the search for these insects may be continued.

Thanks.

The pleasure and comfort of every attendant at this convention has been added to by efforts of the committee and citizens of San Jose, and the educational value of the program is fully appreciated; therefore,

Resolved, That we express our thanks to officers of the State Horticultural Commission; to members of the Faculty and Experiment Station force of the State University, and others who addressed the convention; to the Chamber of Commerce and citizens of San Jose, and the daily press and all who have united in making this convention most profitable.

Parcel Post.

WHEREAS, The parcel post has opened up a new avenue for the shipment of dried fruits, cured fruits, nuts or any of the products of the land which may not prove perishable in transit or which may not in any manner contaminate other mail matter; and

WHEREAS, Section 469, paragraph 5 of the Postal Laws and Regulations of 1913, provide that soaps, tobacco, pills, tablets and proprietary articles may be shipped in sealed packages by parcel post, said packages to be sealed in the simplest form; be it further

Resolved, That dried fruits, cured fruits or nuts or other products as named above be permitted to go through parcel post sealed as provided in the above section at the same rate as applies to proprietary articles in said section; and be it further

Resolved, That it is the sense of this meeting that the California State Fruit Growers herein assembled, request Mr. A. M. Dockery, Third Assistant Postmaster General, to issue a bulletin to the postmasters of California instructing them to permit of the above products being shipped sealed in original packages by parcel post at the same rate as provided in section 469, paragraph 5 of the Postal Regulations of 1913.

(Signed): F. B. MCKEVITT, *Chairman*; C. B. MESSENGER; EARL L. MORRIS; WILLIAM WOOD; GEO. B. WEATHERBY.

REPORT OF THE MEDITERRANEAN FRUIT FLY COMMITTEE.

State Fruit Growers' Convention, San Jose, Cal., December 2–4, 1913.

We, the California Fruit Growers in convention assembled, representing California's major industry producing an income to the State in excess of one hundred million dollars per annum, greatly fearing the possibility of an invasion of the Mediterranean fruit fly from the islands of the Pacific, and appreciating the gravity of the situation: and

WHEREAS, We are more and more forced to the conclusion that the Federal Government, and the Federal Government only, has the power, authority and equipment to properly meet the grievous conditions that confront the fruit growers of our State in this matter; therefore, we do

Resolved, That in view of the excellent and efficient work done by the United States Government in controlling and preparing for export the shipments of bananas from the Hawaiian Islands to the United States, as reported to us by the special agent, Mr. Frederick Maskew, sent to these islands by the Federal Government to investigate this situation; and in view of the fact that the Federal Government alone can meet the exigencies of the situation, we earnestly urge that the United States Government extend this diligent and effectual supervision until it covers *all* avenues by which the Mediterranean fruit fly may reach the mainland, including the mail, the ships' stores, sealed baggage and the general passenger and freight traffic; and, further, that the secretary of the convention be instructed to forward a copy of these resolutions to Dr. C. L. Marlatt, chairman of the Federal Horticultural Board, Washington, D. C.

(Signed): MARSHALL DEMOTTE, Chairman; FRANK T. SWETT; E. N. RICHMOND.

Delegate to Washington, D. C.

Resolved, That in view of the many phases of the work of the Mediterranean fruit fly and the possibility of its hosts being brought to the mainland, as explained by the special agent, Mr. Frederick Maskew, who investigated the situation, we recommend that this agent be sent to Washington immediately to in person apprise the Federal Horticultural Board of the details as related to us.

(Signed): MARSHALL DEMOTTE, Chairman; FRANK T. SWETT; E. N. RICHMOND.

DATE GROWING IN THE OLD AND NEW WORLDS.

Under the above title Mr. Paul B. Popenoe has brought together in excellent form a great amount of valuable data relative to date growing as it exists in the various countries to-day. We are all familiar with the previous writings of Mr. Popenoe, and know that he is probably the best American authority on date growing in this country to-day.

The book is divided into two parts and an appendix. Part 1 contains the history of commercial date growing, methods of propagating and growing the trees, harvesting and marketing the fruit, together with profits of date growing and the uses of the date. In this part is also a chapter on the food value of the date by Dr. Charles L. Bennett. Part 2 includes all the varieties of dates. A very important feature of this division is a splendid reference dictionary for every date grower. In the appendix are found the quarantine regulations relative to the importation of dates into the United States and two early legends concerning date propagation.

The book will be of great value to all parties interested in date culture in the United States, as all the important phases of this industry are fully described. The work is neatly bound, contains 308 pages, and is well illustrated and thoroughly indexed. It is published by the West India Gardens, Altadena, California.—E. O. ESSIG.

THE CHERRY AND PEAR SLUG.

This, like most of our dreaded pests, is of European origin and is widely distributed. Wherever the cherry and pear are cultivated the slug is found. It has dainty habits, as it only takes the parenchyma—green portion—of the leaf. It is no slug, as the true slug is a mollusk, but it carries a slimy secretion like the slug and so carries the name.

Family Tenthredinidæ.

The family of this insect is well defined. Like all of the order of *Hymenoptera* it has four membranous wings, biting mouth-parts and complete transformations. This is the sawfly family. The adult, or imago, has a saw at the tip of the abdomen, which is wondrous in its finish and polish. With this it saws a groove in which to deposit its eggs in stem or leaf. This saw may be single or double. These sawflies often pupate in the earth in a coarse paper-like cocoon. The larvæ have from eighteen to twenty-two legs, more than any other insect larvæ, though most caterpillars approximate this number, having sixteen.

FIG. 5.—The pear or cherry slug (*Caliroa cerasi*) and its work upon the leaf. (After Ewing.)

Life History.

The shining black flies lay their eggs in late spring and early summer. The unctuous greenish-brown large-headed larvæ feed in summer on the green part of the leaves, making them appear gray and sear. There is but one brood in the season. They pass the winter as pupæ in their cocoons. The scientific name is *Caliroa (Selandria) cerasi*. The specific name *cerasi* comes from cherry, one of its two principal food plants. While it attacks other plants, its chief mischief comes from its injury to the pear and the cherry.

Control.

The arsenious poisons are quick death to these pests, but owing to the viscid secretion, lime or even the earth dust thrown on them is effective in their destruction. These last irritate, and the slugs fall to the ground and soon die. That these slugs do not do more harm is doubtless owing to natural enemies.—A. J. COOK.

REPORTS OF STATE FRUIT GROWERS' CONVENTION.

One of the most important functions of the office of the State Commissioner of Horticulture is to issue vital information to the fruit growers throughout the State. To do this the legislature has appropriated a fixed amount which can not be exceeded. The publication of The Monthly Bulletin was a new departure by the present commissioner and represents a considerable outlay of time and money. Adding to this expenditure the special publications, which demands make necessary to issue, and the publication, also, of the proceedings of the State Fruit Growers' conventions, it has become necessary for the commission to make a new departure in the publication of the latter. It has been decided that instead of publishing a regular convention report as heretofore, that the proceedings would be run in The Monthly Bulletin, extending over a period of several months. For example, in this number two papers and the resolutions are included. All of the papers will be published before the June convention. Inasmuch as the bulletins are published in such form that they may be bound at the end of the year and are thoroughly indexed, we can see no reason why the plan as adopted will meet with serious objection. It allows of a greater distribution of the reports, as heretofore only two or three thousand were published, while The Monthly Bulletin has a mailing list now of nearly five thousand.—E. O. Essig.

INSECT LARVÆ.

In insects with complete transformations, or metamorphoses, where the larvæ are entirely unlike the adults, or imagoes, they take different names and vary as to number of feet in the several orders. Beetle larvæ, except weevil, which are apodous, have six legs and are called grubs. Dipterous larvæ are like weevils—apodous, or footless, and are known as maggots. The larvæ of butterflies and moths are called caterpillars and usually have sixteen legs, though one family, the measuring worms *(Geometrida)*, has only ten legs, and some noctuid moths have ten or twelve legs. All hymenopterous larvæ are footless, except sawfly larvæ, which have eighteen, twenty or twenty-two legs. Though footless these are never called maggots, but are, unfortunately, sometimes referred to as grubs.—A. J. Cook.

DOES BORDEAUX PASTE CAUSE INJURY WHEN FOLLOWED BY FUMIGATION?

In the past few years, since citrus growers have sprayed to some extent with Bordeaux mixture for certain fungous diseases, it has been noticed that if the spraying be followed too soon by fumigation with hydrocyanic acid gas, the trees are more likely to be injured than those not sprayed. The injury that results is from partial defoliation and killing back of the small twigs. This does not seem to be true in case of lime sulphur spraying. It has been found that considerable defoliation will result even though the spraying with Bordeaux has been four to eight months in advance of the fumigation, especially when no rains have intervened to wash off a part of the Bordeaux from the leaves. The writer's attention was called to a case last fall where certain rows

of trees in an orchard were sprayed with Bordeaux mixture twice, once in January and again in April. The remainder of the orchard was not sprayed. In October this entire orchard was fumigated for black scale. On all the trees which had been sprayed with Bordeaux, at least half of the leaves were dropped, while only a few leaves were injured on the trees that had not been sprayed. If the fumigation is a year or more after the spraying, or heavy rains have occurred between the spraying and fumigation, very little injury results.

Many growers, having heard of this injury to trees by fumigation following the spraying with Bordeaux mixture, have raised the question as to whether the Bordeaux paste put only on the trunks and not on the leaves in the treatment for gummosis will cause any injury when fumigation is done soon afterward. In answer to this question it may be said that hundreds of lemon trees that had previously been treated with Bordeaux paste on the trunks for gummosis last fall, were after-

FIG. 6.—Both rows of orange trees were fumigated the same night. A had been sprayed with Bordeaux; B had not been sprayed. (Original.)

wards fumigated, some of them only a short time after the Bordeaux had been applied, and no apparent injury has resulted either to the bark or to the foliage in any case so far observed. This past few months, the writer was shown two recently fumigated orange groves in which the limbs high up in some of the trees had been painted with Bordeaux for sealy bark. These orchards were fumigated on different nights by the same fumigators. In one orchard the leaves in the tops near the Bordeauxed limbs had been burned more than leaves in the surrounding trees not Bordeauxed, but in the other orchard, very little difference could be detected between the Bordeauxed and non-Bordeauxed trees. It was said that the weather conditions at the time the first orchard was fumigated were somewhat unfavorable. It would seem, therefore, that where the proper precautions as to weather and moisture conditions are observed by the fumigator, there is no injury to

be feared from the Bordeaux paste, even when applied to the large limbs, but that when Bordeaux mixture is sprayed on the leaves, more or less defoliation is likely to occur.

Briefly stated: (1) after treating tree trunks with Bordeaux paste fumigation is safe, (2) after treating the limbs with Bordeaux high up in the tree a little more care should be observed as to correct weather conditions when fumigating, and (3) after spraying the leaves with Bordeaux mixture, great care should be exercised when fumigating, to prevent defoliation.—H. S. Fawcett.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent of the State Insectary.

(Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plants as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers. The material is, for the most part, compiled from the various state and Government publications.)

DECIDUOUS FRUIT INSECTS.

The Peach Twig-borer.

The peach is the principal host of this destructive insect and is damaged by the immature larvæ burrowing into the young buds and tender shoots, besides later on entering the fruit at the stem end, often completely encircling the pit rendering the fruit unsaleable as a first-class product. The larva varies in color from a dusky white to a dark brown, the head and first three body segments being black. It is rarely over one half inch in length after becoming full grown.

Briefly the life history of this insect is as follows: There are three generations a year or less according to the locality. The generation of moths which emerges around the last of July gives rise to the very young larvæ which make minute burrows in the bark, principally located in the crotches of the limbs. These burrows can be located by the tiny silken tubes made of chewed bark which project upwards. The small larvæ pass the winter in these burrows and come out in early spring to feed on the tender shoots and starting buds. They become full grown about May, passing the resting stage in the crevices in the bark of trees. The adults emerge about seven days later and a new brood of worms results which do their greatest damage to the fruit.

The use of a commercial preparation of lime sulphur diluted one to ten when the blossoms are just opening has given excellent results.

Codling Moth.

Although the time is not at hand for applying the first spray against the codling moth, perhaps a word or two concerning this insect will not be out of place. The codling moth (apple worm) is the most destructive insect to the apple or pear if no control measures are practiced. Good thorough spraying at the proper times determines whether the apple or pear grower shall have clean or wormy fruit, and little or no profit or a fair return.

The codling moth is now passing the resting stage in cracks in the bark of trees, under trash, in packing-houses and other places of shelter. The adults will be out to deposit their small whitish eggs on the leaves and twigs soon after the trees are in bloom. In order to destroy the small whitish or pink worms before they enter the young fruit, a thorough application of arsenate of lead, five pounds to one hundred gallons of water should be made as soon as the petals of the blossoms fall and before the calyx cups close. Practically 80 per cent of the worms enter the fruit through the calyx end, so that the necessity of filling the calyx cup with the poison is obvious.

The Pear Thrips.

Figure 7 gives the reader an idea as to the appearance of the pear thrips. It passes the winter in the resting stage in the ground and the adult emerges early in the spring, laying its white bean-shaped eggs in the tender tissues of the host. The adult and young attack the tender flowers and leaf buds. In badly infested orchards the buds fail to open and the trees have a brown, dead appearance.

The pear suffers the most. Besides this host, prunes, plums, peaches, apricots, almonds, apples, cherries, figs, grapes and English walnuts are often attacked.*

The best spray to use against the pear thrips is known as the Government formula and consists of three per cent distillate oil emulsion to which is added nicotine sulphate (Black-leaf 40) in the proportions of one part to fifteen hundred to two thousand of the spray mixture.† Spray at the time the thrips are present.

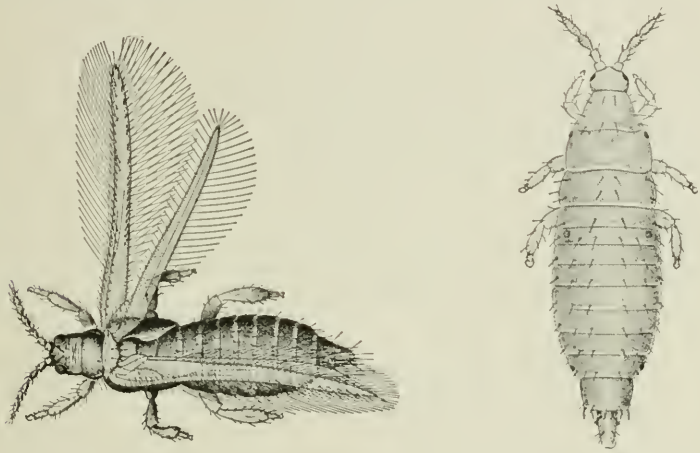

FIG. 7.—The pear thrips; adult female and nymph. (After Moulton.)

Potato Eelworm.

The eelworm is not an insect but belongs to a lower class of animals. It infests over four hundred and eighty species of plants which includes most of our general garden crops, as well as fruit trees and field crops. It is a microscopic, almost transparent eel-like creature, which causes what is known as root-knot on nursery trees, galls on tomato vines and the warty surface on potato tubers. Soils which contain infested crops must be either sterilized to prevent new crops becoming infested or rotated to crops which are not attacked by the nematode. Sterilization of the soil by steam or formaldehyde, one part to 100 parts of water is practical only when a small lot of soil is handled, as in greenhouses.

*E. O. Essig, "Injurious and Beneficial Insects of California," p. 36.

†G. E. Merrill, Mo. Bul. Cal. Hort. Com., Vol. I, No. 2, p. 54.

FUNGOUS DISEASES OF PLANTS.

Peach-leaf Curl.

This disease curls the peach leaves which afterwards fall, often with part of the fruit which has become infested. A new crop of leaves will appear later but the damage has been done. Spray with lime sulphur solution 4.5 degrees Baumé, (1.030) specific gravity, just before the buds open in the spring.

Apple Scab.

Diseased apples have the characteristic scabby patches on the surface of the fruit. Bordeaux mixture 5/5/50, is used just as the buds are opening and again after the petals fall. If necessary the same mixture is used at later intervals. Some growers combine arsenate of lead for the codling moth with this spray to save making two applications.

Apple Mildew.

Apple mildew dwarfs the tips of the new shoots and their leaves covering them with the white mildewy growth of the fungus. The resistance of varieties varies. It has been hard to control but some growers have obtained good results by using a solution of iron sulphide.*

Pear Scab.

The scab of pear is similar to apple scab and appears as dark brown spots on the young fruit, leaves and sometimes on the blossoms. The percentage of moisture in the spring determines the amount of damage wrought by this fungus. Use Bordeaux mixture 5/5/50 formula, applying as with apple scab.†

Melon, Cucumber and Cantaloupe Wilt.

Vines affected with the fungus wilt and die with a dry rot of the stems and leaves. The fungus lives in the soil year after year infesting new crops as they appear, unless rotation is practiced with crops which are not susceptible to this disease.

Potato Scab.

The potato scab fungus causes a scabby appearance on the surface of the tubers, consequently lowering their commercial value. The use of clean seed and treating before placed in the soil by immersing about one and a half hours in a solution consisting of one pound of formalin to thirty gallons of water. On badly infested soil plant to other crops for several years.

*R. E. Smith and Elizabeth H. Smith, Bul. No. 218, Cal. Exp. Sta., p. 1088.
†R. E. Smith and Elizabeth H. Smith, Bul. No. 218, Cal. Exp. Sta., p. 1153.

INSECT NOTES.

CONDUCTED BY THE EDITOR.

The so-called **sweet birch scale,** *Chionaspis salicis-nigræ* (Walsh), was recently taken by the writer in the Sierra Nevada Mountains in the districts around Yankee Jims and Forest Hill (Placer County) at elevations varying from 2,000 to 3,500 feet high. The sweet birch, *Ceanothus integerrimus* H. and A. is generally attacked at the base near the ground and the infested areas appear whitewashed. In not a few cases the entire bushes were killed by the great numbers of the insect. The scale appears to be exceedingly common in the Sierra Nevada Mountains east of the Sacramento Valley.—November 22, 1913.

Kermes cockerelli Ehrh. was collected in limited numbers by the writer at Colfax (Placer County), California, at an altitude of 2,500 feet. It occurred upon the Maul or Canyon oak, *Quercus chrysolepis* Liebm.—November 21, 1913.

Roots bearing typical **nematode** injury have been recently sent in by County Horticultural Commissioner Garden of San Joaquin County. The infested plants include celery, turnip, parsnip and cherry.—LEROY CHILDS.

Aspidiotus densifloræ Bremner has been taken by the writer on the leaves of the Maul or Canyon oak, *Quercus chrysolepis* Liebm. at Colfax (Placer County), California (altitude 2,500), November 21, 1913, and at Auburn (Placer County), California (altitude 1,360), 1912 and December 18, 1913. Bremner's type material was taken on leaves of the tanbark oak, *Pasania* (*Quercus*) *densiflora* Orst. in Mendocino County.

The pine-leaf scale, *Chionaspis pinifoliæ* (Fitch) is exceedingly common on the needles of the yellow pine, *Pinus ponderosa* Dougl. in the vicinity of Forest Hill (Placer County).—November 23, 1913.

The black pine-needle scale, *Aspidiotus californicus* Colm. is very abundant upon the needles of the yellow pine, *Pinus ponderosa* Dougl. at Colfax (Placer County) California (altitude 2,500 feet).—November 21, 1913.

The devastating grasshopper, *Melanoplus devastator* Scudd., *M. cinereus* Scudd. and *Schistocerca venusta* Scudd., were found in considerable numbers mating and laying eggs in the sunny places along the north fork of the American River, seven miles from Towles, Placer County, California.—November 19, 1913.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

It is designed to make this department of The Monthly Bulletin of particular interest and value to the county commissioners, and with that idea in view the editor of the department would be glad to receive short notes in regard to the work in the various counties, which is being done for the benefit of the fruit growers. We believe that nowhere else can be found a like body of men performing such valuable horticultural service as is being rendered by the county commissioners of this State. Things that are of value in one county may also be in others, and a dissemination of such information as may be helpful to all those in the work, through the county commissioner department of the Bulletin, should be well worth while. All articles should be short and to the point, as the greatest good will come out of great numbers from various parts of the State.

December 5th to 12th proved to be a very enjoyable and helpful time to members of the State Commission and County Horticultural Commissioners who were in attendance at a course of lectures given under the auspices of the State Commission at Sacramento. The following county commissioners were in attendance: Fred Seulberger, Oakland; F. C. Schell, Fresno; H. H. Bowman, Bowman; H. P. Stabler, Yuba City; F. Swett, Martinez; Wm. Garden, Stockton; Geo. Hecke, Woodland; Carl J. Ley, Willows; H. A. Weinland, San Diego; C. W. Beers, Santa Barbara; S. A. Pease, San Bernardino; C. R. McBride, Vacaville; F. W. Waite, El Centro; Geo. Marchbank, Madera; C. B. Weeks, Red Bluff; Wm. Wood, Los Angeles; A. L. Rutherford, Modesto; J. E. Hassler, Placerville; J. B. Hickman, Aromas; K. Knowlton, Bakersfield; R. P. Cundiff, Riverside; Geo. Weatherby, Eureka; Geo. A. Lyon, Lakeport; R. K. Bishop, Santa Ana; A. G. Schulz, Porterville; G. E. Lamiman, Anderson; O. C. McManus, Modoc; D. F. Norton, Grass Valley; A. R. Gallaway, Santa Rosa; Earl Mills, Oroville, E. L. Morris, San Jose; J. F. Wetzel, Yreka.

The get-together spirit was very evident at this meeting and great good will undoubtedly result from it.

An examination was given at Redwood City on December 20th. There were five applicants for certificates entitling them to serve as county horticultural commissioners. It is hoped that San Mateo County will soon be numbered among those having the advantage of the services of a commissioner.

The following interesting item comes to us from Kern County: "I wish to report the conditions in this county regarding the potato tuber moth: The Tehachapi district is by far the worst infested. In some cases the loss was nearly 60 per cent of the crop, where the potatoes were planted in ridges. There is very slight damage in any other part of the county."—*Kent S. Knowlton.*

Mr. J. E. Hassler, of El Dorado County, is carrying on a strenuous campaign against the pear blight. He is requiring the disinfection of all tools in orchards where pruning is being done, and where the blight is known to occur.

REPORT OF THE STATE BOARD OF HORTICULTURAL EXAMINERS.

On August 1, 1913, the Attorney General expressed his opinion that the Board must hold examinations for new lists of eligibles just previous to the expiration of the four-year terms of the county horticultural commissioners. In accordance with his advice, the following examinations have been held, and the list of names accompanying each has been certified:

Orange County. Examination held at Santa Ana, on November 10, 1913. The following names were certified:

Richard Baird.
Roy K. Bishop.
Roy E. Campbell.
Roger Palmer.
J. H. Norton.
Murray J. Black.

San Bernardino County. Examination held at San Bernardino on November 11, 1913. The following names were certified:

Geo. R. Wilson.
D. D. Sharp.
J. H. Norton.
J. B. Hundley.
John P. Coy.
S. A. Pease.

Yuba County. Examination held at Marysville on November 19, 1913. The following names were certified:

R. M. Lelong.
G. W. Harney.

Placer County. Examination held at Auburn on December 18, 1913. The following names were certified:

R. M. Lelong.
J. H. Bowman.

San Mateo County. Examination held at Redwood City on December 20, 1913. The following names were certified:

Henry Harmeling.
W. J. Hartung.
F. G. Hutchinson.
Newton Peck.

Sutter County. Examination held at Yuba City on December 20, 1913. The following name was certified:

Harry P. Stabler.

Tulare County. Examination held at Visalia on December 24, 1913. The following names were certified.

Murray J. Black.
Chas. P. Collins.
A. G. Schulz.

Riverside County. Examination held at Riverside on December 27, 1913. The following names were certified:

Geo. R. Wilson.
R. P. Cundiff.
D. D. Sharp.
J. H. Norton.

The following dates are set for examinations to be held in the near future:

Los Angeles County, at Los Angeles, January 9, 1914.
Yolo County, at Woodland, January 22, 1914.
Butte County, at Oroville, January 24, 1914.
Nevada County, at Nevada City, January 27, 1914.
Mendocino County, at Ukiah, February 3, 1914.

A. J. Cook,
Thomas F. Hunt,
Harry S. Smith,
State Board of Horticultural Examiners.

By Harry S. Smith, Secretary.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF NOVEMBER, 1913.

By FREDERICK MASKEW, Chief Deputy Quarantine Officer, San Francisco, California.

The interest, the attention and the action of the fruit growers in convention assembled at San Jose, California, on December 4, 1913, demonstrated clearly that what the State Horticultural Quarantine service needs above all other things is the acquaintance of every producer in California with the details of its work. If it could secure this it would soon obtain all that it requires for the permanent betterment of the service. It is no longer an experimental side issue, but a department that has been developed until it has reached the standard of a modern business institution in touch with every point of delivery in the State. The coast division alone handled a volume of over 200,000 parcels during the month of November. Its system, service and policies have won the respect of the commercial bodies of California, and the protection it affords to the agricultural and horticultural industries would promptly win the full support of the producers were they even casually acquainted with its methods, findings and rulings. Its interpretation of the meaning of quarantine regulations is exciting the attention and interest of the horticultural officials in all lands, and its systematic endeavors to eliminate the various causes for rejection of material at the source of origin are rapidly reaching fruition. Of a necessity the personnel divorced itself long ago from a continuance of scientific study and research work, and its success in satisfactorily handling the large volume of imports is due as much to the fact that each member of the force is devoting his entire time and thought to the actual work for which he is paid, as it is to his practical ability to translate the findings of the schools and courts, and promptly apply their meaning to all the contingencies of modern traffic.

SAN FRANCISCO STATION.

		Parcels.
Horticultural imports.		
Ships inspected	41	
Passed as free from pests		163,762
Fumigated		2,877
Destroyed or returned		107
Contraband destroyed		12
Total parcels horticultural products for the month		166,758
Horticultural exports.		
Inspected and certified		950

Pests Intercepted.

From Honolulu—

Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Hemichionaspis minor on cocoanuts.
Lecanium sp. on betel leaves.

From China—
Lepidosaphes beckii, Pseudaonidia trilobitiformis, Chrysomphalus aurantii, Chionaspis citri, Parlatoria ziziphus and *Phomopsis citri* on pomelos.
Ants in package of burdock.
Cylas formicarius in sweet potatoes.
From Japan—
Weevils in chestnuts.
Aulacaspis pentagona on peach tree.
Parlatoria theæ on maple tree.
Lapidopterous larvæ and coleopterous larvæ in chestnuts.
From Mexico—
Saissetia hemisphærica, Parlatoria pergandii and *Howardia biclavis* on gardenia.
From Florida—
Phomopsis citri and *Parlatoria pergandii* on foliage of kumquat oranges.
From Holland—
Lepidosaphes ulmi on boxwood trees.

LOS ANGELES STATION.

Horticultural imports.	Parcels.
Ships inspected	24
Passed as free from pests	52,849
Fumigated	378
Destroyed	23
Returned	—
Contraband	1
Total parcels horticultural products for the month	53,251

Pests Intercepted.

From Belgium—
Coccus hesperidum on camellias.
From Florida—
Lepidosaphes beckii, Phomopsis citri on pomelos.
Unidentified weevils in avocado seeds.
From Holland—
Aspidiotus abietis on blue spruce.
Lepidosaphes ulmi on maples and boxwoods.
Red spider on flowering cherry.
From Missouri—
Saissetia oleæ on kentia palms.
From Pennsylvania—
Aleyrodes sp. on palms.
From Porto Rico—
Chrysomphalus aonidum and *Lepidosaphes beckii* on pomelos.

SAN DIEGO STATION.

Horticultural imports.	Parcels.
Ships inspected	22
Passed as free from pests	1,758
Fumigated	—
Destroyed	2
Returned	60
Contraband	9
Total parcels horticultural products for the month	1,829

Pests Intercepted.

From Oregon—
Sanninoidea exitiosa in peach tree.
From Mexico—
Calandra sp. in corn and cow-peas.
Unidentified weevil larvæ and worms in avocado seeds.
Unidentified lepidopterous larvæ in dried bell peppers.
Unidentified dipterous larvæ in guava and on lemon.

EUREKA STATION.

Ships inspected 2
No horticultural imports.

SANTA BARBARA STATION.

Ships inspected 1
No horticultural imports.

OFFICERS OF THE CALIFORNIA STATE COMMISSION OF HORTICULTURE

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Capitol Building, Sacramento.

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GEO. P. WELDON.....Chief Deputy Commissioner
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VOLUME III No. 2

THE MONTHLY BULLETIN

Stem of alfalfa showing arrangement of leaves and flowers. (*a*) and (*b*) spiral seed pod; (*c*) seeds. (From A. I. Root Co.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA FEBRUARY, 1914

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STATE COMMISSION OF HORTICULTURE

February, 1914

THE MONTHLY BULLETIN

VOLUME III No. 2

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

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1914

THE MONTHLY BULLETIN

ALFALFA.

Address, State Fruit Growers' Convention, San Jose, California, December 2-4, 1913.
By A. J. Cook, State Commissioner of Horticulture, Sacramento, Cal.

If, as is stated, the word "alfalfa" signifies "best fodder," it is truly an apt term, as alfalfa is indeed a wonderful forage crop. For both pasture and hay it is without a rival. Its great root system, often pushing down to a depth of thirty feet or more, secures from the soil a wealth of nutritive food material that no other plant is able to obtain. This accounts for its marvelous growth and production. Think of eight or even nine or ten crops a season and twelve tons per acre in a single year, and you have a conception of what alfalfa can do. On my own alfalfa farm, alfalfa sown in April produced a crop of hay that same year that staggers belief. If there is any other crop comparable with this, I have not learned of it. Indian corn at its best is a marvel, producing fifteen or twenty tons per acre in a season, but this only in the uncured state. As dry, or cured forage, it is far eclipsed by alfalfa. Alfalfa yields four or five times the quantity of food in pounds that the red clover of the East produces, and surpasses timothy hay to even a greater extent.

The deep rooting of this wonderful forage plant has other significance. The pushing down of the tap root acts as a cultivator and permits air and moisture to reach down deeply into the earth, and makes the soil more alive; it also utilizes potash and phosphates, which would otherwise be beneath the feeding rootlets. This with the ability of alfalfa to combine the free nitrogen of the air explains why alfalfa is indirectly a complete fertilizer. Its deep and ample root system explains why it is grown successfully without irrigation in some arid regions with a rainfall of only fourteen inches, and gives remarkable crops in the Gulf States with an annual rainfall of over sixty inches.

Alfalfa is also peculiar and unique in its chemical composition. Its nitrogen content makes it comparable with bran as a valuable food. Eleven pounds of alfalfa is equal in food value to ten pounds of bran. For both beef and butter it is a very superior food. It is asserted that a ton of alfalfa leaves contains as much protein as do 2,800 pounds of bran. It leads all forage crops in its large amount of digestible protein. We know that protein, so abundant in cheese and the muscle of meat, is the most expensive food element. Analysis shows that 10,000 pounds of alfalfa contain as much protein as do 9,016 pounds of wheat bran and as much as do 16,176 pounds of red clover hay. Though so rich and valuable a food, alfalfa is not in itself a well balanced ration. It is too rich in protein and lacking in carbohydrates. By adding cornmeal, or other starchy grains, it becomes a most excellent food, with no other addition.

From the above statement we see that alfalfa must also be a good manurial crop. Doctor Hilgard says it is worth $8.00 or more per ton simply to plow under. Dr. C. G. Hopkins told us at Santa Barbara that it might very likely pay the California orchardist to raise alfalfa to use solely as a fertilizer—that it might pay as well to use it to give

us concentrated fruit or vegetable products as to make beef or mutton. A ton of alfalfa takes from the soil 44 pounds of nitrogen, 8.27 pounds of phosphoric acid, 50.95 pounds of potash and 40 pounds of lime. As we have seen, alfalfa is strong in quantity of material, and so will give a maximum amount of humus, and is *very rich* in nitrogen, the most costly fertilizing element. Thus it is without a rival as a manurial farm crop. We have already praised it as one of the best foods for farm animals, and thus if we feed it to our stock we get a double profit—first, in the meat or milk products which it produces, as does no other agricultural crop, and secondly, it furnishes a large amount of farm yard manure of very high value.

FIG. 8.—Stem of alfalfa showing arrangement of leaves and flowers. (*a*) spiral seed pod, lateral view; (*b*) same, showing tip of pod; (*c*) seeds. (From A. I. Root Co.)

ENRICHES THE SOIL.

As we shall see, alfalfa is, like clover, beans, peas, etc., a legume and so attracts countless bacteria to make home and food of the tubercles which they cause, and which we can see by observing its roots. As we know, the asmosphere is four fifths nitrogen, but this the higher plants can not use in the uncombined state. But, as we have seen, micro-organisms, infinitesimally small, may exist already in the soil, collect upon the roots of legumes, appropriate the nitrogen of the air as we do the oxygen, combine it with some mineral base and so form nitrates which the higher plants can now utilize, and thus the plants are supplied with the necessary and most expensive fertilizing element, nitrogen. As already noted, the deep rooting finds added stores of potash and the

phosphates which with the nitrogen given complete fertilization. It has been found in Nebraska and Colorado that grain production is doubled by following alfalfa. We see that in growing legumes like clover, alfalfa and beans we eat our cake and also keep it.

Our California soils are often lacking in both humus and nitrogen. These are perhaps the most important soil elements. The decaying organic matter brings to the door of every tiny root hair the needed nutriment, so that none need go hungry—will never call in vain for food. Nitrogen is an essential part of every plant cell, so it is easy to understand why these two substances are the very meat and drink of the plants. These two essentials are usually, as stated above, scant in our California soils, though the humus that we do have is strong in its content of nitrogen. Fortunately, alfalfa, easily our "king of crops," hands over to us great quantities of both, which scores big for alfalfa as a field crop. How red clover renovates eastern soils and raises mortgages! We in California have a still better friend in our "king of crops," alfalfa.

Alfalfa is also peculiar in its persistence, though it may be crowded out by weeds. This may and should always be in great part prevented. Alfalfa has been grown on the same land for seventy-five years, and showed little lack of thrift. I have in mind a field which has grown alfalfa since the sixties with only slight interruption. Beans have the same peculiarity. We now understand why. They constantly add to the nitrogen content of the soil. Our soils are rich in potash, and the phosphates are often sufficient for years. Crops of beans in Ventura County have been grown on the same land for twenty years with no fertilization, and the last crop was the equal of any of them. I believe alfalfa would exceed beans, as it is more vigorous in every way. Its deeper root system is also greatly to its advantage. Our soils are very deep, often a hundred feet or more. The roots of alfalfa push down a score of feet or more and so the supply of potash and the phosphates is well nigh inexhaustible.

We shall discuss the enemies of alfalfa later and shall find that insects and blights claim tribute, but fortunately the pests are not very numerous, and are for the most part easily controlled.

A weighty argument in favor of alfalfa is the fact that in California we can never hope to equal the demand. Prices must rule high. It rarely ever sells for less than $8.00 per ton; often it reaches $20.00. The cost of production is not great, and properly managed it rivals even the nuts and the citrus fruits at their best as a "money getter."

HISTORY.

Alfalfa is one of the oldest of our cultivated plants. One enthusiast says that it carpeted the orchard plats in the Garden of Eden, and nourished Nebuchadnezzar in his grass-eating days. We have authentic records of it in Pliny's time. Its origin, like that of man, is supposed to have been central or southern Asia, from whence it was carried to north Africa, and to northern and eastern Europe. Either from northern and eastern Europe or Africa it was carried to Spain and Portugal. Spain introduced it into Mexico and South America. It is also thought that it was introduced by the Spanish settlers into the eastern part of the United States, where it has existed for over one hundred years. From Mexico it crossed the line into southern Cali-

fornia, and later, 1854, was introduced from Chili into northern California. Here it developed that it was incomparable as a forage plant. California's success has caught the ear of the whole country, until now every state and nearly every agricultural county in the United States has given glad welcome to this "king" of forage crops. While it reaches its best only under irrigation, yet almost everywhere it is proving to be the leading forage crop. The hardy drought and cold-resisting Turkestan alfalfa comes direct from northern Asia, introduced by our U. S. Department of Agriculture. It not only resists drought and heat, but it is also well suited to endure the cold of the more northern of the states of our country.

CLASSIFICATION.

As already stated, alfalfa is a legume, and so related to clovers, beans, peas, vetches and many other native and exotic plants. The legumes are

FIG. 9.—Alfalfa stem attacked by dodder. This parasite of the alfalfa is a true flowering plant and often causes much injury to the growing crop on account of its peculiar choking habits. (U. S. Dept. Agriculture.)

unique in that they are able to utilize the free nitrogen of the air in the nutrition and growth of the higher plants. This is done through symbiosus with bacteria and is indicated by root nodules. See Fig. 10. The flowers of our common forms are irregular, papilionaceous, but-

terfly-like. Two of the petals are larger and wing-like. Darwin taught that such irregular flowers had been developed to insure cross-pollination by insects. This implies nectar secretion. We know that alfalfa, mesquite and sweet and white clover are very superior as honey plants. The leaves of alfalfa (Fig. 8) are like the clovers—trifoliate. The name, *Leguminosæ*—pulse family—comes from the fact that the ovary, or seed vessel, becomes a legume, or pod, which in the case of alfalfa is spiral (Fig. 8*a*), often making three twists. Some of the species are shrubs, mesquite (*Prosopis juliflora*); others, trees, as illustrated by locusts and acacias; still others, vines as in wistaria. We may say that alfalfa is the crowning species of one of the largest and most important of all the families of the vegetable kingdom.

The scientific name of alfalfa is *Medicago sativa*. The genus *Medicago* is characterized by the possession of a spiral pod (Fig. 8, *a*. and *b*.). The flowers are not in a head like red and white clover, but are in a raceme. Like those of many other genera the leaves are trifoliate. We are all familiar with our three-leaved clovers. All of the fifty or more species of *Medicago* are natives of Asia and Africa. Some are vines; some, shrubs.

Besides the upright species of *Medicago*, the much branching perennial alfalfa, or lucern, with flowers varying from whitish to reddish purple, and spiral pods with from one to three twists, carrying from one to eight seeds, we have the yellow lucern, or Swedish clover, *Medicago falcata*. As we should expect from its far northern birthplace, it is very resistant to cold, and as the name suggests, the flowers are yellow. Sand lucern, *Medicago media*, is spreading like the last. It has been thought by some to be a hybrid between yellow lucern and alfalfa. Like yellow lucern it lacks the productivity of alfalfa and is only superior in its hardiness against cold. Its spreading habit, its pod with only two thirds of a twist, its less weighty seed, would seem to justify its position as a distinct species.

Yellow trefoil, *Medicago luputina*, is an annual. It is more spreading than alfalfa, has shorter leaves, yellow flowers and a single incomplete spiral. The ripe pods are black. It is greatly inferior to alfalfa as a forage plant.

Bur clover, *Medicago denticulata*, is common in all parts of California. It is an annual and has value as a cover crop.

VARIETIES.

We are not surprised that alfalfa, so long in cultivation, has several varietal forms. As already suggested, sand lucern may be only a variety of alfalfa. The Grimm alfalfa is much like the last. Both are suited to the states of the far North—North Dakota, Minnesota, Wisconsin and Michigan. Neither of these is equal in value to our common alfalfa in the warmer states like California.

The Turkestan variety is from a dry hot country and resists drought, heat and cold exceptionally well. In this respect it rivals the sand lucern and Grimm alfalfa. It is low and spreading and has narrow leaves, which are small and somewhat hairy. It is an inferior variety and would not find favor in a warm climate where irrigation is practiced.

The German variety is like the last, but the leaves are broader, the stem more succulent and less hairy, and its productivity, though greater

than the Turkestan type, is not comparable with the American, or Chilian, variety. It is not as hardy as the kinds mentioned above.

The Arabian and Algerian varieties are upright, with large succulent stems and large broad light-colored leaves. While they are thought to be more productive and vigorous than our common, or American, alfalfa, they are less resistant to cold. They have won favor in the mild climate of New Mexico, Arizona and California, where irrigation is practiced.

The Peruvian variety, recently imported by the U. S. Department of Agriculture, has all the excellence of the Arabian type, usually somewhat exaggerated. Its one drawback is impatience to cold. The leaflets of this variety are very long—four times as long as broad. The leaflets in the Arabian are short and broad. The flowers of the Peruvian type are small, while the calyx teeth are much longer than the tube. This is not true of either the common or Arabian varieties.

The American, common, western or Chilian, variety is more vigorous and productive than any except the Arabian and Peruvian varieties, and is more resistant to cold than these last. It would seem wise for us in California to grow this variety in the main and to experiment to a greater or less degree with the Arabian and Peruvian types and to enlarge our plantings of the one type of these three that does best on our ranches, under our own special management.

SOILS.

While I have seen fine fields of alfalfa on all kinds of soils, from light sand to heavy clay, yet a clay loam seems best. The *one thing* that bars success is improper drainage. Water nearer the surface than five feet kills success. In arid California drainage is rarely required, though in places the water table is too high for alfalfa to thrive. Seepage from irrigation higher up often saturates the subsoil, and may bring alkali, which would do serious harm. It is well to add that growing alfalfa is very quickly killed by an overflow; while in a dormant state, it may be covered with water for some eight or ten days with no serious harm.

Another impediment in arid regions where the soil is heavy and poorly drained is alkali. While, as Hilgard shows, the mature plants are quite tolerant of alkali, this is not true of the young plants. Heavy irrigation, with an open subsoil, will often wash the salt down and enable the rancher to secure a good stand, which in maturity will tolerate considerable of the noxious salt. Fall planting of alfalfa is often recommended, as the rains will wash the black alkali down, and the plants will get a good growth before the rise of alkali in summer. The effect of the alkali is to girdle the young plants by its corrosive action just at the crown.

PREPARATION FOR SOWING SEED.

The soil should be thoroughly and deeply cultivated some time before planting. As with a lawn, repeated cultivation, alternating with irrigation or rains, will sprout the weed seed already in the soil and save much labor, loss and vexation later. One objection to spring seeding is the likelihood of abundant weeds. In this case the repeated cultivations before planting are the more to be commended. We must guard against weeds in every possible way.

FIG. 10.—Nodules containing bacteria on the roots of young alfalfa. The presence of beneficial bacteria is decidedly necessary in growing alfalfa with success. Plants on the left much enlarged; on right natural size. (Photo by George P. Weldon.)

The starting of an alfalfa growth will be hastened if the land has had a generous coat of stable fertilizer some time before. It is best to add the manure the previous year, which will help to eliminate the trouble from the weed-seed, so likely to be in the barnyard fertilizer. If we grow a hoed crop, it will be all the more successful. We must never lose sight of the weed problem. If possible it will often pay to plow under a good crop of vetch before seeding to alfalfa. This will put the soil in excellent condition for the crop.

Lime is often found to work wonders if sowed two or three tons to the acre. This may be added before planting. Stone lime finely ground is best. It is always wise to sow lime on a small area and watch results. An acid soil is death to alfalfa, and alfalfa requires a large amount of lime for its proper nutrition.

The grading should be very carefully looked after, the field should be leveled by a surveyor's level, and the slope should be uniform, in case the ground is not level. Care and plan in grading, especially in case of a slope, will pay many times over.

THE SEED.

Alfalfa seed, though varying slightly in form and size, is kidney-shape (Fig. 11-1), about one twelfth of an inch long and about one half as broad. In color, when good, it is either olive green or bright yellow.

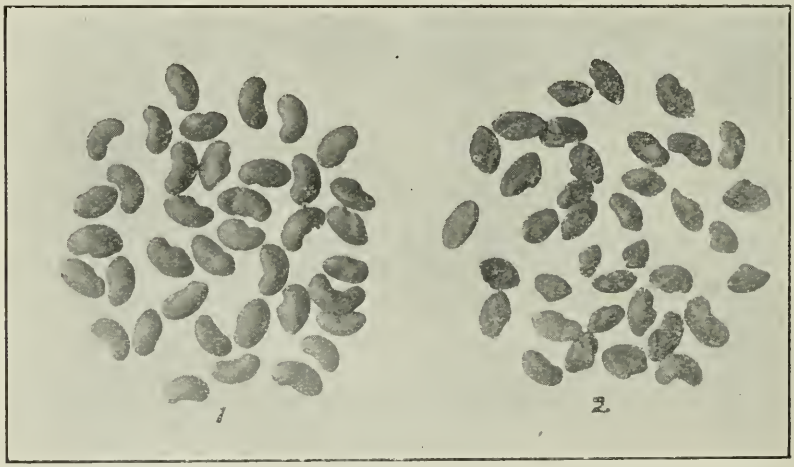

FIG. 11.—Alfalfa seed. (1) shows plump, well-filled, kidney-shaped seeds, the type that should always be used in sowing, and (2) poorly filled, irregular seeds of which only a few will germinate. (Photo by Geo. P. Weldon.)

Seed is sometimes foul with dirt and rubbish and more often adulterated with weed seed. It is easy to detect the former; not so easy to discover adulterants. Of course clover and grass seeds are impurities, while such weeds as dodder, or love vine (*Cuscula* sps. Fig. 9), and foxtail are common in much of California. Seed before planting should be examined by experts at the State University that its purity may be assured. Our worst adulterant, dodder (Figs. 17, 5 and 8), is so common and the size of the seeds is so similar that safety requires special pains. By examining seed on a white background by aid of a lens we

can assure ourselves of both cleanliness and purity. By placing between layers of damp blotting paper we can test its power of germination. It should sprout in five days. Good seed is quick to germinate. If kept in a dry place, alfalfa seed keeps good for five or six years.

We have great advantages here in our rainless summers of California to produce our own seed, and should generally do so. It is always desirable that seed be grown in a locality where the climate is not unlike that where it is to be sown. Seed production is often most profitable. Subirrigation is specially favorable to seed production. By keeping our fields clean so we can guarantee purity, we can make seed production exceedingly profitable. Four sacks (400 pounds) are often produced per acre in a large acreage, and $13.00 per sack is not an unusual price. Alfalfa seed weighs sixty pounds to the bushel. It takes much longer to produce seed than it does hay. If one crop of seed is harvested, it will result in one less crop or cutting in the season.

TIME TO PLANT.

There are two seasons for planting, spring and fall. If we plant in fall, we must be sure that there is sufficient moisture to germinate the seed. If we have not sufficient moisture to insure subirrigation, we better sow as early as October. The ground should have been cultivated some time before, and as the *subsoil must be compact*, it ought to have been well settled, either by a rain or thorough irrigation. The upper two inches should be loose and finely pulverized. The seed on clay land should be one inch beneath the surface of the soil; on sand, a little deeper to insure moisture.

About twenty pounds of seed to the acre are found desirable. Good ranchers often succeed with fifteen pounds. If we were sure that the seed was first-class, and that all conditions were favorable, ten pounds would often give excellent results. I think most growers agree on twenty pounds as giving the best promise of success. The seed may be sown broadcast, but it is better drilled in, as this gives even distribution, and places all at a uniform depth beneath the surface of the soil.

A NURSE CROP.

While a nurse crop is advocated in the East, we do not think it favored in the Pacific coast states. Its purpose is to shade the young alfalfa plants and to protect against drifting sand in case of light soils and regions of high winds. In case the nurse crop is used, barley is preferable, and to conserve the moisture, this may be cut early for hay. Straw or coarse weed-free manure is often spread over the surface with advantage after seeding to prevent injury by drifting sand.

INOCULATION.

It has been repeatedly proven that unless alfalfa has been grown on the soil recently occupied by alfalfa or sweet clover (*Melilotus*) the nitrifying bacteria will likely be absent, and success uncertain. *It is always wise to inoculate the soil.* This can be done by taking earth—three hundred pounds for each acre—from an old alfalfa field and scattering it broadcast on the field to be planted. This inoculating soil should not be exposed to the sun and best be applied late in the day, and the land harrowed at once.

We can also buy the inoculating material, "farmogerm," or "nitragin," and apply to the seed. These are kept by dealers, and it costs 50 cents to treat twenty pounds of seed. Some contend that this is the better method.

If the spring-sown alfalfa is weedy and likely to be choked out, it ought to be cut before the weed seeds form. In this case the cutting knives should be set rather high so as not to injure the crown. Lower cutting, after bloom commences, does no harm. Sowing a little alfalfa seed two or three years before the regular seeding will often inoculate the soil.

HARROWING.

An alfalfa harrow, a spike-toothed disk, is even better than a spring-toothed harrow for cultivating alfalfa. This loosens the ground, lets in the air, conserves the moisture and kills the weeds. Even the splitting of the crowns of the alfalfa some claim may be of use. This is thought by some to increase the production ten per cent. Many do this the second season only in spring; others, after the first three cuttings, and not a few cultivate after each cutting. The short teeth of the alfalfa harrow, or renovator (Fig. 12), are especially desirable, as they serve every purpose and do not tear the plants, though the alfalfa may be harrowed quite severely, with no appreciable damage. In the sub-irrigated river bottoms of the Sacramento Valley, the spring-toothed harrow has often given much better satisfaction than has the alfalfa harrow.

THE HAY CROP.

The best use for the "King of Crops" is for hay. It takes thirty to forty days in favorable weather to grow the crop. In the East two cuttings are the limit, while in Arizona and California five to nine have been possible in the long hot seasons with irrigation. The rule should be to cut as often as is possible, remembering that we should wait only until it is about one tenth in bloom, or, better, until the new growths start well from the crown of the plants. These sprouts should be an inch long. If we cut at this time, we secure more digestible protein than if we cut later. In the East, weather, especially frost, limits the season, while in California there may be no limit. We can make hay while the sun shines, and that is well-nigh perpetual. Again, in the East only one crop, more often none, is secured the first season. This is far from true in California.

CUTTING AND CURING.

As soon as the racemes are one tenth in bloom, the cutting should take place. Then the plants have highest feeding value, and the early cutting favors a large production for the next crop. This course also increases the number of cuttings. The leaves are very rich in protein, and early cutting increases the holding of the leaves. Frosted alfalfa, should be cut at once, even if only half matured—a suggestion of little worth in California. For horses alfalfa should be more mature before it is cut, and should be fed sparingly—one and one fifth pounds for every 100 pounds of weight of the animal. With these precautions it is excellent. The mower should be started as soon as the dew is off. As soon as the herbage is well wilted, especially if heavy, shake it up with the tedder. Before the leaves become brittle, rake it into windrows.

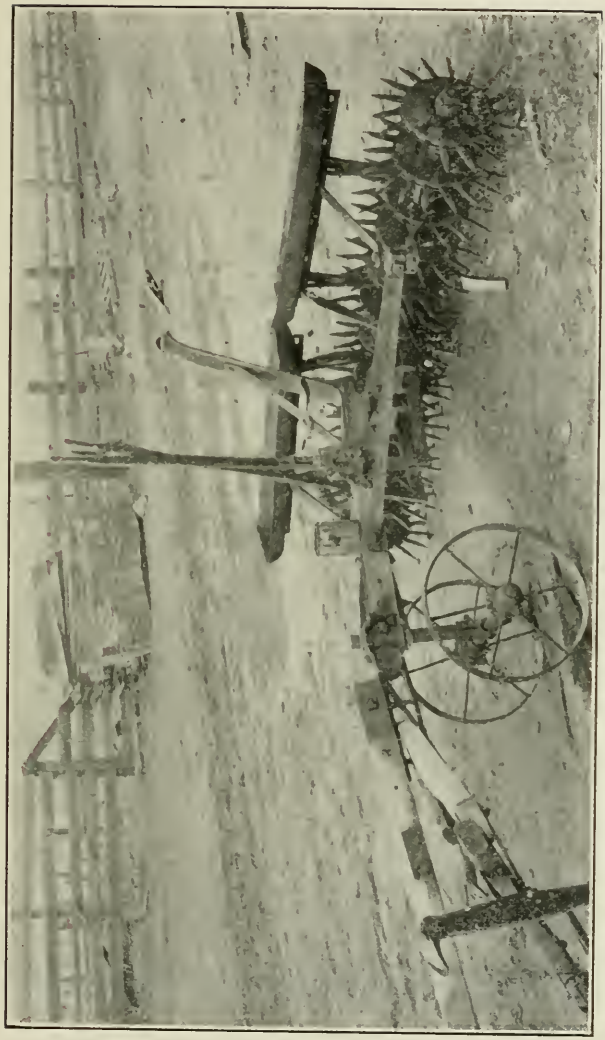

FIG. 12.—The alfalfa renovator or disc harrow. Used with much success by many growers. It is also of much value in controlling the ravages of the zebra caterpillar. (Photo by Geo. P. Weldon.)

It should remain in the windrows two days—three days for baling—as we have no summer rains, when the stems as well as the leaves will be cured. Instead of leaving it in the windrow we can cock it, which will protect from dew, and give us the bright green color, which adds to its value. It requires experience and good judgment to know just when to commence drawing from field to stack or barn. We must wait till it

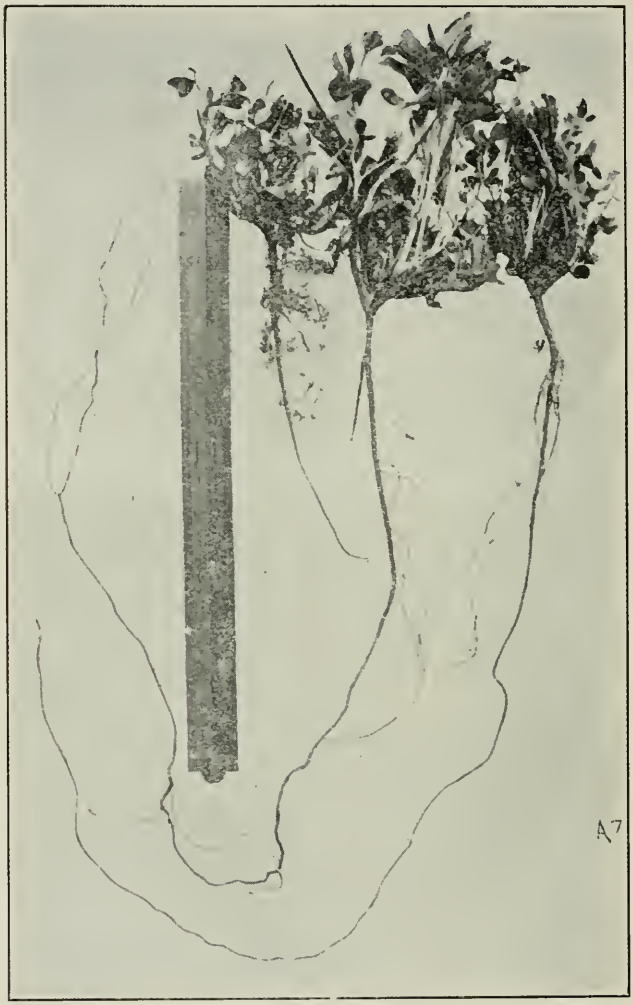

FIG. 13.—Young alfalfa plants showing the vigorous penetrating style of growth of the tap root. (After H. G. Hughes.)

will not hurt in stack or mow, and must avoid overcuring and loss of leaves. When cured it is carried to stack or barn. If there is any doubt of its being cured, it can remain longer in cock or windrow, though our occasional—very rare—summer rains may do us damage. It is also better for the new growth to have the hay removed as soon as it is cured. Promptitude pays here as in most farm operations.

We may at times start the mower late in the day, as the dew does little harm on the green herbage.

We must never bunch or place hay in stack or barn when the hay is wet. This fosters mold and does much damage. In rare cases, with uncured hay, heating has been followed by spontaneous combustion and loss by fire.

SHEDS OR STACKS.

The hay may be placed in stacks and very rapidly by use of sweep rakes. Derricks are often of great advantage. The stacks should be topped with canvas, hay or millet to shed rain. It is stated that a load of green alfalfa to top the stack serves excellently well, as when cured it is said to protect against rains. Of course, sheds, well roofed, and barns are better than stacks and pay well for their extra cost. For years I have used slings for unloading in preference to forks, as they are more sure and do clean work.

KANSAS METHODS.

The Kansas plan of putting green, freshly-cut alfalfa—*never at all wet*—in large sheds, with open floors two feet above ground, has proven valuable in careful hands. The shed is large enough so that one cutting covers only to a depth of three or four feet. This receives the second and later the third cutting, etc. The theory here is that the heating of the hay causes the air to rise. This cures the hay and is said to be a marked success. The green alfalfa is heavy and hard to handle, and incaution would cause loss, and possible fire from spontaneous combustion might result in great damage. The old way appeals more to me, possibly because of inexperience and consequent ignorance.

THE SILO.

Corn is the great crop for silage, but upon occasion alfalfa may well fill the silo. If the first cutting, or first cutting of any year, is full of foxtail, local name for *Hordecum murinum*, or if the first or last cutting is wet with showers, then it will pay well to use it to fill the silo. Many in the fall prefer to mix alfalfa and corn in the silo. Silage is a succulent appetizing food, which gives it rare value for feeding.

BALING.

It often, generally, pays to bale the hay. This costs $1.50 to $2.00 per ton. A power press will bale fifteen to twenty tons of alfalfa a day. Besides the plant it requires five teams and nine men to bale economically. Baling secures ease of handling and is usually an absolute necessity. Only thoroughly cured hay should be baled, and in California it may be baled right from the field.

PASTURE.

Alfalfa makes an excellent pasture for stock. Sheep and cattle often suffer with bloat and indigestion unless great care is exercised. If cattle bloat, a piece of wood an inch in diameter fastened in the mouth as a bit often effects a cure. Making the animal jump over a two-foot obstruction may bring relief. A tube passed from the mouth into the paunch, or first stomach, often proves a cure by allowing the gas to

escape. Bloating will usually be prevented if we pasture one half hour the first day, a little longer the second and so on for three or four days. As a last resort, a small bladed knife may be used to make an incision into the digestive cavity. This incision should be about six inches in front and slightly below the left hip bone. Placing a quill or other tube in this incision will aid the gas to escape. A trocar, which consists of a large needle enclosed by a close-fitting tube, is best for this purpose. After making the puncture the needle is withdrawn.

Horses do well on such pasture; hogs are best of all. An acre of good alfalfa will support ten large hogs in prime condition.

I doubt if it is wise to pasture alfalfa. I feel sure it is not the first or second year. It may be wise to pasture in the late fall, especially if the weather is uncertain. The alfalfa may be injured by being trod upon, and this is certain to be true in wet seasons. If we must pasture alfalfa, hogs with nose rings are preferable to turn upon the land. The leaves of the alfalfa are the workers; pasturing cuts these short, and our gains are greatly reduced.

SOILING.

Alfalfa serves admirably as a soiling crop. It should be cut when it commences to bloom. All kinds of stock thrive on this, and if fed to sheep or cattle, no care is required, as it does not cause bloat, as does alfalfa when pastured. I believe it is generally more economical to feed the cured alfalfa.

SEED CROP.

Seed production is often very remunerative. From three hundred to six hundred pounds per acre have been secured from a single cutting. Fifteen dollars per hundred pounds is often paid for this seed. We see that this gives us from $45.00 to $90.00 per acre. Yet we must remember that raising a crop of alfalfa seed reduces the number of cuttings by one. If, as one large grower on the Sacramento River reports, the average crop for four years has been eight tons, and the average price $9.00, the total would be $72.00. If we can secure $90.00, or even $45,00, for one cutting for seed, we can see it pays well. The straw has a value equal to about one half that of the hay.

The advantages of seed production mean more than money. This also gives opportunity to breed a choice strain by careful seed selections from the most productive plants. By great pains and caution we may secure weed-free seed, which is a substantial asset to the locality, and would soon gain a reputation that would justly augment the price to a top figure.

California is a veritable mecca for this phase of alfalfa culture. A rather thin stand, not too luxuriant, is best for seed. We can select this by close observation. Enough water, early, and never too much, is very important. We can absolutely control this in our fields with irrigation. Warm, growing weather is very helpful. We always have it. Rains and damps are great impediments to success. Our summers are rainless. A good loamy soil is desirable; we have this everywhere. The soil should not be too rich. We can select that most suitable. Bees to cross pollinate the bloom are imperative to success. Our genial climate, with its wealth of sunshine, stimulates activity in bees as it does growth and productivity in the plants. True there are wild bees

and other sweet-loving insects, but they would be wholly inadequate in our great fields of alfalfa.

The early cutting may be selected for seed, but I prefer the third or fourth. Then we have more bees to cross pollinate and more warmth and sunshine to quickly cure the freshly cut plants. There are also less weeds, which should be wholly absent. The plants must show health, but should not be too luxuriant, as that goes with scarcity of seeds. Having selected the field that is not overcrowded with plants, we wait until two thirds to three fourths of the pods are brown, as then more of the seeds are bright yellow. The less mature will be olive green and less plump. The green seeds will grow well, and if the hay is cut at this time, there will be little loss.

A mowing machine that bunches, or one with a side delivery, is desirable, as raking is attended with too much shelling and loss of seed. If the hay is left in windrows it should be carefully bunched. The bunches should be of a size to permit of being lifted at a single forkful. The barley fork is best to use. The bunches can remain in the field until the hay is thoroughly cured. There need be no anxiety, as we have no summer rains. Usually in two days the bunches can be drawn to stack, barn or thresher. Canvas spread over the wagon rack and under where the unloading occurs will save much seed. Every caution must be observed to save the seed. Cutting before too ripe, drawing before too dry and brittle, and handling with the least possible jar.

Threshing may be done very rapidly by use of a threshing machine with a huller attachment, though a huller saves more seed, which compensates for the longer time required. A special huller is desirable and will soon pay for itself. In case of a small acreage if a huller is not to be had several growers may well combine to purchase one.

The time to sell the seed is in spring or fall when the demand insures a good price. It is wise to raise and sell only clean, first-class seed. It has been found that plants grown in drills, three feet apart, irrigated in furrows and cultivated often, pay well. Weed-free seeds and vigorous, but not too stalky, plants from carefully selected seed will soon establish a reputation that will insure a good market at highest prices.

FIG. 14.—Vigorous taproot of alfalfa. (After N. E. Hansen.)

WEEDS.

The following weeds are to be reckoned with, as all are likely to be found in commercial seed (See Fig. 17):

1. Dodder (*Cuscuta* sps.).
2. Barley grass, commonly called foxtail (*Hordecum murinum*).
3. Plantain (*Plantago* sps.).
4. Russian thistle (*Salsoli kali* var. *tragus*).
5. Currant (*Ribes floridum americanum*).
6. Dock (*Rumex*) many species.
7. Charlock, or wild mustard (*Brassica* sps.)
8. Kentucky blue grass (*Poa pratensis*).
9. Canada blue grass (*P. compressa*).
10. Chicory (*Cichorium intybus*).
11. Sweet clover (*Melilotus alba*).
12. Other clovers.
13. Yellow trefoil.

Dodder, also called love-vine and gold thread, has a peculiar life history. The seeds take root, throw up a stem which winds about its host and victim, after which it lets go its hold in the earth and becomes a parasite which soon chokes the life out of its host. Dodder seed (Fig. 17, 5 and 8) is smaller and more spherical than that of alfalfa. It is easily distinguished, and seed with dodder adulteration should never be planted. Dodder seed can be removed by use of a screen with a one twentieth of an inch mesh. Unless alfalfa growers study seeds and themselves become expert, they must always have seed intended for planting examined by an expert. The dodder must never be allowed to seed. If it appears, cut the alfalfa, and when dry burn it.

The germination of seeds should also be determined. If the seed be placed between several layers of damp blotting paper and kept in a warm room, it should sprout in about five days; the quicker, the better the seed. From 85 per cent to 90 per cent of the seed should germinate. It pays to spare no pains in procuring seed, and it is far better to grow our own seed, using the well-known principles of selection and breeding. Pedigreed plants are just as superior as are pedigreed animals.

INSECTS, EELWORMS AND GOPHERS.

The following insects are pests in the alfalfa fields of California:

1. Army worm (*Peridroma margaritosa* var. *saucia*).*
2. Locusts (*Acridiidæ*).*
3. Alfalfa butterfly (*Eurymus eurytheme*).
4. Wireworms (*Elateridæ*).*
5. Alfalfa looper (*Autographa gamma californica*).*
6. Alfalfa crane fly (*Tipula simplex*).*
7. Apple leaf-hopper (*Empoasca mali*).*
8. Clover mite (*Bryobia pratensis*).*
9. Grain thrips (*Euthrips tritici*).*
10. Grape leaf-hopper (*Typhlocyba comes*).*
11. Twelve-spotted cucumber bettle (*Diabrotica soror*).*
12. Western army worm (*Chorizagrotis agrestis*).*
13. Serpentine leaf miner (*Agromyza pusilla*).

*Injurious and Beneficial Insects of California, E. O. Essig, State Commission of Horticulture, The Monthly Bulletin, Vol. 2, Nos. 1 and 2, p. 7.

The army worm moth, like all the cutworm moths, is often very destructive. Fortunately, it has so many insect enemies—braconid fly parasites and carabid predators—that it comes only rarely in alarming numbers. The same is less true of the alfalfa butterfly, which in occasional years is no mean pest.

The bran mash—twenty pounds of wheat bran, one pound white arsenic, one gallon cheap molasses, with enough water, about one gallon, so it will ball in the hands—placed in the affected area poisons both the army worms and locusts. Burning adjacent weed fields where the young locusts hatch and may be cremated wholesale, is another means of extermination. The hopper-dozer,[1] a scraper-shaped arrangement, with a shallow pan of kerosene oil, drawn through the field will often capture the hoppers by the millions.

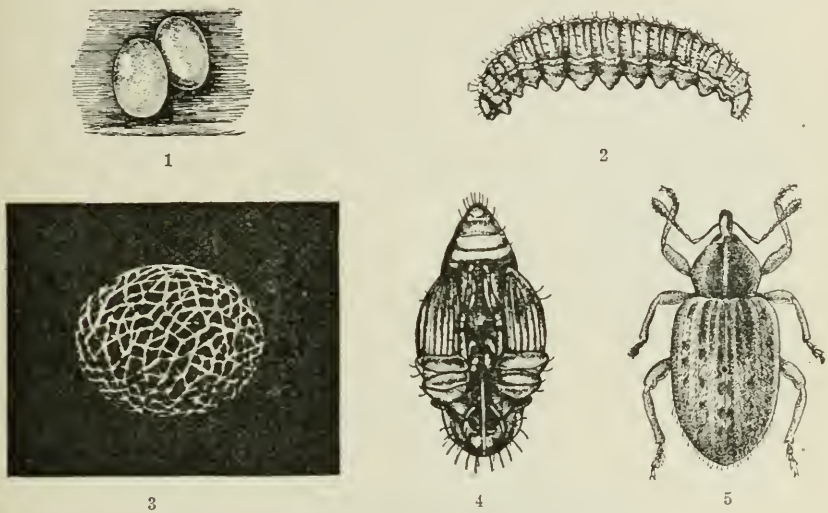

FIG. 15.—The alfalfa weevil (*Phytonomus posticus* Gyll.). 1, eggs; 2, larva; 3, cocoon; 4, pupa; 5, adult. (After Webster.)

The wireworms are a problem yet unsolved Fortunately, they are seldom widespread or alarming.

The alfalfa weevil *Phytonomus posticus* (Fig. 15, 5), not yet in California, is a formidable pest. If diligence and hard effort will hold it off, it will never come here. If, in spite of all effort, it is introduced, we must know it at once and stamp it out before it becomes distributed.[2]

Root Knot.

This trouble, characterized by knots on the roots, is doubtless caused by the common eelworm (*Heterodera radicicola*). It works on several of our valued plants and on many weeds. It is assuming great importance agriculturally among our economic problems.

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[1]Injurious and Beneficial Insects of California, E. O. Essig, State Commission of Horticulture, The Monthly Bulletin, Vol. 2, Nos. 1 and 2, p. 7.

[2]See The Monthly Bulletin, State Commission of Horticulture, Vol. 1, No. 1, p. 19.

The Gopher (Thomomys sps.)

These rodents are often very destructive to alfalfa. They may be drowned out where irrigation is practiced, may be trapped or poisoned by the use of raisins with a little strychnine inserted in a slit made in the raisin, and all placed in their runways.

FUNGI.

The following rather formidable list of fungi attacks alfalfa; the first four menace the crop in California:

1. *Pseudomonas medicaginis.*
2. Crown gall (*Urophlyctis alfalfæ*).
3. Leaf spot (*Pseudopeziza medicaginis*).
4. Rust (*Uromyces striatus*).
5. Wilt, or stem rot (*Sclerotinia libertiana*).
6. Anthracnose (*Colletotrichum trifolii*).
7. Root rot (*Rhizoctonia violacæ*).
8. Downy mildew (*Peronospora trifolium*).
9. Leaf spot (*Ascochyta* sp.).
10. Brown root rot (*Ozonium auricomum*).
11. Leaf spot (*Cercospora medicaginis*).
12. Seed disease (*Alternaria* sp.).
13. Damping off fungus (*Pythium de baryanum*).

Fig. 16.—The alfalfa weevil. Adults clustering on and attacking the stems and leaves of alfalfa. (After Webster.)

Our knowledge of these often invisible intruders is all too limited, but it is rapidly increasing, and we need not be nervous. The fungi send minute threads, hyphæ, into the plant tissue and bring disease, often death. The mass, or tangle, of hyphæ forms the mycelium. A

black hard mass often found forms the sclerotia; minute cells, known as spores, are usually formed. These are the seeds, if we may so speak. The spores, mycelium and sclerotia, each and all, will reproduce the fungus.

The mycelium often appears as mold. If spots, wilt, knots or any blight appear on leaves, stem, crown or roots, we may suspect that some fungus is present. We may introduce a fungus in our seed, or we may

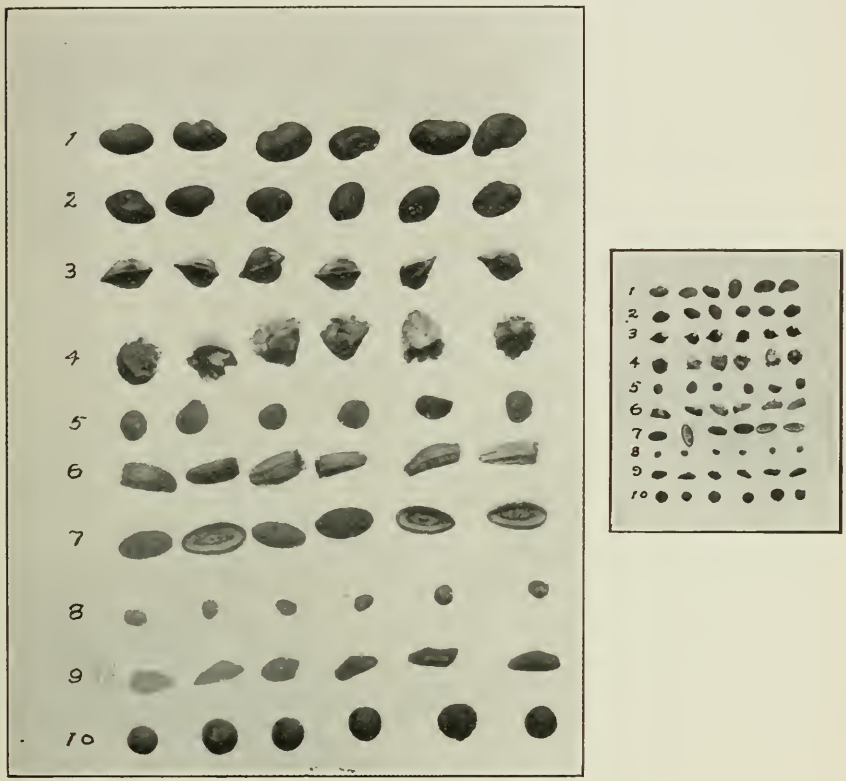

FIG. 17.—Weed seeds that are often found as impurities in commercial alfalfa seed; photo to the left much enlarged; seeds on right natural size. (1) alfalfa, (2) sweet clover, (3) curly dock, (4) Russian thistle, (5) dodder (*Cuscuta* sp.), (6) chicory, (7) plantain, (8) dodder (*Cuscuta planiflora*), (9) black seeded plantain, (10) charlock. (Photo by Geo. P. Weldon.)

introduce it by soil inoculation from a field where the fungus exists. The spores may be conveyed by wind, so we are all interested in keeping these fungi entirely out of our State.

The copper sulphate (bluestone) solutions, lime-sulphur spray and the cutting out of blight, as soon as it appears, are the methods of control.

IRRIGATION.

In some cases the water table is so high that subirrigation is possible. This of course is a great saving of labor. It is estimated that five per cent of the alfalfa is thus watered. My own ranch on the Sacramento

River is an illustration. In such cases we must watch that the water table does not rise fatally near the surface, and that injury from the rise of alkali is not risked. Silt soils along rivers in California are usually so well drained that danger is greatly lessened.

Four methods are used in our arid regions to bring water to the plants: Strip, or border, check, flooding and ditches. See Farmers' Bulletin, U. S. Dept. Agr., No. 373.

Border irrigation is used when much water is at command; it is inexpensive to operate. The cost of preparation is an objection. Here long narrow strips are surrounded by levees to retain the water. A head ditch at the upper end with adjustable gates lets in the water. The ground must be well graded. If the grade is considerable, the separate pieces may be contoured. This method is much used in parts of California.

The check system has small square or rectangular areas, also enclosed each with a levee. If necessary, these may run in contour lines. Water is introduced into each by a gate. In applying water, the highest check is watered first. In both of these methods the irregularities are inconvenient. This method has the same advantages as the border, but to a less degree. These small checks are desirable in very sandy areas and in very stiff clay. The objections are also the same, rather exaggerated.

The flooding method is most common. It permits quite a grade and even depressions. By means of laterals from the head ditch water is carried to the highest points, and there laterals follow contour lines. Canvas dams, or manure, may be placed in the laterals to hold back the water to irrigate each succeeding level in turn.

In certain places furrows are used much as they are in orchards, especially in the case of irrigating cover crops. Here slow percolation gives the needed water supply.

Usually three irrigations a season are sufficient though many irrigate after each cutting. Of course the character of the soil is the factor which controls in this case. Clay holds moisture much longer than does sand. As in orchard work, the plants should never feel the need of water. Such vigor as shown in the alfalfa field calls for a great water supply.

ALFALFA IN THE ORCHARD.

Orchardists often grow alfalfa among the trees. If as is said: "Alfalfa boards itself and pays for the privilege," then this practice is not to be brushed lightly aside. Mr. Hampton of Corona has grown alfalfa in his citrus orchard, he thinks with advantage. I have seen an olive orchard in Tehama County which had been greatly benefited apparently by the presence of alfalfa. I am told that the best orchards in Yakima, Washington, are growing great crops of alfalfa as well as of finest apples. In case alfalfa is grown among the trees great quantities of water must be at command, else it is not to be thought of. Of course it would be better for the orchard to leave the alfalfa wholly for manure, but it might pay better to cut it and feed to stock, using the manure formed to fertilize the orchard. The large amount of water demanded by alfalfa, may be harmful, possibly fatal, to some varieties of fruit trees.

GROUND ALFALFA.

Alfalfa meal is a new product that gives good promise. It is a very valuable nutritious food, and the grinding utilizes the leaves, stems and all and very likely makes all more digestible. It is said that when ground it is one fourth more valuable for feeding lambs. It is even suggested that this may become a valuable human food. Certainly strange things have happened over and over. Why not this?

THE LARGE NARCISSUS BULB FLY.

(*Merodon equestris*, Fab.)

Order—Diptera. **Family—Syrphidæ.**

By Leroy Childs, Assistant Secretary, State Commission of Horticulture.

Among the many interesting insects that this office is continually receiving is one, a bulb fly from Sutter County, the larvæ of which were taken living in and destroying the bulbs of narcissus. The fly belongs to the family *Syrphidæ*, a group which is for the most part decidedly beneficial in that the larvæ, during their development, feed predaciously upon many small soft bodied injurious insects, the most prominent of which are the plant-lice or aphids.

The bulb fly has also been taken by Mr. B. B. Whitney at San Rafael, California, where he reports it living in the bulbs of Amaryllis. The material that was taken in this locality was forwarded to Prof. J. M. Aldrich from whom a determination was obtained together with some other interesting information relative to this species. The following quotations are taken from the letter of Prof. Aldrich to Mr. Whitney:

> "The fly you sent is *Merodon equestris* Fabr., a well-known enemy of the Narcissus and allied plants in Europe. It has been imported in bulbs from Holland probably many times, and has thus made its appearance occasionally in the East; it is also reported from British Columbia by Osburn (Canadian Entomologist XL-10), who says it occurs so widely there that he believes that it must be native. * * * I do not find that the insect has been treated from the economic standpoint in American publications, or only to the extent of mentioning the habit. * * * There are no records of the western occurrence of the species except in British Columbia as cited."

The native habitat of *Merodon equestris*, as this bulb fly is called, is Southern Europe, from where, following the plantings of its favorite food, the bulbs, it gradually spread into England and Northern Europe, and later to other continents where it is now known to occur in the Americas and New Zealand.

In Europe this species has inflicted at various times considerable damage, often reducing very appreciably the profits of the bulb dealers and growers, to say nothing of the destruction of lilies in the gardens. So far as is known the pest has never been reported occurring in alarming numbers in the United States, and exceedingly little is known relative to its distribution.

The larva of the grub feeds vigorously upon the soft interior scales of the bulbs, completely hollowing out the centers, in many instances a thin shell only remaining (Fig. 18). The maggot does not always totally destroy the bulb, and occasionally infested bulbs will grow and

develop flowers, but are lacking in sufficient vitality to reproduce more bulbs. The infestation is often very difficult to detect, especially in cases where this period has been of short duration. The best method of ascertaining the presence of a larva, or a bulb that has been hollowed out by the feeding maggot, is recommended by Mr. R. Stewart MacDougall[1] as follows: "It is often difficult to say without opening a bulb that a Merodon grub is present within, but in typical cases, when the grub has been at work for a considerable time, the infestation can be recognized by the bulb 'giving' on being squeezed between finger and thumb."

FIG. 18.—Larva of the Narcissus bulb fly and infested lily bulb showing the characteristic feeding habits of the insect. (Original.)

Larvæ. The larvæ (Fig. 18) are very conspicuous, light grey grub-like maggots, measuring from one half to three fourths of an inch in length and about 2½ times as long as broad. The segmental rings are very distinct and deeply indented; the body is decidedly arched on the dorsal surface and flattened on the under side. The head can not be differentiated from the rest of the body. At this end are two mouth hooks and a pair of spiral openings or breathing tubes. Both hooks and tubes are composed of rigid black chitin. On the posterior end near the center is a small black projection, flattened at the extremity and much resembling the snout of a pig in outline; two openings may be noticed by close observation. These are the posterior spiracle apertures.

[1]Narcissus Flies, R. S. MacDougall, Journal of the Board of Agriculture, October, 1913.

Pupa. The pupa is very dark grey-brown; distinctly ridged by transverse segmental rings. At the anterior end two small horn-like projections will be noticed. These are the spiracle openings.

Adult. The fly (Fig. 19) is a large somewhat hairy insect about the size of a honey bee, and is very active. It first makes its appearance in late spring or early summer and will be found about the flowers in the sunshine in infested areas. The head, thorax and anterior part of the abdomen are black, the tip of the latter possessing a thick covering of light brown hairs.

The adult insect will be found flying throughout the greater part of the summer and during this period the females are depositing their eggs. This fact will account for the various sizes of maggots that may often be noticed. The eggs are placed, as a rule, at or near the base of the leaves, close to the ground. The young larvæ upon hatching make their way into the bulb by gnawing and eating their way through the succulent scales, here to undergo their development. Occasionally a

FIG. 19.—The large Narcissus bulb fly, *Merodon equestris* Fab. (Original.)

maggot will leave a bulb before its complete consumption or before it reaches maturity and enter another bulb. When food is plentiful, however, the maggot only rarely leaves the host plant until ready to pupate, which usually takes place near the surface of the surrounding soils.

Control. Before planting bulbs carefully examine for the presence of the worm. Care at this time will often save an infestation. Submit each to a thorough test by pressing them between the thumb and fingers. If there is a distinct "giving" resulting from this pressure examine with a knife. If the larva or its burrow is found to exist discard all such bulbs.

Driving out the larvæ by placing the bulbs in water has been used in England with varying success. The bulbs should remain in the water for from two to eight days, during which time most of the maggots will leave the host plant and drown. The bulbs should be thoroughly dried after this process.

The following recommendation for the control of this insect is taken from Collinge's Manual of Injurious Insects: "Whenever an attack is noticed the bulbs should be taken up and burned and the top soil deeply buried. This should be done in September or early in October."

Host Plants. The following genera of the lily family have been reported[2] as subject to the attack of *Merodon equestris*: *Narcissus, Amaryllis, Vollota, Habranthus, Eurycles, Saltonia* and the bulbs of the wild hyacinth, *Scilla nutoris.*

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[2]Journal of Board of Agriculture, p. 595, R. S. MacDougall.

GENERAL NOTES.

THE SEASON'S WORK WITH HIPPODAMIA CONVERGENS.

During the season of 1914 it is our earnest desire to carry on the distribution of this beneficial insect on an even greater scale than in the past. Mr. Branigan, our collector, has finished his preliminary scouting work in the Sierras, and reports a number of excellent colonies which have not heretofore been utilized. This is encouraging, and we confidently expect to exceed the one hundred million mark before the end of the present year. This means that much additional work will be thrown upon the insectary force with no increase in assistants, and we therefore earnestly solicit the co-operation of the public, that the work may go forward with as little friction as possible.

We will probably make a radical change with regard to the handling of this matter in the Imperial Valley, where perhaps one half to two thirds of our entire supply is colonized. During the past four or more seasons the European grain aphis, *Aphis avenæ*, has been the cause of very great loss to the barley growers of that section. Its season of greatest abundance is from February up to the melon aphis season, *i. e.*, May and June. This grain aphis is one of the favorite foods of *Hippodamia convergens*, and as it occurs in such great abundance at the time just previous to when the melon aphis begins to appear, it is thought that, in theory at least, we can better serve the interests of the melon growers, and at the same time be of assistance to the grain men, by releasing the ladybirds upon the barley aphis during February. This should give them an opportunity to go through a full generation before the melon aphis becomes abundant, and the force brought to bear against the latter pest should, theoretically, be very greatly augmented. It is hoped, by this practice, that the melon aphis plague will be "nipped in the bud."

This will, of course, mean that we can not supply ladybirds to the cantaloupe growers later in the season, because practically the entire quota for Imperial County will be distributed in the barley fields during February. For this reason, unless our plan is changed, we respectfully urge that the melon growers in Imperial Valley do not send in applications for ladybirds, as it will only unnecessarily increase the correspondence of the insectary. We will do our utmost to take care of the melon aphis problem in co-operation with the county horticultural commissioner, Mr. Waite. Cantaloupe growers outside the Imperial Valley will, of course, send in applications as in previous years.

With the exception of the Imperial Valley the distribution of *Hippodamia convergens* will be carried on practically as in the past, but we would urge that all who desire colonies of these insects make their applications through their county horticultural commissioner instead of directly to the insectary. The ladybirds will be shipped either to the

commissioner for distribution or direct to the growers themselves, according to the wishes of the individual commissioners. This will avoid much waste, as it enables the commissioners to investigate the requests and to ascertain whether or not there is a real necessity for the colony. Unfortunately, a few growers apply for the ladybirds when they have no need for them, merely because they are furnished free of charge. In this way many are wasted, and as the supply is never equal to the demand, many growers who have a real reason for asking for the insects are unable to obtain them. This we believe can be remedied to a considerable extent by having all applications come through the horticultural commissioners of their respective counties.—HARRY S. SMITH.

THE CALTROP OR GROUND BUR-NUT.

(*Tribulus terrestris.*)

The ground bur-nut was first sent to the Commission of Horticulture by Mr. K. S. Knowlton, Horticultural Commissioner of Kern County,

FIG. 20.—The caltrop or ground bur-nut, showing the seed burs and leaves. (Photo by Leroy Childs.)

September 3, 1912. At that time Mr. Knowlton stated that the weed was scattered to some extent in the immediate vicinity of Bakersfield, growing along the sides of the streets and on vacant lots. The specimens were forwarded to Prof. H. M. Hall of the University of Cali-

fornia and determined by him as the ground bur-nut, *Tribulus terrestris.* Regarding it he also made the following comments:

> "It is an undesirable immigrant which is becoming well established in the upper San Joaquin Valley, spreading especially from the railroads. It has also quite recently appeared in the coast side of the mountains."

No other information regarding the weed was received by this office until September 26, 1913, when Mr. H. H. Bowman, Horticultural Commissioner of Placer County, forwarded specimens, asking for a determination, which was again made by Professor Hall. I have since been informed by Carl J. Ley, Horticultural Commissioner of Glenn County, that he has taken the weed in his county.

The exact distribution of the plant has not yet been definitely settled but in all probability it is quite widely scattered by this time. As little is known relative to the seriousness of it as a pest a letter was directed to the Chief of the Bureau of Plant Industry, U. S. Department of Agriculture, under date of October 14, 1913, and a reply from Mr. H. R. Cox, under date of October 21, follows:

> "Your letter of the 14th, relative to *Tribulus terrestris,* is received.
>
> "This plant, to which the common name of caltrop is given in Gray's last edition, is an annual plant introduced from Europe and appears to be widely scattered in many parts of the United States from the Atlantic to the Pacific. Our records show that we have had but one inquiry on this subject which came from New Jersey, the statement accompanying it that it was very abundant that year, some of the plants covering a space of three feet in diameter. I would suppose it could be handled in much the same manner as any other annual, that is by preventing seed production. I am sorry we can not give you more definite information on this subject."

The weed is an annual and control methods as employed against the Russian thistle will in all probability be efficient in handling this pest. Mr. Knowlton, especially, has conducted a vigorous campaign for its extermination and we believe that any such campaign is always advisable, as prompt action may prove the extinction of what might become a very undesirable weed pest.—E. O. Essig.

NOTICE REGARDING SEED TESTING.

Inasmuch as the Agricultural Experiment Station is maintaining a laboratory for the purpose of testing all kinds of seeds with regard to their purity and germination, the Horticultural Commission has decided to discontinue that particular line of service to the growers. Samples for testing, properly labeled with the name of sender and other distinguishing marks, should be addressed to "The Seed Testing Laboratory, Agricultural Experiment Station, Berkeley, California."—Harry S. Smith.

A JAPANESE FORMULA FOR DESTROYING THE WOOLLY APHIS.

Mr. T. Machida[1] of Japan has recently found a very satisfactory wash formula which has been found to be of much value in the control of the woolly apple aphis. His recommendations for the various ingredients to be used are as follows:

Rape-seed oil	$3\frac{1}{3}$ pints
Sulphur	$1\frac{1}{2}$ ounces
Turpentine	$7\frac{1}{3}$ ounces

The rape-seed oil should be boiled alone for a very short time followed by adding the turpentine slowly, stirring continually until they are thoroughly mixed. Stir in the required amount of well crushed sulphur. Use a strong fire and allow to cool, when the mixture assumes a darkish color. Paint the attacked parts of fruit trees. This wash can also be recommended for use in the control of other aphids and the destruction of their eggs.—S. Nakayama, Stanford University.

[1]Rev. The Insect World (Gifu, Japan) Vol. XVII, No. 2, pp. 33-36 (Feb. 1913).

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent, State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plants as near as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

The Almond Mite.

Although the mites are not insects they may be just as injurious in the orchard. The almond mite or clover mite, as it is sometimes termed, is one of the more important pests of the almond, as well as many other deciduous fruits. The young mites, smaller than the head of a pin, are red and become brownish on development into the adult stage. They deposit their egg masses in the fall on the twigs. These hatch in the early spring and as the mites reproduce in great numbers much damage often results to the tender growth of the tree. The commercial lime-sulphur solution with flour paste as a spreader seems to be more effective than the dry flowers of sulphur in the control of this mite. The formula used by Mr. W. H. Volck consists of water, one hundred gallons; flour paste, four gallons; lime-sulphur solution, five quarts, and iron-sulphate, two pounds. The lime-sulphur and the flour paste are mixed in the tank before adding the iron-sulphate. Thorough agitation is essential to good results.

The Pear-leaf Blister Mite.

Another mite destructive to fruit is the pear-leaf blister mite. It causes the reddish or greenish spots to appear on the young foliage of the pear and apple. Later on the spots become brownish and dead, impairing the leaf functions to a large extent, if the mite happens to appear in great numbers. They may be seen during the dormant season on the trees under the bud scales and deposit their eggs, which soon develop into young, in the interior of the newly developed leaves. The only stage in which the mite can be commercially controlled is the adult, as the eggs and young are inside the leaves where no spray will reach them. Only severe cases will warrant a special spraying. A. L. Quaintance[1] recommends lime sulphur washes, using the commercial preparation or the home-made, which consists of lime, 20 pounds, sulphur, 15 pounds, and water to make 50 gallons. The application should be made just before the foliage is out and must be thoroughly applied.

The Spring Canker-worm.

According to Essig, the spring canker-worm is distributed throughout the apple growing sections of the central part of the State.[2] It attacks the foliage of the elm, apricot, cherry and prune. The caterpillars often cause the entire defoliation of their host. Early in the spring, often in the winter, the wingless female moth crawls up the tree trunk to deposit its egg masses on the bark. Tree tanglefoot or any adhesive bands which will prevent the ascension of the female moth into the upper portion of the tree will be effective. These should be applied near the first of March. The egg masses will then be placed below the

[1]A. L. Quaintance, Circular 154, Bur. Ent., U. S. D. A., p. 6.
[2]E. O. Essig, Injurious and Beneficial Insects of Cal., p. 185.

bands and either they or the young larvæ as they appear can be readily destroyed. Arsenate of lead, 5 pounds to 100 gallons of water, sprayed on the foliage will destroy the young caterpillars if they succeed in reaching the upper portions of the tree.

The Codling Moth.

The small flattened whitish-eggs of the codling moth are laid on the leaves and fruit of the apple and pear by the adult moths which first emerge about the time the trees are in bloom. The first brood larvæ enter the fruit soon after hatching and remain there from three to five weeks, after which they will leave the fruit, passing the resting stage in cracks and under the bark. Another generation of moths emerge which is much more destructive than the first. Generally there are two broods which greatly overlap. The codling moth is one of the easiest to control. In unsprayed orchards the percentage of wormy fruit often runs as high as 80 per cent. In general three applications of arsenate of lead, 5 pounds to 100 gallons of water, are necessary to control this insect on apples, and two applications on pears. The first application must be made when the petals are 90 per cent off and before the calyx cups close. A high pressure in spraying should be maintained and all parts of the trees covered.

The Pear Thrips.

In a previous issue of the Monthly Bulletin a brief description of the appearance and work of the pear thrips was given. Its importance as a pest can not be overestimated as its sudden attack may completely wipe out all prospects for a crop of fruit. At the time they appear on the trees in numbers, Jones and Foster[1] recommend thorough spraying, using high pressure, holding nozzles close to the buds and directing the spray into the ends of the buds. The government formula consists of three per cent distillate emulsion combined with black-leaf 40, 1 to 2,000 parts of water.

CITRUS FRUIT INSECTS.

The Citrus Mealy-bug.

During the past two or three weeks there has been much discussion as to the best methods for controlling the citrus mealy bugs. The insect in question is a soft-bodied mealy-coated sucking insect about one fourth of an inch in length in the adult stage. The female deposits large numbers of eggs in a cottony mass. The small young mealy bugs are very active and soon seek out the tender foliage or fruit. There are a number of generations each year overlapping to a large extent, but they appear to do the greatest damage in the fall and spring months. Mr. E. O. Essig, one of the best authorities on the control of this pest, finds that a carbolic acid emulsion spray, plentifully applied (from 10 to 15 gallons to an average sized tree), under a pressure of two hundred pounds is the principal remedy. The two angle "Bean Jumbo" nozzles on a "Y" to each rod give excellent results. Sometimes two or even four applications, a week apart, are necessary. The winter or early spring seems to be the most advantageous time for spraying. Fumigation has given good results but has not been as effective as the emulsion. The ordinary black scale dosage is the one generally used.

[1]S. W. Foster & P. R. Jones, Cir. No. 131, Bur. Ent., U. S. D. A.

TRUCK CROP AND CEREAL INSECTS.

The Grain Aphis.

During the early spring the grain aphis is often very abundant in California on grain, especially in the Imperial Valley. The aphids are green soft-bodied lice which suck the juices from their host. Their capacity for reproduction is enormous, so that great damage results if they have had a sufficient start. We know of no practical remedy for them at the time they appear in the spring.

THE SUGAR BEET LEAF HOPPERS AND CURLY LEAF.

Curly leaf is a condition of the sugar beet which results from the attack of small insects known as the beet leaf hoppers. The adult insects are small pale yellowish-green species and have sucking mouth parts. Beets affected by the leaf hoppers have thickened curled leaves, are stunted, have black and concentric rings in the interior, knot-like swellings on the veinlets of the leaves and abundant fibrous roots. Beets may remain in this condition the entire season or shrivel and die, although sometimes they may recover, the sugar content remaining low. In 1905 the Utah beet crop fell below the average, about 75,000 tons, resulting from the attack of these beet leaf hoppers, the loss amounting to approximately a half million dollars. In June, 1913, the writer noted a field of beets having the curly leaf condition at Davis, California.

By ascertaining the best time for planting in affected localities we may avoid much of the damage done by the leaf hoppers. For an extended account of these insects and their relation to the curly leaf of beet the reader is referred to Bulletin No. 66, Part IV, Bureau of Entomology, U. S. Department of Agriculture, by Doctor E. D. Ball, of the Utah Agricultural Experiment Station.

The Asparagus Beetle.

The adult beetle is about one fourth of an inch in length, bluish-black with a red thorax marked with black dots. The wing covers are of a yellowish color and are marked with black. The grayish colored larvæ have black heads and legs. The beetles pass the winter in some protected place and appear as soon as the asparagus shoots emerge from the ground. They lay their eggs on the tender shoots which hatch in about ten days, the young larvæ feeding on the sprouts. Control measures used against this insect consist of cutting and burning egg-infested shoots, and after the crop has been harvested spraying the plants with arsenical sprays, using one pound of lead arsenate to 16 gallons of water.

FUNGOUS DISEASES OF PLANTS.

Brown Rot of Stone Fruits.

Brown rot is a fungous disease causing the fruit to decay while still on the trees as well as attacking the flowers and new shoots which soon die back. Besides, the fruit in shipment or on the market is also damaged. The peach, plum, apricot and cherry act as hosts of this fungus. According to R. E. Smith, in bulletin 218 of the California

Experiment Station, no definite remedy has been demonstrated in California, but self-boiled lime-sulphur, just as the fruit is setting and again after the rains are over, is recommended for trial.

Anthracnose of Beans.

Bean anthracnose is a disease of fungous nature which attacks the pods, stems and leaves. The scabby spots are most conspicuous on the pods. These appear as purplish discolorations which later become dark and sunken. The spores are of a pinkish color and if abundant give the spots that tint. In the control of this disease clean seed, the use of Bordeaux mixture, 5/5/50 formula sprayed on the plants is recommended by Duggar. Burning infested material and rotation of crops are important.

Winter Blight of the Tomato.

Winter blight occurs on the winter shipping crop or in early spring plants. The leaves and stems are blackened and killed and spots appear on the fruit causing it to soon decay. Bordeaux mixture 5/5/50 formula, sprayed on the plants following a rain holds the disease in check. The late blight of the potato is also caused by this fungus.

Apple and Pear Scab.

A fungus produces the scabby patches on the fruit and leaves. Bordeaux mixture 5/5/50 formula is used just as the buds are opening; a second or third spraying is sometimes applied at later intervals. Conditions determine the number of applications to be made.

Peach-leaf Curl.

Entire defoliation of the peach may result from a heavy infestation of the leaf curl fungus. The young branches and fruit, together with the flowers, are also subject to attack. Gummy exudations may appear on the enlarged twigs which may become distorted in cases of serious infestations. This disease caused a loss of about three million dollars in the United States before satisfactory preventative measures were used. Apply lime-sulphur or Bordeaux mixture just before the buds open in the spring. Subsequent sprayings are of little importance. A good thorough application is necessary in order for the fungicide to become effective.

INSECT NOTES.

CONDUCTED BY THE EDITOR.

Mr. J. P. Lyons, a large barley grower of Brawley, reports the **barley aphis**, *A. avenæ* (Fab.) Perg. doing serious damage to that grain in the Imperial Valley.—HARRY S. SMITH.

The maple plant louse, *Drepanaphis accrifolii* (Thos.) has recently been reported as occurring on maple at Hanford, California, by B. V. Sharp, and the writer has repeatedly taken it on maple trees at Sacramento.

San Jose scale, *Aspidiotus perniciosus* Comst. has been found existing in very great numbers in pear orchards in Yolo County near Sacramento.—LEROY CHILDS.

Mr. Edward J. Branigan, who has spent considerable time during the past two months scouting for *Hippodamia convergens* colonies in the Sierras, reports an unusually good supply, but difficulty will be experienced in getting them out this season owing to the closing down of the mines, where the collectors formerly made their headquarters.—HARRY S. SMITH.

Mr. Geo. A. Lamiman has recently sent in some fine specimens of the **willow scale**, *Chionaspis salicis-nigræ* (Walsh), collected at Castella, California, on maple (*Acer* sp.). This is the first time that maple has been reported as a host of this insect.—LEROY CHILDS.

The strawberry crown-borer, *Scsia rutilans* (Edw.), has been received from H. H. Bowman, Horticultural Commissioner of Placer County. At this season the insect is hibernating in the larval stage in the crowns of the strawberry plants.—January 7, 1914.

County Commissioner Geo. H. Hecke of Yolo reports the **European fruit scale**, *Lecanium corni*, still in excellent shape for successful spraying.—GEO. P. WELDON.

The ivy or oleander scale, *Aspidiotus hederæ* (Vall.), has been sent to the office by C. W. Beers of Santa Barbara, where it was found on palm leaves. The writer has taken this species on both leaves and leaf-stems of palms in many localities and its distribution is quite universally established in the state.—LEROY CHILDS.

The orange tortrix, *Tortrix citrana* Fern, is quite common infesting the fruit of the navel orange trees in the vicinity of Upland, California.—January 16, 1914.

The white sage mealy bug, *Pseudococcus crawii* (Coq.), occurs at this season in the vicinity of Upland upon the large stems of the white sage close to the surface of the ground.—January 17, 1914.

The artemisia mealy bug, *Pseudococcus artemisiæ* Essig, was collected in the vicinity of Upland, California, January 16, 1914, upon the roots of the California sage, *Artemisia californica*. The adults are distinctly lead colored and have short white anal filaments.

Baker's mealy bug, *Pseudococcus bakeri*, Essig, has been collected in the vicinity of Upland, California, upon the following host plants: foliage and fruits of oranges and lemons, roots of nightshade (*Solanum douglasii*) and wild sunflower, also upon the grevillea, ivy, *Senecio* sp., and a few other ornamental plants.

The nightshade mealy bug, *Pseudococcus solani* Ckll., has recently been collected in the vicinity of Upland upon the roots of nightshade, wild sunflower and tomatoes.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Mr. O. E. Bremner recently made the important discovery in Sonoma County that certain nursery trees shipped in from the outside were diseased with the oak root fungus, *Armillaria mellea*. We quote in part from a letter written by him on December 30th, as follows:

> "On December 22d there arrived at Sebastopol, two shipments of nursery stock; one of these consisted of 685 Imperial prunes, the other contained 200 sugar prunes. Upon examination both appeared to be infected with oak root fungus. They were, therefore, held while samples were sent to the Whittier Plant Disease Laboratory, and last night we received word confirming our diagnosis. These trees may not have been grown in California, for I find that many nurserymen are importing from Eastern states and Oregon and are then reshipping to other parts of the state, and only last week we refused to issue our certificates for some of this stock, obliging the nurserymen to ship under the original tags."

The fact that this disease may be disseminated by the planting of affected nursery trees necessitates the greatest care on the part of all county commissioners in looking over nursery stock, that its presence may be detected. To spread such a disease broadcast in this manner would be little short of a calamity and Mr. Bremner deserves the co-operation of every commissioner in the state in his efforts to prevent such trees from being planted.

The following horticultural commissioners have been reappointed for the coming four years: Geo. W. Harney, Yuba County; H. P. Stabler, Sutter County; H. H. Bowman, Placer County; Roy K. Bishop, Orange County.

In Riverside County R. P. Cundiff, after long years of service as a commissioner, during which time he has made a host of friends, was succeeded by David D. Sharp. Mr. Sharp has been working under Mr. Cundiff and is well qualified for his new position.

In Tulare County Charles F. Collins was appointed in place of A. G. Schulz. The latter has been a faithful worker as commissioner in his county for the past four years. Mr. Collins is a wide-awake peach grower of the county and those who know him best bespeak success for him in the work of county horticultural commissioner.

Report of the State Board of Horticultural Examiners.

Since the last report examinations for eligibles to the position of county horticultural commissioner have been held with the following results:

Los Angeles County—
- Roger Palmer.
- A. G. Smith.
- B. R. Jones.
- William Wood.
- Murray J. Black.

Yolo County—
- G. H. Hecke.
- Fred C. Brosius.
- Wm. Gould.

Butte County—
- Earle Mills.

Nevada County—
- D. F. Norton.

Mendocino County—
- Guy E. Alpynne.
- E. W. Dutton.
- W. M. Brandt.
- Claude Van Dyke.

A. J. Cook,
Thomas F. Hunt,
Harry S. Smith,
State Board of Horticultural Examiners.

By Harry S. Smith, Secretary.

NOTES AND RECORDS OF COUNTY HORTICULTURAL COMMISSIONERS.

Address, State Fruit Growers' Convention, San Jose, Cal., December 2-4, 1913.
By R. S. VAILE, County Horticultural Commissioner, Ventura County.

The title which has been announced for our discussion might appear to be better fitted to a meeting of the horticultural commissioners alone than for this more general assembly, but I hope to show that it is general in its interest. As one of the younger of the county commissioners I would hesitate to present this matter to you were it not that many of the points covered have been made to me by other commissioners. In fact, almost every one of our body has been so kind as to send me suggestions for this paper, and what I will present is a composite of many ideas. For this reason, when I use the plural pronoun I refer in a general way to all the county commissioners.

In the first place it will be necessary to explain with some detail the nature and scope of our work, so that the reasons for and purpose of our records will be clear. Incidentally, it is hoped that in this way you may arrive at an appreciation of the breadth of our activities which will add materially to our usefulness, for only with complete appreciation from the public which we serve, can the best work be accomplished. Later we will turn our attention to the form of record which seems best fitted to the needs of such an office.

Our work falls naturally under four main divisions. The first of these divisions deals with our quarantine inspections of all plants and other horticultural shipments moved into, out of, or within our separate counties. Some record is kept of each shipment that is handled, and in some counties these records are quite detailed. The consignee, kind and number of plants are noted so that, in case of fruit trees, the orchard census may be kept complete. The shipper is noted so that if some disease is discovered in the inspection or later its origin will be known. Any pests and treatment for same are noted so that this work may be followed by subsequent inspection to make sure that eradication is complete. Many times, in case of fruit trees, records of particular varieties planted, together with kind of root stocks, are kept so that in after years an accurate line can be obtained on those best adapted to a certain environment.

From time to time these reports are extremely valuable. As an example, the commissioners and inspectors are able to predict with considerable accuracy a good many things concerning incoming stock, from the records of diseases or pests found, and an interesting fact is that we usually agree regarding any special nurserymen or districts.

Again, some months ago, when Dr. Briggs of the Bureau of Plant Industry took up the work on the citrus nematode, he felt that it would be a big help in the problem if the type and origin of the citrus root stock in our orchards were definitely known. Our office was able to partially furnish that data for recent years, and will have it complete for future plantings. The writer's work on this particular problem has convinced him that this worm is not native in some of our important districts, and such a conclusion could not have been reached had not the data on the origin of stock been at hand.

Again, each fall the particular office of which the writer has charge receives many inquiries regarding the best root stock to use with apricots under certain conditions. The State University can answer this question in a general way for general conditions, but our office is gathering data on this point by keeping track of individual shipments which in a few years will be of great value to every district in our county. These are merely examples of points on which no other organization is in so good a position to get absolute data for individual localities, and if our records are properly kept they should form a large supplement to the University experiment work.

The second main division of our work is the orchard inspection for scale pests and plant diseases, including, of course, field inspection for weed pests, etc. The third division is the treatment of infested orchards and fields. In our records the inspection and treatment are kept somewhat together. In many ways we may be likened to field superintendents of horticulture on large ranches, with the whole county as our field. We must be familiar, a good deal in detail, with conditions in various districts and even in individual orchards. In the best organized of our counties each local inspector is expected to know, personally, the condition of every orchard in his district. Such facts as he turns in to the commissioner regarding these orchards are so tabulated by the latter that the essential points can be referred to at any time. In some of the smaller counties, where there is a minimum of work, much of the necessary data can be remembered fairly accurately during the term of a commissioner, but in the larger counties this is impossible, and nowhere is it possible to pass on information to a new administration without carefully prepared written records.

Referring again to the Ventura County office (and this is equally true of almost all the offices), any one can find out from us when any particular grove was inspected, what was found in it, whether it has been treated, etc. For instance, a little over a year ago the oak root fungus (*Armillaria mellea*) was found in Ventura County. Since then its distribution has been quite generally worked up, and the owners of infected trees have all been notified of its presence. Records of these inspections are on file, and from them the rate of spread in various soils, etc., may be determined. On the other hand, certain old reports of this office show that pests were found in certain districts of the county, and were treated, but it is impossible to find the exact, or even approximate location of these infestations, and in order to be sure of the work the whole district would have to be reinspected.

Other items which are frequently kept regarding treatment work are the method, the operator, the cost, and the result. In some counties all operators are licensed and as the responsibility of granting such licenses rests largely on the commissioner, data of the sort mentioned is necessary to know if these licenses should be continued or revoked. Besides that, the grower will very often feel that the cost is too high and our office will be appealed to for an opinion. It is a significant fact that in no case where the records of cost of previous treatments were on file in the writer's office has there been the least trouble in deciding the controversies that have arisen.

The fourth division of our work is experimental. Although some claim that this is not our sphere, yet in my judgment it is almost essential that at least a certain amount of experimentation be carried on in

conjunction with the work prescribed by law. In very many cases the best treatments for specific troubles under given conditions have not been worked out, and in order to remedy the trouble, someone must conduct experiments. The State University and the U. S. Department of Agriculture are doing what they can along these lines, but many times they are unable to find opportunity for particular work. In such cases the county commissioner is the logical person to take up the problem and much valuable work has been accomplished throughout the state in this manner. Co-operation between University or Department experimenters and county commissioners is often a very desirable way of carrying out lines of work. The results of this work should be recorded in such a manner as to be available in the future, both as to positive and negative results, not only to the commissioner himself, but to the grower and the other experimenters as well.

So much for the general statement of the type of information which our offices carry. We might spend some time going further into the details of our work, but after a brief reference to the office library, we will leave this side of the question.

Practically all of our offices have at their immediate command a collection of agricultural and horticultural literature, always available to the public, which covers a wide range of subjects, including distribution and control of pests, adaptability of crops to soils and climate, cultural methods, etc. This is usually so arranged that all the data on any particular subject can quickly be gathered together.

We hope that enough has been said to show that our offices are maintained to be of service to the farmers, not a burden to them. We would make the further point, that we deal with more than the control of insects; we deal with the general health of the crop, including its adaptability to its natural environment, its general care, its liability to infection through outside agencies, and its varietal improvement. The average farmer might well make more use of our offices than he does, and even the state experiment station could at times find more valuable assistance from us then they do.

In order that the information which we gather in these several ways may be more easily and permanently available, we must arrive at the very best system for keeping records of all work and observations. In the first place there are certain official notices prescribed by law, namely, notices of abatement of pests and notices of lien on property after abatement. The form of these notices is practically the same in the various counties and is similar to other legal notices, so need not be given in this paper. I would merely say that these notices must be made out with great care, in duplicate, and a copy, with the affidavit of the inspector serving same, should be kept on file in the office.

Referring to the more general records, it will be impossible to describe in detail the systems adopted by the several commissioners. Suffice it to say that there are three main ideas around which the systems are built up. First, the daily ledger, showing in notebook form all the activities of each day separately; second, the large size, definite, record book, in which various data concerning a given shipment or grove are entered under prescribed headings on a single line or lines across the page; such data in some cases covering as much as a year of time. All work commenced during a certain week or month is entered

in the order in which performed and other notes on the particular case in question are entered later as occasion may require; third, card index system, with a separate card for each shipment and each grove, on which may be shown records of inspections, with pests found; records of treatments, with material used, and results; and if desired, a cross reference to other cards showing the same pest or treatments in other cases. This system has appealed to the writer as so far superior to the others mentioned that it will be presented in detail, with just this brief reference to the other systems.

For such a system there must be some method of designating the orchard besides the owner's name, for especially in the citrus districts property changes hands so often, that such a designation alone would mean very little. In Ventura County we have adopted a plan briefly as follows: The county is divided into several districts—for convenience road districts may be used, numbered consecutively through the county. Each of these districts is divided into zones by road boundaries and these zones are numbered consecutively through the district. Every grove or piece of property in the zone is numbered in rotation, following as far as possible a definite direction in numbering. In other words, each grove or piece of property has three numbers in our records, as for instance, Patterson Ranch, Simi, 14-1-21; Teague Lemon Co., Santa Paula, 5-7-8. These numbers are recorded on copies of county maps made in our office, which are on file both in our office and with the local inspector. A list of owners is kept in conjunction with the maps which may be corrected from time to time from the official county records or the personal knowledge of the inspectors. While there are great differences in the various localities, some such system could, I believe, be used to advantage in almost every county. We have not applied this system to town work where the houses and yards may be designated by house numbers, but have applied it to all parts of the county where there are commercial groves, and even to our bean and beet fields. We have also made provision for the addition of new numbers with the subdivision of property.

Let us turn now to a consideration of the records themselves. The illustrations which I will use are not exact copies from any of the offices but are a combination of ideas.

First there is the record from the inspector to the main office, and then a permanent record or summary for office filing. In all the inspector's notes, a form convenient to carry in the pocket seems advisable. These may be made up in the form of loose leaf books, or they may have perforated leaves with permanent stubs. Such a record for quarantine work includes variety of stock, amount, shipper, consignee, where grown, pests and treatment, and in the case of orchard trees, where planted.

Each inspector sends in these forms every week, when they are numbered in rotation through the month and entered on the forms to give the total inspections, or the number treated or rejected and the reasons for same.

In so far as possible, similar records are kept, whether the shipment comes from outside the county or is grown locally. The co-operation of all the nurserymen, even the small ones, and the constant alertness on the part of the inspectors is essential in keeping this complete, but

if it is so kept our orchard census cards may be added to and corrected from the quarantine cards. The nursery cards may also be filled out in the same way.

A similar type of blanks may be used by the inspectors for the orchard inspection and treatment reports. Copies of the inspection sheets are sent to the owner as a warning or reminder whenever it is deemed wise to do so. In this way several of the commissioners feel that they avoid the unpleasantness of serving the legal abatement notices in many instances.

From these notes the data is at hand to fill in the orchard records for the office. On the reverse side of the treatment sheet there is opportunity for the inspector to note the various items which go to make up the county charge for the work in case the operator is the county. From this the bill can be made up in the office.

From time to time summaries may be made from the office records. For instance at the close of each fumigation season a list of properties treated is arranged according to rotation of orchard numbers. This record is on file in the office and a copy is sent to the inspector in charge of each district. By comparing this list with the numbered map and total orchard list, a glance is sufficient to show just what groves were and what were not treated. If these lists are available over several years, the planning of subsequent campaigns will be much simplified. More than that, the inspector will be in a position to say definitely when any grove was treated—something which many growers do not remember accurately. Summaries are also sent to the inspectors from time to time of all incoming stock treated or rejected anywhere in the county that they may know just what pests have been found from various localities or nurseries. Other summaries of similar nature are issued from time to time as they are thought advisable.

In case some special or new pest is found and is present only in limited amounts or on individual trees, cross section charts may be used to record the exact location of infection. In making a tree to tree inspection of any district or in making a forced cleanup looking to eradication of any pests, such charts are of especial value because with them a given orchard can be reinspected after treatment without going to every individual tree, but simply to those marked.

In the matter of data for experimental work, details as to form and arrangement depend entirely on the particular problem under consideration. The main requirements are accuracy, clearness, brevity, and availability. Some form of the card system, with cross reference, etc., always seems to me advisable for such work, as it most easily meets all these requirements. Special card forms may be devised for special cases or general notes may be entered and referred to by index.

Certain other things of a statistical nature are usually kept on file in our offices. Among these may be numbered crop yields, irrigation tables, cultural data, etc. These must be collected and arranged according to individual requirements and they hardly come under the scope of this paper.

To complete the card system, copies of all official notices, both abatement and lien, should be kept on file and should be indexed both by orchard number and pests. Action under such notices may be noted directly upon same, and of course such treatment would be listed on orchard cards.

The state law requires that monthly reports be submitted to the board of supervisors and that an annual report be presented to the State Commissioner of Horticulture. In recent years blank forms have been sent out for the latter purpose and the data gathered and recorded as above will easily be sufficient for filling in the points requested. The monthly report to the supervisors can also be easily compiled either as a detailed or as a general report from the office records. The one thing which must be included in these reports which we have not touched upon is the financial statement. This of course depends somewhat upon the type of bookkeeping in vogue in the particular county, as some auditors demand one thing and some another. The office records should, however, show in detail all the claims which have been O. K.'d by the commissioner and all the collections which have been made in payment for work done. In Ventura County we keep such general accounts as Material, Appliances, Labor, etc., showing each month the amount paid out by claim, or received in cash under each of these headings. A separate-leaf ledger is used, and the page number refers directly to the orchard number.

Doubtless there are points which have not been covered in this paper and doubtless there are conditions which will call for a variation in the program outlined. On the whole, however, the card index system is better adapted to variations than any other. It is also easy of interpretation and more especially it is complete and accurate.

My purpose was not to go too far into a detailed description of business efficiency; let us leave that for bankers and merchants to work out for us. I have hoped, rather, to show you the breadth of problems with which our offices are confronted, and the various methods by which we are endeavoring to aid in the agricultural development of our State. The time is coming when our offices will be in still closer touch with the experimental agriculture of the world; when better equipped men will fill our places; when the people will more and more look to us for authority and advice. In building for that time we must conduct, as nearly as possible, efficient and business-like institutions and the information which we gather in our various activities must be made available to all to the best of our abilities.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF DECEMBER, 1913.

By FREDERICK MASKEW, Chief Deputy Quarantine Officer, San Francisco, Cal.

With this report for the month of December ends a very busy year for the Quarantine Division. I carefully tabulated the statistics of the five coast stations to show the diversity as well as the totals and results of this work for the past year, but after much deliberation decided not to offer the same for publication. The activities of the horticultural quarantine officers at the ports of entry on the California coast line are too numerous to be presented in the form of a column of dry statistics. In perusing an agglomeration of numerals all color and definition is lost to the average reader, and I doubt very much if any fruit grower would take the pains to analyze the mass and deduce from them their actual meaning even if the same were published. What is it all about, is perhaps the substance of the remarks the array of figures would engender, and for the benefit of any one interested in the work of the horticultural quarantine service which has for its prime purpose the maintenance of land values in California, it is here set forth that an itemized record has been kept of each transaction, and the same is readily available to all parties interested. To those intimately acquainted with each detail of the work a résumé of last year's results brings out in strong relief a few items of interest concerning in particular the San Francisco station.

At this point the volume of business increased to the extent of 35 per cent more parcels intercepted and inspected than during the previous year.

The amount of material denied admittance into the State of California as a result of insect pests and diseases compared with the total imports decreased from .33 of 1 per cent in 1912, to .31 of 1 per cent in 1913.

The number of parcels intercepted in the baggage of passengers and members of the crews of vessels arriving at San Francisco from foreign ports increased from .37 of 1 per cent in 1912, to .42 of 1 per cent in 1913, or a gain of 1,530 parcels.

That we have been able to attend to this increase of one third more business with the same number of inspectors is due to their assimilation and practice of the system which has been put into the quarantine service. That we have been able to intercept for inspection this increase is due to the policy of the office in dealing with the transportation companies and enlisting their capable co-operation on the basis that the fundamental principle of the horticultural quarantine law is a matter that vitally concerns carriers and consumers equally with producers.

The reduction of the percentage of material denied admittance into the State while apparently trivial is highly important from an economic standpoint, as it concerns a class of goods that are very generally distributed throughout the State—fruit trees and ornamental trees and plants from Japan. A thorough systematic attempt to eliminate the causes for rejection of this class of material at the source of origin was undertaken by the writer, working in conjunction with the Japanese Consulate, at the end of last year's shipping season, and the far-reaching value of this policy is already apparent in the improved condition of the material that has arrived so far this season.

The matter of horticultural products in the possession of passengers and crews from fruit fly regions is the phase of the quarantine work upon which every energy is bent. It is paramount to, and takes precedence of all other inspection, and while but few of the parcels intercepted and examined are found to contain hosts of the fruit flies, the increase in receipts from this source is an index of the thoroughness with which the same is pursued.

Synopsis of Work for Month of December, 1913.

SAN FRANCISCO STATION.

		Parcels.
Horticultural Imports.		
Ships inspected	50	
Passed as free from pests		131,689
Fumigated		3,777
Destroyed or returned		117
Contraband destroyed		3
Total parcels horticultural products for the month		135,586
Horticultural Exports.		
Inspected and certified		850

Pests Intercepted.

From United States Hawaiian Experiment Station—

Howardia biclavis, *Parlatoria* sp. *Saissetia nigra* and *Coccus elongatus* on Hibiscus cuttings.

From Honolulu—

Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Lecanium sp. on betel leaves.

From Japan—

Cylas formicarius in sweet potatoes.
Weevils in chestnuts.
Pseudaonidia duplex, *Parlatoria pergandii* var. *camelliæ* and cocoons of *Thyridopteryx* sp. on camellia.
Parlatoria theæ var. *viridis* on maples.
Aulacaspis pentagona on peach.
Ceroplastes ceriferus on magnolia.
Poliaspis pini on pines.
Phomopsis citri, *Chrysomphalus aonidum*, *Chionaspis citri* and *Pseudococcus* sp. on oranges.
Aspidiotus sp. on bamboo.

From Holland—

Lepidosaphes ulmi on boxwood.
Aphis sp. on genista.
Aleyrodes and larvæ of *Thrip* sp. on azaleas.
Coccus hesperidum and *Aspidiotus britannicus* on bay.

From China—

Chionaspis citri, *Parlatoria ziziphus*, *Lepidosaphes beckii*, *Chrysomphalus aurantii* and *Phomopsis citri* on pomelos.
Cylas formicarius in sweet potatoes.

From England—

Aphis sp. on cannas.
Lecanium sp. on *Ilex*.

From Manila—
Calandra oryzia in broom corn seed.

From New Jersey—
Aspidiotus sp. on juniper.

From Florida—
Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From Porto Rico—
Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

LOS ANGELES STATION.

Horticultural Imports.

		Parcels.
Ships inspected	18	
Passed as free from pests		49,837½
Fumigated		407
Destroyed		1½
Returned		0
Contraband		0
Total parcels horticultural products for the month		50,246

Pests Intercepted.

From England—
Eriosoma lanigera and *Lepidosaphes ulmi* on trained apple trees.

From Florida—
Ischnaspis longirostris, *Lepidosaphes beckii* and *Phomopsis citri* on pomelos.

From Holland—
Aspidiotus perniciosus on trained apples.

From Japan—
Aleyrodes citri on gardenias.
Unidentified borers in flowering prunes.
Hemichionaspis aspidistræ on *Aspidistra lurida*.
Pseudaonidia pæoniæ on camellias.

From Louisiana—
Pseudococcus sp. on orchids.

From Ohio—
Cicada eggs on berry plants.
Unidentified borers on berry plants.
Phylloxera vastatrix on grapevines.

From Oregon—
Aspidiotus perniciosus on peach trees.

From Pennsylvania—
Ceratophis lataniæ, *Chrysomphalus aurantii* and *Orthezia insignis* on palms.

From Washington—
Eriosoma lanigera on apple trees.

SAN DIEGO STATION.

Horticultural Imports.

		Parcels.
Ships inspected	24	
Passed as free from pests		2,602
Fumigated		2
Destroyed		3
Returned		1
Contraband		1
Total parcels horticultural products for the month		2,609

Pests Intercepted.

From Missouri—
Aphis sorbi on apple trees.

EUREKA STATION.

Horticultural Imports.

Ships inspected	9	
Passed as free from pests		7

SANTA BARBARA STATION.

No report.

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California
State Printing Office
1914

VOLUME III No. 3

THE MONTHLY BULLETIN

The citrus mealy bug, *Pseudococcus citri* (Risso). Young and mature females on lemon. Twice enlarged (Essig).

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA MARCH, 1914

CONTENTS

STATE COMMISSION OF HORTICULTURE

March, 1914

THE MONTHLY BULLETIN

VOLUME III No. 3

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

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STATE PRINTING OFFICE
1914

THE MONTHLY BULLETIN.

THE MEALY BUGS OF CALIFORNIA.

By E. O. Essig, Secretary State Commission of Horticulture, Sacramento, California.

INTRODUCTION.

Under the heading of "The Mealy Bugs of California" the writer hopes to bring together all of the information known at present relative to these often troublesome pests. Particular attention will be given to the economic forms, though a mention of the non-economic species will be made in order that the reader may have a comprehensive idea of the whole group. It is aimed to present the material in as simple a way as possible and to avoid the technical expressions which would naturally creep into such an article as this.

Relative to the economic forms, practically all of the material has been segregated by the writer, who has been working upon the group for some four years, but much of the material relative to the handling of the non-economic species has been collected from original descriptions published in numerous periodicals throughout the country.

This paper is written at the special request of the fruit growers assembled at an emergency convention held at Ontario, Cal., January 30, 1914, where the ravages of the mealy bugs were given considerable attention. It was the desire of the growers that the material presented at that time be written up by the secretary of the convention and distributed through the channels of the periodicals issued from the office of the State Commission of Horticulture. Many valuable papers were read at the convention by practical fruit growers and county horticultural commissioners, among whom were the following: A. J. Cook, State Commissioner of Horticulture, Sacramento, Cal.; J. A. Prizer, Entomologist San Diego Fruit Company, Chula Vista, Cal.; H. A. Weinland, County Horticultural Commissioner, San Diego County, San Diego, Cal.; Wm. Wood, Horticultural Commissioner, Los Angeles County, Los Angeles, Cal.; A. G. Smith, Horticultural Inspector, Los Angeles County, Pasadena, Cal.; P. E. Edourt, Horticultural Inspector, Los Angeles County, Los Angeles, Cal., and R. S. Vaile, Horticultural Commissioner, Ventura County, Santa Paula, Cal. Practically all of these papers dealt directly with experimentation and control of the citrus mealy bug (*Pseudococcus citri*) and in the discussion of this insect the writer intends to quote freely from these papers.

CLASSIFICATION.

The mealy bugs belong to an order of insects known as *Homoptera* (to which order also belong such sucking insects as plant lice, cicadas, leaf-hoppers, lantern flies, spittle bugs, etc.), to the family *Coccidæ* (which includes all of the scale insects) and to the subfamily *Dactylopiinæ*. The members of this subfamily do not have a shell or armor protection, as do the red and purple scales, neither do they have a hard chitinous outer skin like the black and soft brown scales, but the body is usually covered with a fine white powdery or cottony wax, or with a

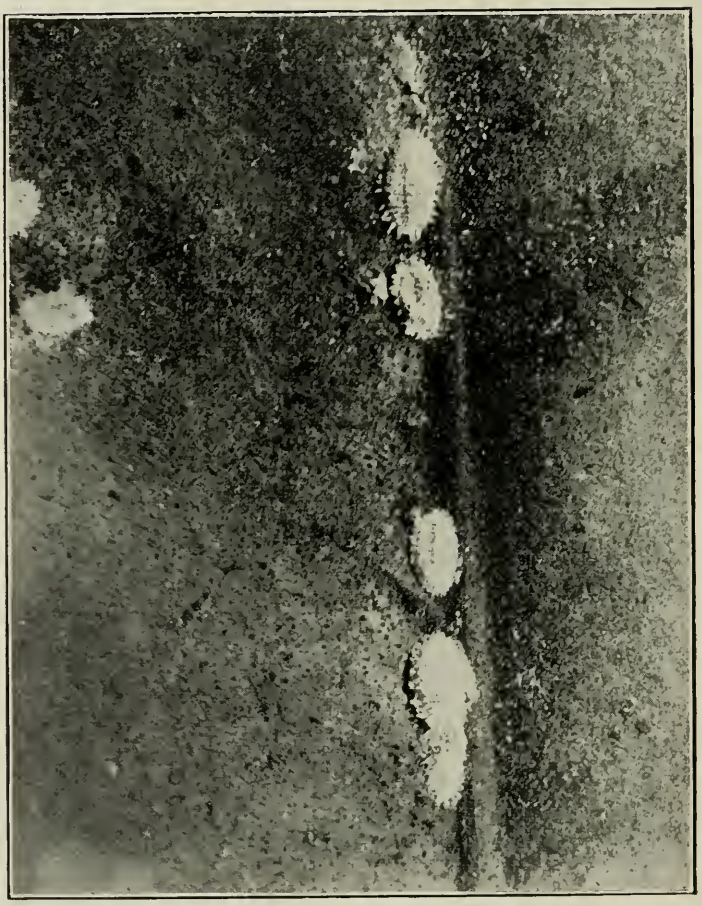


FIG. 21.—Mealy bugs. Adult males at the top and adult females at bottom. (Author's illustration.)

thick coat of solid wax, which enables them to withstand severe treatment without bodily injury. In the subfamily *Dactylopiinæ* there are several genera of insects which greatly resemble the mealy bugs, but in this paper it is the aim of the writer to discuss only the genus *Pseudococcus,* to which the true mealy bugs belong, and one species in the genus *Ceroputo*, a very closely allied insect, which is included only because it is so often confused with the true mealy bugs.

GENERAL CHARACTERS.

In the mealy bugs there are two distinct sexes, males and females. Due to their minuteness (scarcely more than one eighth or one fourth of an inch in length) the males are seldom observed. They have two well-developed wings which enable them to fly and two long white anal filaments (Fig. 21) which are characters common to nearly all of the males of scale insects. The young males and females greatly resemble each other, and while the male takes on a distinctly different form when full grown, the female continues to look like the young, differing only in size and the covering which is later secreted over the body. When mature the females are regularly oval, flattened and usually completely covered with a fine white powdery wax which extends along the sides as lateral filaments, with often two or more at the posterior end (commonly called tails), which may or may not be longer than those along the sides. The average length varies from about one fourth to three eighths of an inch and the width from one half to two thirds the length. All have six legs and are able to move about freely throughout their entire existence.

There are two distinct methods of reproduction: one where eggs are laid and the other where the young are born alive. There is quite a varied method, also, in the arrangement of eggs. In some cases they are laid in loose cottony masses, in others the eggs are enclosed in a tightly woven egg sac (ovisac), which does not include the female, while in still others the eggs are enclosed in an egg sac which also entirely envelops the female. These characters are mentioned because they are exceedingly important in distinguishing the various species, and it is the belief of the writer that we will never have an accurate and scientific knowledge of all stages of the various species of mealy bugs until more definite work is done on the life histories of all of these species as they occur, not only upon their favorite host plants, but upon many others which they infest, for no doubt their habits are somewhat determined by the host plant.

GENERAL LIFE HISTORY.

As previously stated, some of the mealy bugs are born alive and others emerge from eggs previously deposited by the females. In either case the young usually appear about the same time which, roughly speaking, covers a period from the first of October until about the first of February or even later. In greenhouses and conservatories where the insect lives under artificial conditions, eggs and young may be found almost any season and several broods appear, while out of doors there

may be but one or two broods during the entire year. The females are quite prolific, producing from twenty to three or four hundred eggs or young, and due to the hardiness of the species, very few of these fail to mature unless preyed upon by some natural enemy. The development of the young is very slow at first and during the summer months the mealy bugs are usually little in evidence, which is partly due to their small size and partly to the fact that they are hidden away in places where they are not easily observed. The young male soon after hatching

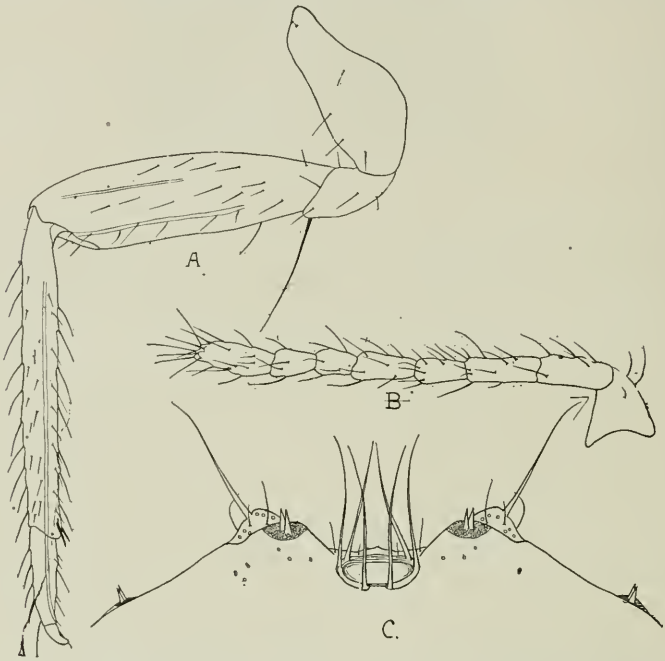


FIG. 22.—Body characters of Baker's mealy bug, *Pseudococcus bakeri*. A, leg; B, antenna; C, posterior end or pygidium. (Author's illustration.)

spins a small white, cottony cocoon, in which it transforms and reaches the adult stage when the females are about one third grown. At this time copulation takes place and the males soon die. The females begin to mature along in July, August and September, when egg laying or bringing forth young occurs. In general we may say that there is but one uneven brood a year under out-door conditions, though in some cases there may be two or even more.

Most of the species live above ground upon the bark, fruit or foliage of the host plants, while some live almost entirely underground upon the roots of the plants. Others live both above and below ground. In Los Angeles County it is claimed by many authorities that the citrus mealy bug lives upon the roots of the plants as well as above ground. This is one point in the life history of this species which has not been well worked out and is of tremendous importance in formulating

methods of control. Working upon the belief that the mealy bug was attacking the roots of his orange trees, a grower in Ventura County placed tanglefoot bands around the trees of an entire 100-acre block. The orchard was closely watched for one and one half years by the writer and nothing was observed that led to the belief that the mealy bugs ever descended to or ascended from the roots. The roots of badly infested trees were entirely exposed at various seasons, but without ever finding the insects upon them. The tanglefoot did, however, catch thousands of ladybird beetle larvæ and adults, as well as other beneficial insects, and were finally removed because of this. These observations, though they may hold true in only one locality for one and one half years, do not necessarily prove such will be the case in other localities or in the same locality for other years.

ECONOMIC AND NON-ECONOMIC SPECIES.

The history of economic entomology shows that it is difficult for any one to say whether an insect which is not an economic factor to-day will not become so in the future, and while we may definitely state now what species of mealy bugs are economic and what are not, it is not our intention to predict that any of those listed as non-economic will continue to remain so. In fact, in 1889, D. W. Coquillett termed the citrus species a "harmless mealy bug." The appearance of a native species, Baker's mealy bug (*Pseudococcus bakeri*) in the citrus orchards in a number of localities in southern California would indicate that this native species might also in time become a pest of no little economic importance. However, for the convenience of the growers, we desire to list the species herein described as economic and non-economic. Those considered as non-economic have so far confined their attacks only to native vegetation and have never proven a detriment to mankind. Those considered as economic may be considered under two headings: those infesting only ornamental plants and those infesting orchards and cultivated plants.

Non-Economic:

Pseudococcus agrifoliæ Essig.
Pseudococcus artemisiæ Essig.
Pseudococcus crawii (Coq.).
Pseudococcus ephedræ (Coq.).
Pseudococcus hymenocleæ (Ckll.).
Pseudococcus maritimus (Ehrh.).
Pseudococcus quercus (Ehrh.).
Pseudococcus salinus (Ckll.).
Pseudococcus sequoiæ (Colm.).
Pseudococcus yerba-santæ Essig.

Of the foregoing *Pseudococcus agrifoliæ*, *Pseudococcus quercus* and *Pseudococcus sequoiæ* might be listed under those injuring ornamental plants whenever the hosts are grown as such.

Economic:

Attacking Ornamentals.

The species affecting the plants which are generally grown as ornamentals are as follows:

Pseudococcus andersoni (Colm.).
Pseudococcus aurilanatus (Mask.).
Pseudococcus azaleæ (Tins.).
Pseudococcus cupressi (Colm.).
Pseudococcus dudleyi (Colm.).
Pseudococcus obscurus Essig.
Pseudococcus pseudonipæ (Ckll.).
Ceroputo yuccæ (Coq.).

In addition to the above all of the species listed below as affecting cultivated plants and fruit trees should be included as they also attack ornamental trees.

Attacking Cultivated Plants and Fruit Trees.

Pseudococcus bakeri Essig.
Pseudococcus citri (Risso).
Pseudococcus longispinus (Targ.).
Pseudococcus solani (Ckll.).

HOST PLANTS.

The following list of host plants is given for the convenience of the growers. The plants are arranged alphabetically under the common names—the scientific names being included also in the alphabetical arrangement—so that any reference as such elsewhere in literature may be readily looked up in this index:

Amaranthus retroflexus—see Pigweed.
Anemone sp.
Pseudococcus affinis.
Apple (*Pyrus malus*).
Pseudococcus bakeri.
Araucaria bidwillii—see Monkey Puzzler.
Araucaria excelsa—see Norfolk Island Pine.
Artemisia californica—see Sage, California.
Aster sp.
Pseudococcus solani (roots).
Azalea sp.
Pseudococcus azaleæ.
Banana (*Musa sapientium*).
Ceroputo yuccæ.
Begonia, Rex.
Pseudococcus citri.
Pseudococcus longispinus.
Bignonia sp.
Pseudococcus citri.
Bottle Brush (*Callistemon lanceolatus*).
Pseudococcus citri.
Bouvardia sp.
Pseudococcus citri.
Calla sp.
Pseudococcus longispinus.
Callistemon lanceolatus—see Bottle Brush.
Ceanothus hirsutus.
Ceroputo yuccæ.
Ceoanthus integerrimus—see Deer-Brush.
Cedar, White or Incense (*Libocedrus decurrens*).
Pseudococcus andersoni.
Ceneraria sp.
Pseudococcus longispinus.

Cereus sp.
Pseudococcus longispinus.
Chilean Ornamental Orange—see Mexican Orange.
Chinese Arbor-vitæ (*Thuya orientalis*).
Pseudococcus ryani.
Choisya ternata—see Mexican Orange.
Christmas Cactus—see Lobster Cactus.
Citron (*Citrus medica genuiana*).
Pseudococcus citri.
Pseudococcus longispinus.
Citrus aurantium—see Orange.
Citrus decumana—see Pomelo.
Citrus medica acida—see Lime.
Citrus medica genuiana—see Citron.
Citrus medica limon—see Lemon.
Cocoanut Palm (*Cocos nucifera*).
Pseudococcus pseudonipæ.
Cocus nucifera—see Cocoanut Palm.
Coffea arabica—see Coffee.
Coffee (*Coffea arabica*).
Pseudococcus citri.
Coleus sps.
Pseudococcus citri.
Pseudococcus longispinus.
Cotton (*Gossypium* sp.).
Pseudococcus citri.
Crane's-Bill (*Geranium* sp.).
Pseudococcus citri.
Croton sp.
Pseudococcus longispinus.
Cucurbita pepo—see Pumpkin.
Cupressus goveniana.
Pseudococcus andersoni.
Cupressus macnabiana.
Pseudococcus dudleyi.
Cupressus macrocarpa—see Monterey Cypress.
Cycas revoluta—see Sago Palm.
Cydonia japonica—see Quince, Japanese.
Cyperus alternifolius—see Umbrella Plant.
Dammara ovata.
Pseudococcus aurilantus.
Dammara vitiensis.
Pseudococcus aurilanatus.
Deer-Brush (*Ceanothus integerrimus*).
Pseudococcus citri.
Diplacus glutinosus—see Monkey Flower.
Dracæna sp.
Pseudococcus longispinus.
Elder (*Sambucus glauca*).
Pseudococcus bakeri.
English Ivy—see Ivy, English.
Epiphyllum sp.—see Lobster Cactus.
Eriodictyon californicum—see Yerba Santa.
Eriogonum latifolium.
Pseudococcus maritimus.
Ephedra californica.
Pseudococcus ephedræ.
Erythea edulis—see Guadalupe Island Palm.
Euphorbia pulcherrima—see Poinsettia.
Ferns (*Filicales*).
Pseudococcus citri.
Pseudococcus longispinus.
Ficus sp.—see Fig.
Fig (*Ficus* sp.).
Pseudococcus longispinus.
Filicales—see Ferns.
Flacourtia sepiaria.
Pseudococcus longispinus.
Fuchsia, sp.
Pseudococcus citri.
Pseudococcus longispinus.
Geranium sp.—see Crane's-Bill.
Gossypium sp.—see Cotton.
Grape (*Vitis vinifera*).
Pseudococcus citri in Fresno County said to be this species.

Grass
Pseudococcus salinus.
Grevillea sp.
Pseudococcus bakeri.
Guadalupe Island Palm (*Erythea edulis*).
Pseudococcus citri.
Pseudococcus longispinus.
Guava (*Psidium* sp.).
Pseudococcus longispinus.
Habrothamnus sp.
Pseudococcus citri.
Hedera helix—see Ivy, English.
Helianthus annuus—see Sunflower, Wild.
Ipomœa—see Moon Flower.
Ivy, English (*Hedera helix*).
Pseudococcus bakeri.
Pseudococcus citri.
Juglans regia—see Walnut.
Lantana sp.
Ceroputo yuccæ.
Lemon (*Citrus medica limon*).
Ceroputo yuccæ.
Pseudococcus bakeri.
Pseudococcus citri.
Pseudococcus longispinus.
Libocedrus decurrens—see Cedar, White or Incense.
Lime (*Citrus medica acida*).
Ceroputo yuccæ.
Live Oak, Coast (*Quercus agrifolia*).
Pseudococcus agrifoliæ.
Live Oak, Interior (*Quercus chrysolepis*).
Pseudococcus quercus.
Lobster Cactus (*Epiphyllum* sp.).
Pseudococcus longispinus.
Lycopersicum esculentum—see Tomato.
Malva rotundifolia.
Pseudococcus solani.
Mangifera sp.—see Mango.
Mango (*Mangifera* sp.).
Pseudococcus longispinus.
Mesembryanthemum sp.
Ceroputo yuccæ.
Mexican Orange (*Choisya ternata*).
Pseudococcus bakeri.
Monkey Flower (*Diplacus glutinosus*).
Ceroputo yuccæ.
Monkey Puzzler (*Araucaria bidwillii*).
Pseudococcus aurilanatus.
Monterey Cypress (*Cupressus macrocarpa*).
Pseudococcus cupressi.
Pseudococcus ryani.
Moon Flower (*Ipomœa* sp.).
Pseudococcus citri.
Pseudococcus longispinus.
Mountain Balm—see Yerba Santa.
Musa sapientium—see Banana.
Nephrodium sp.
Pseudococcus longispinus.
Nerium oleander—see Oleander.
Nettle (*Urtica* sp.).
Pseudococcus citri.
Nightshade (*Solanum douglasii*).
Pseudococcus bakeri (roots and foliage).
Pseudococcus citri (foliage).
Pseudococcus solani (roots).
Norfolk Island Pine (*Araucaria excelsa*).
Pseudococcus aurilanatus.
Pseudococcus ryani.
Oleander (*Nerium oleander*).
Pseudococcus citri.
Pseudococcus longispinus.
Opuntia sp.
Pseudococcus obscurus (roots).
Pseudococcus longispinus.

Orange (*Citrus aurantium*).
Pseudococcus bakeri.
Pseudococcus citri.
Pseudococcus longispinus.
Pæonia sp.
Pseudococcus citri.
Passion Flower, Purple (*Passiflora violacea*).
Pseudococcus citri.
Pear (*Pyrus communis*).
Pseudococcus bakeri.
Pigweed (*Amaranthus retroflexus*).
Pseudococcus solani (roots).
Platycerium sp.—see Staghorn Fern.
Plum (*Prunus domestica*).
Pseudococcus longispinus.
Plumbago sp.
Pseudococcus citri.
Poinsettia (*Euphorbia pulcherrima*).
Pseudococcus citri.
Pomelo (*Citrus decumana*).
Pseudococcus citri.
Pseudococcus longispinus.
Portulaca oleracea—see Purslane.
Potato (*Solanum tuberosum*).
Pseudococcus solani.
Pseudococcus bakeri.
Potato Vine (*Solanum jasminoides*).
Pseudococcus bakeri (roots and foliage).
Pseudococcus citri (foliage).
Primula obconica.
Pseudococcus longispinus.
Prunus domestica—see Plum.
Psidium sp.—see Guava.
Pumpkin (*Cucurbita pepo*).
Pseudococcus citri.
Purslane (*Portulaca oleracea*).
Pseudococcus solani.
Pyrus malus—see Apple.
Pyrus communis—see Pear.
Quercus agrifolia—see Live Oak, Coast.
Quercus chrysolepis—see Live Oak, Interior.
Quince, Japanese (*Cydonia japonica*).
Pseudococcus bakeri.
Ramona polystachya—see Sage, White.
Ramona stachyoides—see Sage, Black.
Redwood (*Sequoia sempervirens*).
Pseudococcus citri.
Pseudococcus sequoiæ.
Sage, Black (*Ramona stachyoides*).
Ceroputo yuccæ.
Sage, California (*Artemisia californica*).
Ceroputo yuccæ.
Pseudococcus artemisiæ.
Pseudococcus hymenoclæ (U. S. Dept. Agrcl.).
Sage, White (*Ramona polystachya*).
Pseudococcus crawii.
Sago Palm (*Cycas revoluta*).
Pseudococcus longispinus.
Salix sp.—see Willow.
Sambucus glauca—see Elder.
Senecio sp.
Pseudococcus artemisiæ.
Sequoia sempervirens—see Redwood.
Solanum douglasii—see Nightshade.
Solanum jasminoides—see Potato Vine.
Solanum tuberosum—see Potato.
Staghorn Fern (*Platycerium* sp.).
Pseudococcus longispinus.
Stangeria schizodon.
Pseudococcus longispinus.
Strelitzia gigantea.
Pseudococcus citri.
Pseudococcus longispinus.

Strelitzia regina.
Pseudococcus citri.
Sunflower, Wild (*Helianthus annuus*).
Pseudococcus bakeri (roots).
Pseudococcus solani (roots).
Tacsonia jasminoides.
Pseudococcus citri.
Thuya orientalis—see Chinese Arbor-vitæ.
Tobacco (*Nicotiana tabacum*).
Pseudococcus citri.
Tomato (*Lycopersicum esculentum*).
Pseudococcus solani (roots).
Tradescantia multicolor—see Wandering Jew, Variegated.
Umbrella Plant (*Cyperus alternifolius*).
Pseudococcus citri.
Pseudococcus longispinus.
Walnut (*Juglans regia*).
Pseudococcus bakeri.
Wandering Jew, Variegated (*Tradescantia multicolor*).
Pseudococcus citri.
Willow (*Salix* sp.).
Pseudococcus bakeri.
Yerba Santa or **Mountain Balm** (*Eriodictyon californicum*).
Pseudococcus yerba-santæ.
Yucca australis.
Ceroputo yuccæ.
Yucca filifera.
Ceroputo yuccæ.
Yucca whipplei.
Ceroputo yuccæ.
Zamia sp.
Pseudococcus longispinus.

DESCRIPTIONS OF SPECIES.

Under the descriptions of species it is desired to be as brief as possible and in most of the non-economic forms, especially, only the fewest possible characters will be included. It is hoped that the illustrations will prove of value in the distinguishing of the various species and it is suggested that they be referred to often.

THE TUBER MEALY BUG.

Pseudococcus affinis (Mask.).

The U. S. Department of Agriculture has recorded this species in California as attacking *Anemone* sp. The tuber mealy bug occurs in Australia, and if found in California was undoubtedly imported upon some of its host plants, those recorded being the tubers of dahlias and potatoes.

THE COAST LIVE OAK MEALY BUG.

Pseudococcus agrifoliæ Essig.

(Fig. 23.)

Color—The bodies of the adult females are usually yellow, though they may vary from this color to light pink. They are covered with a very fine white wax, which allows the segmentation and the color of the body to show very clearly. Many specimens appear entirely naked.

Eggs—It is not known whether eggs are laid or the young are born alive.

Filaments—The lateral filaments are scarcely perceptible and the anal filaments or tails are no longer than those on the sides.

Food Plant—So far this species has been found feeding on the tender bark around the edges of wounds under the rough outer bark of the coast live oak (*Quercus agrifolia*).

Distribution—Taken only in the vicinity of Santa Paula, Ventura County, Cal.

Pseudococcus andersoni (Coleman).

Color—Body lead gray and covered with fine white powdery wax.

Eggs—Laid in a white ovisac which is solidly constructed.

Filaments—The lateral filaments short; anal filaments or tails short and stout.

Food Plants—Taken upon *Cupressus goveniana* and incense cedar (*Libocedrus decurrens*).

Distribution—So far reported only from the Scott Valley, Siskiyou County, Cal., and from the southern part of Lake County.

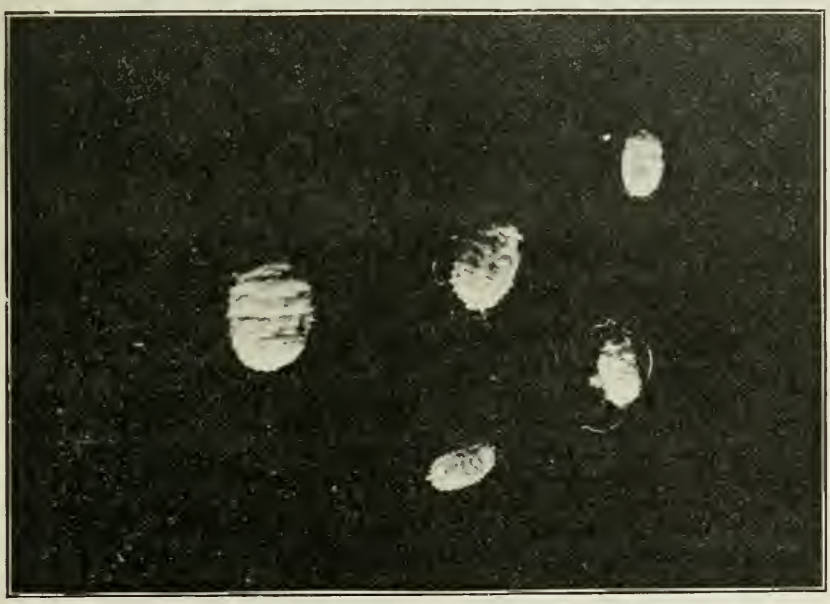


FIG. 23.—The coast live oak mealy bug, *Pseudococcus agrifoliæ*. (Author's illustration.)

THE ARTEMISIA MEALY BUG.

Pseudococcus artemisiæ Essig.

(Fig. 24.)

Color—Body slate colored when mature. The younger immature forms appear from pinkish to lead color. The adults are covered with very fine white powder which does not entirely hide the color of the body.

Eggs—Enclosed in an ovisac with the female.

Filaments—The lateral filaments are very short and the tails are inconspicuous.

Food Plants—The species feeds upon the bark above or just below the

ground of the California sage (*Artemisia californica*) and upon the roots of *Senicio* sp.

Distribution—In the waste areas in the vicinities of Claremont and Upland, Cal.

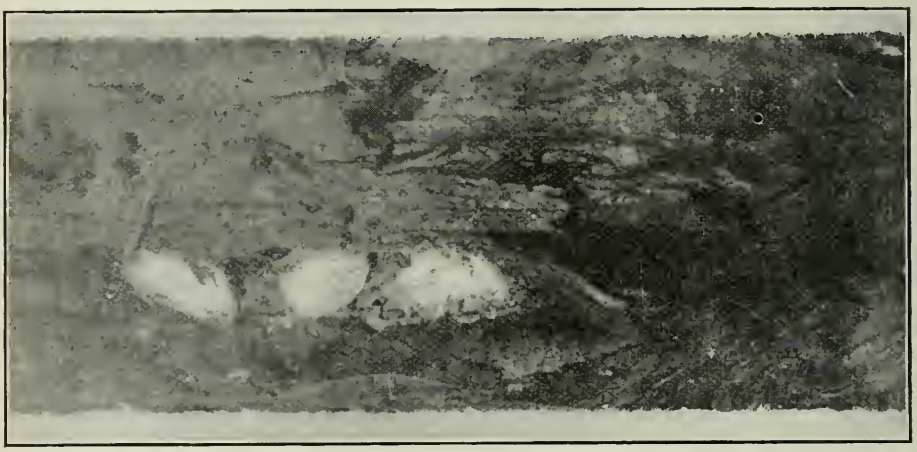


FIG. 24.—The artemisia mealy bug, *Pseudococcus artemisiæ*, showing adult and egg mass in the bark of the California sage. (Author's illustration.)

THE GOLDEN OR ARAUCARIA MEALY BUG.

Pseudococcus aurilanatus (Mask.).

(Fig. 25.)

Color—The body is dark purple and partially covered with thick bright yellow cottony wax, which is distinctly arranged in small definite patches in rows on the dorsum.

Eggs—The eggs are purple and laid in compact cottony masses surrounded by yellow or purplish cottony material.

Filaments—The lateral and anal filaments consist of wide plates which are distinctly shown in the illustrations.

Food Plants—This species works upon the smaller stems of the monkey puzzler (*Araucaria bidwillii*), the Norfolk Island pine (*Araucaria excelsa*), *Dammara ovata* and *D. vitiensis*.

Distribution—This species is generally distributed in the greenhouses throughout the State, and has been reported as occurring out of doors in several of the southern counties.

THE AZALEA MEALY BUG.

Pseudococcus azaleæ (Tins.).

Color—The body is purplish gray and covered with a fine white wax which entirely hides the color beneath.

Eggs—Purplish, enclosed in a loose, fluffy ovisac which does not enclose the female.

Filaments—The lateral and anal filaments are short and about equal in length.

Food Plant—Taken upon *Azalea* sp.

Distribution—This species has only been collected in a single Japanese nursery at San Jose, Cal., and was probably imported from Japan. It is not known to occur in any other portion of the State.

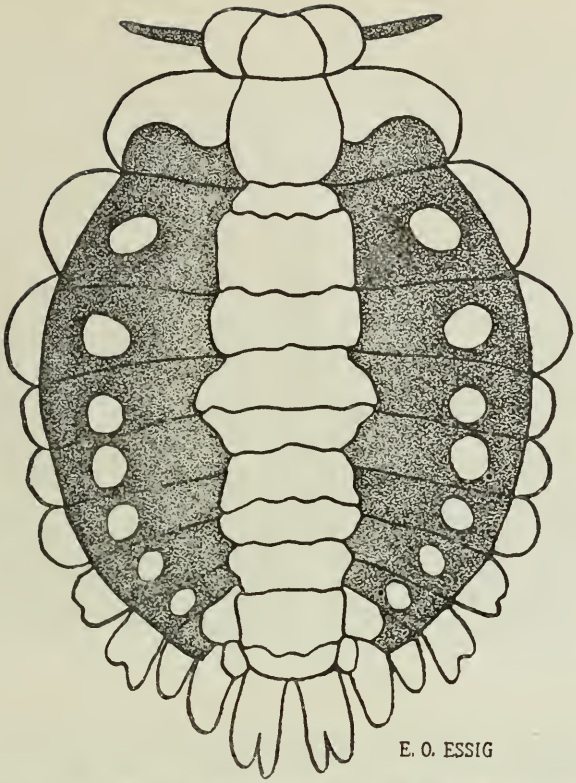


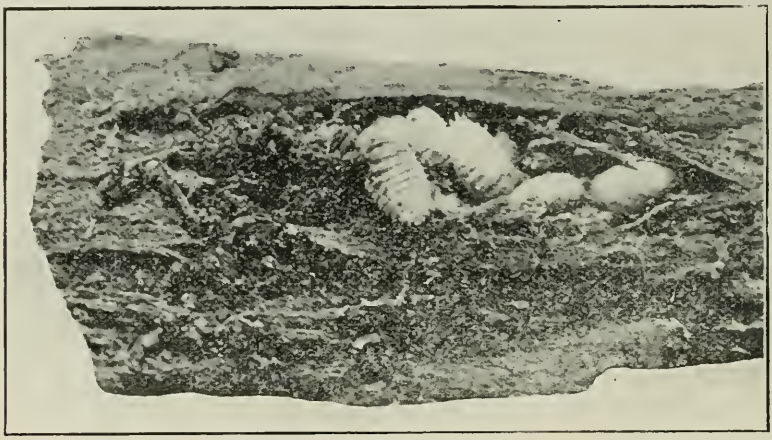
FIG. 25.—The golden or araucaria mealy bug, *Pseudococcus aurilanatus*. Drawing of mature female showing arrangement of cottony covering and females and egg masses on Norfolk Island pine. (Author's illustration.)

BAKER'S MEALY BUG.[1]

Pseudococcus bakeri Essig.

(Figs. 22, 26.)

Color—The body is from light gray to bluish gray and is usually covered with a thick white waxy powder which entirely hides the color of the body.



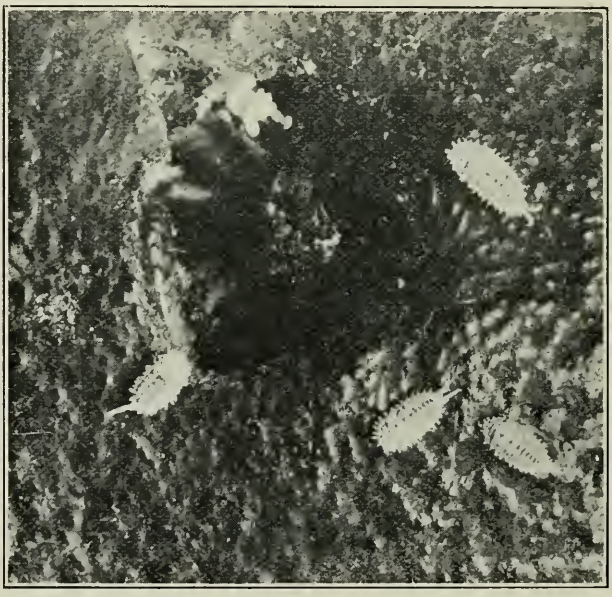


FIG. 26.—Baker's mealy bug, *Pseudococcus bakeri*. Top, females on elder (*Sambucus glauca*); bottom, adult females around the navel of an orange. (Author's illustration.)

[1]In the author's previous writings the common name of this species has been the walnut mealy bug, but due to its great variety of host plants this is a misnomer and the name Baker's mealy bug is now preferred.

Eggs—Pale yellow, rather small and laid in loose white cottony masses.

Filaments—The lateral filaments are very short, while the anal filaments or tails are from one fourth to one half as long as the body.

Food Plants—The food plants of this species are varied and the list is gradually increasing. So far we have recorded it upon the following: elder (*Sambucus glauca*), *Grevillea* sp., English Ivy (*Hedera helix*), lemon (*Citrus medica limon*), Mexican orange (*Choisya ternata*), nightshade (*Solanum douglasii*), orange (*Citrus aurantium*), pear (*Pyrus communis*), potato (*Solanum tuberosum*), potato vine (*Solanum jasminoides*), Japanese quince (*Cydonia japonica*), wild sunflower (*Helianthus annuus*), walnut (*Juglans regia*), and willow (*Salix* sp.).

Distribution—To the writer's knowledge this species is quite common in Ventura, Los Angeles and a portion of San Bernardino County adjacent to Los Angeles County.

Economic Importance—This species, though native to southern California, promises to be one of economic importance, since in many localities it has been found in considerable numbers upon citrus and deciduous fruit trees. It was first observed upon lemon trees at Oxnard, Ventura County, by the writer in 1910. In 1913 R. S. Vaile, County Horticultural Commissioner of Ventura County, found it quite extensively distributed in the orange orchards in upper Ojai Valley, Nordhoff, Cal. In December, 1913, Commissioner S. A. Pease of San Bernardino County located the severest infestation, so far found, in the citrus groves at Upland, Cal., and the presence of the pest there caused much excitement and no little damage in an effort to completely exterminate it. As this species is a native form it has undoubtedly been held in check by natural enemies, and while it may prove to be somewhat serious in certain instances it ought not become a general, serious pest. Its presence should be carefully watched and control measures adopted whenever it becomes an economic factor in the production of the crop.

THE CITRUS MEALY BUG.

Pseudococcus citri (Risso).

(Figs. 27-31.)

Color—The body is light yellow and completely hidden by a thick white cottony secretion.

Eggs—Light yellow, oval, very small and laid in large loose white cottony masses.

Filaments—The lateral filaments are short but distinct. The anal filaments or tails are little if any longer than those along the sides.

Food Plants—This is a very omnivorous feeder and is found in nearly every greenhouse of the United States and in many parts of the world. The list of host plants herein presented is very incomplete, but are all that have so far been definitely reported. Rex begonia, *Bignonia* sp., bottle brush (*Callistemon lanceolatus*), *Bouvardia* sp., citron (*Citrus medica genuiana*), coffee (*Coffea arabica*), *Coleus* sp., cotton (*Gossypium* sp.), crane's-bill (*Geranium* sp.), deer-brush (*Ceanothus integerrimus*), ferns (*Filicales*), *Fuchsia* sp., grape (*Vitis vinifera*), Guadalupe Island palm (*Erythea edulis*), *Habrothamnus* sp., English ivy (*Hedera helix*), lemon (*Citrus medica limon*), moon flower (*Ipo-*

mœa sp.), nettle (*Urtica* sp.), nightshade (*Solanum douglasii*), oleander (*Nerium oleander*), orange (*Citrus aurantium*), *Pæonia* sp., purple passion flower (*Passiflora violacea*), *Plumbago* sp., poinsettia (*Euphorbia pulcherrima*), pomelo (*Citrus decumana*), potato vine (*Solanum*

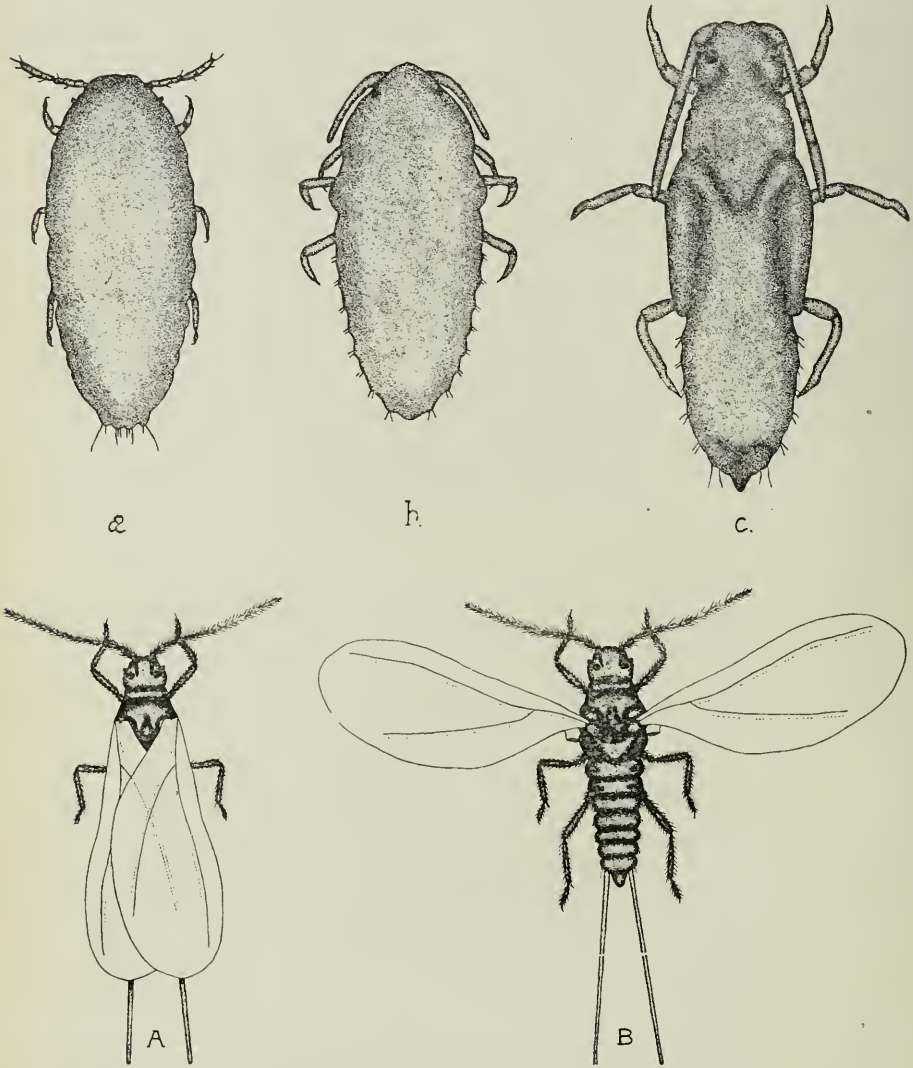


FIG. 27.—The citrus mealy bug, *Pseudococcus citri*. Development of the male: a, young just hatched from the egg; b, young just after cocoon is made; c, nearly matured; A, adult male in normal attitude; B, adult male with wings spread. (Author's illustration.)

jasminoides), pumpkin (*Cucurbita pepo*), redwood (*Sequoia sempervirens*), *Strelitzia gigantea, Strelitzia regina, Tacsonia jasminoides,* tobacco (*Nicotiana tabacum*), umbrella plant (*Cyperus alternifolius*), variegated wandering jew (*Tradescantia multicolor*).

Distribution—The citrus mealy bug is probably more widely distributed throughout the State than any other species. It has been recorded as occurring in many of the northern counties, particularly in Yuba and Butte counties. Fresno County, also, reported a severe infestation to grapevines, though no one has definitely decided that the species there is the citrus mealy bug. The distribution in southern California is plainly given in Fig. 31 prepared by the author in the year 1910.

FIG. 28.—The citrus mealy bug. Orange leaf covered with immature females and the cocoons of the males. (Original.)

Economic Importance—Of all the mealy bugs this is of the greatest economic importance and has been known and treated by citrus fruit growers for a number of years, though it has been a common insect in some localities since 1880, where it was first observed in San Diego County. All florists are familiar with the destructiveness of this pest in the greenhouses and know how difficult it is to control without injury to the tender plants infested. During the years 1908 and 1910 the mealy bug was particularly destructive in several counties, so much so that not a little experimental work was done to find some methods of sub-

during it. Many articles were published broadcast in the horticultural press throughout the State. Among those doing work upon the pest was the writer, who published in the Pomona Journal of Entomology, vol. II, p. 4, December, 1910, an article entitled "The Citrus Mealy Bug," which discussed quite fully the situation as it appeared at that

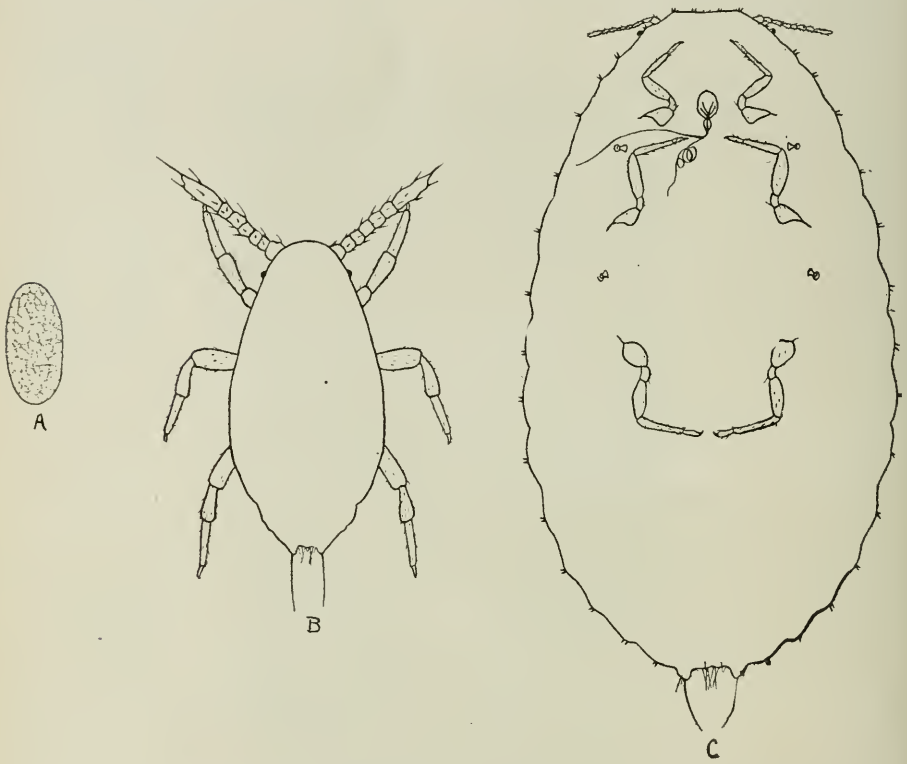


FIG. 29.—The citrus mealy bug. A, egg; B, young female; C, adult female with cottony covering removed to show the ventral side. (Author's illustration.)

time. Since then there seems to have been a general decline in the attacks of the pest. Whether this is due to the artificial control measures so vigorously employed or to natural enemies we are unable to state, but at the present time, while there is a just recognition of the seriousness of this pest, it is not held in awe, particularly by those who have been actually fighting it and who are coming to feel concerning it much as they do regarding such pests as the black, yellow, red and purple scales.

Control and Natural Enemies—A general discussion of the methods of control, quarantine, etc., to be adopted against the citrus mealy bug will be included at the end, as well as descriptions of the natural enemies, inasmuch as these concern all the species included.

FIG. 30.—The citrus mealy bug. Top showing infested lemon; bottom, portion of same showing egg masses and young and adult females. (Original.)

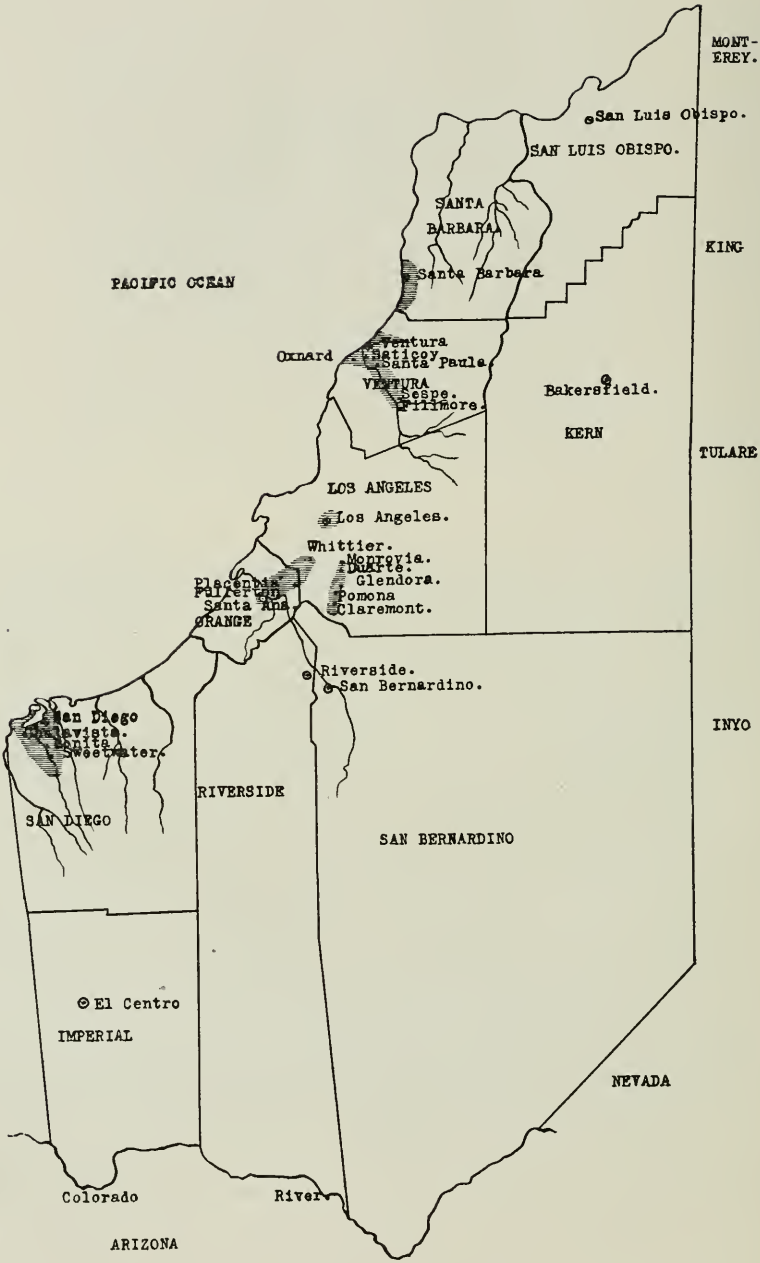


FIG. 31.—Map of southern California showing the distribution of the citrus mealy bug in 1910. At the present time the distribution varies little. Some localities are not so severely infested, however, as in 1910. (Author's illustration.)

THE WHITE SAGE MEALY BUG.

Pseudococcus crawii (Coq.).
(Fig. 32.)

Color—The body is light yellow, covered with thick plates of white cottony material which entirely hide the color.

Eggs—No eggs are laid, the young being born alive.

Filaments—The lateral filaments are very distinct, being about one fourth as long as the width of the body. The anal filaments or tails vary from one third to one half the length of the body. They usually form a sharp angle at the posterior end and in some individuals the ends are curved inwardly.

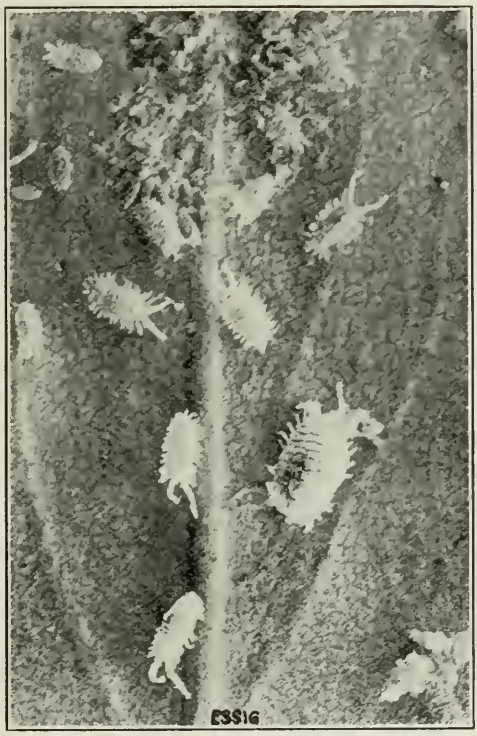


FIG. 32.—The white sage mealy bug, *Pseudococcus crawii*, on leaf of white sage. (Author's illustration.)

Food Plants—The young and adults work upon the larger stems and foliage of the white sage (*Ramona polystachya*) and the California sage (*Artemisia californica*). During the summer and fall they may be found quite near the tips of the branches or thickly upon the leaves, while in the winter the young are found very close to the ground, or may be even under the ground at the bases of the plants.

Distribution—The species is evidently limited to southern California and has only been reported as occurring in Ventura, Los Angeles and San Bernardino counties, though in all probability it occurs in other counties as well.

Pseudococcus cupressi (Colm.).

Color—The body is olive brown in color and sparsely covered with fine white powdery wax.

Eggs—Deposited in an ovisac.

Filaments—The marginal and anal filaments are short and rather broad, tapering toward the tips.

Food Plant—Occurs only upon the Monterey cypress (*Cupressus macrocarpa*). The young feed principally about the bases of the cypress cones.

Distribution—Collected by Prof. George A. Coleman at Cypress Point, Pacific Grove, Cal.

DUDLEY'S MEALY BUG.

Pseudococcus dudleyi (Colm.).

Color—Female body grayish white, covered with fine whitish powder.

Eggs—Dark yellow, deposited in an ovisac which encloses the body of the female. The ovisac is very loosely constructed and the female and eggs may be seen from above.

Filaments—The lateral filaments are short and inconspicuous, as are also the tails.

Food Plant—Taken only upon *Cupressus macnabiana.*

Distribution—Clear Creek near Shasta, Shasta County, Cal.

THE EPHEDRA MEALY BUG.

Pseudococcus ephedræ (Coq.).

Color—Body dark olive, almost black, thinly covered with fine white wax which allows the color of the body to show through.

Eggs—Coquillett states that the female secretes a sac completely around herself in which the young are born alive. In all probability the eggs are first laid in the ovisae.

Filaments—Lateral filaments inconspicuous or wanting. The anal filaments or tails are less than half the length of the body.

Food Plant—On *Ephedra californica.*

Distribution—Los Angeles County, Cal. No particular locality was given by D. W. Coquillett, who named it.

Pseudococcus hymenoclœ (Ckll.).

Color—Body almost black, covered with white cottony wax.

Food Plant—California sage (*Artemisia californica*). The author is unable to get any data relative to this species. It was reported as occurring in California by the U. S. Department of Agriculture and may prove to be synonymous with *Pseudococcus artemisiæ* Essig.

THE LONG-TAILED MEALY BUG.

Pseudococcus longispinus (Targ.).

(*Pseudococcus adonidum* Linn.)

(Fig. 33.)

Color—Body, yellow to light gray, entirely covered with a thick white powdery wax.

Eggs—No eggs laid, as the young are born alive.

Filaments—The lateral filaments are rather short—about one fourth the width of the body. The anal filaments or tails are very conspicuous

and are usually as long as, or longer than, the body. These give the common name to the insect and easily distinguish it from all the other species known in California.

Food Plants—This insect, like the citrus mealy bug, is both a greenhouse and outdoor pest, being particularly fond of Dracænas. In southern California it is very difficult to find one of these plants not infested by it. It also works upon the following plants: Rex begonia, *Calla* sp., *Cineraria* sp., citron (*Citrus medica genuiana*), *Coleus* sp., *Croton* sp., ferns (*Filicales*), fig (*Ficus* sp.), *Flacourtia sepiaria*, *Fuchsia* sp., Guadalupe Island palm (*Erythea edulis*), guava (*Psidium*

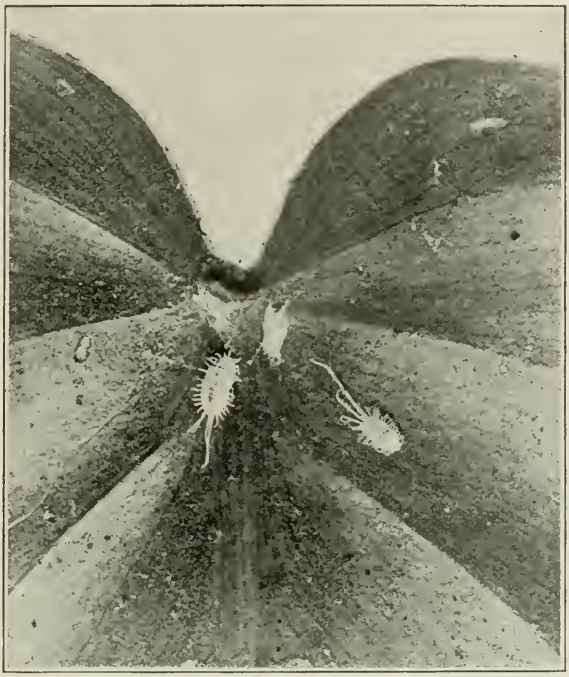


FIG. 33.—The long-tailed mealy bug, *Pseudococcus longispinus*, on leaf of calla. (Original.)

sp.), lemon (*Citrus medica limon*), lobster cactus (*Epiphyllum* sp.), mango (*Mangifera* sp.), moon flower (*Ipomœa* sp.), *Nephrodium* sp., oleander (*Nerium oleander*), *Opuntia* sp., plum (*Prunus domestica*), *Primula obconica*, sago palm (*Cycas revoluta*), staghorn fern (*Platycerium* sp.), *Stangeria schizodon*, *Strelitzia gigantea*, umbrella plant (*Cyperus alternifolius*), *Zamia* sp.

Distribution—Found generally throughout the state in greenhouses and in the ornamental gardens, particularly in the southern part.

Economic Importance—Though not as serious a pest as the citrus mealy bug, this species is nevertheless quite troublesome in greenhouses and especially in ornamental gardens, and has occasionally been found in considerable numbers upon citrus trees, though the latter do not seem to be preferred host. It is primarily a pest of ornamental plants.

THE OCEAN MEALY BUG.

Pseudococcus maritimus (Ehrh.).

Color—Body reddish brown, covered with thin white waxy powder which does not hide the color of the body.

Eggs—Orange yellow, laid in a well developed ovisac.

Filaments—Lateral filaments short. The anal filaments or tails are one half as long as the body.

Food Plant—On the roots of *Eriogonum latifolium*.

Distribution—On the cliffs near the ocean at Santa Cruz, Cal. It has not been reported from any other locality.

THE OBSCURE MEALY BUG.

Pseudococcus obscurus Essig.

Color—Body light gray, covered with very thin white powder which does not hide the color and segmentation of the body.

Eggs—Light yellow, laid in loose cottony masses.

Filaments—Lateral and anal filaments are short, of about the same length and often indistinct.

Food Plant—On the roots of cactus (*Opuntia* sp.).

Distribution—Boyle Heights, Los Angeles, Cal.

THE KENTIA MEALY BUG.

Pseudococcus pseudonipæ (Ckll.).

(Fig. 34.)

Color—Body covered with a cream-colored cottony wax which is arranged in rows of small definite patches.

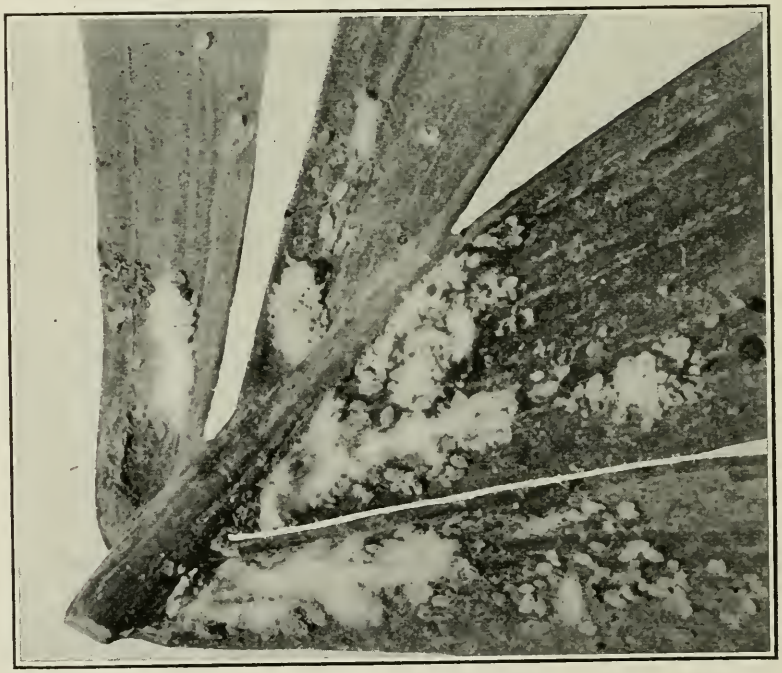


FIG. 34.—The kentia mealy bug, *Pseudococcus pseudonipæ*. Eggs, young, cocoons of males and females on leaf of kentia palm. (Author's illustration.)

Eggs—Yellow, laid in delicate cottony masses.

Filaments—Lateral and anal filaments rather wide and of about the same length.

Food Plants—So far recorded on kentia palm (*Kentia* sp.) and cocoanut palm (*Cocos nucifera*).

THE INTERIOR LIVE OAK MEALY BUG.

Pseudococcus quercus (Ehrh.).

Color—The body is greenish brown and partially concealed by fine, white powder.

Eggs—Not observed.

Filaments—The lateral and anal filaments are rather wide, the tails being one third as long as the body.

Food Plant—On the leaves and in the cracks of the bark of the maul or interior live oak (*Quercus chrysolepis*).

Distribution—Originally collected in Stevens Creek Canyon, near Mountain View, Cal., by Mr. E. M. Ehrhorn. It has never been recorded from any other locality.

THE CYPRESS MEALY BUG.

Pseudococcus ryani (Coq.).

Color—The body is dull salmon-brown with antennæ and legs lighter and sparsely covered with a fine, white powdery wax which does not conceal the color.

Eggs—Pale yellow, deposited in loose, white cottony masses.

Filaments—The lateral filaments short—those at the anal end never more than one third the length of the body.

Food Plants—This species infests Chinese arbor-vitæ (*Thuya orientalis*), Monterey cypress (*Cupressus macrocarpa*) and Norfolk Island pine (*Araucaria excelsa*).

Distribution—Collected at Anaheim, Orange County, Cal. It has also been reported from various localities along the Pacific coast as far north as Berkeley, Cal.

THE GRASS MEALY BUG.[2]

Pseudococcus salinus (Ckll.).

Color—The body is gray, finely covered with white waxy powder.

Eggs—Not recorded.

Filaments—Lateral and anal filaments are very short.

Food Plant—Grass.

Distribution—La Jolla, San Diego County, Cal.

THE REDWOOD MEALY BUG.

Pseudococcus sequoiæ (Colm.).

Color—The body is gray and covered with thick white waxy material.

Eggs—Laid in an ovisac which does not enclose the female.

[2]The writer has collected a mealy bug at Sacramento on Bermuda grass, but is not sure whether it is this species or not.

Filaments—The lateral filaments are in the form of rather wide plates, and their length is equal to about one sixth the width of the body. The anal filaments or tails are about as wide and twice as long as the lateral filaments.

Food Plant—So far as the records show this insect feeds only upon the coast sequoia or redwood (*Sequoia sempervirens*).

Distribution—Collected by Prof. George A. Coleman upon the Stanford University campus, Palo Alto, Cal., at Woodside, Cal., and in the Sierra Morena Mountains.

THE SOLANUM MEALY BUG.

Pseudococcus solani (Ckll.).

(Fig. 35.)

Color—The body is pale yellowish and sparsely covered with fine white powdery wax.

Eggs—It has never been determined whether this species lays eggs or produces the young alive.

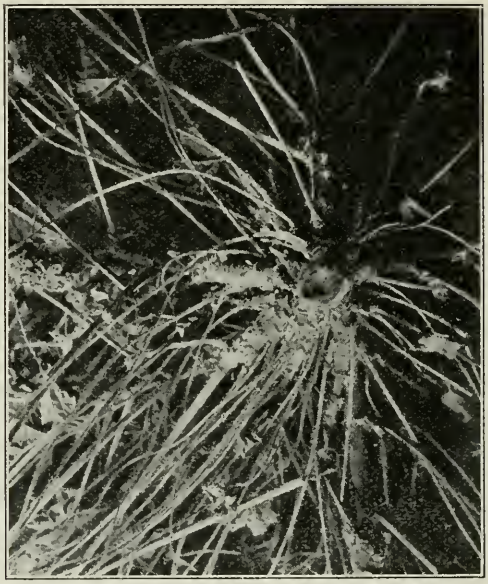


FIG. 35.—The solanum mealy bug, *Pseudococcus solani*, on the lower branches of *Malva rotundifolia*. Reduced. (Original.)

Filaments—The lateral and anal filaments are about the same length and very short, often entirely wanting.

Food Plants—This species appears to be a subterranean form and lives either entirely under the ground or upon the branches which touch the ground. It has been found feeding upon the following plants: *Aster* sp., *Malva rotundifolia*, nightshade (*Solanum douglasii*), pigweed (*Amaranthus retroflexus*), potato (*Solanum tuberosum*), purslane (*Portulaca oleracea*), wild sunflower (*Helianthus annuus*), tomato (*Lycopersicum esculentum*).

Distribution—Specimens of this mealy bug have been collected by the writer at Santa Paula, Ventura County, and Upland, San Bernardino County, and has been received on potatoes from Stockton, San Joaquin County, Cal.

THE YERBA SANTA MEALY BUG.

Pseudococcus yerba-santæ Essig.

(Fig. 36.)

Color—Body light yellow, completely covered with a very fine white powdery wax.

Eggs—Pale yellow laid in an ovisac which entirely encloses the female.

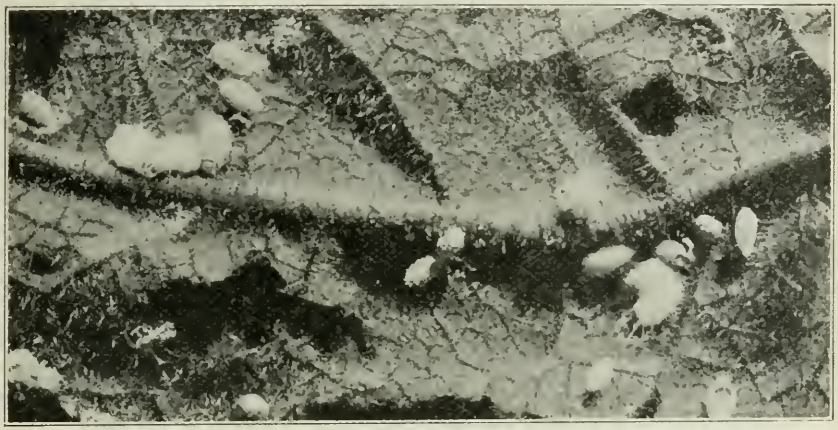


FIG. 36.—The yerba santa mealy bug, *Pseudococcus yerba-santæ*, on leaf of yerba santa. Young adult females and ovisacs. (Author's illustration.)

Filaments—The anal and lateral filaments are of about the same length and very short and inconspicuous.

Food Plant—Abundant upon the leaves of yerba santa or mountain balm (*Eriodictyon californicum*).

Distribution—Sespe Canyon, Ventura County, Cal. It has only been reported from this locality.

THE DIPLACUS OR YUCCA CEROPUTO.

Ceroputo yuccæ (Coq.).

(Figs. 37-38.)

Though not a true mealy bug of the genus *Pseudococcus* this insect is included here because of its great resemblance to and confusion with the mealy bugs. So far it has proven to be of no economic importance but may become so at any time.

Color—The body is light yellowish and covered with thick plates of white cottony wax. It is larger than the ordinary citrus mealy bug, being a little more than three eighths of an inch long.

Eggs—No eggs are laid, as the young are born alive.

Filaments—The lateral filaments are about one fourth as long as the width of the body and the anal filaments are slightly longer than those on the sides, as shown in Fig. 38.

Food Plants—This species works upon the roots, stems and foliage of the following plants: banana (*Musa sapientium*), black sage (*Ramona stachyoides*), *Ceanothus hirsutus*, *lantana* sp., lemon (*Citurs medica limon*), lime (*Citrus medica acida*), *Mesembryanthemum* sp., monkey flower (*Diplacus glutinosus*), California sage (*Artemisia californica*), *Yucca australis*, *Yucca filifera*, *Yucca whipplei*. Though some of these plants are commercially grown the insect has never been a pest upon any of them.

FIG. 37.—The diplacus or yucca ceroputo, *Ceroputo yuccæ*. Young females colonized at the base of black sage. (Author's illustration.)

Distribution—It has been collected or obtained by the writer from the following counties: Ventura, Los Angeles, San Bernardino and San Mateo. Undoubtedly it occurs in many other counties south of San Francisco Bay.

FIG. 38.—The diplacus or yucca ceroputo. Young and adult females at top; cocoons of males at bottom. (Author's illustration.)

NATURAL ENEMIES.

As in the case of most insects the mealy bugs are affected materially by natural enemies. If it were not for these, undoubtedly our native species would become more numerous and harmful and the imported species would be even more serious pests. Nature has provided a very nice arrangement for the protection of these natural enemies and we find some working within the host, out of the way of harm, while many of the young of predaceous ladybird beetles so resemble mealy bugs that only a skillful eye can detect the differences. Natural enemies are usually placed in two groups according to their methods of attacking the host, viz: internal parasites or those feeding and developing within the body of the host, and predaceous enemies, or those completely devouring the host.

Internal Parasites.

Our knowledge as to the internal parasites of the mealy bugs is yet meager and we are finding that some of the insects claimed to have been parasitic are secondary parasites, that is, they are parasites upon the parasites or predaceous insects working upon the mealy bug. However, there are several true parasites which are of considerable importance, and brief descriptions follow.

Chrysoplatycerus splendens How.

(Fig. 39.)

This parasite is a very minute shiny black four-winged insect which is only about 2.1 mm. long, having a wing expanse of 1.93 mm. The

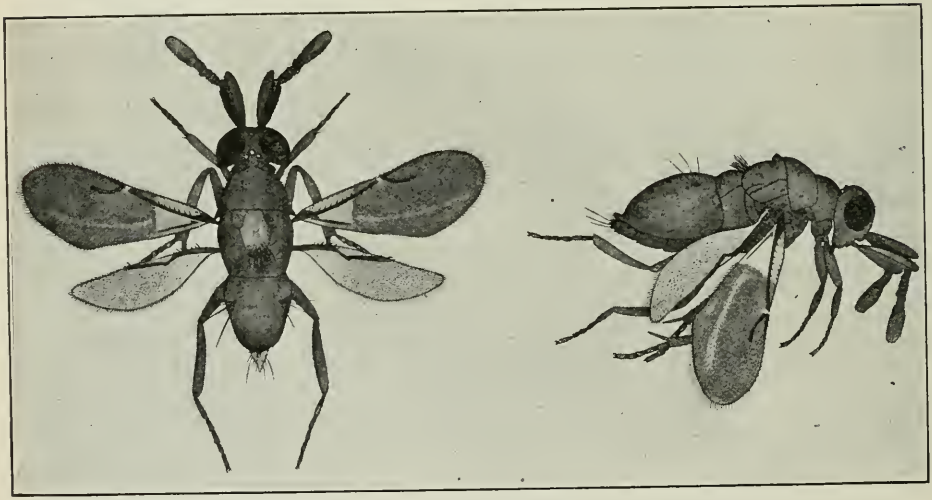


Fig. 39.—*Chrysoplatycerus splendens*, internal parasite of several species of mealy bugs. Greatly enlarged. (Author's illustration.)

antennæ are noticeably large and elbowed, the basal half being much larger than the rest. The basal third of the fore wings is light and the remainder distinctly clouded. The hind wings are light, except the veins. There is a distinct tuft of hairs at the tip of the scutellum on the middle of the back, a smaller tuft on each side of the abdomen and

a large tuft at the tip of the abdomen as shown in the illustration. As the adults are exceedingly small they are seldom if ever observed by the orchardist. The females are very deliberate in their actions and slowly feel the mealy bugs with their antennæ. When a suitable host is found she inserts her ovipositor and injects an egg into the body. If disturbed she jumps quickly and may fly away. When at rest the legs and antennæ are spread out and the latter protruding forward greatly resemble two extra front legs. The larva develops entirely within the body of the mealy bug and when the interior is entirely eaten out transforms to the adult and later emerges through a hole in the back of the host. This insect is evidently quite widely distributed throughout southern California and has been bred by the writer from the citrus mealy bug in Ventura and San Diego counties and Baker's mealy bug at Upland, Cal. Undoubtedly it also works upon other mealy bugs.

Leucopis bella Lœw.

This insect is a small bluish two-winged fly, scarcely exceeding one sixteenth of an inch in length and very active. The exact nature of its attack upon the mealy bug is not known, but it is thought to be parasitic upon the females. It has been reared out of masses of citrus mealy bugs and also from the yerba santa mealy bug by the writer. In both cases large numbers were obtained.

Predacious Enemies.

Of the predaceous enemies the ladybird beetles are the most important, and their value in subduing the mealy bugs is generally underestimated. These beetles are evidently entirely responsible for the complete subjugation of most of the natural forms, and it is exceedingly difficult to find mealy bugs without finding some of these predaceous enemies feeding upon them. Though the ladybird beetles are most important, there are a number of other insects which are no less effective in their work.

THE MEALY BUG DESTROYER.

Cryptolæmus montrouzieri Muls.

(Figs. 40-41.)

This beetle is by far the most important natural enemy of the mealy bugs. It was introduced into California many years ago from Australia and other places by Albert Koebele and has since been distributed in various sections of the State by the State Insectary. The first efficient work done by this insect was at San Diego County, and from there Mr. P. E. Smith introduced it into Ventura County, where in 1909-1910 it did really remarkable work, as has also been claimed for it by Mr. J. A. Prizer in San Diego County.

Its eggs are exceedingly small, light yellow in color, and laid singly in the egg masses or among the colonies of the mealy bugs. These eggs hatch into small yellowish larvæ which secrete a white cottony material not unlike that of the mealy bugs, except that the cotton is arranged in filaments all over the back, as shown in Fig 40. This covering seems to be a protective arrangement enabling the predaceous larvæ to have the same natural protection as the mealy bugs upon which they feed. The very young larvæ of the ladybird beetle feed upon the eggs and smaller

mealy bugs, while the full-grown larvæ (which measure about one fourth of an inch in length and about one third as much in width) feed upon all stages of the mealy bugs. Upon dissecting the mature larvæ it will be found, by examining the intestinal contents, that the entire mealy bug is devoured. When mature the larvæ go into the crevices or under cracks of the bark, among dead leaves, under clods on the ground or other protective places, and there transform into pupæ and finally into the adult stage—the metamorphoses occurring within the cottony skins of the larvæ. Often these pupæ may be seen in great quantities upon the trunks of the mealy bug infested trees, so that thousands have been

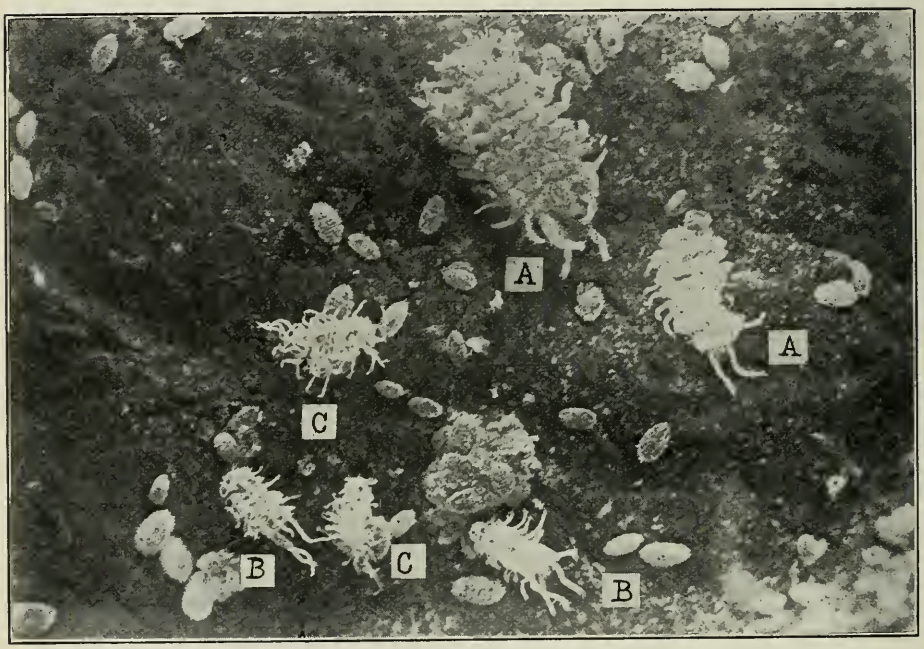


FIG. 40.—Larvae of ladybird beetles predaceous upon mealy bugs. A, the mealy bug destroyer, *Cryptolamus montrouzieri*; B, *Cryptogonus orbiculus*; C, *Scymnus guttulatus*. (Author's illustration.)

counted upon a single tree. The adult beetles are about one fourth of an inch in length, black in color, with the head, prothorax and the tips of the wing covers salmon red, as is also the color of the body beneath the elytra. The markings are shown in Fig. 41.

The beetle preys upon nearly all of the species of mealy bugs and has been observed by the writer feeding upon the citrus mealy bug and the long-tailed mealy bug, while it is recorded by other writers as feeding upon the various species in different countries.

This insect is very easy to distribute throughout the State, and should be introduced into all communities where the mealy bugs are in any considerable numbers. The adults may be obtained from the districts where they have become established, especially from San Diego, Ventura and parts of Los Angeles counties, or by applying to the State

Insectary at Sacramento, Cal. A few turned loose in the orchards will soon multiply to considerable numbers.

While it has never been able to control the mealy bugs as has the Vedalia, the cottony cushion scale, yet in a few instances its work has been as complete. For some reason it is not able to increase as rapidly as the mealy bugs and the pest soon gets the upper hand. As the mealy bugs are gradually diminished in a community the beetles die off and it may be necessary to re-establish them in certain small districts if the mealy bugs again increase.

FIG. 41.—Adult of the mealy bug destroyer, *Cryptolæmus montrouzieri*. Greatly enlarged. (Author's illustration.)

Cryptogonus orbiculus Schön.

(Fig. 42.)

The adults appear at first sight to be black, but upon closer examination it will be found that there are two quite large reddish-brown spots upon the elytra, as shown in the illustration. They are elongate or oval in shape, scarcely one eighth of an inch long and are exceedingly active. The eggs are oblong, and very small. They are laid singly among the egg masses and young of the mealy bugs. The bodies of the larvæ are yellow and covered with long, white cottony-like filaments (Fig. 40, B). The pupal stage is passed within the old skins of the larvæ in some sheltered or hidden places. Being a very small beetle, it preys principally upon the eggs and the young mealy bugs.

FIG. 42. — Adult *Cryptogonus orbiculus*. Enlarged. (Author's illustration.)

This ladybird beetle was introduced into California by George Compere from the Philippine Islands during the year 1910, and was liberated in the various parts of southern California. Its establishment does not seem to have been complete. Mr. Harry S. Smith also brought some of this species with him from the Philippine Islands in December, 1913, and has great hopes for it, as it is an effectual enemy in many countries of the Far East.

THE TWO-STABBED LADYBIRD BEETLE.

Chilocorus bivulnerus Muls.

(Fig. 43.)

The adult beetles are broadly oval in shape and about three sixteenths of an inch in length. The color is shiny black, with one irregular blood-red spot upon each wing cover. The extreme margins of the

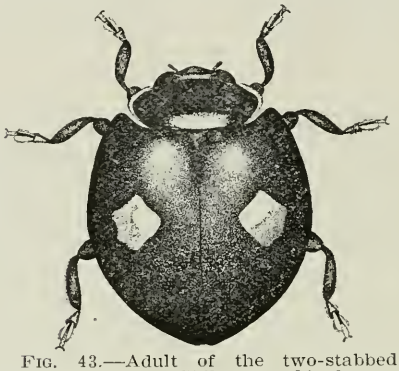


FIG. 43.—Adult of the two-stabbed ladybird beetle, *Chilocorus bivulnerus*. Greatly enlarged. (Author's illustration.)

prothorax are pale. The under side of the abdomen is red. The larvæ are dark in color, covered with long forked spines and have a yellow transverse band across the middle.

This beetle has been found feeding upon the citrus and the long-tailed species, and as it feeds also upon many other scales, it no doubt proved effectual in the subjection of other mealy bugs as well. It is a native species distributed throughout the entire State.

Hyperaspis lateralis Muls.

(Fig. 44.)

This ladybird beetle is quite generally distributed throughout the State and works principally upon native mealy bugs. The adult beetles

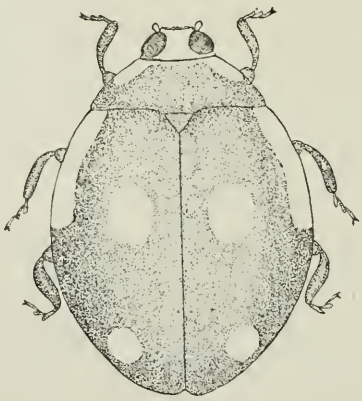


FIG. 44.—Adult *Hyperaspis lateralis*. Greatly enlarged. (Author's illustration.)

are about one eighth of an inch long, rather broadly oval and nearly hemispherical in shape. The general color is shiny black, and the dorsum is marked by a number of red or yellow spots, as shown in Fig. 44. The larvæ greatly resemble those of *Cryptolæmus montrouzieri* Muls., and may be easily mistaken for them.

The efficiency of this ladybird beetle is greatly lessened by the attacks of a small internal parasite, which attacks the larval and pupal stages. From a single pupa the writer bred eleven of these parasites.

Scymnus guttulatus Lec.

(Fig. 45.)

This beetle is very small, being scarcely more than one sixteenth of an inch in length. The body is black, mottled with reddish brown, as shown in the illustration. The adults are exceedingly active and fly readily when disturbed. The larvæ, like some of those previously described, are covered with long, white, waxy filaments and measure less than one fourth of an inch in length (Fig. 40, C).

This is a native species which is generally found throughout the State. It often does phenomenal work, and Mr. R. S. Vaile has noted a case where it entirely eliminated a serious infestation of mealy bugs in a greenhouse in Ventura in a very short time. It feeds upon nearly all of the mealy bugs.

FIG. 45.—*Scymnus guttulatus*. Adult female. Enlarged. (Author's illustration.)

Scymnus marginicollis Mann.

(Fig. 46.)

This is a small dull black beetle, about one eighth of an inch long and easily distinguished by a salmon-red prothorax and head. The larvæ do not secrete a white cottony covering. They work upon many other scale insects as well as the mealy bugs.

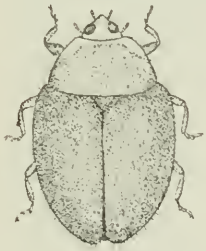


FIG. 46.—*Scymnus marginicollis*. Enlarged. (Author's illustration.)

It is a native species, found throughout the entire State.

Scymnus nebulosus Lec.

(Fig. 47.)

FIG. 47.—*Scymnus nebulosus.* Adult beetle. (After Quayle. Courtesy Cal. Agrcl. Exp. Station.)

The adult beetles are exceedingly small, being less than one eighth of an inch in length. They are somewhat elongated in shape and vary from light to dark brown in color, with indistinct markings upon the back. The larvæ are covered with long white cottony filaments.

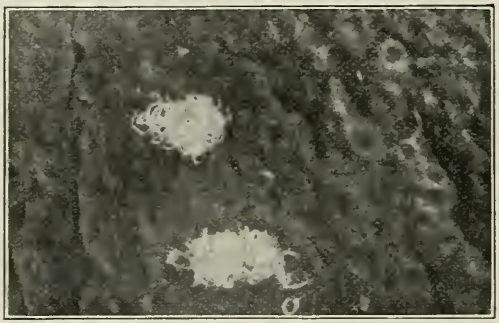
The species is native and generally distributed throughout the State. It preys upon the mealy bugs, other scale insects and plant lice.

THE SMALL BROWN LADYBIRD BEETLE.

Scymnus sordidus Horn.

(Fig. 48.)

This is another very minute beetle, scarcely more than one sixteenth of an inch long, and entirely light brown in color. The larvæ are about one fourth of an inch long, yellow in color and covered with a thick coat of long white waxy filaments.



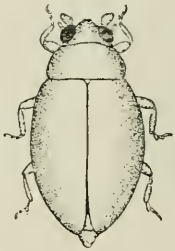


FIG. 48.—Larvæ and adult female of the small brown ladybird beetle, *Scymnus sordidus.* Enlarged. (Author's illustration.)

It is a native species occurring throughout the State and feeds not only upon the mealy bugs but also upon other scale insects and plant lice.

THE BLACK LADYBIRD BEETLE.

Rhizobius ventralis Er.

(Fig. 49.)

The adult beetle is entirely black and less than one fourth of an inch in length. The abdomen beneath the wing covers is dull red. The larvæ are slightly more than three eighths of an inch in length and are dark brown or almost black in color.

This beetle was introduced a number of years ago by Albert Koebele, and established as an enemy of the black scale. It works upon many of the scale insects, and has been found to be a bountiful feeder upon the citrus mealy bug in Ventura County.

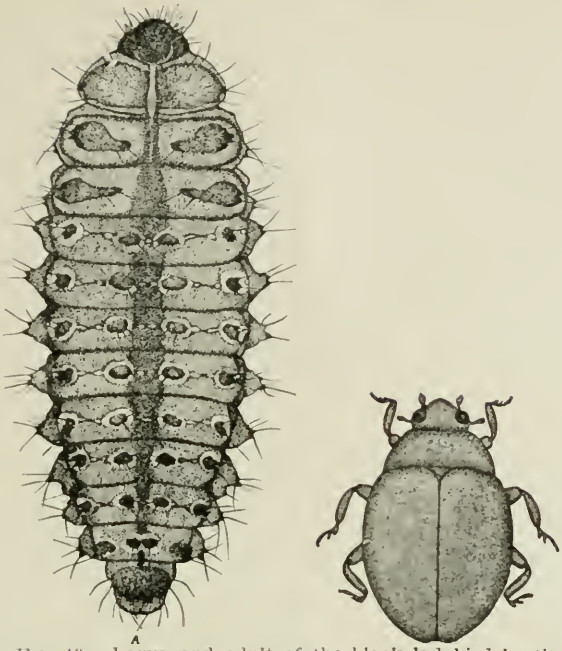


FIG. 49.—Larva and adult of the black ladybird beetle, *Rhizobius ventralis*. Larva enlarged three times as much as the adult. (Author's illustration.)

Lindorus lopanthæ Blaisd.

(Fig. 50.)

The adult beetles of this insect greatly resemble those of *Scymnus marginicollis* Mann. They are about the same size and the same general

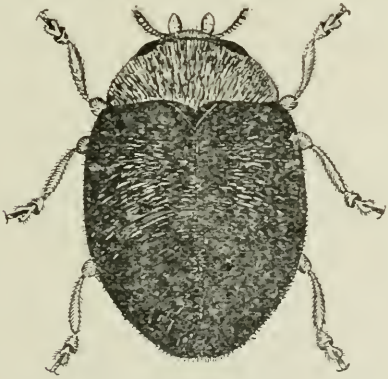


FIG. 50.—*Lindorus lopanthæ*. Adult much enlarged. (Author's illustration.)

color, except that the wing covers have a bronze luster instead of being dull black. The larvæ are light brown, with an elongated yellow spot along the middle of the back.

This species was introduced into California some years ago by Albert Koebele, and is generally distributed throughout the southern part.

THE GREEN LACEWING.

Chrysopa californica Coq.

(Fig. 51.)

The adult insects are commonly known as green lacewings, because of their four delicate green lace-like wings. The color is light green, the body having a conspicuous yellow longitudinal stripe down the entire length of the dorsum. The adults measure about one inch in length. The eggs are elongated, pearly white and attached to a long thin stalk which suspends them about one fourth of an inch in the air. The young vary from one eighth of an inch to three fourths of an inch in length, and are yellow with reddish markings. They have very formidable, long, sickle-like jaws or mandibles, which they insert into

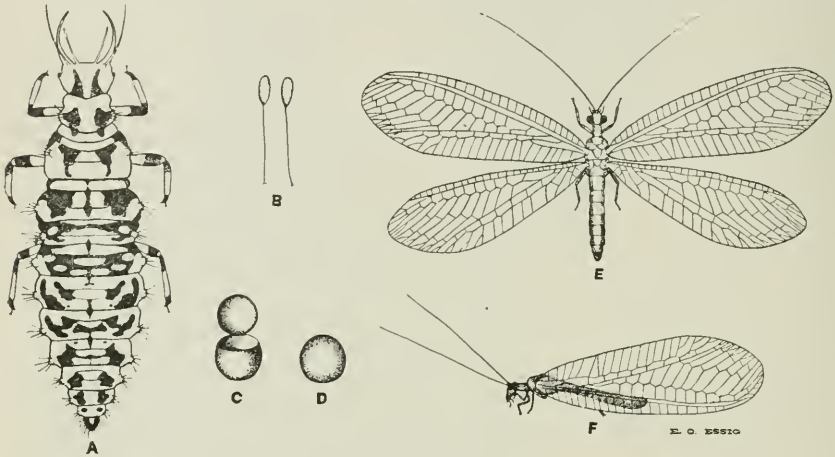


Fig. 51.—The green lacewing, *Chrysopa californica*. A, larva; B, eggs on the supporting stalks; C, cocoon with lid open; D, cocoon before escape of the adult; E, adult with wings expanded; F, adult in normal resting attitude. (Author's illustration.)

the bodies of the host and by means of which the body juices are extracted. The cocoons of the pupæ are small, pearly white, globular bodies, held by threads, or a stiff white web, and are usually found in the cracks or under the scales of bark or in any protected places. All forms of the insect are abundant in the orchard. The eggs may be observed attached to the leaves, while the young are usually found feeding wherever soft-bodied insects occur. The adults are active on the wing and fly as soon as the branches of the tree are disturbed.

THE BROWN LACEWING.

Sympherobius angustus Banks.

(Figs. 52-53.)

The adults of the brown lacewing are slightly smaller than those of the green lacewing and the wings are wider and the body more robust in proportion to the size. The general color is brown, the wings being artistically clouded with brown, as shown in the illustration (Fig. 52). The eggs have never been observed but they hatch into small slate or tan colored larvæ which are exceedingly active. When full grown they are nearly one half an inch long. The jaws or mandibles are not nearly

FIG. 52.—Adult female of the brown lacewing, *Symphrerobius augustus*. Greatly enlarged. (Author's illustration.)

as large as those of the larvæ of the green lacewing, as will be seen by comparing the drawings of each. When mature the larvæ spin thick white cocoons in which they pupate and from which they emerge in several weeks as adult insects. The cocoons are hidden in protected places and are often found massed together in considerable numbers.

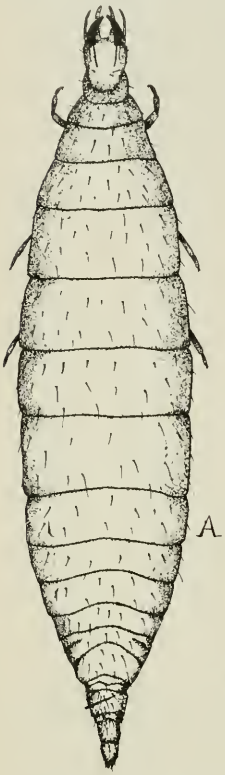


FIG. 53. — Larva of the brown lacewing, *Symphcrobius angustus*. Greatly enlarged. (Author's illustration.)

This insect would be far more effective were it not heavily preyed upon by an internal parasite (*Isodromus iceryæ* How.) which attacks the pupæ in the cocoons. The writer has bred great numbers of this parasite from the cocoons and has estimated that only about ten per cent of the brown lacewings are able to escape the attacks of the parasite and become mature.

Baccha lemur O. S.

A fly belonging to the family *Syrphidæ* was found feeding extensively upon the yerba santa mealy bug. The adult flies are dark, one half inch long with very slender bodies and a large black spot near the middle of each wing. The larvæ evidently feed upon the egg masses or the adult mealy bugs, which may or may not be enclosed in the ovisac. This insect and the small dipterous parasite, *Leucopis bella,* are evidently responsible for holding the yerba santa mealy bug in check.

ARTIFICIAL CONTROL.

The cottony, waxy material secreted by the mealy bugs renders them resistant to most of the methods employed in the control of other scale insects. The wax does not allow the ordinary sprays to penetrate and in order to reach the body at all it is necessary to employ an insecticide which will first dissolve the wax. Oil emulsions usually do this. The covering, also, seems to assist the mealy bugs in resisting fumigation, as it is one of the hardest pests to control by this method that we have found in the orchards. While, under some conditions, the mealy bugs will succumb very readily to fumigation, under others it is impossible to kill all without great injury to the tree. The splendid success obtained in a few instances has often led to the belief that the mealy bug could be easily and entirely exterminated by one or two heavy fumigation doses, while poor results obtained under the most favorable conditions have led others to believe that fumigation was entirely futile in the subjugation of this pest.

In a discussion of the control of the mealy bugs the writer wishes to take it up from two viewpoints: first, the general case of where the mealy bugs are widely distributed in a district, and should be commercially controlled as other scale insects; and second, from the viewpoint of a small, isolated infestation, where the object would be to entirely eliminate or eradicate, if possible, the infestation.

Commercial Orchard Control.

The usual practice in the control of insect pests in the commercial orchards of our State is to keep them so reduced that the cost of fighting is always less than the damage done had control measures not been employed. If an additional application of a spray or another fumigation would cost more than the damage due to the insect pest, it is the usual practice to withhold such a spraying or fumigation. This plan has adjusted itself throughout the State with regard to almost every insect pest and is as applicable to the mealy bugs as to any other pests, and should be enforced in exactly the same way. In the districts where the citrus mealy bug has been the most serious it should be stated that prior to the infestations little or no control work had been employed and the infestations gradually grew until it looked as if many orchards would be entirely destroyed. When this peculiar situation had arrived it was found necessary to do something, and, due to the tremendous quantities of mealy bugs present where the first experimental work was done, the results were very unsatisfactory and so varied that the general impression immediately made was that the control of the mealy bug was almost a physical impossibility. Continued work, however, indicates that if control measures are as consistently adopted against the mealy bug as against other scale insects, its ravages need be feared no more than those of the black scale, red scale, yellow scale, purple scale, etc.; and while it is not the purpose of the writer to intimate that the presence of the mealy bug in the orchard is not a serious thing, yet he desires that the seriousness of the case be not over estimated, as has apparently been the case in the past.

Artificial control work naturally falls under two heads, spraying and fumigation.

SPRAYING.

In the years 1909 and 1910 the writer conducted some rather extensive experiments with sprays, in order to find, if possible, one that might be of value in controlling the citrus mealy bug. In all of the experiments conducted it was found that an oil emulsion which would readily dissolve the cottony wax gave the best results, and the work then resolved itself into the selection of a spray that would not only give good efficiency in killing the mealy bugs, but which would cause less injury to the fruit and foliage of the trees and would be the least expensive. The spray that more nearly fulfilled these requirements proved to be the carbolic acid emulsion prepared as follows:

Water	40 gallons
Whale-oil soap	40 pounds
Crude carbolic acid	5 gallons

The water should be brought to the boiling point in an iron kettle and the whale-oil soap chopped into small pieces and thoroughly dissolved in it. After this add the crude carbolic acid and boil for ten or fifteen minutes. The resulting mixture should be a thick light creamy emulsion. For orchard use one gallon of this stock emulsion is added to every twenty gallons of water, the resultant spray being milky-white in color. We had considerable trouble in procuring good whale-oil soap and crude carbolic acid. We found the best whale-oil soap to be rather light in color and easily dissolved in hot water, while the best crude

carbolic acid (about 25% pure) was rather thin and did not greatly color the stock solution. In a number of instances we procured very dark whale-oil soap, which was absolutely unfit for use, and also thick, black crude carbolic acid, which did not make a good emulsion and which formed a black substance which adhered to the foliage and fruit of the trees, giving them a most disgusting appearance. During the past year the writer has had occasion to examine several emulsions made in various parts of the State and found most of them to be exceedingly poor. In one case no emulsion at all was formed, and the crude carbolic acid floated around on the top in the form of a dark, thick, curdy mass, which could not be brought into solution except by heating. In another case the crude carbolic acid separated out and floated on the top of the diluted spray. The best stock solutions should be creamy in consistency, milky white in color. They will keep indefinitely and emulsify easily when cold. To my mind many of the poor results obtained from spraying have been due to the poor stock solutions made from improper ingredients.

Commercial Sprays.

There are several commercial sprays upon the market which the writer has not had an opportunity to experiment with, but many of the growers in California have used them, some with good and some with poor success, as we might expect from the use of any sprays. The one objection to these commercial preparations is the great cost, which is so many times that of the home made product that one might well go to the trouble of preparing a spray which will give practically as good results as the ready made product. For small infestations, however, it is often advised to buy the ready made sprays rather than to go to the trouble of making one.

Time for Spraying.

The best time to spray for mealy bugs appears to be during the fall, winter and spring months, when the eggs are being laid and the young hatching and the insects are more in evidence than at any other time of the year. At this season the citrus trees are also more or less dormant and are better able to withstand the sprayings than during the summer months. The general experience seems to indicate that between October first and March first is the best time to make the applications. In the case of navel oranges, however, the spraying should be made either before the fruit is formed or before the navel is enlarged enough to admit the mealy bugs, as it is almost impossible to kill the insects after they are massed in the navel.

Application of Sprays.

Without doubt the greatest factor in the efficiency of sprays is their application. The work must be thoroughly done, otherwise it might just as well not be done at all. The first essential is a good power sprayer, capable of maintaining a pressure of from one hundred and fifty to two hundred pounds. The liquid should be applied as a coarse driving spray. The nozzles best adapted to this have proved to be the large-holed "Jumbo" and "Mistry Jr." A spraying rod, equipped with a straight "Y" and two angled nozzles, or an angled "Y" and two

straight nozzles are recommended, and with this equipment many growers have been able to get very satisfactory results. The use of a single small fine-holed nozzle is not to be recommended at all. The amount of liquid to be applied will naturally vary with the size of the tree and the extent of the infestation, but for an average sized tree the use of fifteen gallons will cost only about seven cents and is not too much to insure a fairly even distribution to all parts. One of the great objections to spraying is that not all portions of the tree are drenched. The operator should bear this in mind when he is making the application and meet, so far as possible, this difficulty. In severe infestations we have made such an application as many as five times without any apparent damage to the trees.

Conclusions.

Spraying is not recommended as the only or even the most efficient means of controlling the mealy bug. It is simply a means, and if properly done and under favorable conditions will give good results. Under other conditions, however, almost complete failure may attend the work, as has often been the case and many may be led to think that spraying as a control measure is a failure. At the convention at Ontario Mr. Wood reported that an orchard had been sprayed six times in the summer and at the end of the year was as badly infested as orchards not sprayed. Mr. Prizer reported that in his work at Chula Vista plots sprayed apparently showed no better results than those which were not treated at all. Similar cases have been observed by the writer. However, he has also a personal knowledge that very bad infestations have been almost entirely eliminated with spraying. Mr. R. S. Vaile reported good results from spraying with carbolic acid emulsion.

Remembering all the factors one should not be discouraged by these failures, and it is the belief of the writer that persistent work will bring results which will amply repay the cost to the orchardist.

Spraying is never recommended as a single method of control or eradication. It is only one means to these ends.

FUMIGATION.

In the year 1908 Mr. Philip E. Smith, then horticultural commissioner of Ventura County, began the first experimental work in the control of the citrus mealy bug by fumigation. The results of his experiments were published in Bulletin No. 1 of the Claremont Pomological Club, January 18, 1909, and were not at all encouraging. His work was continued during the year 1909 by the writer and by many other parties, particularly Mr. R. S. Vaile, the present horticultural commissioner of Ventura County; Mr. John A. Prizer, the entomologist of the San Diego Fruit Company, Chula Vista, Cal.; Mr. H. A. Weinland, horticultural commissioner of San Diego County, San Diego, Cal.; Mr. Wm. Wood, horticultural commissioner of Los Angeles County, Los Angeles, Cal.; Mr. Roy K. Bishop, horticultural commissioner of Orange County, Santa Ana, Cal., and many others, with varying success. From all the experiments there seems to be a common belief that fumigation is an efficient means of commercial control in the orchard and that by

repeated applications small infestations might be entirely eradicated. It has also been learned that a repetition of small doses, one half to three fourths or full schedule No. 1, have usually given as good results with the least injury to the trees, as the excessive doses which were thought to be the best in the first work done. In Ventura County the writer obtained good results by using the three fourths schedule, No. 1 (potassium cyanide), making a second charge at the end of the first hour, thus using two doses at hourly intervals, making the entire exposure two hours. Mr. H. A. Weinland reports that he has had the best results by the use of the one half schedule, No. 1 (sodium cyanide), under the same system. He reports a slight damage to leaves and fruit, but no serious results.

Much has been said relative to the use of oiled tents in the control of the mealy bug. Undoubtedly the oiled tent could be as successfully used as the ordinary tent if the dosage were cut down proportionately, but, due to the difficulty in handling the tents and their greater susceptibility to tearing and wear, they do not seem to be satisfactory for this work. Repeated experiments carried on in Ventura County in 1909-1910 caused the writer to entirely drop the idea of procuring an air-tight tent, because of the great damage done to the foliage of the tree, when the ordinary fumigation dosage with the untreated tent appeared to be giving as good, or nearly as good, killing results without the accompanying injury to fruit and trees.

Conclusions.

In Ventura County, where the mealy bug has been under observation for a number of years and where control work has been carried on quite effectively, it is the general belief now among orchardists and by County Horticultural Commissioner R. S. Vaile as well, that the fumigation ordinarily used against black scale and such other pests as are present in the orchard will serve to keep the mealy bug in such control that it will not be an economic factor in the growing of citrus fruits. It is recognized, however, that under certain favorable conditions the mealy bug might increase more rapidly than these other pests, and that occasionally a special fumigation or spraying might be necessary to maintain an equilibrium. It is a fact that in the districts where fumigation has not been practiced for a number of years the mealy bug has become the worst, and in general where this method of fighting insect pests has been adopted and continued regularly for some time, it has not been a serious consideration. This is by no means a universal rule, for in some districts where fumigation has been used for a good many years the mealy bug continues to be a pest. This is not strange, however, when we consider that the black scale, though recognized as easily controlled by fumigation, promises always to be a pest in citrus orchards, unless other than our present-day methods are employed. Why, then, should we not expect that the mealy bug would occasionally share a like position?

The results of the discussion given at the convention at Ontario plainly indicate that of the two methods, spraying and fumigation, the latter is the more efficient and reliable and, though often unsatisfactory, has usually given the best results.

Where Eradication is Desired.

No doubt every orchardist would desire to see an insect entirely eradicated, no matter how wide its distribution, but the history of insect control is full of instances where even the eradication of small infestations have proven impossible. So many are these instances that it is held that an insect, once established, can never be entirely eradicated, and this is certainly true wherever the establishment is thorough and over a considerable area. The first thing, then, to consider, is the extent of the infestation. Wherever this would cover one to a dozen trees in a very definite area, then the eradication might be possible, if the methods adopted were properly applied. The writer is aware of a number of such cases where by untiring labor and great expense the mealy bug has been apparently eliminated. To do this, however, without some loss to property, is very difficult. The work might be accomplished in a number of ways: by repeated fumigations, by cutting back the tops and thoroughly washing the trunks of the trees a number of times before the new growth comes out, and by entirely grubbing out and burning all the infested trees. Either of the first two might prove a failure, and while the last one is sure, it is not a method which most growers would care to adopt.

Other Control Measures.

SPRAYING WITH WATER.

At the Ontario convention the control of the mealy bug by the application of water was briefly discussed. This office is also in receipt of a paper by Mr. E. O. Amundsen, containing experiments along this line. The method employed is the application, by strong pressure, of water to the infested trees, thus washing the mealy bugs to the ground. They are prevented from getting on to the trees again by a tanglefoot band around the tree trunk near the ground. The experiments have been limited and cover only a short period of time, and while this may prove to be a method of value its indefiniteness will not permit of a further discussion here.

GENERAL CONSIDERATIONS.

Under the above heading the writer desires to discuss such other important phases as have not been included in previous topics.

Climatic Conditions.

Climatic conditions undoubtedly have much to do with the increase of the mealy bugs. In a warm, moist condition, such as a greenhouse affords, certain species thrive and are in evidence throughout the entire year, while out of doors the same species are usually confined to one brood a year and are not much in evidence during the hot summers. That the mealy bugs occur throughout the entire State and often become exceedingly abundant in the interior valleys, as well as along the coast, shows that they are able to withstand a great variety of climatic conditions, but it has been in the milder southern coast regions of Santa

Barbara, Ventura, Los Angeles, Orange and San Diego counties that the insects have thrived best and proven most destructive, though it has been reported that the vineyards in Fresno County were seriously infested during the years 1910-1911. The writer has also observed very severe infestations of the citrus trees in Marysville during the year 1912.

Little reliance can be placed in the argument that mealy bugs can not withstand the warm, dryer climate, though we would hardly expect them to prove as serious as along the coast.

Means of Distribution.

The adult female mealy bugs are able to move about during their entire existence and the young are exceedingly active, covering quite a long distance in a very short time. The adults are very hardy and able to withstand long periods without feeding, especially when they are ready to begin egg laying, which may be any time after they are one half or two thirds matured. At this period they may be easily distributed from one district to another in picking boxes, picking sacks, or on ladders, clothing or any other carrier. The eggs of the mealy bugs are deposited in loose, cottony masses, which enables them to adhere readily to any object. The feet of birds, clothing, ladders, or anything that might come in contact with these egg masses, are sure to carry some of the eggs along, and this, without doubt, is the most ready means of distributing the mealy bugs from one place to another. The larger insects carry not only the young, which may crawl upon them, but also the eggs from tree to tree. Mealy bugs, like other scale insects and plant lice, secrete a honey dew which attracts large numbers of insects, such as bees, flies, ants, and certain species of beetles, etc., which are often found abundant, walking over the egg masses and feeding upon the honeydew. In some instances the writer has found these insects almost enveloped in the cottony egg masses, portions of which they carried off with them. Of course an infestation must be severe to offer these means of distribution, and the slighter the infestation the less likelihood there is of any of these agencies causing a reinfestation. In some cases, in Ventura County, the writer could plainly point out the box rows by the infestations of the mealy bug, which had evidently been carried from the infested orchards to those subsequently attacked. In any community, then, contiguous to an infested district and desiring to remain free from this pest, certain regulations may be necessary to prevent the artificial distribution. These regulations will be discussed under the heading "Quarantine Regulations."

Quarantine Regulations.

Granting that the mealy bugs are controllable, it is always desirable to prevent the distribution of such pests from an infested to a clean district, even though the regulations adopted may work some hardships upon a given locality. The state law has contemplated such situations when it has given the State Horticultural Commissioner authority to quarantine districts within the State against certain other districts to prevent the distribution of injurious pests. Such a plan may well be, and has often been, adopted by a county to prevent not only the impor-

tation of an insect pest from another county, but also the distribution of a pest from one district to another district within the county. To do this certain quarantine regulations are enforced to prevent picking boxes, ladders, sacks, orchard implements and other appliances from being taken from an infested to a non-infested district, unless they have been properly treated by fumigation, dipping or some other equally effective means.

It is often customary for a grower in one district to ship his fruit out to another district for packing. This should never be allowed if the fruit is grown in an infested district and shipped to a clean district, but if grown in a clean district no objections could be found to shipping fruit to a packing-house in an infested district, if no boxes are returned, or if the picking boxes to be returned are first subjected to a fumigation in an air-tight room, with a dosage of four ounces of potassium cyanide per one hundred cubic feet of air space. Such a dosage will kill all life and eliminate any possibility of carrying living mealy bugs or fertile eggs with the boxes. In a district where a few of the orchards may become infested seriously enough to endanger the rest of the orchards within the district, the infested fruit is likely to distribute the mealy bugs over the packing house. In such a case all the picking boxes would need to be fumigated before going back to the orchards to insure against the mealy bugs crawling from the infested boxes to those going out to clean orchards. The infestation of the packing-house might be avoided by dipping all of the infested fruit in the orchard, just before it goes to the packing-house, in a concentrated solution of denatured alcohol, allowing the fruit to remain five or ten minutes in the liquid. If picking boxes are to be taken to the packing-house the entire box might be immersed, otherwise the fruit could be taken in clean shipping boxes. This is to be particularly recommended where there is a severe infestation. If a few orchards are only slightly infested, so that the mealy bug is rather difficult to find, it does not seem to the writer that such drastic measures are necessary, for the chances of distributing the pest under such conditions are so slight as to make such rules seem too drastic.

Seed Bed and Nursery Stock.

Great care should be taken to see that all seed bed and nursery stock imported from any district where mealy bugs occur is perfectly clean as this is one of the best ways of introducing the pest. Due to the difficulty of exterminating the pest, infested stock from infested districts is often not allowed to enter uninfested districts even though inspection fails to reveal the presence of mealy bugs.

THE PEACH AND ITS CULTURE.

Address, State Fruit Growers' Convention, San Jose, Cal., December 2-4, 1913.

By CHAS. F. COLLINS, County Horticultural Commissioner of Tulare County, Visalia, Cal.

The peach (*Prunus persica*) is supposed to be a native of China but is now grown in all temperate climates of the civilized world. It has been cultivated since prehistoric times and to-day ranks among the most important fruits of the world. About 300 varieties are cultivated in the United States and classified as clingstone and freestone; white-fleshed and yellow-fleshed. In practically all parts of California below an elevation of 4,000 feet, some varieties are grown more or less extensively, but the foothills of the Sierras and the broad valleys of the Sacramento and San Joaquin are recognized as the home of the peach.

Many expensive mistakes, however, have been made in California by planting peaches in localities not adapted to peach culture, and the commercial planter should give the matter of soil and location most serious consideration before planting. It has been clearly demonstrated many times over, and at an expense of thousands of dollars, that the peach will not prove a success on shallow soils. In soils underlaid with hardpan, even at a depth of three or four feet, dynamiting for each tree is advisable. Alkaline soils should also be avoided, as the peach on its own roots is very sensitive to alkali. Even under most favorable conditions and best management the average commercial orchard seldom exceeds twelve years of profitable service.

Peaches are always propagated by means of seeds. Probably the most common method is to bed the seeds or pits in the fall by excavating to a depth of four inches an area of sufficient capacity to hold the required amount of seed not over two layers deep. Spread the pits evenly over the bottom and cover with a layer of burlap or old sacks over which place earth and keep moist. In March the seeds will crack open and sprout. Carefully remove the covering and transfer all seeds which have sprouted to the spot desired for the nursery, planting in rows to a depth of four inches and six inches apart in the row. The soil should be in a moist condition and thoroughly pulverized to a depth of sixteen inches. The plants are cultivated like any other crop until large enough to be budded with the desired varieties, which may be done any time from June to September or when the trees have attained nearly the diameter of a lead pencil and while the sap is flowing so the bark will slip readily from the wood. Buds should be secured from trees known to be healthy, vigorous and heavy, regular producers of the best quality of fruit. In other words, pedigree your fruit stock as you would your live stock. This is the most important step in the whole process, as under no other circumstances can the best results be even hoped for.

In this enlightened age, a stock breeder would be considered daft for breeding cayuses and mustangs, but hundreds of fruit growers continue to breed "mustang" trees and vines when with a little care in selection of stock for budding and grafting the yield could easily be increased 50 to 100 per cent. If a breeder of swine, which are mostly slaughtered before the age of two years, finds it profitable to select the best sires and dams for his purpose, how much more so might the breeder of trees and vines from which he expects fifteen to fifty years of service.

In budding the young trees the buds should be set as close to the ground as the operator can conveniently place them, and when they start to grow the original top is partly or wholly removed in order to force the growth of the young sprout. When set in the orchard the young tree should be buried to the point of union of stock and scion. Peach trees, more than one year old from scion are rarely planted, as they are less satisfactory than yearling trees. For my own use, I prefer a vigorous June bud that has made a growth of eighteen to twenty-four inches rather than a yearling of six feet, as the shock of transplanting is less and the laterals for forming the head of the future tree will nearly always be more systematically arranged at the end of the first year in the orchard. In transplanting from nursery to orchard see that the roots are kept moist, as the small rootlets will not endure long exposure.

The peach may be set in orchard while in dormant bud and grown successfully with a little extra care, though this is seldom advisable. In the last three days of March, 1902, I set 500 dormant buds, 250 each of Lovells and Muirs with a loss of but three. On planting I removed the stock just above the bud with a sharp knife and used a protector, six inches in diameter and twelve inches high, made from one-ply "P and B" roofing, perforated for better circulation of air and held in place by a couple of small stakes on the inner side. These trees bore a light crop in 1905, or the third year from planting, and gave good returns a year later.

Generally speaking the peach thrives best in this State upon its own roots, the Salway being considered the best seed for stock. In exceptionally moist locations, the plum root may prove more satisfactory. The tree prefers a deep, sandy loam, but will prove satisfactory on heavier soils if well drained. Since the blossom buds open very early, they are liable to injury by frosts, and localities where late frosts prevail should be avoided.

The first preliminary step to proper planting is thorough and deep plowing and pulverizing of the soil. Late winter or early spring planting is advisable, and if planted in squares, twenty-four feet apart each way is the best distance. The roots should be carefully examined and all bruised or broken parts cut away to a smooth surface. The hole should be wide and deep enough to allow plenty of room for the roots to lie in their natural position. The tree should be planted slightly deeper than it naturally grew in the nursery. Loosen the soil in the bottom of the hole the length of the shovel blade. The roots will appreciate this, and if heat and moisture conditions are favorable, will follow the line of least resistance and penetrate downward. A tree setter or planting board should of course be used to hold the tree in position while carefully filling in around the roots with loose moist earth. Do not tramp the soil as though setting a post, but when the hole is two thirds full firm gently by pressing with the foot at the same time pulling up lightly on the tree with the hand. Then fill the hole, leaving the top soil loose. Unless the ground is well moistened by rains, irrigation and cultivation should follow soon. It is also very important, especially in the interior valleys, to protect the bodies from the hot rays of the sun. Remember you are dealing with a young and tender plant that needs your care and attention, and will respond to good or ill treatment as readily as a young animal. As soon as planted all laterals should be

removed and the main stem shortened to a height of eighteen inches. This insures a low head which will protect the body from sunburn and greatly facilitate the work of picking, pruning, spraying, and thinning.

The method of pruning considered best suited to conditions in this State, and almost universally adopted here, is known as the vase form. There are various ways of securing and maintaining this form. The most popular method is as follows: At planting remove all laterals and cut the tree back to a height of about eighteen inches. The following winter three or four of the strongest and best placed branches are selected to form the head of the tree. All laterals are removed from these and they are cut back to a length of about eighteen inches. All other growth is removed from the tree.

The second winter leave two strong laterals on each of the main branches left the previous year, and cut these back to about two feet in length, removing all large laterals on these as well as on the other parts of the tree. It is better at this pruning to leave some of the smaller growth to protect the tree from sunburn and induce greater leaf action. At the third pruning leave two of the strongest laterals properly distributed on each of the branches left from previous year's growth. Shorten these to about two feet. Remove all the larger laterals from the tree, but leave most of the small laterals especially those that hang down from the main branches as these will bear a few peaches.

Future pruning will consist mainly in renewing and regulating the amount of bearing wood and preserving the form already established. The tree should be kept well balanced and the center not too open, as the fruit will naturally pull the branches outward, and if the center of the tree is too much exposed, sunburn, borers and a rapidly decaying tree will be the result. Trees making a feeble growth must be cut back more severely than vigorous ones. The general rule is to cut back from one half to two thirds of the season's growth. As the tree comes into full bearing the growth of new wood diminishes and the number of fruit buds increase, necessitating more severe pruning.

Another method of vase form, known locally as the Sims method, has been practiced for many years by Mr. Wm. Sims of Farmersville, and is now practiced by the California Fruit Canners' Association in their large orchard near there, by Hunt Bros. in their orchards near Exeter, and by many individual growers in that vicinity. By this method the trees are cut back to eighteen inches at planting and at the first winter's pruning four or five of the most upright growing branches are left to form the head. These are cut to a uniform height and as great a length as the season's growth will allow. On a vigorous tree this will be about six feet. All laterals are removed from these.

The second winter retain one strong upright branch emerging from near the end of each branch of previous season's growth, and remove all laterals from the tree larger than a lead pencil. Top these main branches at a uniform height of ten or twelve feet from the ground according to the growth made. Sometimes a lateral is allowed to grow from one of these main limbs to fill in an open space in the outline of the tree. At the end of the second winter's pruning we have a low headed tree with four or five main branches ten or twelve feet long and so upright that the tree is only six or seven feet across the top. Enough small laterals are left for abundant shade. After this each season

remove all large laterals leaving only the small fruiting wood and cut this back to the required amount.

Some of the claims made for this system are that no propping is required to support the limbs and as these are so nearly perpendicular in growth the orchard is more easily worked close to the trees and the trees are more easily kept down to a proper height than when pruned by the ordinary method. This system certainly works admirably in the sections where it is used, and in my opinion on true peach soil, where the trees are vigorous and grow large, strong limbs, it is far superior to the old vase form, but it is a question if it would prove as satisfactory in many of our orchards where the trees make a more feeble growth, and especially with a tree of as slender growth as the Muir. Of course, with a less vigorous tree it would require three or even four years to get the tree to a proper height by this method.

When the trees set too heavy a crop thinning should always be resorted to, as it is just as easy to overwork a tree as a horse and the results are fully as disastrous. Furthermore, the difference between a crop of large and a crop of small fruit is often the difference between profit and loss. Thinning should not be done till just before the pit hardens and the period of natural drop has passed.

In sections where irrigation is practiced great care should be taken to supply the necessary amount of moisture before the tree shows any visible signs of needing it, as when this occurs it has already suffered great injury. The deep furrow method of irrigation or running water slowly through one or two deep furrows in the center of the row until the soil is sufficiently wet by seepage should be practiced on all heavy soils and in all localities where flooding is not absolutely necessary.

Cultivation with some tool that will stir the soil to a depth of at least five or six inches should always follow irrigation as soon as the land is in the proper condition to work. It should never be stirred when sticky, or when it will slip from the plow in smooth shining chunks, but should crumble and fall into fine particles as it turns over. It is an excellent plan, especially in heavy soils, to run a subsoiler in each irrigation furrow as well as in the center of each row at right angles to these and to a depth of eighteen or twenty inches. This breaks up the plow sole and facilitates deep irrigation. The number of irrigations must be governed by circumstances. Plenty of moisture in the spring when the tree is starting its season's work is necessary, but in the hot dry valleys of the interior this is not sufficient for its needs. No one would expect his horse to drink enough in the morning of a long hot day to last him till the next morning and trees, like horses, should be watered when they need it. The way to determine when they need it is with the aid of a soil tester or in the absence of this a "long-back" irrigating shovel. This will show the exact conditions at any time.

When the whole surface of the peach becomes soft to the touch it is ready for drying and should be picked from the tree, cut into halves and placed in the sulfur bath as quickly as possible, using three pounds of the best sublimed sulfur to the ton of fruit with an exposure of at least three hours to the fumes. Sufficient sulfuring will be indicated by the skin slipping readily when taken from the sulfur bath. If for any reason the cut surface of the peach becomes dry before sulfuring it should be sprinkled with water before entering the sulfur house. Care

should be taken to place the peaches on the trays with the cut surface squarely up so the cups formed by the pits will retain the syrup which fills them in the sulfur bath, otherwise this will flow out upon the trays, causing the fruit to adhere to them when dry and the dried product will be lighter in weight. On emerging from the sulfur house the trays should be immediately spread upon the drying ground, and in ordinary weather exposed to the sun for about three days, when they are stacked or piled one upon the other to a convenient height and the balance of the curing process is completed in the shade. Generally they will be ready for the sweat box in about two days, but no hard-and-fast rule can be laid down for this, and it is only in the school of experience that the proper time for boxing can be learned. A good general rule is when the curing process has so far advanced that the skin can not be slipped from the fruit by rubbing between the thumb and fingers. I always aim to box a little before they are in this condition as the smaller and drier ones will readily absorb the excessive moisture from the larger fruit, and if packed firmly in the sweat boxes or in bins for ten or twelve days the whole mass will be evenly cured and in excellent condition for the packing-house.

An orchard is usually cleaned in three or four pickings and as little fruit as possible should be knocked or shaken from the trees. Houses for sulfuring must be made tight with only sufficient ventilation to insure the burning of the sulfur. These can be very cheaply and easily made by building a frame of 2 by 4 scantling and covering with one-ply roofing paper. I have used houses of this sort four years before renewing the covering. The most satisfactory method, however, is to cover the frame with cheap boards and then line outside with roofing paper. This makes a strong, tight, serviceable and inexpensive house that will last for many years.

The transfer fruit cars now so common in the peach growing sections and steel track are indispensable to quick and satisfactory service where more than a very limited quantity of fruit is to be handled. Each sulfur house should be of such size that either one or two loads of the fruit car will exactly fill it.

In the packing-house the fruit is graded into five different sizes or grades by passing it over a series of screens of different sizes in the grader. These grades are termed standard, choice, extra-choice, fancy, and extra-fancy. The smaller sizes are nearly all packed in fifty pound boxes and the better grades in twenty-five pound cases though some one pound cartons are now being put upon the market. The bulk of the crop is consumed in the United States.

Like most commercial fruits, the peach is subject to some diseases and is preyed upon by a variety of insects. Through the alertness of our horticultural officers this great industry has so far been preserved, in this State, from those insidious diseases known as yellows, rosette and little peach, with which so many of the growers in the east and middle west are only too familiar. One of the most common diseases of the peach in this State is blight, but as this is a fungus easily controlled by spraying with Bordeaux mixture in the late fall or early winter it is not to be dreaded, though this spraying should never under any circumstances be omitted.

Leaf-curl is quite common with some varieties, especially in the coast counties and also in the interior valleys in wet springs. A Bordeaux or lime-sulfur spray applied just as the buds begin to open affords complete control. In fact, there is very little danger of leaf-curl in the interior valleys on trees that have been sprayed, thoroughly, with a strong Bordeaux mixture in December for blight. If a spring spray is used for leaf-curl, it is better to use the lime-sulfur just as the buds are opening as this will also control the peach worm or twig borer, which is one of the most serious insect pests of the peach in this State, but easily controlled by this method.

Probably few orchards in this State are free from the bacterial disease known as crown gall, for which no control is yet known. It is often the cause of considerable loss in the nurseries, and, no doubt, renders thousands of trees unprofitable in the orchards of California. Much of this trouble may be eliminated by selecting seed for nursery stock from vigorous trees known to be free from crown gall as seed from diseased trees will produce crown gall stock. As an example, I will relate a little personal experience: For several years I grew a small quantity of peach stock each season using seed from a near-by vigorous Salway orchard and obtained fully 90 per cent of clean stock. One season I could not get the required amount from this orchard so purchased some from another Salway orchard in the neighborhood keeping the seed separate and planting side by side in the nursery. The last lot of seed produced 90 per cent of crown gall stock. The first lot 90 per cent of clean stock. Part of the affected lot was budded to Elbertas, and as I needed a few of this variety to square up an orchard, I selected from this lot 121 of as clean, vigorous and healthy looking June buds from sixteen to twenty inches high as any one could wish for and planted. That season all but a dozen of them made an excellent growth. The following spring two or three did not start and several more looked feeble. I impressed the "long-back" shovel into service, beginning with the dead ones and continued up one row and down another until the whole 121 trees were uprooted and 120 of them showed plain evidence of crown gall. Three years later the orchard from which I obtained the infected pits was uprooted at the age of fourteen years and nearly every tree was affected.

In the interior valleys the almond mite often attacks the trees in early summer, but a very effective control is secured by dusting the trees with flowers of sulfur. This should be applied as soon as the mites appear, and can be easily and quickly done with any good hand-operated sulfur blower if the operator will use it from a wagon. In this way the tops of the trees where most of the mites are found are easily reached, there is no walking over soft or cloddy ground, and the operator carries his sulfur with him. One man, with a steady team, will easily cover 400 full grown trees in ten hours.

When properly cured the Muir and Lovell will each yield about one pound of dried fruit for five pounds of green, though this will vary in different seasons. While the Muir contains less juice and more sugar, the Lovell has the smaller pit and therefore thicker flesh. The Elberta yields about one pound of dried fruit to six or six and one half of green.

OAK PESTS—THE OAK TWIG GIRDLER.

(*Agrilus politus* Say.)

Order—Coleoptera. Family—Buprestidæ.

By LEROY CHILDS, Assistant Secretary State Commission of Horticulture.

The live oaks (*Quercus agrifolia*) throughout the greater part of the State are subject to the attacks of numerous insect pests and fungous diseases which cause a great deal of damage not only to the actual health of the trees, but distinctly mar the beauty of one of California's most picturesque native trees. Neglect is especially apparent in the smaller cities and towns where the oaks, the property of the cities, continue to be breeding centers of many injurious insects which could be entirely eliminated with no great expense. It is the aim of the author to publish short accounts of the descriptions, life-history and control measures to be applied in combatting these injurious insects, the first of which will deal with the twig girdler, *Agrilus politus*.

The injury inflicted by the oak twig girdler is very conspicuous (Fig. 54), and the damage occasioned by its attack upon the smaller twigs is more in the destruction of beauty than actual physical injury, though in the case of a severe infestation, especially in trees where the beetles' presence has been one of long standing, the writer has seen oaks whose vigor has been greatly reduced through the reduction of the foliage surface and consequent limitation of food making possibilities as a result of the curious girdling habits of this interesting insect.

The presence of the small borer is easily detected on account of the killing of the smaller twigs of the tree, the results of the girdling habits the larva of this beetle possesses.

Character of Injury.

The movements of the feeding larvæ are always of a definite character, a continuation of which results in the formation of a spiral-shaped burrow which has often been found to encircle the attacked twig from four to seven times, death of the twig always advancing as the length of the burrow is increased by the feeding grub. The feeding operations occur in the soft growing tissues of the twig in the cambium layer at the point that separates the bark from the woody portions of the stem. Occasionally, in cases where the wood is exceptionally soft, the burrow may extend into the wood a little but never to any great extent. This point of attack is a very vital and sensitive part of the plant structure, as not only the growth of the plant takes place there but the transportation of food properties and water occurs in the tissue that is affected by the feeding larvæ. It is therefore quite evident that as soon as the insect encircles the twig the connectives joining the small twig and leaves are cut off from the rest of the tree, and the result is sudden death to that portion above the point of infestation. A tree attacked by this pest is readily noticeable, owing to the presence of the many small patches or tufts of dead leaves scattered irregularly over the entire crown of the tree.

The beetle larvæ seldom operate in twigs of a greater diameter than a half inch, and will be more often found in the smaller branches of about the size of a lead pencil.

This small buprestid beetle must not be blamed, however, for all of the foliage that is destroyed upon our oaks, for there are a number of insects and fungi that have as a host plant this tree. There is one pathological trouble of which little seems to be known which kills the smaller branches and leaves in such a way as to greatly resemble those killed by the twig girdler, and is quite liable to cause confusion in establishing the identity of the disease in question. There is, nevertheless, a superficial distinguishing character that enables one to differentiate these two diseases at a glance, and this is found in the coloration

FIG. 54.—Small twig of the live oak showing the characteristic injury of the twig girdler. The corky bark covering has been removed above the burrow. (Original.)

of the dead leaves. The foliage that has died as a result of beetle work, appears, when thoroughly dry, a light straw color, while those that have been killed as a result of a fungous attack in the branches below, possess a distinctive reddish-brown tinge. These characteristic qualities have been found to be quite reliable in the Santa Clara Valley, where most of the observations relative to the life-habits of *Agrilus politus* were noted. Observations have not been made in any other region than that cited,

and there is a possibility that varying conditions such as altitude and climate might make them unreliable elsewhere. In case there is any doubt, however, as to the cause of the trouble, carefully cut away the bark on one of the dead twigs and in case it is beetle work that has caused an abnormality which has made itself manifest, the burrows and accompanying "frass" will be noted. The larva is a very slender delicate little creature, and will be overlooked or cut away if care is not taken. The insect will usually be found at a point near the union of dead and living wood.

Life-history.

Little seems to be known relative to the various stages in the transformation of this beetle. The author has casually watched the development and growth of the species while attending Stanford University, where the insect is found abundantly.

From the various collecting dates that have been recorded with the insects that have been taken in various years it would appear that the

FIG. 55.—Larva and adult of the oak twig girdler, *Agrilus politus*. About twice natural size. (Original.)

adults may issue as early as April. The beetle has been reared from infested twigs by the writer and the emergence of the adult has never occurred before the first of June. Weather conditions and the variable supply of available foodstuffs in different trees doubtless have a great deal to do with the time the insects make their appearance. The time of the issuance of the adult is very important in the control of the pest, and this work should be undertaken during the fall and winter. This precaution will greatly reduce the infestation for the following year.

The eggs or egg-laying has not been observed, but must take place soon after emergence for the young larvæ show considerable growth by the first of August. From the fact that the young grubs begin their burrows at some weakness that the small twig affords, *i. e.*, at the base of a leaf or at a branching point of the small twig where there is an irregularity in the bark surface, the egg-laying habits of the twig girdler

must be much the same as the habits of some of its closely related buprestid relatives. Many of these beetles seek out some protected location, a crack or crevice, or crawl under some irregularly formed bark into which or under which the ovipositor is inserted and the egg deposited. The newly hatched larva not only finds itself well protected from outside influences in this location but also from the fact that the bark covering is very thin at these points the grub readily bores its way into a position under the cambium. The adult of the twig girdler doubtless possesses this same instinct. In the case of *Agrilus* the eggs must be deposited singly for at no time has there ever been found more than one grub in an infested branchlet.

Larva—By the first of September most of the larvæ have reached a length of something more than a quarter of an inch. At this time their operations do not extend down the branchlet to any great distance, possibly three or four inches from the point of entrance. Already the presence of the little feeding grub has made itself felt, and the leaves above the points of infestation show a distinct discoloration, and in many places will be entirely dead. Growth of the twig-girdler continues throughout the winter, the grub showing little signs of development after the latter part of February, at which time it possesses a length of nine sixteenths to three quarters of an inch, and is very slender, seldom exceeding a width of one eighth of an inch. This mature larva (Fig. 55) does not closely resemble the buprestid or "flat-head" type of which the flat-headed apple tree borer is such a striking example, but is an exceedingly delicate, soft-bodied, distinctly segmented grub, possessing a somewhat flattened head which is decidely curved in outline anteriorily. The general color of the larva is light cream shading into brown in the more or less highly chitinized portions about the regions of the mandibles and at the tip of the abdomen.

Adult—The transformation from the pupa to the adult state takes place near the lower end of the burrow, at which point the insect makes its appearance through a small round hole. The beetle is a small insect moderately elongate, seldom measuring more than five sixteenths of an inch in length and with a width of about one sixteenth inch. The general coloration is quite variable, ranging from bright brassy to purplish or greenish and always somewhat metallic and shining. The antennæ are short and serrate, not reaching the middle of the thorax.

Control.

Mr. S. Nakayama of Stanford University reports a hymenopterous parasite (Fig. 56) attacking the larva. Unfortunately the material from which the accompanying drawing was made was destroyed before a determination could be obtained. The importance of this parasite in the control of *Agrilus* is as yet unknown, as Mr. Nakayama's record of the presence of a natural enemy of the twig girdler seems to be the first of its kind.

Control measures by thoroughly pruning out of infested parts was undertaken by the author at Palo Alto in the fall of 1911 and 1912, and the results obtained very conclusively prove that the trouble from the twig borer can be almost entirely eliminated by the occasional cutting out of the attacked twigs in individual trees, even though there is not

an entire clean-up of all surrounding infestations. This fact seems to indicate that the insect is not a strong flier, and proper precautions carried on by the individual property owner will greatly improve the general appearance and health of his oak trees, and at the same time have little fear from an immediate infestation from his less thrifty neighbor.

The process of eliminating this insect is indeed simple, requiring only a willing, conscientious man—a young man preferably. To remove all infested parts a great deal of climbing will be found necessary, and the success of the operation depends upon the pursuance of thoroughness.

The tools required in accomplishing the work are not many but all that are listed are quite essential that best results may be obtained.

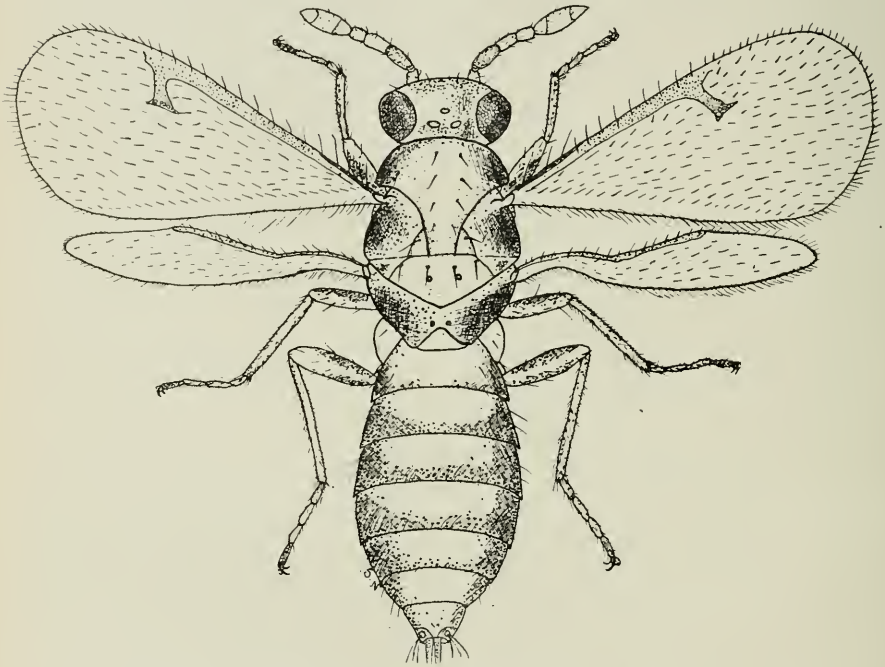


FIG. 56.—Undetermined hymenopterous parasite of the oak twig girdler. (Drawing by S. Nakayama, Stanford University.)

These include a long extension ladder; the longest that may be obtained will be found to give best results and aid very materially in reaching the infested parts near the top of the tree. Regular pruning shears for close work, and the long-handled pruning hooks are both necessities as well as a good pruning saw. The latter is seldom used in removing the beetle larva, but can be used to much advantage in cutting out some of the dead limbs which have accumulated on the inside of the trees, the removal of which not only improves the general appearance and health of the oaks, but removes the danger of falling branches.

In many of the larger trees a great deal of climbing about in the branches is required, that all parts may be reached. This should not be

undertaken by persons who are afraid to climb, or a fall and serious injury is quite liable to result. The pruner should wear soft soled or rubber soled shoes, not only for his protection but to avoid the bruising and destruction of the bark, the injury and removal of which is exceedingly advantageous to the entrance of beetles and destructive fungi. This matter of proper shoes is very important and parties contracting for the pruning of their trees should insist upon the wearing of the soft soled shoes.

The cutting out and burning of infested parts should be undertaken some time between the first of October and the first of April. It should be remembered that if the dead twigs are cut out before the first of April the insects are killed with the removal of the dead wood and a reinfestation is thereby avoided. Observations made at Palo Alto, extending over a period of years seem to indicate that the insect does not fly any great distances, and that the beetle confines its egg-laying for the most part to the trees in which it underwent its development, consequently a reinfestation in the case of trees that have been cleaned up, from outside trees containing the twig girdlers, will be very slow.

A thorough cutting out of the dead portions of the tree will greatly improve the general appearance, and will demand thereafter only a little attention to keep it in a healthy, vigorous condition.

GENERAL NOTES.

IDAHO QUARANTINES AGAINST CALIFORNIA.

Because of the infestation of California potatoes with the potato tuber moth the State of Idaho has declared a quarantine against the potatoes of our entire State. California will be permitted to ship no potatoes into that state in the future until the authorities in Idaho are assured and convinced that the tuber moth no longer infests our potato fields and store houses.

Idaho has also placed an embargo on all shipments of nursery stock from twenty-one of our counties, as follows: San Benito, Mereed, Stanislaus, Santa Clara, Santa Cruz, San Mateo, Alameda, San Joaquin, Sacramento, Placer, Sutter, Yolo, Solano, Contra Costa, Napa, San Francisco, Marin, Sonoma, Mendocino, Lake and Colusa, this because of the ravages of the pear thrips in the orchards of California.

This is a vivid illustration of the necessity of keeping our fields and orchards pest-free; only by so doing can we safeguard our products and our markets. There is no reason to think that Idaho has any motive only that of her own safety in declaring these quarantines. Each state must protect its own people and its own industries. It must also be the judge of the necessities in each case.

In the case of the pear thrips our investigations incline us to believe that the embargo was unnecessary. It is very doubtful if the insects are in the soil in nurseries. If they are ever in the ground where young trees are grown, the thorough washing of the roots, which could be required, would doubtless remove all possible danger.—A. J. Cook.

NEW SOUTH AMERICAN POTATO WEEVILS.

A very important article by W. Dwight Pierce of the U. S. Bureau of Entomology appears in the new publication, "Journal of Agricultural Research," Vol. 1, No. 4, p. 347 which deeply concerns not only California potato growers, but also those of the whole Pacific Coast.

This article describes two small weevils, *Rhigopsidius tucumanus* and *Premnotrypes solani,* the first 9 mm. and the second 7 mm. long, so small—about one third of an inch in length—that they are not easily observed in the whole potato and are very apt to be overlooked by shipper and consignee alike. This article is beautifully illustrated, and from the illustrations of the injured tubers these weevils would seem to rival the tuber moths as potato pests.

Our quarantine officers are urged to be on the sharp lookout that any importations from South America which may harbor these weevils, one or both, may be discovered and intercepted.

The weevils are known to exist in places in Chile, Bolivia and Peru. Happily the Federal Horticultural Board has acted to aid in keeping these pests from the United States.—A. J. Cook.

POTATO TUBER MOTH AND EELWORM.

We now know that this moth and this nematode are existent in several parts of our State. We know that other sections, often whole counties, are entirely free of them. We know also that both these pests disfigure the tubers and render them unmarketable.

All of our county horticultural commissioners should use every effort to restrict infestations of both these destroyers to the utmost. If affected potatoes are refused in any locality, they can not be planted, and so the extent of infection will not be increased. All who grow potatoes should be instructed as to the life history of the pests and the appearance of infested tubers, and should be urged with special emphasis not to plant any but sound potatoes.

I have just received eelworm tubers from a county horticultural commissioner who says that seventy-five sacks have been shipped to his county. At this planting season the menace from such a shipment would be great. It would certainly warrant the rejection of the entire lot.—A. J. Cook.

POTATO COUNTY.

I have just visited one of our northern counties, El Dorado, which grows a considerable area of very fine potatoes. So far as I know, the vegetables are largely free from blemish or disease. Even scab is very rare. These potatoes are much sought for seed, their reputation being such that they find ready sale at a good profit. Surely, the people of this county are deeply concerned in keeping all these enemies of the potato absolutely out of their county.—A. J. Cook.

THE WAYSIDE TREES.

In an article by A. L. Bancroft, Oakland, California, in The Monthly Bulletin No. 10, Vol. II, of the State Commission of Horticulture, entitled "An Improvement in the Setting of Wayside Trees," the author states that he has found an improvement in the placing of roadside trees and thinks his way has never been tried or thought of.

He says: "In place of rows set the trees in clumps. Let the clumps vary in size and natural groupings to fit the place, from three to thirty in a bunch; the distance apart of the trees and the number in a clump to depend upon the size and growth, habit of the tree, and the distance between the clumps to depend upon the lay of the land, the soil, moisture, exposure and other conditions. The spaces between clumps should be, probably, from fifty to two hundred feet."

Frank J. Scott, in his book, "Beautiful Homes," published over thirty years ago, says: "To attempt the varieties of park scenery on an avenue is as much out of place as to compose a park of straight rows of trees." William Saunders, writing on this subject in 1863 says: "In the planting of straight roads and avenues it is essential to preserve regularity of line, as also uniformity in the color and shape of the trees. The nearest approach to the sublime in landscape gardening is in effect produced by extended uniform lines of trees. Continuity of line and uniformity of object, when combined with great extension, produce sublimity. Objects are sublime which possess quantity and simplicity in conjunction. To produce this effect it is therefore imperative that only one variety of

trees should be used. Anything that tends to break up the uniform continuity will at once destroy it. A straight avenue planted with a variety of trees of varied forms, some broad and spreading, others tall, pointed and spiry, is as much at variance with good taste as would be a Grecian facade furnished with columns embracing all the different orders of architecture."

Mr. Bancroft says the "English garden," with its stiff, straight lines, is an abomination. Of course, Mr. Bancroft shows in this statement that he is writing about a subject with which he is not very familiar. It is the Italian or French garden, or the geometrical garden with its stiff, straight lines, he means. It is the English style of gardening we call natural gardening, as the English gardeners first broke away from the formal gardening.

The clumping and grouping on the side of the road on proper places within the adjoining property line is delightful, but the roads themselves are mostly too narrow to allow any planting of this kind inside their limits. Distant views from the road are very little interfered with if trees are planted the right distance apart (at least fifty feet) and properly pruned (at least ten feet up when full grown).

The drying out of the road would be more even on a regular, well planted road than on a road densely planted in spots, consequently the keeping of the road is more economical.

Mr. Bancroft's suggestions have been and can be used to best advantage in very hilly or mountainous regions.—W. VORTRIEDE, State Gardener.

REPORT OF THE RESOLUTIONS COMMITTEE.

At the Emergency State Fruit Growers' Convention, Ontario, Cal., January 30, 19914.

At the request of the Resolutions Committee, a statement summarizing the best methods now known in the control of the citrus mealy bug and the prevention of its spread has been prepared by Mr. E. O. Essig, Secretary of the Commission of Horticulture, and Mr. R. S. Vaile, horticultural commissioner, Ventura County. This statement is thought to be interesting as summarizing the results of this convention. The statement follows:

In reporting to the Committee on Resolutions relative to the control of mealy bugs we desire to consider the subject under two main heads, viz:

1. In localities where the infestation is limited to a small, definite area.
2. In localities where there is a general infestation covering many acres.

In either case we would recommend:

1. A scientific determination of the species.
2. An accurate inspection of groves and surrounding vegetation to determine as nearly as possible the exact distribution and seriousness of the infestation of the species in questoin.

In the special care of a small definite infestation we would also recommend that if possible the pest be extirpated even at the expense of a few

trees. Such action would eliminate many complications in the commercial handling of fruit and in quarantine matters which might eventually arise.

In the case of a general infestation we would also recommend:

1. Control.

   (*a*) As in the case of any insect pest we recommend control measures only when the damage threatened or done becomes a commercial consideration and that whenever possible the measures adopted be coordinated with the control of other pests as based upon the experience of investigators and orchardists.

   (*b*) Realizing the value of natural agencies in the control of this pest we further urge the use of such parasitic and predaceous insects as are available.

2. Quarantine.

   The matter of quarantine must of necessity be determined by the nature of the infestation. Believing that all practical means should be employed to confine the mealy bug to the determined infested areas, we suggest that the local fruit associations and county horticultural authorities take all possible precautions to prevent the artificial carrying of the pest to groves outside such infested areas.

(Signed) R. S. VAILE.
E. O. ESSIG.

The convention expresses its gratification that the true citrus mealy bug, *Pseudococcus citri,* has not been found in the Ontario and Upland districts but that the insect that caused the alarm is a common less harmful species, *Pseudococcus bakeri,* not hitherto known to be injurious to citrus fruits.

The convention requests the Commissioner of Horticulture to print a summary of the papers and discussions, including other useful information, in order that the information given in the convention may be widely disseminated.

In view of the imperfect knowledge of the life history and habits of the different species of mealy bugs and their relation to methods of control, the convention would urge that a comprehensive investigation of the different species of mealy bugs be made by the citrus experiment station; that a definite project looking towards an investigation of further methods of control be made; and that a survey of the work accomplished in combatting this pest be made and the results given to the public.

The convention expresses its appreciation of the work of the Commission of Horticulture, looking toward the introduction of parasites that assist in the subjection of the injurious citrus insects; it endorses this work and expresses the hope that the Commission of Horticulture may be enabled to extend the investigation to a critical study of the parasites in citrus producing countries that have not already been thoroughly searched for parasites, the investigation along this line to be conducted in close co-operation with the work of the citrus experiment station and of the county horticultural commissioners.

The convention desires further to express to Commissioner Cook and his associates its appreciation of the interest they have shown in the welfare of the citrus industry as evidenced by their aid in the investigation of the control of the mealy bug and in arranging for this convention. We feel that the influence of such conventions or bringing together of scientific investigators and practical growers in an interchange of ideas has a very beneficial and lasting effect. We also desire to express our thanks to the local committee that arranged for this meeting and to the high school authorities for the use of their assembly hall.

(Signed) G. Harold Powell (Chairman).
Geo. H. Hecke.
E. O. Essig.
R. S. Vaile.
H. J. Webber.
D. D. Sharp.
R. O. Price.

HORTICULTURAL LEGISLATIVE COMMITTEE.

The legislative committee appointed by the fruit growers at the State Fruit Growers' Convention at San Jose, Cal., December 2-4, 1913, consisted of the following members: C. C. Teague, chairman, Santa Paula, Cal.; Judge Peter Shields, Sacramento, Cal.; Dr. Thomas F. Hunt, Berkeley, Cal.; Dr. G. Harold Powell, Los Angeles, Cal.; Dr. A. J. Cook, Sacramento, Cal. At the emergency state fruit growers' convention at Ontario, Cal., it was voted that the State Commissioner enlarge this committee as he saw fit. In accordance with this, Dr. A. J. Cook appointed at the convention the following additional members: Dr. H. J. Webber, Riverside, Cal.; E. K. Strobridge, Hayward, Cal.; Geo. H. Hecke, Woodland, Cal.; W. A. Johnstone, San Dimas, Cal.. Since then the following name has also been added to the committee: Marshall Demotte, Corning, Cal.

THE VALUE OF SMALL CLUBS.

There are numerous organizations, of diverse aims and limitations of size, such as: the farmers' clubs, improvement clubs, civic associations, parent-teacher associations, and for young people the boy scouts, camp-fire girls and the chapters of the Agassiz association are doing fine work among the boys and girls in developing character and interest in life.

Recently in Los Angeles there was organized the Lorquin Natural History Club for boys, named for the pioneer naturalist who came to California in 1849. This organization, limited to twenty boys, from twelve to sixteen years of age, meets once a month at the homes of the members, in much the same way as the older scientific societies; it has its own constitution and by-laws, and goes through the usual formalities; the boys report on recent excursions and show specimens collected; and a lecture from some special older student from outside the club is given at each meeting; and last, but not least, are the refreshments. The boys all have their own collections and books—and are naturalists. The Rivers' Natural History Club, a similar society, has also been organized.

And the Director of Nature Study in the Los Angeles public schools has a nature study council, with representatives from each school, meeting at regular intervals. So the young people of Los Angeles are receiving encouragement in their natural history studies. The young people in other places should be offered similar opportunities.

The farmers' clubs are informal associations of groups of people in a community, for co-operation, for improvement of themselves, their homes and the community in general. Under proper leadership every community, rural and urban, should have such clubs, with definite aims and lines of work and study; individual initiative and responsibility encouraged and thus a strong organization built up. Besides the strictly utilitarian uses of such organizations—schools, roads, churches, etc.—natural history studies should be included and sections of the club formed for such purposes, and they would thus be an aid to the State Commission in diffusing useful knowledge, besides cultivating the æsthetic side of such studies.

I believe it should be the duty of the State Commission to encourage and establish clubs in different parts of the State. It would further the horticultural interests of the commonwealth and create a happy, contented and studious population, and counteract the tendency to the current cheap amusements.

Watching and studying the wonderful facts and processes of animal and plant life, injurious and beneficial insects, fungi, etc., would be an education, recreation and amusement.—FORDYCE GRINNELL, JR., Pasadena, Cal.

ENTOMOLOGICAL EXPLORER FOR INSECTARY.

We are glad to announce the appointment of Mr. Henry L. Viereck of the University of Kansas as foreign collector of beneficial insects. Mr. Viereck was for some time a specialist on the Hymenoptera at the Philadelphia Academy of Natural Sciences, later accepting the position of entomological expert for Parke, Davis & Company, Detroit. In 1908 he accepted a position under Doctor Howard of the U. S. Department of Agriculture as specialist on the parasitic Hymenoptera, which position he held for five years. He has an international reputation as an authority on the hymenopterous parasites of the world.

Mr. Viereck sailed on March 5, 1914, for Naples, Italy. He will devote his energies during the next eighteen months to the securing of natural enemies of the more important pests of California horticultural products. His field of endeavor will be the Mediterranean region of Europe.—HARRY S. SMITH.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent of the State Insectary.

(Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plants as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers. The material is, for the most part, compiled from the various state and Government publications.)

CITRUS FRUIT INSECTS.

The Orange Thrips.

The minute active brownish or yellowish insects so common in the orange or lemon blossoms and on the tender foliage of the trees are known as thrips. Several species often attack the trees at the same time; one, the citrus thrips, causes a leathery distorted growth to the leaves and marks the fruit, generally in the form of a ring around the stem end or down in streaks. Another species attacks the leaves causing them to turn a mottled pale color, and causing the surface of the fruit to turn silvery. Others feed on the parts of the flowers.

Spraying seems to be the most satisfactory method for combatting the thrips, and the U. S. Bureau of Entomology recommends the following spray: Commercial lime-sulphur 33 degrees, $2\frac{1}{3}$ gallons; black-leaf extract, 2 gallons of $2\frac{3}{4}$ per cent, or 14 fluid ounces of 40 per cent; water, 200 gallons. Maintain a strong pressure of about 175 pounds.

Fuller's Rose Beetle.

The injury caused by the Fuller's rose beetle consists in the destruction of the foliage, particularly the new. The adult insect is of a greyish-brown color, about a quarter of an inch in length and has the head prolonged into a short snout. The beetles being unable to fly must crawl up the tree trunks in order to attack the leaves. Barriers placed around the trunks have been used by many growers. One type of barrier is made of cotton, about four inches wide, and tied with a string on the lower side of the band. The band is then pulled down over the string so that it extends out a short distance from the trunk. Tree tanglefoot is also used as a barrier.

Diabrotica soror.

Another beetle commonly found attacking the foliage of the citrus tree is the *Diabrotica*. It is easily recognized by its green color and the twelve black spots on the wing-covers. Two means of control are: by jarring the beetles off the trees into a tarred or oil screen in the early morning while they are sluggish, and by poisoning them by spraying the tender growth with arsenate of lead, 2 pounds to 50 gallons of water.

The Cottony Cushion Scale.

The adult female scales are distinguished by the large white cottony masses secreted by them. These sucking insects are in main pests of citrus as well as the apple, peach, apricot, fig, walnut, acacia, etc., and are usually held in check by the Australian ladybird beetle, *Novius cardinalis* (*Vedalia*), supplied by the State Insectary.

DECIDUOUS FRUIT INSECTS.

The Peach Twig-borer.

In a recent issue of the Bulletin a brief description of the work and appearance of the twig-borer was given, and need not be duplicated here, except to say that the small black-headed larvæ destroy the young buds and shoots in the spring and summer. The lime-sulphur solution, the best spray that we know for this insect, must be applied when the blossoms begin to open. The commercial preparation diluted one part to ten of water and applied under a pressure of about 200 pounds, has given excellent results.

The Peach Borer.

This pest is fortunately rather limited in its distribution, where it is found in the Santa Clara Valley, Alameda and San Mateo counties; slight infestations are also reported from the more southern counties, Ventura and Riverside. It attacks primarily the peach, apricot, plum, prune and cherry. The eggs of this moth are laid on the lower trunks of the trees a few inches above the surface of the soil and the newly hatched larvæ bore through the bark. The burrows are generally made under the surface of the ground and through exit holes; the exuding gum, indicating the presence of the borer, is forced. The larvæ remain in their burrows during the winter months, passing there the resting stage in the early spring. The adults emerge sometime later. Control measures consist in the use of the resistant Myrobolan cherry-plum as a stock upon which trees are budded or grafted; protective washes of lome-crude oil mixture, lime-sulphur-salt mixture, digging out the worms or killing them with a crooked wire. The use of hard asphaltum, grade "C" and "D" applied to the tree trunks, preventing the issuance and entrance of a vast majority of the insects has been advocated by Earl Morris, Commissioner of Santa Clara County. The warm asphaltum is applied from five to six inches below and above the surface of the soil with a brush; two coatings are put on.

The Pear Thrips.

The description and work of this pest appears in a previous issue. The pear, prune, plum, peach, apricot and almond growers should be on the lookout for these minute active insects and at the time they appear in numbers a thorough high pressure spraying should be applied, holding the nozzle close to the buds and directing the spray into them. The Government formula for this spray consists of three per cent distillate emulsion combined with Black-leaf 40, 1 to 2000 parts of water.

The Codling Moth.

Because of the importance of the codling moth as an apple and pear pest, we beg to call attention again to this insect. It is generally known that wormy apples are the result of the attack by the larvæ of this moth and that clean apples are the result of spraying with arsenate of lead. Two applications are necessary on pears and three, as a rule, on apples. The strength of poison to use is 5 pounds to 100 gallons of water. The first spray must be made when the petals are falling and before the calyx cups close. A high pressure in spraying must be maintained and all parts of the tree covered.

The Woolly Aphis.

The woolly aphis is a sucking insect of the plant lice family. It is dark red or purplish in color and covered with a long white cottony excrescence and is the most serious apple pest in many of the northern counties. There are two forms, the aerial form living on the branches of the tree, and the subterranean or underground form living on the roots. This latter form is by far the most destructive. In setting out a young orchard care must be taken to buy clean stock. The roots should be examined and if puddled the mud must be washed off. Northern Spy stock is practically woolly aphis proof. Trees should be set in deep and cultivated frequently so as to force the root to grow deeper. The aphis seldom works more than twelve inches below the surface of the soil.

The Brown Day Moth.

In the early spring the salmon colored eggs of this moth are laid in clusters around the small twigs. The larvæ are dark colored with fine red stripes and spots on the dorsal surface and are covered with long tufts of hair. They are voracious feeders on the foliage of the various fruits and bushes, both wild and cultivated, and often defoliate their host. Prune tree foliage is a favorite food of these caterpillars. Destroy the egg masses and apply arsenical sprays when larvæ are numerous enough to do much damage.

MISCELLANEOUS INSECTS.

The Rose Aphis.

The rose aphids are the soft bodied sucking plant lice, green or pink in color, that thickly infest the young shoots and buds of the rose during the entire year, and especially in April and May. Washing the bushes with a high pressure of water will knock many of them off, and a soap solution or tobacco spray applied as frequently as necessary will easily destroy them.

The Rose Scale

The small whitish scales when thickly massed give to the rose, raspberry and blackberry canes a conspicuous appearance. All stages occur practically throughout the year and as the eggs are hard to kill, successive sprayings with kerosene emulsion are necessary to control it. Badly infested canes should be cut off and burned.

The Raspberry Horn-tail.

The raspberry horn-tail is a wasp-like insect whose larvæ burrow into the canes of the rosaceous host, such as the raspberry, blackberry, rose and loganberry. The winter is spent in the larval and resting stages within the canes, the adults emerging in April. The eggs are inserted in the tips of the young shoots and soon hatch, the larvæ burrowing outward into the shoots. As soon as the tips are killed they turn about and make their way down into the canes. The destruction of the tender eggs before they hatch by exerting a slight pressure on them will tend to control them. The shoots will not be injured by this treatment. A good plan is to cut out infested canes.

The Strawberry Crown Moth.

The larvæ of the crown moth work within the stems near the base or the roots of the host. Sometimes the roots and canes of raspberry and blackberry plants are affected. The adult moth begins to emerge about April and soon lays its eggs. There is much overlapping of broods, pupæ often occurring in the summer months. In irrigated districts submersion of infested fields after the crop is harvested offers a solution to the problem. Water should be left standing for four or five days. Destruction of infested plants is also advocated.

Cutworms.

Cutworms are common nuisances in the garden, some cutting off the tender plants at the surface of the ground, others crawling up the stems and eating the leaves. These dark greasy looking worms can be found in the day time an inch or two under the surface of the soil near the destroyed plant ready to emerge again at the return of night fall, and continue their work of destruction. Their control is a difficult problem. Many will be killed by using a poisoned bait which is placed near affected plants. The bait is composed of one pound of Paris green, 40 or 50 pounds of bran, sweetened with a cheap grade of molasses and mixed with enough water to make a stiff mass.

Wireworms.

The wireworms are the larvæ of the click beetles, are cylindrical in shape and have a hard external covering. They do much damage to planted seed and the roots of many species of plants. Of these plants, corn, beans and beets are favorite hosts. Poisoned slices of potatoes or other vegetables buried in the ground or placed under a board near the infested plants will destroy many of them. Green alfalfa treated with strychnine has been used with success. Such salty fertilizers as nitrate of soda or Kainit will render the soil distasteful for a certain time.

DISEASES OF PLANTS.

The Blue Mold and the Green Mold of Citrus.

The blue and green mold fungi have caused much loss to citrus growers who have persisted in the careless handling of their fruit so that it became injured or bruised, thus furnishing an entrance for the molds. The U. S. Department of Agriculture has demonstrated that careful handling of the fruit in the process of picking, hauling, grading and packing will reduce the losses to a minimum.

Brown Rot.

This decay fungus appears to be most common on lemons in the process of storage for curing. Characteristic of this disease is a brown somewhat dry decay of the rind upon which a scanty whitish mold develops. Diseased specimens have a typical odor. During moist weather the fungus sometimes appears on the lower branches of the trees. It lives naturally in the ground beneath trees where its spores are produced. R. E. Smith[1] states that orchard infection is prevented by keeping the trees pruned up somewhat from the ground, cultivating

[1]Bulletin No. 218, California Exp. Station.

the soil under the trees in summer and covering it in winter with a straw or a green cover crop. Thick Bordeaux mixture sprayed on the ground under the trees in winter aids in controlling the disease. Lemons are most liable to contract the rot in the tank of the washing machine where the water becomes filled with spore-infested orchard soil. Disinfect wash water with copper sulfate. See Bulletin 190, California Experiment Station.

Apple and Pear Scab.

Attention has been called to this fungus which produces the scabby patches on the fruit and leaves of these two fruits. Bordeaux mixture 5/5/50 formula is used just before the buds are opening; a second or third spraying is sometimes applied at later intervals. Conditions will determine number of applications of the fungicide.

Brown Rot of Stone Fruits.

Brown rot is another important disease of a fungous nature which attacks the stone fruits in localities where suitable moisture conditions prevail. Georgia peach and plum growers lost approximately $600,000 in 1900 from an attack of the brown rot. Preventive measures consist in destroying mummied diseased fruits or blighted twigs and spraying with a fungicide. R. E. Smith recommends for trial self-boiled lime-sulfur just as the fruit is setting, and again after the rains are over. See Bulletin No. 203, page 39, California Experiment Station.

Apple Mildew.

Apple mildew causes a dwarfing of the tips of new shoots and covers them with the characteristic whitish growth. Some growers have used the caustic-soda-sulfur spray. 10 pounds of dry sulfur being added to each fifty gallons of the spray; others iron sulfide, spraying frequently throughout the early part of the season, beginning just before the buds open.

Cherry Gummosis.

The formation and exudation of gum by an abnormal condition of the cherry is commonly termed "Cherry gummosis." Often death of the tree results. The work of F. L. Griffin of the Oregon Agricultural College has demonstrated that gumming in the sweet cherry may result from the attack of a certain species of bacteria. These same organisms may also cause the blight of the cherry buds, gum may or may not exude from the affected portions. The Mazzard cherry as a resistant stock, the cutting out of diseased parts of the tree, sterilization of the wounds thus made by the application of a solution of corrosive sublimate, 1 to 1000, when dry, the coating of large wounds with walnut-grafting wax as a protection against the entrance of rot fungi, have been recommended as control factors.

Rose Mildew.

Last year many samples of rose leaves and shoots affected with a whitish thick growth came to the office of the Commission. This diseased condition of the rose results from the attack of the powdery mildew fungus. The most effective treatment consists in thoroughly spraying

the bushes with a solution of sulfide of potash (liver of sulfur), one ounce to three gallons of water. The under sides of the leaves as well as the upper must be covered and a fresh solution used each time spraying becomes necessary.

Potato Scab and Eelworm.

Precaution to prevent planting of scabby tubers should be taken in the use of clean seed and treating before planting or cutting by soaking one and one half hours in a solution of one pint of formalin to thirty gallons of water. If soil is badly infested plant to some other crop for several years. Potato scab is recognized by the rough scabby surface of the tuber. Planters should also be on the lookout for any diseased tubers containing eelworms. These tubers have a rough warty surface, and if one of these is cut in two a ring of black dots is visible on the cut surface near the skin.

Sunburn.

Young trees are more susceptible to sunburn that the older ones. The southwest sides of the trees suffer the most. The cambium layer is killed by the heat and as a result there is an area of dead bark. This furnishes entrance to rot fungi and borers. It may be prevented by insuring the presence of an abundant moisture supply in the soil. Protecting the trunk with whitewash and using wrappers of various material is advised particularly for young trees.

INSECT NOTES.

The **peach twig-borer**, *Anarsia lineatella*, was taken in hibernaculæ, from crotches of almond trees at Paso Robles, on January 21st.—GEO. P. WELDON.

Reports of **termite** injury to prune, peach and almond trees, from Riverside County, led to an inspection of affected trees in the vicinity of Banning. In all cases that were observed the insects were burrowing into dead wood, and it could not be determined that they were responsible for its death. On the other hand it was concluded that their injury was largely if not wholly secondary. The infested trees practically all had crown gall and the termites had gained entrance through these galls into portions of the trunks where decay had set in and where there was dead wood for them to work upon. While there may be cases of damage to good wood as well, observations in this orchard indicated that they were working entirely in dead wood.—GEO. P. WELDON.

The eggs of the **brown or almond mite**, *Bryobia pratensis*, were found abundantly on almond trees in the Banning section of Riverside County, indicating that this species of mite is very common there.—GEO. P. WELDON.

A few egg masses of the **fruit tree leafroller**, *Archips argyrospila*, were found on the bark of apple trees in the Yucaipa section of San Bernardino County on February 3d. They were not abundant enough to cause any worry at the present time.—GEO. P. WELDON.

Quite a severe infestation of *Sanninoidea opalescens*, **the peach borer**, was found recently by County Horticultural Commissioner Sharp in Riverside County. This is the first report of its occurrence in the county.—GEO. P. WELDON.

Immature specimens of **the Monterey pine scale** *Physokermes insignicola* (Craw.), have recently been sent in from Burlingame. This species is usually kept well under control by its predaceous and parasitic enemies, of which there are many.—LEROY CHILDS.

The orange tortrix, *Tortrix citrana*, was found to be doing considerable damage in parts of Orange County visited on February 4th and 5th.—GEO P. WELDON. [Later reports of serious injury at Pasadena have been received.—*A. J. Cook.*]

The black scale, *Saissetia oleæ*, while not considered to be a pest of the walnut, it is interesting to note that it does live upon trees of the English variety. Several groves in Santa Ana County were recently found to be infested to a slight extent.—GEO. P. WELDON.

The seriousness of *Heterodera radicicola*, the potato eelworm, under favorable conditions in the nursery, may be judged from a recent bad infestation observed in Kings County. About 75,000 peach trees out of a total of 100,000 had to be destroyed because of an abundance of galls on the roots. The trees were grown on light, sandy soil which probably favored the increase of the pest.—GEO. P. WELDON.

The black scale, *Saissetia oleæ*, (Bern.), has been found to occur in conspicuous numbers on olive trees at Marysville. Adjoining grapefruit trees show a slight infestation while none could be found on orange stock. This same extraordinary condition is found in the interior citrus growing sections of the south in and about Redlands.—LEROY CHILDS.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

The following interesting report from Horticultural Commissioner F. R. M. Bloomer of Sacramento County, tells of the horticultural products inspected during the months of November, December and January, and gives a good idea of the very heavy planting of trees in the county:

Fruits, vegetables, hay and seeds (from outside of State), 257 cars.

Citrus fruits (from points outside of Sacramento County), 10,821 boxes.

Nursery stock (deciduous fruit, ornamental trees and vines), 133,919.

PESTS AND TREATMENT.

Alfalfa seed from Utah; fumigated 5 cars.

Potatoes from Nevada infested with *Heterodera radicicola;* condemned 9 cars.

Lemons from Nevada infested with *Lepidosaphes beckii;* condemned 55 boxes.

Diseased with *Bacterium tumefaciens;* condemned 720 trees.

Diseased with *Pseudomonas juglandis;* condemned and returned 330 walnut trees.

Infested with *Chysobothris femorata;* condemned 121 trees.

Infested with *Eriosoma lanigera;* treated 7,000 trees.

Large orders for citrus and olives have been placed, and shipments are beginning to arrive. The citrus planting will be double of that of last year; our groves are entirely free of *Lepidosaphes beckii, Pseudococcus citri* and *Chrysomphalus aurantii,* and so far very little gummosis has been found.—F. R. M. Bloomer.

F. W. Waite of El Centro is making close observations of the aphids that affect barley in the Imperial Valley, to determine when it will be necessary to import *Hippodamia convergens,* in an effort to control them. At present the situation is not at all alarming, and prospects are for less trouble than was experienced by the barley growers with this pest last season.

S. A. Pease of San Bernardino County has appointed Mr. J. B. Hundley to look after the work in the Yucaipa section where a large planting in apples is being done. He expects to carry on a clean-up campaign of old apple orchards.

D. D. Sharp, recently appointed county horticultural commissioner of Riverside County, upon the discovery of peach tree borer, *Sanninoidea opalescens,* near Banning, placed two inspectors at work cutting them from the trees. An effort will be made to eradicate the pest.

G. W. Harney of Marysville reports quite heavy planting of berries in his county. Tree planting is somewhat light so far; more peaches have been set than any other fruits. Rice culture is receiving considerable attention in the county and hundreds of acres are being prepared for planting.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF JANUARY, 1914.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, California.

The quarantine service has made a new alliance and a valuable one, during the past month. The Forestry service of the United States is now co-operating with the quarantine officers in the detection and determination of plant diseases likely to prove injurious to the forest growths and commercial plantings of trees destined for economic purposes in the United States. This was brought about by the detection of serious fungous diseases upon chestnut trees imported from Japan, and through the co-operation of Dr. C. L. Marlatt of the Federal Horticultural Board who had requested the writer to report any such findings by the California quarantine officers to Dr. Haven Metcalf, Pathologist in charge of the United States Bureau of Plant Industry. In the instance in question this was done, and the Bureau promptly responded by sending Dr. E. P. Meinecke to co-operate with the State quarantine officers in locating and destroying all the infected material in the shipment; all of which makes for progress and solidarity in this work of protecting our crops.

SAN FRANCISCO STATION.

Horticultural imports—

		Parcels
Ships inspected	45	
Passed as free from pests		142,844½
Fumigated		2,576
Destroyed or returned		259½
Contraband		5
Total parcels horticultural products for the month		145,685

Horticultural exports—

	Parcels
Inspected and certified	1,113

Pests Intercepted.

From China—

Cylas formicarius in sweet potatoes.
Cladosporium citri and *Phomopsis citri* on oranges and pomelos.
Chionaspis citri, Parlatoria ziziphus and *Lepidosaphes beckii* on pomelos.

From Florida—

Lepidosaphes beckii and *Phomopsis citri* on oranges.
Lepidosaphes beckii and *Phomopsis citri* on grape fruit.

From Guatemala—

Lepidosaphes beckii, Lepidosaphes gloverii and *Chrysomphalus* sp. on oranges.
Parlatoria pergandii on limes.

From Holland—

Lepidosaphes ulmi on cherry, peach, prunes and boxwood.
Aphids on junipers.

From Honolulu—

Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Saissetia nigra on betel leaves.

From Isle of Pines—

Lepidosaphes beckii and *Phomopsis citri* on grapefruit.

From Japan—

Weevils in chestnuts.
Parlatoria theæ on maple.
Pseudaonidia duplex on camellia.
Slug moth pupæ on *Pyrus*.
Agromyza schineri on wistaria.
Thyridopteryx sp., tepidopterous larvæ and asphids on cedar and juniper.
Cicada eggs, mantis eggs and *Thyridopteryx* sp. on persimmons.
Poliaspis pini on pines.
Egg mass of gypsy moth on cedar.
Pseudaonidia pæoniæ on azaleas.
Fungous diseases, canker, and *Marmara* sp., on chestnuts.

From Manila—

Cerataphis lataniæ on species of palm.

From New York—

Calandra oryzæ in pearl barley.

From Porto Rico—

Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From Tennessee—

Chionaspis furfura on apple scions.

LOS ANGELES STATION.

Horticultural imports—

		Parcels
Ships inspected	14	
Passed as free from pests		68,542
Fumigated		745½
Destroyed		11½
Returned		½
Contraband		1
Total parcels horticultural products for the month		69,300½

Pests Intercepted.

From Florida—

Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From Iowa—

Schizoneura lanigera on apples.

From Japan—

Aleyrodes sp., and *Pseudococcus* sp., on azaleas.
Ceroplastes ceriferus, mantis eggs and cicada eggs on persimmons.
Chionaspis wistariæ, *Pseudococcus* sp., and *Agromyza schineri* on wistaria.
Chrysomphalus ficus and *Hemichionaspis aspidistræ* on *Aspidistra lurida*.
Lepidosaphes newsteadi on umbrella pine.
Tetranychus mytilaspidis on citrus.

From Washington—

Schizoneura lanigera on apples.
Aspidiotus perniciosus on peach.

SAN DIEGO STATION.

Horticultural imports—

		Parcels
Ships inspected	24	
Passed as free from pests		1,918½
Fumigated		0
Destroyed		1
Returned		1
Contraband		8¼
Held for disposition		¼
Total parcels horticultural products for the month		1,929

SANTA BARBARA STATION.

Ships inspected 1

No horticultural imports.

EUREKA STATION.

No report.

O

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California
State Printing Office
1914

VOLUME III No. 4

THE MONTHLY BULLETIN

The cabbage-butterfly, *Pontia rapæ*.
(U. S. Dept. Agriculture.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA APRIL, 1914

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STATE COMMISSION OF HORTICULTURE

April, 1914

THE MONTHLY BULLETIN

VOLUME III No. 4

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

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CALIFORNIA
STATE PRINTING OFFICE
1914

THE MONTHLY BULLETIN.

THINNING DECIDUOUS FRUITS.

Address, State Fruit Growers' Convention, San Jose, Cal., December 2-4, 1913.
By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Probably nowhere has the science of fruit growing reached greater perfection than in California. We take much pride in our orchards and well we may, for we believe that there are no better to be found anywhere. The craving for gold of the immigrants of forty-nine is satisfied in our day by the bounteous crops of luscious fruit. Nature has done her part toward making soil, moisture and climatic conditions favorable to the development of practically all the good fruits that are grown. In fact, she has done so much for us that I wonder sometimes if we have not become too dependent upon her. We plant the trees and they grow with little or no care; they produce crops without careful nursing, and the orchardist harvests, but is it always the best fruit that his particular trees are capable of producing that he gets? As the years go by more and more attention is being given to our orchards. Necessity has forced upon us certain practices that were not indulged in by our predecessors of a few years ago. Competition has become so keen that only the man whose fruit is first-class can hope to make a success of his business, for orcharding is truly a business requiring just as shrewd a knowledge of good business methods as the grocery, dry goods, or hardware business. Each one requires a certain outlay of capital and the man who knows his business well enough so that he can see where a dollar spent will bring him two dollars in return is the man who is sure to succeed. The desire to get rich quick has not always been conducive to the best business sense in fruit growing, for it has prompted men to spend all their efforts toward making their trees produce the heaviest possible crops. While there is no denying the fact that such a practice has made many rich in the past we have reached a period in our history where we can not afford to sacrifice quality for quantity. We may harvest twenty-five boxes of pears or apples from a tree and get very little for them because of their inferior size and quality when half as many of good size and good quality will bring a handsome profit.

Thinning.

One important operation in connection with the handling of our immature crop, viz, thinning, is too often neglected. The excuse so often given for not thinning is that it costs too much. This is a case, however, where a little extra money invested will add greatly to the income of an orchard whether peaches, pears, apples, apricots, and I am tempted to say, prunes, plums or cherries are grown. There are records of a number of experiments that have been carried out which prove conclusively that thinning pays, and some of these will be cited later.

Influence Upon the Fruit.

It is the desire of every fruit grower to produce fruit possessing a good size, high color, fine quality and uniformity. Such is usually impossible unless thinning is practiced.

The size that fruit attains, not taking into consideration the variation due to variety, is influenced more or less by age of trees, stock, soil, climate, cultural methods and the presence of disease or insect pests. Some of these influences may be such as to prevent the production of a desirable size of fruit, but in general our trees will with ordinary care produce fruit of good size, provided that they are not overloaded. The time has passed when we want to place a premium on abnormally large fruit. It is not our purpose to advocate thinning so heavily as to bring about an overgrown condition, but during seasons of big crops to thin to a point where the most desirable size for the variety can be attained. Any one who is at all familiar with the orchard business knows that great losses are often occasioned because of undersized apples, peaches or pears as the case may be, which could have been prevented by attention to thinning. The grower who would make the greatest success of his business must have the kind of fruit that the packer, the canner or the dryer desires. It is hardly necessary to say that none of these can pay much for undersized fruit.

The desirability of producing good color is unquestioned. Not only does this please the eye but also adds to quality. A rosy red Winesap or Baldwin apple will be sweet and juicy with a flavor to suit the most delicate palate, while the same varieties grown on the same trees, but uncolored, will be scarcely relished. Leaving out of consideration the fact that color influences quality in the variety, the beautiful red apple, or the rosy cheeked peach will command higher prices on the market than better varieties without color.

While size, color and quality must all be taken into consideration in the growing of deciduous fruits there is probably nothing more desirable than uniformity, and in no way can this condition be brought about better than by thinning; in fact, it is impossible during seasons of large crops at least to secure uniformity in size in any other way. The greatest argument in favor of thinning, as far as the fruit alone is concerned, is based on the above statement. A lack of uniformity complicates standardization methods and all the operations of packing and is not at all desirable in the canning and drying business. If by thinning, fruit can be made to average well in size a considerable outlay of money is justifiable for the operation.

Another argument in favor of thinning which applies to the apple at least has to do with the presence of the worst insect pest of this fruit, viz, the codling moth. If apples are allowed to grow in clusters so that they are touching one another the larvæ not only take advantage of the ideal point of entry between the apples, but the sprayer is placed at a decided disadvantage, for he finds it extremely difficult to get the spray where it will be eaten by the worms. Varieties that have a tendency to cluster are nearly always riddled by codling moth if the pest is present in large numbers, unless the clusters are broken up by thinning.

Influence of Thinning Upon Trees.

As far as the trees themselves are concerned there are three main reasons why thinning should be practiced: first, it allows them to make a proper growth; secondly, it prevents breakage of limbs, and thirdly, it induces uniform annual crops.

A tree is capable of taking just so much plant food in the way of nitrogen, potash, phosphoric acid, etc., from the soil through its roots, and carbon from the air through its leaves. An excessive amount of fruit is apt to require most of this food at the expense of a good thrifty growth. The desire of most orchardists is to develop a tree to bearing size in the shortest possible time, and to have it bear abundant crops each season, often being deprived of proper growth in so doing. Our trees, I fear, are too often worked to death and we wonder why in a few years' time they begin to deteriorate and the crops of former years are not harvested. The splendid deep soils so full of plant foods that we find so commonly in our State, will do much towards bringing about the heavy annual bearing so greatly desired, but no soil will last forever, and the time will come when trees or whatever else may be grown on land for year after year will develop large crops only at the expense of growth and health, unless something is done in the way of fertilizing to build up the soil and thinning to prevent overbearing.

Thinning to prevent branches from breaking down under their weight of fruit is quite generally practiced, but more generally do we find the prop doing this duty. Some of the best horticulturists of our land have claimed that props have no place in the orchard, and are indicative of improper methods of pruning and thinning. While with only a very limited experience in the State it would be hasty to condemn such a practice, yet the system is open to criticism. If proper pruning and thinning will do away with the use of these unsightly and unhandy appliances, and also relieve the trees of too heavy a burden, then by all means the pruning and thinning shears should be brought into more general and more intelligent use.

In the case of apples at least a heavy crop is usually followed by a light one. This is undoubtedly due to the fact that the trees are allowed to bear too heavily during seasons of good crops, consequently the formation of fruit buds for the next season's crop is prevented. A tree not only has to mature its crop of fruit and make a certain amount of growth during a season, but it also has to make fruit buds for the succeeding season, a process which is frequently rendered impossible by overproduction. There is experimental evidence which goes to prove that this is also true in the case of peaches. Professor C. P. Close, in the Delaware State Report of 1902, comments upon results he attained in thinning Elberta peaches, as follows:

> "The writer has conducted a number of experiments in thinning peaches, plums and apricots and has gotten most favorable results. These favorable results have not only been marked in the year in which the thinning was done, but also in the two following seasons at least. There has been an influence which caused the thinned trees to set a good load of uniformly distributed fruit, while adjoined unthinned trees set either an excessively heavy or a very

light load. The points in favor of thinning are an even distribution of fruit on the tree, larger size, brighter color, better quality and flavor, more fancy and first class fruit, less culls, higher prices and trees in better condition for a crop the following year."

Results of Experiments in Thinning Apples.

The results of experiments in thinning apples carried through in four different states, viz, Ohio, Delaware, Utah and Colorado, are here recorded. The work in Ohio was done by F. H. Ballou. In a series of different experiments, variety of fruit not given, 9 trees in all were thinned and 6 left for checks. The average gain per tree was $1.35, the average percentage of first grade fruit from thinned trees was 76, and from unthinned 47. Bulletin 240 of the Ohio Experiment Station contains all information relative to these experiments.

In Delaware Prof. C. P. Close selected a block of 8 Lankford seedling trees; 4 of these were thinned and 4 left without thinning, as checks. The report for this station, dated June 30, 1902, gives the results of this experiment. The thinned trees yielded from 1½ to 3 times as much first grade fruit as did the unthinned; the former produced 116¼ baskets and the latter 117¾. While in this case the amount of fruit picked from the trees was about equal, that from the thinned trees averaged so much better that there was no question but that the operation paid.

Leon D. Batchelor of the Utah Experiment Station records some of his experimental work in thinning Ben Davis and Jonathan apples, in Circular No. 12. His work extended through the seasons of 1911 and 1912 and we quote in part from him as follows:

"Ben Davis (8-year-old trees) 4 trees per plot, 1911. The thinned plot was thinned to a minimum distance of 4 inches.

1911.

Net increase, 4 trees	$4 66
Net increase per tree	1 16
Net increase per acre	133 40

(Trees were set 16 by 24, making 115 to the acre.)

Jonathans—

Net increase per tree	$ 30
Net increase per acre	34 50

Jonathan trees (9 years old) 1912.

Net increase per tree	$ 71
Net increase per acre	81 65

In the above calculation for 1912, no charge was made for thinning. Experience shows this is fully paid for in reduced cost of sorting, when the fruit is packed. The culls were salable in 1912 at 10 cents per hundred pounds for cider, while this grade was a total loss in 1911."

In 1910 R. S. Herrick of the Colorado Experiment Station did some work in thinning the Winesap. His results were published in Bulletin No. 170 of the Colorado Experiment Station. A record of 8 thinned trees was kept and compared with a record of 2 unthinned. The gain per tree in favor of the thinned was $1.85, or estimating 85 trees to the acre the gain per acre would be $157.25. The cost of thinning these trees which were 13 years old and large for their age, was about 64 cents per tree. The following table copied from his bulletin shows how heavily trees may be thinned and still produce a big crop. It shows

that on some of the trees the fruit was thinned so that the apples on a branch were spaced a distance of from 8 to 10 inches. The author recommends this distance for the Winesap.

Thinning Winesap—Season 1910.

Tree No.	Number apples thinned off		Windfalls before and at picking time				Total number apples picked per tree		Total number borne per tree.	Thinning distance in inches
	Date	Number	Date	Before	At picking	Number boxes	Boxes	Apples		
1 ----	6—16	3167	10—7	93	18	.5	20.5	3391	6669	About 10 except in top.
2 ----	6—16	2550	10—7	76	47	.5	21.5	3526	6199	6 to 8
3 ----	6—17	2150	10—7	101	4	.5	18	3134	5389	8
4 ----	6—17	1000	10—8	48	12	.3	10	1908	2968	10 to 12
5 ----	6—17	1980	10—8	58	40	.5	14	2155	4233	About 8
6 ----	6—20	3250	10—8	52	43	.5	14	2036	5381	10
7 ----	7—22	2033	10—8	40	15	.25	12	1711	3799	8 to 10
8 ----	7—22	3060	10—8	75	21	.5	14	2371	5527	6 to 8
Check 1 --	--------	-------	10—10	246	133	1.25	26	6293	6672	Not thinned
Check 2 --	--------	-------	10—10	312	71	1.25	16	3249	3632	Not thinned

Thinning by Pruning.

The cutting out of wood containing fruit buds during the dormant season may be done as the first step in thinning the crop. To do this properly requires a knowledge of the bearing habits of the different kinds of trees. If the fruit buds are borne on the last year's growth from auxiliary buds then a shortening of this growth will give the desired results; if on fruit spurs from terminal buds as is usually the case with the apple, then the removal of some of the spurs may be necessary. Pruning when done with the idea of thinning the fruit must be done intelligently and not by men whose only knowledge of the business consists in their ability to cut off a branch because they think it interferes with the proper shape of the tree. Because of no knowledge of the bearing habits of an apple tree we sometimes see them from which all the fruit spurs have been cut as high above the ground as a man can reach, or peach trees from which all the new growth, the bearing wood, is removed. These are exaggerated cases, but serve to illustrate the fact that too little attention is paid to some of these fundamental principles which bear upon the subject of thinning.

Pruning can not be made to take the place of thinning altogether. Fruit will cluster just the same on pruned trees as those unpruned and there is no way of breaking up these clusters and giving each fruit room for development except by picking off part of it by hand.

Thinning by Removing the Fruit After it Sets.

The earlier that the fruit is removed the better chance will the remainder have to develop. While no time that will not be subject to wide variation with seasons and different fruits can be set, in general thinning should be done just as soon as possible after the fruit sets and danger of the early or so-called June drop, is over. The work may be done quite handily with a pair of thinning shears. These may be purchased at small cost and will greatly aid in the work.

The amount of fruit that should be left on a tree is, of course, an exceedingly hard thing to judge. Some have advocated thinning with the idea of leaving a certain number of boxes of well developed fruit. While this might not be done with a very great degree of accuracy at first, those who have tried it claim that in a very short time one will learn just about how to space apples or other fruit, so that an amount approximating a certain number of boxes is left. This spacing will, of course, vary with kind of fruit and variety. In the experiments previously mentioned with apples, the spacing varied from 4 to 10 inches, the latter distance proving to be none too much in the case of Winesaps, which have a tendency to run small. If trees are well set with fruit so that an even distribution can be brought about all clusters should be broken up until no two apples touch, and all fruit on the tips of small twigs should be removed. Careful, systematic work is necessary for the greatest success. He who goes into his orchard with a pole and knocks off some fruit here and there has not thinned. True, he has relieved the tree of some of its burden, but, in all probability, in such a way that he will not be repaid to any extent for his efforts.

The few ideas set forth in this paper have not been given without a knowledge of the fact that many are practicing thinning with success. It is not a new thing in California and there are, no doubt, those in the hall to-day who have had experience and can throw many side lights on the points that I have tried to bring out. There is no question in my mind, however, but that the whole subject is one which has been dealt with in a superficial way, not only by fruit growers, but experiment station workers as well, and that there is great need for carefully conducted thinning experiments with the different fruits, so that data possessing something of scientific accuracy may be obtained. The many and varied problems that suggest themselves to the horticultural investigator in their solution afford abundant opportunities for service that will be of great value to the future fruit interests.. While the orchardist must depend principally upon the trained worker from the experiment station or elsewhere for the solution of most of these problems, I would like to make a plea for more experimental work in a small way, at least, by the orchardists themselves, and why not plan some careful thinning experiments? A half dozen trees carefully thinned early in the season, an exact record being kept of the cost of the operation, can be compared at picking time with a half dozen others alongside, where no thinning was done. If time permitted several such experiments differing in the amount of fruit taken off, could be carried through. The value of such work might be very great and there is no man who owns an orchard who couldn't take time for such little experiments as these.

IDAHO'S QUARANTINE AGAINST PEAR THRIPS.

By A. J. Cook, State Commissioner of Horticulture, Sacramento, Cal.

In her quarantine against the pear thrips, *Euthrips pyri,* the State of Idaho included Placer County. A few years ago an agent of the Department of Agriculture reported that this pest was in the Placer County orchards. Later Mr. Dudley Moulton corrected this statement.

Mr. H. H. Bowman, County Horticultural Commissioner of Placer County, who from ability, training and experience is exceptionally well prepared to pass judgment, says he feels certain that pear thrips have never been in that county. Dr. L. O. Howard writes me that the Department has no knowledge that this pest is or ever has been in Placer County. Mr. Essig and Mr. Paul Jones give the same testimony.

It seems more than probable that a false report has done Placer County great wrong. Trees shipped from this county were condemned by the county horticultural commissioner of one other county because of this report. We see how easily injustice may be done by incautious reports.

STANDARDIZATION.

Address, State Fruit Growers' Convention, San Jose, Cal., December 2-4, 1913.
By F. B. McKevitt, Sacramento, California.

This term as applied to California shipping fruit, means the selection of good fruit, in good condition, and proper packing. Its general application to our shipments means the upbuilding and prosperity of the industry.

The time has gone by when anything in the shape of fruit can be sold at a good price. That condition existed in the past when production was small and demand great. Now with the heavy planting of fruit trees all over the country from Michigan to Texas and from Connecticut to Washington and Oregon, California finds abundance of competition, much of it from fruit produced in orchards near to the markets and offered in a better, and naturally ripened, condition; this means in the local fruit a perfection of flavor in respect to which much of our own fruits are necessarily somewhat lacking.

It is generally admitted in the Eastern markets that California fruit excels in size and beauty, and its great popularity is the result of its irresistible appeal to the eye. Here, where it is picked ripe from the trees, its flavor is unexcelled, but when gathered in suitable condition for a ten-days' shipment, flavor is the quality sacrificed. If we can not excel Eastern fruit in every respect, we must practice the most modern and up to date methods of packing and handling so that the attractiveness of our offering will be as near perfection as possible. Care in the selection of fruit for packing, after same has been carefully picked in suitable condition for a long distance shipment, followed by selection for size, with as good fruit on the bottom, in the middle, as on the top of the package, will keep California fruit in the high position which previous years have given it. Standardization is the term covering the above requirements.

In Placer County we find that greatest progress has been made in this direction. Certain rules and regulations have been made regarding packing, through a mutual agreement of growers and shippers, and a corps of disinterested, salaried inspectors is constantly in attendance at the shipping houses during the season to inspect and pass upon the packed fruit brought in for consignment or sale. Should the quality or packing be below the established standard the shipment is rejected

and the grower is compelled to take it back to the orchard and re-pack same or otherwise dispose of it. The system when properly enforced has worked out very satisfactorily and has bettered conditions for growers, shippers and consumers alike. As the problem has been worked out there more successfully than anywhere else in the State it will be interesting to show just how it is being done and I quote the following "Rules and Regulations for Packing Fruit, According to Standard of Growers' and Shippers' Association of Placer County, California, for 1913." (Fruit is packed by growers on their own premises and delivered to shipper ready for shipment.)

Peaches—Good color and maturity, sound, no worms, sides of boxes sprung. All varieties; bottom and top layers to consist of same number and size. Each box to be stamped with standard rubber stamp showing actual number of fruits contained. Small varieties of peaches may be packed in crates like plums.

Plums—Free from worms, bruise or defect.

4 x 4 All varieties; in crates of 4 baskets, 2 or 3 tiers to the basket. Every tier uniformly numbered.

4 x 5 With the exception that Climas, Wickson and Kelsey must be packed not
5 x 5 smaller than 5 x 5 for top tier and 4 x 5 on bottom of basket. Each crate
5 x 5 to be stamped with standard stamp. Toyal Hative, Clyman, Tradegy, Red
5 x 6 June, Botan and kindred varieties.

"84-95" 2 tiers admissible in peach boxes wrapped and marked.

Apricots—The grading of apricots will be governed practically by the same rule as applied to plums.

Pears—Neatness and uniformity, free from worms, bruise or defect, to weigh not less than 50 pounds.

4 tier—No pear less than 2½ inches in diameter.
5 tier—No pear less than 2¼ inches in diameter.
Half boxes may be packed with not less than 3 tiers, no pear less than 2¼ inches in diameter, to weigh not less than 25 pounds to the half box.
Cover of boxes to be sprung. Each box to be marked with standard stamp.

Grapes—Fully matured; carefully picked; properly trimmed, wilted at least 24 hours before packing; to be packed in crates 4 baskets to the crate, crates to be 4¼ inches deep with an 11-16-inch cleat under the cover; no stems in sight. Weight to be not less than 26 pounds; crate not to exceed 5 inches in depth inside measurement.

Cherries—

9 row All varieties; perfect condition; right degree of ripeness; neatly square
10 row packed double faced; no stems showing on top or bottom.
11 row All boxes to be marked with standard stamp.
12 row
Solid pack.
Cartons, 4, 5 and 6 row.
Number refers to number of cherries across end of box.

NOTE.—To comply with the net container law of New York, and other states, all grape and plum baskets must be stamped "Net weight 5 pounds."

In order that the rules for packing of fruit on these lines may be enforced, the inspectors employed examine samples taken at random from the wagons of the growers as they make delivery; if the regulations have not been complied with the fruit can not be received by any shipper, but must be returned to the owner for such disposition as he chooses. Inspectors are paid a monthly salary from a fund derived from a small assessment levied on the shipments of the district, this assessment amounting to from one fourth to one half cent per package.

The plan has been found to work well in Placer County and with the hearty support and co-operation of all the growers and shippers would be perfect when faithfully adhered to.

So far as the general shipment of tree fruits is concerned we are doing pretty well but this is not true of grapes.

This fruit is one of the finest produced in the State and will always enjoy widespread distribution and strong demand owing to the fact that California is practically the only State in the Union able to grow the so-called European varieties. They are deservedly popular, but in marketing are compelled to meet most strenuous competition from the native grapes which are produced in enormous quantities in Michigan, New York and other states; these being grown close to the best markets in the country and favored with transportation charges which are insignificant when compared with ours, can be and are sold at very low prices. These grapes are very good and being packed in exceedingly convenient and attractive little market baskets are very popular. The Michigan and New York grape crops ripen at the same time as the bulk of our grapes, which greatly enhance the difficulty in marketing profitably. It would seem that with the constantly increasing production of grapes here, and the even greater increase in the East, that every grower and shipper would be alive not only to the importance, but to the absolute necessity of shipping nothing but the best and perfectly matured stock; from the middle to the close of the season this fact is recognized, but from the beginning to the middle of August, considerable quantities of grapes are shipped in such an immature condition that even swine would reject them as food. This is because of the fact that early shipments usually command high prices and the unscrupulous desire to participate in them has prompted shipping regardless of the immaturity of the product. The first carload or two of this sour trash can be sold in every large market at good prices, but as soon as the public has tasted the fruit, demand is over, and the appetite for California grapes is killed until the disagreeable experience is forgotten. At the very time that the public turns naturally to our splendid grapes, these cramp-inducing, teeth-on-edge producers appear and ruin the trade; later on, when full sugar development has been made and the fruit becomes the perfect food which nature intended it to be, the public gradually learn this fact, and then only will they buy again. Early grapes are not sour if picked in proper condition; if every section can be compelled to market its product when ripe and then only, there is no doubt as to the ability of the markets to consume much larger quantities than in the past and at a better average price. It is a shame that premature shipments of Thompson Seedless and Malagas from the lower San Joaquin Valley should be permitted, as these shipments absolutely spoil the market for weeks to come, not only working a great loss on subsequent shipments of good grapes but perpetrating an actual fraud upon the defenseless consumer, who being unaware of their unripe condition, invests his money in them only to find that they are too sour for consumption. Such grapes are unfit for food, and if eaten, are liable to produce serious gastric disturbances; it may be that the pure food law could be made to apply; if it can not, then something else must be done to protect the industry and the consuming public. A law, defining the percentage of sugar that grapes must contain before they can be considered proper food for human beings would cover the ground. It has been found that grapes containing 18 per cent of sugar are palatable—a higher percentage of course is better. Public sentiment should be educated to the fact that great injury threatens table grape growing unless this minimum standard is adopted. Thinking

and honest growers should demand that no fruit under this standard should be packed, or accepted for shipment; shippers should reject all immature shipments whether purchased or offered for consignment and measures should be taken in every locality to see that this is done. If the evil can not be successfully handled in this way, then let us have a law that will fittingly punish the perpetrators of this fraud and protect the fame of our magnificent grapes, as well as the fair name of California.

In the opinion of many of our most intelligent growers and shippers the principles of standardization should be made to apply to *all* shipments of fruit both green and dried. As in many localities nothing has been done in this direction and probably never voluntarily will be, I propose that this convention refer the matter to the commission on legislation, with instructions to draft a comprehensive law covering the subject, to be presented at the next session of the California legislature, and to take all necessary steps to secure its enactment.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent of the State Insectary.

(Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plants as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers. The material is, for the most part, compiled from the various state and Government publications.)

DECIDUOUS FRUIT INSECTS.

The Codling Moth.

The second application of the arsenate of lead spray for the codling moth—that insect causing wormy apples and pears—should be made three or four weeks after the petals of the blossoms have fallen. The strength of the poison to use is 5 pounds to 100 gallons of water. Most of the growers favor a rather coarse driving spray.

Caterpillars Destructive to the Foliage.

Various species of caterpillars are to be found feeding on the foliage of deciduous trees in the spring and throughout the summer. Among these are the hairy, black and yellow tent caterpillars, which spin a web or tent in which they congregate when not feeding; the red hump caterpillars, with their prominent red humps on the fourth body segment; the webworms, hairy and of a yellowish-green color with dark stripes, spinning webs from which they emerge to feed on the leaves; the larvæ of the brown day moth, dark colored with fine red stripes on the body and covered with long hairs; the canker worms, dark colored without hairs, and other species. With the caterpillars making tents or webs, a good method of destruction is to burn out the webs or tents containing the worms with a torch. With those that feed in colonies, particularly when very young, pick off the infested leaves on which they congregate and burn them. If the caterpillars are scattered spray the foliage with arsenate of lead, 3 pounds to 50 gallons of water. The caterpillars will eat the leaves covered with the poison and soon die.

Plant Lice.

Several species of plant lice attack the young shoots and foliage of deciduous trees. They suck the juices from their host, and in order to destroy these small soft bodied greenish or dark colored insects a contact insecticide is necessary. One of the best sprays to use consists of blackleaf 40, three fourths of a pint, soap 3 to 4 pounds, water 100 gallons. Use a strong pressure of from 150 to 200 pounds, and do thorough work. This spray can be combined with the arsenate of lead spray for the apple worm.

The Flat-headed Apple Tree Borer.

The adult insect is a greenish-black beetle. The larvæ are of a yellowish color, legless, and have the anterior portion of the body at the back of the head enlarged and flattened. Of the fruit trees the prin-

cipal host is the apple, although sometimes pears, plums and peaches are attacked. The young grubs bore into the sap wood, and in the case of young trees complete girdling may result from their attack. Usually unhealthy trees and those wounded or sunburnt are selected by the beetles upon which to lay their eggs. Discolored bark and exudation of sap indicate the presence of the larvæ. Protect the trees from sunburn and injury. The burrowing larvæ may be destroyed by a crooked wire or knife blade. Painting the trunks and larger limbs with a solution made by reducing soft-soap to the consistency of paint, by adding a strong solution of washing soda in water serves as a good preventive.

CITRUS FRUIT INSECTS.

The Citrus Red Spider.

The adult red spider is a minute reddish mite with eight legs. The red spiders work on the leaves producing a spotted effect. Some growers use dry flowers of sulphur blown on the trees. However, the commercial lime-sulphur solution diluted to 2 or 2½ per cent and applied as a fine misty spray under a pressure of from 150 to 200 pounds has taken the place of the flowers of sulphur to a large extent. Apply the spray when the mites are numerous.

MISCELLANEOUS INSECTS.

Cutworms.

Cutworms are the larvæ of the *Noctuidæ*, a family of moths. They are very common pests attacking a great variety of plants. Some species are climbers and crawl up the plants to feed on the leaves. Others cut off tender plants near the surface of the ground. They are dark, fat, greasy looking worms and in the day time can usually be located an inch or two under the surface of the soil near the attacked plant ready to emerge again upon the return of night. Control is difficult. Many will be killed by using poisoned bait which is placed near the affected plants. The bait is composed of one pound of Paris green, 40 to 50 pounds of bran sweetened with a cheap grade of molasses and mixed with enough water to make a stiff mass.

(This year climbing cutworms have been exceptionally abundant in parts of the San Joaquin Valley. They have done great damage to grape vines and apricots and other deciduous fruit trees.

As they bury themselves in the earth by day and feed by night, their mischief is not observed in the doing, and so other insects and birds receive the credit which belongs to these climbing cutworms.

In Michigan the west coast-vineyards have been seriously injured at times by these caterpillars. It was found that bright tin bands about the vines were an effective preventive of their destructive work. They could no crawl over the tin. The tin bands were three or four inches wide and long enough to encircle the trunks of the vines. These were kept and used each season. A central hole in one end of each band and a slit at the other end just opposite permitted easier adjustment of the bands, as a tack could be pushed in by the thumb.

Possibly all species would not be held back by this tin band, but it is worth the trying.

It may be that tanglefoot would be equally or more effective and possibly cheaper. In Michigan the bands were gathered and housed at the close of the season of attack, and these were used as certainly as were the pruning shears.—A. J. Cook.)

The Harlequin Cabbage Bug.

The harlequin cabbage bug is a bright yellow and black insect. Spots where the bugs have been feeding on the leaves turn yellow. They are very hard to kill. Hand-picking when adults are clustered on a few plants will do away with many of them. The use of trap crops, which when infested are pulled up and burned, is also advised.

The Cabbage Worm.

The adult cabbage worm is the common white butterfly seen in the cabbage fields. From the eggs deposited by this butterfly are hatched the velvety green worms which destroy the leaves. Before plants begin heading use Paris green, one part, bran 40 parts. Mix well and dust plants before worms eat in. After plants begin heading use white hellebore one ounce to two gallons of water.

The Squash Bug.

The squash bug is a common pest of squash and other cucurbitæ. The insects are commonly recognized by the brownish color above and the mottled yellow beneath, and also by the offensive odor that they discharge. Hand-picking the mature bugs, crushing the eggs and killing the young by spraying with kerosene emulsion will aid in controlling. The planting of trap hills, covering hills with netting, and trapping under boards are also used.

Alfalfa Caterpillar.

The adult of the alfalfa caterpillar is the orange-yellow and black butterfly so numerous in our alfalfa fields. The caterpillars are green in color with a white stripe on each side of the body. These insects do a great deal of damage to alfalfa in the Imperial Valley, as well as in other parts of the State. They feed on the leaves and other parts of the plant. Watch for the caterpillars in the spring crop. In order to save the following crop from being eaten by the caterpillars, cut the first crop at the time the insects are becoming well grown (about one inch in length), even if the alfalfa is not yet in bloom. This will destroy many of them. Cut low and clean and especially along the ditch banks, fences and roadsides.

Grasshoppers.

The work and the appearance of the grasshoppers is well known. To protect young orchard trees place broad tanglefoot bands around the trunks near the base. The bands must be thick or the stronger hoppers will pull out. Whitewashing the trunks if renewed occasionally will prevent the hoppers from crawling up into the trees to a large extent. Poisoned baits placed at the base of the trees will keep most of the hoppers from ascending the trunks. The poisoned bran mash is made as follows: bran 40 pounds, a cheap grade of molasses 2 gallons, arsenic

5 pounds. With the bran stir in the molasses and then the arsenic. Let stand over night and thoroughly mix before placing in the field. Moisten or renew bait as needed. Burning the stubble of the breeding ground (in waste lands), where the young hoppers are plentiful, which should be done in the night time, as they are then inactive; spraying a strip of the green crop near the edge of the fields where the hoppers are entering with Paris green or arsenate of lead, are also worthy of trial.

Grape Root Worm.

The grape root worm injures both the roots and the growing parts of the grapevine. The imago is a small beetle, black or brown in color. The adults eat out chain-like strips from the leaves or similar strips in the stems or in the shoots. The beetles appear during the last of April, May and into June. They are fairly well combatted in the adult stage by an arsenical spray. Use 5 pounds of arsenate of lead to 50 gallons of water. or one pound of Paris green to 100 gallons of water. Spray as soon as beetles appear. Repeat applications if necessary. Jarring them into receptacles containing oil is also used as a means of control.

The Grape Leaf Hopper.

The grape leaf hopper is about one tenth of an inch in length and is of a pale yellow color marked with red in an irregular pattern. The overwintering hoppers begin to lay eggs about May first beneath the epidermis of the leaves. The young hoppers begin to appear about the middle of May. Spray for the first brood of young when they appear. The formula used is blackleaf 40, half pint, water 100 gallons, using high pressure and thoroughly drench the vines, especially the undersides of the leaves.

FUNGOUS DISEASES OF PLANTS.

Apple and Pear Scab.

It often becomes necessary to apply a second spraying for the apple and pear scab fungus which causes the scabby patches on the fruit and brownish spots on the leaves which become swollen and curled. Application is generally made at the time the petals of the blossoms fall. A third spraying if necessary should be made two or three weeks later. Conditions, however, determine time and number of applications to be made. Use Bordeaux mixture 5/5/50 formula. This spray can be combined with the arsenate of lead spray for the codling moth.

Apple Mildew.

Frequent sprayings during the early part of the season are often necessary in order to control the mildew of the apple. The fungus causes the dwarfing of the tips of the new shoots covering them with the characteristic whitish growth. Some growers have had success with the iron sulphide spray. As the process of preparing this fungicide is somewhat complicated it is best for the ordinary person to buy the prepared material.

Olive Knot.

The disease known as olive knot is of bacterial origin, and as the name suggests causes gall-like formations on the trunk, branches and twigs

of the olive. Cut out all diseased parts and saturate the wounds with a strong disinfectant such as corrosive sublimate, using one part to 1,000 parts of water.

Grape Mildew.

Grape mildew may be observed as a white powdery growth on the leaves and fruit clusters of the grape. Dust thoroughly with flowers of sulphur in moist weather before the fungus develops. R. E. Smith[1] states that the common mistake made by many growers is the failure to treat the vines thoroughly and repeatedly enough in the beginning of the season. The first sulphuring should be done when the shoots are between six and fifteen inches long, and every part of the vine and the entire vineyard must be covered. This must be followed by two or three days of warm weather to be effective. It may be necessary to repeat the sulphuring process several times in order to secure proper weather conditions.

Brown Rot of Apricots.

The fruit is the most susceptible to the brown rot fungus, but aften the tender twigs are blighted and killed. The half-grown fruit is more easily attacked than the young. The disease first appears as small brownish decayed spots on the fruit, the spots increasing in size until the whole fruit is infested. Use 8/8/50 self-boiled lime sulphur when fruit is setting and again following subsequent rains.

[1]Bul. 218, Calif. Exp. Sta., page 1115.

MONTHLY CROP REPORT—MARCH.

Compiled from reports sent in by the County Horticultural Commissioners, by Geo. P. Weldon, Chief Deputy State Commissioner.

	Almonds	Apples	Apricots	Berries	Cherries	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Plums	Prunes	Walnuts
Alameda	90	‡	100	100	90	‡	‡	‡	‡	‡	80	‡	‡	90	90	90	‡
Butte	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Colusa	100	100	100	100	100	100	75	75	100	75	100	100	100	100	100	100	100
Contra Costa	100	100	50	‡	80	‡	‡	‡	‡	‡	‡	‡	100	100	100	100	80
El Dorado	‡	100	‡	‡	100	‡	‡	‡	‡	‡	100	‡	100	100	100	100	‡
Fresno	No co mm issi one r se rve d d urin g M are h																
Glenn	100	100	100	100	100	100	100	100	100	100	100	100	—	100	—	100	100
Humboldt	—	100	—	—	—	‡	‡	‡	‡	‡	‡	—	—	—	‡	—	100
Imperial	‡	‡	50	‡	‡	100	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡
Kern	—	100	100	—	—	100	—	—	—	100	100	100	100	100	100	100	—
Kings	‡	‡	100	‡	‡	‡	‡	‡	‡	‡	100	100	100	‡	100	100	‡
Lake	100	100	100	100	100	100	‡	‡	100	‡	‡	100	‡	100	‡	100	100
Los Angeles	100	90	100	100	‡	100	75	75	100	90	100	100	100	100	100		100
Madera	100	100	40	—	—	—	‡	‡	100	‡	95	95	95	100	‡	90	‡
Mendocino	Co mm issi on j ust app oin ted . No c han ce t o p rep are rep ort																
Merced	100	—	100	—	‡	—	‡	100	100	100	100	100	100	100	100	100	—
Modoc	‡	90	90	100	90	‡	‡	‡	‡	‡	90	90	90	90	100	90	‡
Monterey	90	100	125	100	100	‡	‡	‡	‡	‡	‡	‡	—	100	75	75	‡
Napa	75	100	75	100	100	‡	‡	‡	‡	‡	100	100	100	100	100	100	‡
Nevada	‡	100	100	—	100	100	‡	‡	‡	100	100	100	100	100	100	100	—
Orange	‡	100	80	100	‡	‡	100	125	100	120	100			100	100	‡	100
Placer	100	100	100	100	100	100	‡	‡	100	100	100	100	100	100	100	‡	‡
Riverside	100	100	125	100	100	‡	100	80	100	80	100	100	100	100	‡	‡	100
Sacramento	100	100	95	100	100	100	100	95	100	100	95	95	95	95	100	100	95
San Benito	100	—	100	‡	—	‡	‡	‡	‡	‡	100	100	‡	—	‡	100	—
San Bernardino	‡	100	90	‡	100	‡	100	98	100	98	97	97	97	100	‡	‡	100
San Diego	‡	90	‡	‡	—	‡	95	30	100	80	‡	100	100	‡	‡	100	‡
San Joaquin	100	100	100	—	100	—	‡	‡	—	‡	100	100	100	100	100	100	—
Santa Barbara	‡	105	100	‡	110	‡	‡	110	—	—	100	‡	‡	—	‡	‡	105
Santa Clara	100	100	100	100	100	‡	‡	‡	—	‡	100	100	100	100	100	100	—
Santa Cruz	—	100	92	100	85	‡	—	90	—	—	—	—	90	95	—	—	—
Shasta	100	100	50	100	100	100		100	100	100	100	100	100	100	100	100	100
Siskiyou																	
Solano	50	‡	10	‡	50	‡	‡	‡	‡	‡	100	100	100	100	90	90	‡
Sutter	85		90	‡			‡	‡	‡	‡	75	75	75				‡
Sonoma	95	100	90	95	90	‡	‡	90	75	95	75	75	75	95	80	90	90
Stanislaus	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Tehama	100	100	75	—	—	—	—	—	—	—	75	75	75	100	—	75	—
Tulare	90	90	90	100	‡	100	—	—	—	—	100	100	100	90	90	90	—
Ventura	90	100	100	‡	—	‡	90	105	—	95	100	100	‡	‡	‡	‡	95
Yolo	60	‡	50	‡	‡	100	‡	‡			100	90	100	100	100	50	100
Yuba	90	90	80	100	90	100	100	100	100	100	100	100	100	100	90	90	‡

Figures in table indicate condition of crop in per cent on the basis of 100 as normal.
‡ means that crop is not grown sufficiently in a county for a report.
— means that the county horticultural commissioner has insufficient information for a report.
All blank spaces indicate a failure on the part of a county horticultural commissioner to report in time or in the required form.

The crop report on the opposite page gives information on the condition of fruits April 1st. Any changes which may have come about because of frost or other factors will be noted in the April report.

It is yet too early in the season for accurate data on production. Indications at present point toward a bumper crop of apples and pears. The dry hot season of last year interfered materially in some sections with the blooming of apricots and reports from the various counties run from 10 per cent in Solano to 100 per cent in Santa Clara. The drop is not over at the present writing and next month's report will give much more reliable data.

Almonds bloomed very heavily and at first it was thought that there would be a tremendous crop, but the drop has also been heavy. Yolo County is reporting 60 per cent, Sutter 85 per cent and San Joaquin 100 per cent of normal. With the drop still going on these figures are liable to change before next report comes out.

The peach situation is very good throughout the State at present.

Prunes are dropping heavily in Santa Clara County where 100 per cent was first reported and it is yet impossible to forecast the coming crop reliably. Sonoma County reports a 90 per cent condition for March. What the April report may show is yet a matter of conjecture.

With the danger of frosts not yet over, with a heavy drop going on in the case of almonds and prunes in some of the main producing counties, and with a light crop of blossoms in the case of apricots in places, the production of these crops will probably be considerably below normal. Notwithstanding this fact, the situation on the whole is not such as to cause alarm, and California may look toward a prosperous season.

INSECT NOTES.

A new **kermes**, *Kermes branigani*, was collected by Mr. E. J. Branigan and the writer at the Bath mine, near Forest Hill, Placer County, Cal., November 22, 1913, on the interior live oak (*Quercus chrysolepis*). The species was named after Mr. Branigan by George B. King of Lawrence, Mass.—E. O. Essig.

The ladybird beetle, *Psyllobora tædata* Lec., was found feeding upon orchard mites on March 20th, in the neighborhood of Shively, Humboldt County. It occurred very commonly on some apple trees infested with the brown mite, *Bryobia pratensis* and the citrus red spider, *Tetranychus mytilaspidis*.—Geo. P. Weldon.

Tipula simplex Doane, kindly determined by Professor R. W. Doane of Stanford University, was abundant in Sacramento the first two weeks in March.—E. J. Vosler.

The milkweed bug, *Oncopeltus fasciatus*, has been received in considerable numbers from El Dorado and Lake counties. In the winter time this species collects in large colonies and growers have generally believed it to be destructive to the particular plant upon which it congregates. To our knowledge it feeds only upon the species of milkweed (*Asclepias* sp.).—E. O. Essig.

The rosy apple aphis, *Aphis sorbi*, is of common occurrence on apple and pear foliage in orchards that have recently been visited in Humboldt, Shasta and Tehama counties. This is becoming one of our very worst species of plant lice—Geo. P. Weldon.

The pine leaf scale, *Chionaspis pinifoliæ*, was found occurring in great numbers upon the yellow pine, *Pinus ponderosa*, at Portola, Cal. The adult insects are at this time of the year all dead but under the shells were found masses of eggs.—Leroy Childs.

The citrus red spider, *Tetranychus mytilasnidis* Riley, and the **brown or almond mite,** *Bryobia pratensis* Garman, have both been taken working together on apple trees in Humboldt County. In the case of the former this appears to be the first authentic report of its presence in this county.—Geo. P. Weldon.

The Italian pear scale, *Epidiaspis piricola*, has been recently taken on the mountain holly (*Heteromeles arbutifolia*), at St. Helena, Butte County, Cal. This instance shows the adaptability of foreign pests to establish themselves on distantly related host plants in the countries in which they have been introduced.—Leroy Childs.

A recent infestation of **pear thrips,** *Euthrips pyri*, was found in an orchard near Stockton, San Joaquin County. This is the first official record of the pest in the above county.—Geo. P. Weldon.

The tanbark oak scale, *Aspidiotus densifloræ* Bremmer, was taken March 5, 1914, by the writer at Valley Spring, Calaveras County, on the foliage of the interior live oak (*Quercus chrysolepis*). *Chionaspis quercus* Comst. was also collected on *Quercus chrysolepis* at Valley Springs, Cal., March 5, 1914.—E. O. Essig.

The codling moth, *Carpocapsa pomonella*, is mostly in the pupal stage at the present time, April 4th, in Shasta and Tehama counties. This fact was determined by observations in apple orchards during a recent visit to those counties.—Geo. P. Weldon.

The greasewood eriococcus, *Eriococcus adenostomæ* Ehrh., was taken on greasewood or chemiso (*Adenostoma fasciculatum*) at Valley Springs, Cal., March 5, 1914.—E. O. Essig.

The **clover aphis,** *Aphis bakeri* Cowen, was taken on quince foliage in Shasta County near Anderson during a recent visit to that section. This aphis occasionally becomes of considerable economic importance on fruit trees, especially apple and pear. It sometimes works in the blossoms and may cause serious injury.—Geo. P. Weldon.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy Commissioner of Horticulture.

Report of the State Board of Horticultural Examiners.

Since the last report examinations for eligibles to the position of county horticultural commissioner have been held, the following men qualifying in the various counties:

Stanislaus—
A. L. Rutherford.

Madera—
George Marchbank.

Fresno—
Fred P. Roullard.
W. A. Bates.
Aubrey Frink.

Solano—
C. R. McBride.

Kings—
No candidates presented themselves to take the examination. In accordance with section 2322 of the Political Code, the following persons were recommended as competent:
B. V. Sharp.
A. W. Lane.
C. M. Blowers.
J. J. Courtner.
B. P. Shurk.

A. J. Cook,
Thos. F. Hunt,
Harry S. Smith,
State Board of Horticultural Examiners.

COTTON IN IMPERIAL COUNTY.

By F. W. Waite, County Horticultural Commissioner, Imperial County.

In the year 1902 a few cotton plants were grown at Calexico; in the year 1904 there were small plantings of cotton by farmers who believed in the Imperial Valley as a cotton producing section. These plantings, in an experimental way, were carried on each year for four years. During this time it was not possible to interest farmers in the planting of cotton in commercial quantities as cantaloupes were demanding their attention on account of the possible profits of the latter.

In 1909 cotton was grown in a commercial way. The farmers signed up to plant about 1,200 acres and plans were made to erect a gin. Many acres were not cared for after planting which brought the yield down per acre, there being only 350 bales ginned; however the results were so satisfactory that cotton growing was permanently established in Imperial County, the acreage being increased during the following years. Gins were constructed in several towns, also a cotton seed oil mill was built to convert the seed into oil and meal, the latter being used here to fatten cattle with good results.

The acreage in 1910 was increased about eight times over the preceeding year, as there was considerable enthusiam as to the possible profits in cotton culture in the valley. Many went into the business without previous experience, undertaking too large an acreage; the results were somewhat disappointing, as the yield was low, and only about 4,000 bales were ginned.

The results to those who knew how gave encouragement and the planting in the year 1911 was increased to about 12,000 acres, enthusiasm still running high, many entering the business without experience. The final results were an improvement over the year 1910, as about 9,000 bales were ginned.

In 1912 the acreage was reduced to quite an extent; 8,360 acres were planted, the results being much more satisfactory, as 7,200 bales were ginned. The yield per acre was very high, resulting from the fact that those new in the business had been making progress and all the growers were gaining experience in cotton growing, under the conditions here.

During the season 1913 just closing, there were 26,000 acres planted in the valley, including the delta across the line in Lower California (Mexican territory). On account of shortage of water in some localities and labor conditions not being entirely adequate, also a few inexperienced enthusiasts, there were about 21,500 acres actually picked. The following is the number of bales ginned at the several stations as furnished by the Imperial Valley Oil and Cotton Company to date, January 24, 1914:

Calexico	8,401
El Centro	5,121
Imperial	1,205
Holtville	1,097
Brawley	552
Wiest	350
Total	16,726

Estimated total for season, 19,000 bales.

During the several seasons past there have been a few failures, a number of partial failures, and many successes, the same condition that exists in all lines of enterprise. The failures were mostly due to poor condition of ground for irrigation and lack of experience.

The first bale of cotton ginned in the season of 1913 was at Calexico, July 23d; the cotton was grown on second year volunteer and is still being picked, which proves that we do have a long picking season, continuous sunshine being the reason.

Cotton, being a sun plant, the climatic conditions are all that could be desired, practically no rain, ample water for irrigation, warm nights, sunlight and heat, all that seems necessary to produce the maximum yield.

As to being free from all insect pests, it may be true that it is now, but this office takes the stand with men of knowledge and experience along this line, that it is possible and probable that the insect will thrive where the host plant lives, therefore we do not want to take any chances, so are guarding all avenues of approach. A quarantine is now in force prohibiting cotton seed to enter the State from anywhere excepting for experimental purposes. By applying to any horticultural commissioner the information will be cheerfully furnished as to how seed may be brought into the State.

Several varieties of cotton have been grown, principally Upland, Egyptian and Durango. Many growers are quite enthusiastic about Durango, while others think more favorably of short staples. It is a question as to what kinds will eventually be grown; however, it is a fact that all varieties that have been grown are of high quality and sell

at a premium. Short staples now bring a premium of $3.65 to $5.00 per bale; prices principally due to enormous low grades in south on account of storms during season of 1913.

According to advise from Thomas P. Daley, cotton buyer, the average grade of the season is strict middling, the average length is common staple one and one sixteenth; Durango one and three sixteenths; Egyptian one and one half inches. There is no danger of low grades for the reason there is no rain to tinge or rust the cotton.

A few growers have made two bales to the acre, some have made one and a half, and many one bale, which gives an idea what the possibilities are to those who know the business. It is, however, not advisable to go into the cotton growing business on a large scale without experience in the valley.

The best time for planting is from middle of April to middle of May, while it is planted before and after these dates with success. Having a long season for planting and especially for picking (from August to February), labor situation is well handled.

The cost of raising cotton, for water, seed and labor is $10.00 per acre; rent of land from $10.00 to $15.00 per acre; picking (1 bale to acre) $15.00. The seed will more than pay for hauling and ginning.

The 1913 crop is selling from $60.00 to $75.00 per bale (consisting of 500 pounds of lint), or 12 to 15 cents per pound; the profits will be governed by the market price.

On account of the steady increased demand for cotton goods there is not likely to be any serious drop from the present prices. The 1914 crop for Imperial Valley will be about 40,000 acres.

QUARANTINE DIVISION.

Report for the Month of February, 1914.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, California.

		Parcels.
Horticultural Imports—		
Ships inspected	54	
Passed as free from pests		135,866
Fumigated		1,406
Destroyed or returned		182
Contraband destroyed		11
Total parcels horticultural products the month		137,465
Horticultural Exports—		
Inspected and certified		1,037

Pests Intercepted.

From Japan—

Pseudaonidia pæoniæ on azalæ
Aulacaspis pentagona on pot plants.
Aleyrodes citri on orange foliage.
Aulacaspis pentagona on flowering cherry trees.
Chionaspis citri on oranges.
Pseudaonidia duplex, *Parlatoria pergandii* on camellia.
Parlatoria thea on maples.
Larva of gypsy moth on camellia.
Larvæ of weevils in chestnuts.

From Honolulu—

Pseudococcus bromeliæ, *Diaspis bromeliæ* on pineapples.
Lepidopterous larvæ in bolls of roselle.
Coccus elongatus on betel leaves.

From China—

Cylas formicarius in sweet potatoes.

From Florida—

Phomopsis citri, *Lepidosaphes beckii* on grapefruit.

From Isle of Pines—

Lepidosaphes beckii, *Parlatoria* sp. and an undetermined fungus on grapefruit.

From Manila—

Parlatoria sp. and *Pseudococcus* sp. on pot plants.

From Germany—

Bruchophagus funebris in alfalfa seed.

From Louisiana—

Aleyrodes citri on cape jessamine.

From Illinois—

Hæmichionaspis aspidistræ on ferns.

From Pennsylvania—

Coccus hesperidum on citrus trees.

From Nevada—

Heterodera radicicola in potatoes.

LOS ANGELES STATION.

Horticultural Imports—		Parcels.
Ships inspected	19	
Passed as free from pests		82,184¾
Fumigated		464
Destroyed		17½
Returned		2
Contraband		1
Total parcels horticultural products for month		82,669¼

Pests Intercepted.

From Florida—
Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From France—
Bacterium tumefaciens on *Syringa persica.*

From Indiana—
Chionaspis citri, Coccus hesperidum and *Parlatoria pergandii,* on lemon tree.

From Japan—
Pseudococcus ryani on *Thuyopsis juniperus.*
Pseudaonidia pæoniæ on andromeda, *Olea fragrans* and azalea.
Pseudococcus sp. on azalea and wisteria.
Chionaspis wistariæ and *Agromyza schineri* on wisteria.
Lepidosaphes newsteadii on umbrella pines.
Hemichionaspis aspidistræ and *Chrysomphalus ficus* on *Aspidistra lurida.*
Aspidiotus sp. on taxus and jasminum.

From Missouri—
Aphis persicæ-niger on peach.

From Oregon—
Aspidiotus perniciosus on peach.

From Pennsylvania—
Chrysomphalus ficus on pendennis.
Pseudococcus longispinus on dracæna palm.
Aleyrodes sp. on robelinia and kentia.
Pseudococcus sp. on coleus and begonia.

From Porto Rico.
Lepidosaphes beckii on grapefruit.

SAN DIEGO STATION.

Horticultural Imports—		Parcels.
Ships inspected	20	
Passed as free from pests		1,850
Fumigated		0
Destroyed or returned		3
Contraband		3
Total parcels horticultural products for the month		1,856

Pests Intercepted.

From Nebraska—
Crown-gall, *Bacterium tumefaciens* on peach and apple.
Root-knot eelworm, *Heterodera radicicola* in roots of peach, apple and grape.

EUREKA STATION.

Ships inspected 4
No horticultural imports.

SANTA BARBARA STATION.

Ships inspected 2
No horticultural products.

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California
State Printing Office
1914

VOLUME III No. 5

THE MONTHLY BULLETIN

Calliephialtes sp. Drawing of female. (Smith & Vosler.)

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STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA MAY, 1914

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STATE COMMISSION OF HORTICULTURE

May, 1914

THE MONTHLY BULLETIN

VOLUME III No. 5

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

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10522

THE MONTHLY BULLETIN.

CALLIEPHIALTES IN CALIFORNIA.

By Harry S. Smith, Superintendent, and E. J. Vosler, Assistant Superintendent of the State Insectary.

Introduction.

In the spring of 1913 investigation of the life history and economic status of the *Calliephialtes* parasite of the codling moth was undertaken by the Insectary, principally for the reason that the idea seemed to be prevalent to a certain extent that the parasite was of practical value in the control of the codling moth. Demands were frequently made upon the Insectary for colonies of the insect. It was therefore felt that more should be known regarding its habits and economic possibilities. Recently there has appeared, in the Journal of Agricultural Research, United States Department of Agriculture, an excellent paper on this insect by Mr. R. A. Cushman.[1] As Mr. Cushman's observations were confined to Virginia, and since we have found that under California conditions there occur certain deviations from the habits and development of this parasite as recorded by him, we have thought it desirable to publish such information as we have, leaving out entirely or touching but lightly those points covered by the above mentioned paper.

Identity of the Species.

With regard to the scientific name of the parasite, we have nothing to add to what has already been published. It has always been known in California as *Calliephialtes messor* Grav., but it is, of course, quite possible that the original specimens were incorrectly determined as that species.

Introduction Into California.

This species was first brought to the attention of the public from an economic standpoint by Mr. George Compere, who discovered its habit of breeding upon the codling moth in Spain in 1904. He collected a number of the adult parasites and forwarded them to California in a living condition. They were received by the State Board of Horticulture, by which body Mr. Compere was employed, conjointly with the West Australian Government. The Board was successful in getting the species to reproduce in confinement, and within a few months it was possible to make several field colonies in infested orchards. The rapidity and ease with which the parasite bred in confinement coupled with Mr. Compere's faith in the species, led the officials who had in charge the establishment of the parasite to expect very much, resulting in the publication of claims which many believed to be unwarranted. Since the early days of its introduction it has been distributed from the State Insectary by thousands, not only to the various localities of this State, but to other states and countries as well. There is nowhere on record

[1] Journal of Agricultural Research, U. S. D. A., Vol. 1, p. 211.

a case where the insect has proven to be of economic value where introduced, and it is now generally accepted, by entomologists at least, that the parasite has been given a sufficient trial and has been found to be deficient.

The reasons for the failure of the insect to come up to expectations are probably not far to seek. In the handling of the apple crop there are wide differences between the methods in vogue in California and in the native habitat of *Calliephialtes*. In California the apples, where grown commercially, are hauled to packing sheds immediately after picking, and placed in bins. This makes it necessary for the codling moth worms to seek winter quarters within the packing house structure, where they are practically free from parasite attack. In south Europe, however, the apples are piled upon the ground, allowing the apple worms to find hibernating quarters in the orchard, thus making many of them available for attack by *Calliephialtes*. Spraying not being nearly so general in Europe, also gives rise to a large percentage of windfalls caused by the apple worms, and this gives opportunity for a still larger supply of the larvæ to find shelter in the orchard. The differences in methods of handling the crop, however, apply principally to the last brood, and the above remarks are applicable to a lesser extent to the first brood, which pupates largely in the orchard and should be available so far as this factor is concerned for attack by the parasite. It will be seen, therefore, that the apparent failure of *Calliephialtes* is only partially accounted for by the above, and it is necessary to look elsewhere for explanation of its lack of efficiency. This explanation, we believe, is found to lie mainly in the following:

First—The physical inability of *Calliephialtes* to oviposit in more than a comparatively small percentage of the cocoons of the codling moth. This restriction of the ability of the parasite is a common phenomenon and confronts with great frequency the student of insect parasitism. It frequently happens that a parasite is not fitted by nature to accomplish more than a very small amount towards the control of its host. Probably the most common of these restrictions is insufficient length of the ovipositor. This is well illustrated in the case of the egg-parasite of the gypsy moth imported into New England from Japan by the United States Bureau of Entomology. Not more than, say 20 per cent, of the eggs of the gypsy moth can by any possibility be parasitized, no matter how abundant the two species of parasites are. The reason for this is that the egg-mass of the moth is composed of several layers. The ovipositors of the parasites are only sufficiently long to enable them to reach the outer layer of eggs. The remaining 80 per cent of the eggs are fully protected, and one might introduce colonies of these parasites until doomsday and not increase the rate of parasitism one per cent. Insufficient length of the ovipositor seems rather far fetched when applied to *Calliephialtes*, which has that portion of its anatomy rather abnormally developed, but nevertheless this fact is undoubtedly responsible to a large degree for the failure of *Calliephialtes* to accomplish the control of its host. The specific application in this instance lies in the well-known habit of the apple worm of secreting itself to spin its cocoon. *Calliephialtes* can not, of course, deposit eggs in any cocoon which it can not reach with its ovipositor. Just what percentage of the cocoons are formed out of reach of the parasite has never been determined, but at least a majority of them are so situated. The codling

moth larva spins its cocoon mostly under the scales of bark, in crevices in the tree and cracks and holes in the ground. Any cocoon which occurs in a crevice more than one inch deep and of a width too small to permit the parasite to enter, or under a good sized scale of bark, would be inaccessible to the parasite, and as the worm is prone to crawl for some distance into a crevice, sometimes to a distance of ten or twelve inches, before spinning, it is probable that for this reason a large majority succeeds in eluding the parasite by crawling instinctively out of reach. Without doubt this inaccessibility of the apple worm is the most important factor working toward the inefficiency of *Calliephialtes*.

Second—Along this same line, and working directly with the above, is the interrelation of birds and the codling moth. This affects the parasite in two ways. The insect is a large and conspicuous one, slow

FIG. 57.—*Calliephialtes* sp., drawing of female. (Original.)

moving and without means of defense. Undoubtedly a very great number are destroyed by birds. Birds, however, have frequently proven to be very efficient enemies of the apple worm, and in this way would destroy many immature *Calliephialtes* within the codling moth cocoon. An even more important effect of birds upon the problem, however, is their destruction of the apple worms even before they have been parasitized. Those worms which are the least protected and which are most accessible to *Calliephilates* are the very ones which the birds would first devour. It has been determined by the agents of the United States Department of Agriculture that from 66 to 85 per cent of the larvæ of the codling moth are destroyed by birds. These figures would probably mean that most of the worms which could possibly be reached by the parasite are destroyed by other means either before or after parasitism. The fact that the adult *Calliephialtes* is unable to begin

its egg-deposition until about nine days old, as explained further on in this paper, gives the birds ample opportunity to destroy great numbers before they are able to get in their good work. There are, of course, many other factors working against the successful establishment of *Calliephialtes,* such as the toughness of the cocoons of the host, etc., but we believe we have enumerated above the more important ones. As it would be impractical to attempt to overcome these difficulties in the way of the successful use of this interesting parasite, it will not be the policy of the Insectary hereafter to continue its distribution.

Description of the Species.

The female: length 11.8 mm.; head black, occipital region finely punctured, strongly reflexed posteriorly; maxillary and labial palpi lemon-yellow, basal and terminal joints somewhat ferruginous; antennæ blackish, terminal joints of pedicel somewhat piceous, flagellum 27-jointed; thorax black, finely and rather sparsely punctate excepting large area posteriorly on mesopleura, which is impunctate; tegulæ lemon-yellow, as is also a small triangular spot on the posterior angle of the pronotum; metanotum punctate anteriorly, finely transversely striate posteriorly; metasternum strongly longitudinally carinate along latero-ventral angle. Abdomen black dorsally, closely and rather coarsely punctate, segments two to five with a smoother area posteriorly, sides of apical segments piceous; venter pale yellow, first segment black basally, second to fifth segment with a large oval black spot on each side, sixth with a narrow dark band basally. Ovipositor 11.8 mm. long, smooth and ferruginous, sheath blackish and hairy. Legs ferruginous, trochanters yellow, intermediate and posterior tibiæ and tarsi darker, claws piceous. Wings pale brownish-hyaline, iridescent; venation dark brown.

The male: length 10.3 mm., head black, front covered with long silvery pubescence; palpi yellow, lighter than in female; scape and pedicel of antennæ yellow anteriorly—dark posteriorly; flagellum brown. Abdomen black, posterior margin of seventh dorsal segment with a yellow border, sometimes showing slightly on sixth also. Genitalia large and conspicuous. Anterior and intermediate legs including coxæ uniformly light yellow except tarsal claws which are dark; posterior legs as follows: coxæ ferruginous, trochanters yellow, femora ferruginous, tibæ dark, indistinctly banded with yellowish, tarsi dark.

Variation in Size. There is a considerable variation in size in this species. This is more pronounced in the male than in the female.

Emergence of Adults. Practically all the males of *Calliephialtes* sp. emerge several days before the females begin to appear. In 1913, from a lot of overwintering parasitized *Carpocapsa pomonella* material kept at an average temperature of 63° F. for two weeks prior to the emergence of the adults, the first males appeared on February 5th, new males issuing each day until March 3d. The first female appeared on February 14th, or nine days after the first male. On February 22d several more females emerged nineteen days after the first male. Of course this period between emergence of male and emergence of female will depend on the date of oviposition. The time of the oviposition period is so long that males developing from eggs deposited weeks after eggs from which females have emerged will appear at the same time or even after the first appearance of the adult female. Thus, in our records, we have the emergence of the males and females interspersed. However, nine days is the average time between the emergence of males and emergence of the females at the above temperature. As the temperature increases this time will, of course, be shortened. The adults were inactive below 50° F.

The Proportions of the Sexes. The males greatly outnumber the females, the proportions in our breeding cages being approximately three to one.

Feeding Habits of Adults. The adults of both sexes of *Calliephialtes* sp. feed freely on sugar water, honey, honeydew and other sweet liquids supplied them. They will also feed freely on the body contents of the codling moth larva and several have been observed to have fed

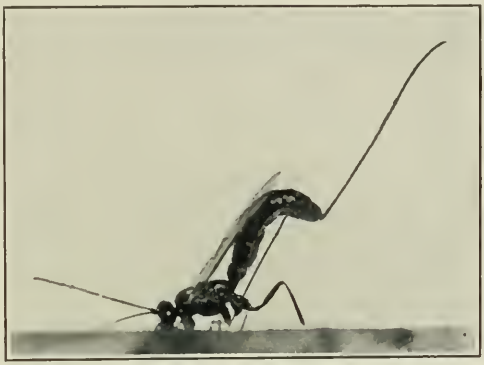

FIG. 58.—Female of *Calliephialtes* sp. puncturing cocoon of host. About three times enlarged. (Original.)

for over thirty minutes on the juices of the host. These made openings in the skin of the apple worm with their mandibles but often they will feed at the wounds made by the ovipositor.

Mating. Mating between the sexes of *Calliephialtes* sp. takes place usually within twenty-four hours after the female emerges. The sexual attraction is very weak. The newly emerged female submits to the attentions of the male readily at the first mating. They may copulate more than once, one female being observed in copula three times within four days after eclosion. They remain in copulation about four minutes. As the female becomes older she is less attracted to the male and resists apparently successfully all advances of the other sex.

Parthenogenesis. The work of R. A. Cushman (loc. cit.) on this species has shown that parthenogenesis does occur, the progeny, however, being all males.

Development of the Eggs. The newly emerged female of *Calliephialtes* sp. is sexually immature. At a mean temperature of 61° F. the ovaries of several females examined eight days after emergence showed the ova not yet half developed. Of course at higher temperatures the ova will develop much faster. The ovipositor is soft and of a whitish color after the female emerges and requires some time in which to harden sufficiently to penetrate the host cocoon. This whitish color gradually changes to the reddish of the sexually mature female. For several females of *Calliephialtes* the color of the ovipositor did not begin to turn noticeably darker until over twelve hours had elapsed after their emergence. They were kept at a temperature of 61° F. Two days usually suffice for the ovipositor to become entirely colored and several days more must elapse before the chitin becomes sufficiently hard for oviposition to take place.

No extensive observations were made on the period between emergence of the adult female *Calliephialtes* sp. and the first deposition of eggs. At a temperature of 63° F. one female emerging on February 26, 1913, began depositing eggs on April 3d, or a preoviposition period of practically seven days.

Each ovary of *Calliephialtes* sp. consists of six ovarian tubes, or ovarioles. A number of the ovaries of the sexually mature females of this species were dissected. The results of these dissections are shown in Table No. 1.

TABLE NO. 1.

Dissection of Ovaries of Calliephialtes sp.

Number of female	Eggs in ovaries		
	Fully developed	Half or over	Less than half
1	4	5	16
2	3	1	8
3	8	6	13
4	7	4	13
5	4	1	18
6	6	0	7
6	32	17	75

The ovaries of the six females dissected contained an average of five fully developed eggs, three half or over half developed eggs and twelve less than half developed. These dissections would indicate that the daily oviposition is small. We have observed one female to deposit five eggs in one day. The average daily egg deposition is from two to three eggs. As the egg development is so slow the number deposited by any female would certainly be less than one hundred eggs.

Oviposition. The stage of the host *Carpocapsa pomonella* attacked by this parasite is the full grown larva in the cocoon. The stimulus to oviposition is evidently the odor of the codling moth. Adults have been noticed to attempt oviposition in wood and even in glass in places formerly occupied by the cocoon of the codling moth. On one occasion a female deposited two eggs in a glass vial which had contained codling moth larvæ. Attempted oviposition was noticed several times in cocoons containing the pupal stage of the codling moth but in no case were eggs deposited. Only one egg is deposited at a time, but several eggs may be laid in the same cocoon by the same parasite or by different individuals. Super-parasitism may occur although it is not common. *Calliephialtes* larvæ, when placed together, readily feed on each other and even on eggs of the parasite.

The general method of oviposition is as follows: The female feels the cocoon of the host with its antennæ, then standing as nearly over the cocoon as is possible, according to the position of the host, raises the abdomen to a vertical position, the ovipositor being released from its sheath and lowered. The parasite presses on the tip of the ovipositor until it penetrates the cocoon of the host, often turning around completely several times, evidently to enlarge the hole in the cocoon. The abdomen is lowered as far as possible if the cocoon of the host is at a distance from the surface on which the parasite is standing. Figure 58 shows the position of the parasite when it is attempting to penetrate the cocoon of the host with its ovipositor, and Figure 59 shows the

parasite in the position of depositing an egg. The parasite jabs the host larva with its ovipositor several times, the larva often offering such a stubborn resistance that the parasite is unable to subdue it. The points at which the ovipositor enters the codling moth larva soon becomes almost black. The larva after being jabbed several times is apparently killed. The parasite, after subduing the host larva, withdraws the ovipositor from the body and remains almost perfectly still for several minutes. Then begins a series of rapid pulsations in the apical abdominal sternites and the lancets or inner pieces of the ovipositor move rapidly up and down. This motion continues for several minutes, after which the parasite rests again. Then another series of

FIG. 59.—Position assumed by female of *Calliephialtes* sp. in oviposition. (Original.)

pulsations is begun, these being much slower and more powerful than the preceding, the egg slips quickly down the ovipositor caudal end first, and may be seen with the naked eye as soon as it leaves the vagina. Having deposited the egg, the parasite withdraws its ovipositor, which snaps back into the sheath. The parasite usually remains quiet for some time.

This method of oviposition varies to some extent, the first series of pulsations being apparently unnecessary for the egg deposition, several having been observed to have laid eggs without these movements having taken place. The parasite also does not always rest after stinging the larva. The average time required for the deposition of an egg is about fifteen minutes. We noticed one female which deposited two eggs in the same cocoon in exactly five minutes and omitted the first series of pulsations mentioned above. Another required thirty-five minutes to

perform the act of oviposition. The time required will depend largely on the accessibility of the host cocoon, thickness of the cocoon and the ease with which the host larva is subdued.

Whether or not the host larva is killed or merely paralyzed by the ovipositor of the parasite we were unable to determine. A codling moth larva having been stung remains in a soft flaccid condition until the parasite larva has developed, when there remains but little of the host. Host larvæ were observed to be in the same condition as when first stung, except for a slight discoloration of the integument for a period of thirty days. Acting on the theory that the stung larvæ were still alive, an experiment was performed in which several unstung codling moth larvæ were killed in boiling water, at the same time several stung larvæ were boiled. Twelve hours after the removal from the liquid the two lots were examined. In both cases the bodies were hard and crumbled up when handled. This would seem to indicate that either the stung larvæ had been paralyzed by the ovipositor of the *Calliephialtes* and had been killed by the immersion in the boiling water, or that the effect of the hot water on the living and dead tissues of the two lots was the same. To eliminate the last possible explanation, two sets of codling moth larvæ, one set living and active, the other stung by the parasite, were placed in a strong cyanide tube for twenty-four hours. The remains of the unstung larvæ dried up within twelve hours after the removal from the cyanide tube, while the remains of the stung larvæ were still in the characteristic soft flaccid condition. The second experiment tends to indicate that the codling moth larvæ were killed and injected with some element which has the effect of preserving the body contents in a semifluid state.

In this connection it might be interesting to note that one codling moth larva was observed in which the ovipositor of the parasite had passed through the integument and was seen underneath. The parasite deposited its egg near the host. The larva was taken from the cocoon and examined under the microscope. There was a considerable twitching noticeable in the palpi, but otherwise the larva had the appearance of the dead. Four days later the host larva was examined again and the twitching of the palpi was still noticeable. The hole made by the ovipositor of *Calliephialtes* in the integument of the host was now surrounded by the blackened area characteristic of stung larvæ. The body of the host had not changed its position. Later the larva was examined again but the twitching of the palpi was not observed. More observations will be necessary to prove whether or not the larvæ are dead or only paralyzed.

Calliephialtes sp. refuse to oviposit below a temperature of 56° F., and were inactive at 50° F.

Longevity of Adults. The length of life of the male *Calliephialtes* is considerably less than that of the female, which lives, approximately, two months. One female was observed to live for ninety days.

Number of Broods. *Calliephialtes* sp. has at Sacramento, California, from five to seven broods each year, depending upon the abundance of the codling moth larvæ. The broods greatly overlap, eggs deposited by one brood of females may develop into the adult stage before the death of the mother parasite, thereby increasing the complexity of determining the number of broods unless each parasite is separated.

Hibernation. The insect has no true hibernation period. The cold weather stops the development. The insect passes the winter as a rule in the last larval or pupal stages. The mortality is much less in these stages than in the younger. They can be successfully kept in cold storage during the summer months, the temperature delaying the development.

The Egg. (Figure 60.) The eggs of *Calliephialtes*, as has been stated, are deposited singly and may be placed at any point within the cocoon of the codling moth larva. They are frequently deposited on the larva and several may be placed in the same cocoon.

The average length of fifteen eggs of this parasite was found to be 1.7 mm. and the average width .3 mm. The longest egg measured 1.9 mm. in length, while the shortest measured 1.5 mm. in length. They are milky white in color, elongate, the two poles are of unequal size, the larger being slightly pointed and tapers off gradually to a long

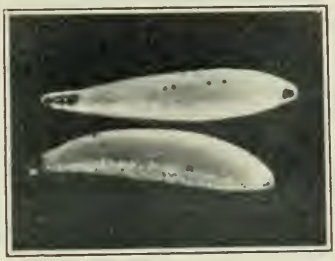

FIG. 60.—Eggs of *Calliephialtes* sp. Greatly enlarged. (Original.)

point at the other pole. In one plane there is a perceptible curve from pole to pole as shown in the photograph. The egg-shell or chorion is sculptured in the form of elliptical protuberances arranged in the form of an irregular hexagonal pattern. As incubation proceeds the yolk draws away from the poles leaving a semitransparent space at each end of the egg. The incubation period for thirteen eggs at a mean temperature of 62° F. was sixty-eight hours. The chorion begins to shrivel up at the time the larva is about to emerge and after emergence is a colorless mass still retaining its sculpture to some extent.

The First Stage Larva. (Figure 61.) The newly emerged larva is quite unlike the last stage, is of a milky white color with a slight yellowish tinge in the abdominal region, due to the contents of the digestive tract. In this stage the head is the most prominent portion of the larva. The size of the head averages .25 mm. in length and .24 mm. in width. There are thirteen body segments. The antennal protuberances are prominent. The newly emerged larva is slightly smaller than the egg and averages 1.2 mm. in length by .3 mm. in width. The smallest newly emerged larva was 1 mm. in length by .3 mm. in width, the largest 1.5 mm. in length by .35 mm. in width. The mandibles are of the same shape as those of the later stages of the larva but the oral ring is not so plainly marked as in the following stages.

From the fact that so many eggs of *Calliephialtes* sp. are found lying in the cocoon away from the codling moth larva it is interesting to note how long a newly emerged larva can live without food. Table 2 shows the result of an experiment with newly emerged larvæ. It will be seen that the shortest period was twenty-two hours and the longest fifty-three

FIG. 61.—Newly emerged first stage larva of *Calliephialtes* sp., greatly enlarged. (Original.)

hours before death ensued, presumably from starvation. The average longevity for the unfed first stage larvæ was thirty-one hours.

TABLE NO. 2.

Longevity of newly emerged larvæ unfed of Calliephialtes species.

Larva number	Date of emergence from egg	Date larvæ died	Longevity period
1	April 3, 10.30 a. m.	April 4, 8.30 a. m.	22 hours
2	April 3, 10.30 a. m.	April 4, 3.15 p. m.	29 hours
3	April 3, 10.30 a. m.	April 5, 3.10 p. m.	53 hours
4	April 3, 10.30 a. m.	April 4, 8.30 a. m.	22 hours
5	April 3, 10.30 a. m.	April 4, 8.30 a. m.	22 hours
6	April 2, 5.15 p. m.	April 4, 8.30 a. m.	39 hours
7	April 4, 2.00 p. m.	April 5, 3.10 p. m.	25 hours
8	April 5, 3.10 p. m.	April 7, 5.00 p. m.	50 hours
9	April 5, 3.10 p. m.	April 6, 2.00 p. m.	23 hours

The newly emerged larvæ are fairly active and are capable of crawling a short distance, one larva having been noticed to have traversed a distance of 18 mm. The larva attaches itself to the host at any point and begins feeding, the body rapidly approaching the width of the head

FIG. 62.—First stage larva of *Calliephialtes* sp. after feeding. Greatly enlarged. (Original.)

and the contents of the alimentary canal become a deeper yellow color, the whitish urates beginning to become noticeable. It may change its point of contact, but is unlikely to do so unless disturbed. In this stage the larva often feeds standing on its head, the body being pointed out at right angles to the point of contact. At the end of this stage the body

becomes wider than the head, the color in the abdominal region is now a deep yellow and the urates are prominent. From two to three days at a temperature mean of 62° F. ecdysis or moulting takes place and the larva enters the second stage. The average length of life of the first stage larva was determined and varied from forty-eight to seventy-two hours and averaged 57 hours.

The Second Stage Larva. (Figure 63.) Characteristic of this stage is the increase in size of the body, the head being practically of the same dimensions as in the preceding stage. The body tapers gradually from the head to the third or fourth abdominal segment where the width is greatest, the body gradually diminishing in size to the posterior end. The urates are much more prominent in this stage than in the first.

FIG. 63.—*Calliephialtes* sp. Second stage larva. Greatly enlarged. (Original.)

The head and the first three body segments are still of the whitish color of the newly emerged larva, as well as the anal segment, but the digestive tract in the abdominal region gives that part a deeper yellow tint than in the preceding stage. There is a slight curve to the body so conspicuous in the last stage. The mandibles are larger than in the first stage but there is no perceptible change in shape. The oral ring is heavier. The head, which in the first stage was about as wide as long, is now transverse, the length ranging from .22 mm. to .3 mm., and the width from .23 mm. to .4 mm., the average length being .25 mm. and the width .32 mm. The larva varies in length from 1.5 mm. to 2.5 mm., averaging 2.01 mm. and the variation in width is from .3 mm. to .6 mm., averaging .49 mm.; in other words, the length of the second stage larva has increased in the proportions of 7 to 4 over the first stage larva, and the width 5 to 3, while the head has not increased in length but has increased in width 4 to 3. From forty-two to forty-eight hours at a mean of 60° F. after the first moult skin is cast off, the segmental lines of the body become indistinct, ecdysis takes place again and the larva enters the third stage.

The Third Stage Larva. (Figure 64.) In the third stage the curve of the body becomes more pronounced than in the preceding stage. The color of the head and first two body segments is still whitish, as well as the anal segment, but the digestive tract assumes a yellow-brown color. The whitish urates are still conspicuous. The body is more widened laterally and the larva is less active. As well as in the preceding stages, the larva changes its point of feeding on the host frequently. The lateral swollen areas are more distinct. The length of the larva varies in this stage from 2.3 mm. to 3.6 mm., averaging 2.8 mm. and in width .8 mm. to 1 mm., averaging .9 mm. The head averages .3 mm. in length

and .4 mm. in width. Compared with the second stage, it has increased in length in the proportions of 7 to 5 and in width 13 to 7. The length of the head has increased in the proportions of 6 to 5, and the width 5 to 4. The mandibles are larger and the oral ring increases

FIG. 64.—Third stage larva of *Calliephialtes* sp. Greatly enlarged. (Original.)

FIG. 65.—*Calliephialtes* sp. Outline of mandibles. Enlarged. (Original.)

in thickness. The third stage is shorter than the preceding, according to our observations, and at a temperature of 60° F. this averaged thirty-eight hours and varied from twenty-four hours to fifty-three hours.

The Fourth Stage Larva. (Figure 66.) In the fourth stage the head of the larva of this parasite does not yet assume the characteristic

FIG. 66.—Fourth stage larva of *Calliephialtes* sp., showing third moult skin attached to anal segment. Greatly enlarged. (Original.)

Ichneumonid type. The oral ring is a brownish color and the mandibles are larger than in the preceding stages. The head is still of a whitish color, the first body segment and the two anal segments are also whitish. The abdominal contents have taken on a dull brownish color and the urates are still fairly conspicuous. The curve of the body becomes more pronounced. The length of the larva averages 3.7 mm., varying from 3.5 mm. to 4 mm., the width averaging 1.2 mm. The head varies in width from .41 mm. to .5 mm. and the length from .32 mm. to .5 mm. The proportionate increase in length of the larva over the third stage larva is about 4 to 3, and in width 4 to 3. The proportionate increase in the length of the head is very small, if any, but in width it is about 8 to 9. The time of the fourth stage at a mean of 65° F. was forty-nine hours.

The Fifth Stage Larva. (Figure 67.) With the casting of the fourth moult skin the head of the larva assumes the Ichneumonid type and is retracted to a great extent into the fleshy first body segment. The mandibles and oral ring are much heavier than in the other stages.

The color of the integument assumes a pinkish tinge. The curve of the body is very strong. The body contents do not show through the skin as conspicuously as in the other stages, the skin becoming more opaque. The urates are indistinct. The swollen areas on the lateral

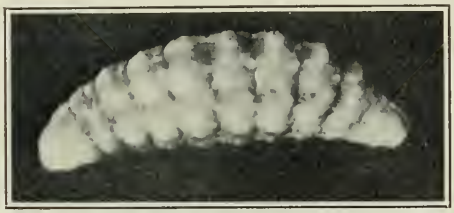

FIG. 67.—Full-grown larva of *Calliephialtes* sp. Greatly enlarged. (Original.)

edges are very prominent. The greatest width is transverse. The contents of the host are nearly drained out and at the end of the stage little remains but the skin, which is pushed to one side and end of the host cocoon at the time the parasite larva starts to spin its cocoon. There is much increase in the size of the head over the preceding stage, the length increasing to about .55 mm., or a proportionate increase of 11 to 8, and the width increases to about .75 mm., or in the ratio of 15

FIG. 68.—Larvæ of *Calliephialtes* sp. feeding on codling moth larvæ. Enlarged. (Photo by Essig.)

to 9 over the fourth stage. The greatest increase in size, of course, is in the body, the larva averaging for both males and females 6.9 mm. and in width 2.7 mm., the males as a rule being the smaller. The females average over 8. mm. and the males under 8. mm. At the temperatures previously recorded the larva will spin its cocoon in from seventeen to thirty days after having emerged from the egg. The larva voids the meconial grains and pushes the remains of the host to one end and side and proceeds to spin the cocoon.

The Cocoon. (Figure 69.) The first process in spinning the cocoon of *Calliephialtes* sp. consists of spinning a series of whitish threads which form the outer network and serve to shape the cocoon. Under this the larva forms the layers of the cocoon proper which are closely woven and impervious to the air, or nearly so. The finished cocoon is usually of a yellow brown color, thin and tissue-like and consists of 3 to

5 layers. The outer layer is the whitish network of threads which may or may not turn brownish as they become older. The closely woven layers underneath this give the color to the cocoon, the very inside layer having little of the brownish color which may be due to lack of contact with the atmosphere. The cocoon varies in shape with the surface, which is in contact with it, and the shape of the cocoon of the codling moth. The upper and lower sides and one end are, as a rule, flat, although this is not constant by any means. The angles are made

Fig. 69.—Cross-section of codling moth cocoon showing remains of codling moth larva and pupa of *Calliephialtes* in its cocoon. Gretaly enlarged. (Original.)

of nearly double the number of layers of which the sides are made up, and are very stiff. The flat end is usually of thicker material than the sides, consisting of, usually, five distinct layers, while the top and bottom have only three. The average cocoon approaches a point at the opposite end. The greatest diameter is transverse and slightly to one side of the center. The lateral sides of the cocoon are more or less rounded.

The larva, at a temperature of 61° or 62° F. requires from four to five days to complete the cocoon. The larva remains in this enclosure from three to six days before the prepupal stage is reached. The cocoons average about 5.7 mm. in width and 9.9 mm. in length.

The Prepupal Larva. (Figure 70.) From twelve to ninety-six hours after the larva voids the meconium, constrictions appear in the integument, the reddish eye spots begin to appear on the first body segment and the prepupal stage is reached in from twelve to twenty-four hours. The constrictions are not visible in the head and first body segments or on the ventral portions of the first two thoracic segments. On the third thoracic segment, however, the constrictions are very plain. The color of the prepupa is whitish. The eye spots increase in density as the stage draws to a close. The partially formed appendages may be seen through the integument of the thoracic region a few hours before

pupation occurs. It is in the prepupal stage that the sex can first be determined. This is illustrated in the accompanying photograph, the anal segments in the female prepupa being somewhat recurved, while in the male they are straight. The length of the prepupal stage is from 3 to 7 days. The prepupa averages about 8. mm. in length, the females, of course, being as a rule the larger.

FIG. 70. — *Calliephialtes* sp. Female and male pre-pupæ. Greatly enlarged. (Original.)

The Pupa. (Figure 71.) With the exuviation of the last larval skin the parasite enters the pupal stage. The last larval skin in the male is thrown off the cerci as a rule, and in the female from the tip of the ovipositor, as shown in the illustration. The pupa of *Calliephialtes* sp. is at first of a whitish color, the compound eyes being partially colored reddish. In the male the first noticeable development in the coloration scheme is the blackish tinge appearing in the eyes. The ocelli at the same time begin to turn reddish. There are no other changes in color for approximately five days after pupation at the temperatures recorded. The head and thorax next begin to take a yellowish tinge and within three days the pupa begins to assume a distinct color pattern which did not vary to any appreciable extent in all specimens examined. This was as follows: Portion of occipital region included by post occipital carinæ, spot on each side of the scutellum, anterior half of metanotum and mesosternum, lower portions of mesopleura blackish; eyes, mandibles and ocelli reddish. The metanotum is strongly bicarinate in both sexes, which is not so in the adult. Twenty-four hours later the entire head and thorax are black, the upper half of the chitinized portion of the second abdominal segment is blackish. The hind coxæ begin to assume the ferruginous color of the adult, the mandibles become darker. Twenty-four hours after these changes take place there is a noticeable darkening of the abdominal plates. The pygidium also blackens. The antennæ begin to assume a darker tinge. The coxæ of the anterior and intermediate legs begin to turn yellowish. At another twenty-four hour period the chitinized portions on the abdomen are practically the color of the adult, and the cerci are also blackish. The next step in the coloration is the darkening of the wing pads. The tarsal claws become dark and the tarsal joints of the posterior legs are also blackish. Otherwise the color is practi-

cally that of the adult. About forty-eight hours later the male emerges. In the female pupa the coloration consists of at first in the darkening of the eyes and ocelli. The next step is the blackish color appearing in the mesopleura; tip of mandibles reddish; area included between post occipital carinæ, prothorax, middle portion of mesonotum, suture between mesonotum and scutellum, blackish, as is a spot on each side of the post-scutellum and mesonotum. Twenty-four hours later at the

FIG. 71.—Male and female pupæ of *Calliephialtes* sp. Greatly enlarged. (Original.)

above temperatures the abdominal plates begin to darken as also do the foreparts of the antennæ; the tips of the tarsi begin to show reddish; the mandibles are dark, and the anterior intermediate and posterior coxæ begin to assume their characteristic color. Forty-eight hours later the wing pads darken and the legs are nearly the color of the adult. The ovipositor sheath begins to blacken at the base. The adult usually issues within four days after this stage in the coloration is reached.

The length of the pupal period varies at a temperature of about 61° F. from thirteen to twenty-four days. The average sized pupa is about 8 mm. The pupa transforms into the adult one or two days before it emerges from the cocoon. The adults bite their way out through one end of the cocoon.

The period from egg to adult at a mean temperature of 61° F. to 62° F. is from forty to fifty days.

Summary.

1. *Calliephialtes* sp. was introduced into California from Spain in 1904, by Mr. George Compere, and was distributed in large numbers throughout the State.

2. On account of the wide differences in handling the apple crop in California and that of the native habitat, the physical limitations of the parasite, the fact that the birds destroy a large percentage of the codling moth larvæ, and the habits of the codling moth larvæ seeking hibernating quarters, we believe that *Calliephialtes* sp. will be of no practical value in controlling the host.

3. The body of the female *Calliephialtes* sp. is approximately half an inch in length and has an ovipositor the same length. The general color is black. The male is smaller.

4. The males of *Calliephialtes* sp. emerge about nine days before the females begin to appear.

5. The males outnumber the females in the proportion of 3 to 1.

6. The adult parasites feed freely on sweet liquids as well as the juices of the codling moth larvæ.

7. Mating may occur several times.

8. The species is parthenogenetic, producing males from unfertilized eggs.

9. The newly emerged female of *Calliephialtes* sp. is sexually immature and requires about nine days to develop eggs and make ready for oviposition.

10. The ovipositor of the female of *Calliephialtes* sp. stings the codling moth larva in its cocoon and deposits its eggs singly and in any portion of the host cocoon.

11. The adult female apparently lays less than one hundred eggs.

12. The average length of life of the female parasite is about two months, but they may live as long as three months. The life of the male is considerably shorter.

13. There are from five to seven broods per annum at Sacramento, California.

14. In California the insect has no true hibernation period.

15. The eggs are white sculptured and average 1.7 mm. in length. They hatch in about sixty-eight hours at a mean temperature of 62° F.

16. There are five larval stages: the first stage averages 57 hours at 62° F.; the second stage, 42 to 48 hours at 60° F.; the third stage, 38 hours at 60° F.; the fourth stage 49 hours at 65° F.; and the fifth stage 9 to 15 days at a temperature of 61° F.

17. The larva of *Calliephialtes* sp. requires from four to five days to complete the cocoon at a mean temperature of 61° F. to 62° F. The cocoon is spun inside the cocoon of the codling moth. It is yellow brown in color and varies in shape with the cocoon of the host. It is made up of several layers.

18. The prepupa of this parasite is whitish and is about 8 mm. long. The sexes can be distinguished in this stage by the recurved anal segments of the female. The anal segments of the male are practically straight. The length of the prepupal stage is from three to seven days at 61° F.

19. The pupal stage at 61° F. is from 13 to 24 days. The pupæ are at first whitish with reddish eyes and require some time for the entire color of the adult to develop.

20. The period from egg to adult at a mean temperature of approximately 61° F. is from 40 to 50 days.

It is with exceeding pleasure that we publish the above from our State Insectary. This insect has attracted wide interest and attention in our State. The reasons for our disappointment in its practical value should be known. The scientific excellence and thoroughness of the article alone warrant its publication. Many of our county horticultural commissioners are earnest students, and we could hardly wish for them a better course of instruction than a very careful reading and study of this article will give.—A. J. Cook.

GENERAL NOTES.

THE IMPORTATION OF BLACK SCALE PARASITES FROM SOUTH AFRICA.

Through the kindness of Prof. C. P. Lounsbury, Entomologist for the Department of Agriculture of the Union of South Africa, the Insectary has received a number of shipments of twigs of *Sparmannia africana*, infested with the black scale (*Saissetia olea*). To date eleven species of parasites have been reared from this material, two of them in considerable quantities, the others not so abundantly. The parasites are entirely undetermined, and have been submitted to Doctor Howard for names. The two more common species are primary. The status of the remaining species has not yet been determined in every case. One we have ascertained to be secondary (*i.e.*, they are parasites of the parasites, therefore injurious), and some of the others undoubtedly will fall in this category. Both primary species emerge from the young scale before the eggs are laid, and hence they should fill a long existing gap in the sequence of the parasites of the black scale and become valuable supplements to the work of *Scutellista* and *Tomocera*, which attack the scale after the eggs are laid.

So far as climatic influences are concerned, it would seem as though these parasites should become established in California, as the climate of the Cape is certainly not less severe than that of California, but of course climate is only one of the many factors which make their influence felt in this kind of work. The interrelations between parasite and host are much more intricate in the case of internal parasites such as the two species above than in "predaceous" parasites like *Scutellista*. However, from our present knowledge of the situation there would seem to be no valid reason why they should not become established and do good service in the work against the black scale.

It is of interest in this connection to note that while the Cape is the locality from whence *Scutellista* was originally obtained for introduction into California, this species in the shipments received is very much less common than the two mentioned above. This is partly accounted for by the fact that when the material left South Africa much of it was not in the proper stage for oviposition by *Scutellista*. However, it is quite evident that these new parasites play an important rôle in the control of the black scale in South Africa and every effort will be made to get them established in California.

Professor Lounsbury has for several years maintained that California has not exhausted the possibilities in the way of parasite control of the black scale with the acclimatization of *Scutellista*, and the interest he has shown in our problems is more than casual. His associate, Mr. C. W. Mally, of Cape Town, was directly concerned in the collection and shipping of the recently received material, and the thanks of all Californians is due to Messrs. Lounsbury and Mally for the effort they have made in our behalf.—Harry S. Smith.

THE JUNE STATE FRUIT GROWERS' CONVENTION.

We had hoped to have the complete program of the Forty-fourth State Fruit Growers' Convention to be held at the University Farm, Davis, June first to sixth, inclusive, in time for this issue of The Monthly Bulletin. I fear it will be too late. I wish, however, to state that it will be of phenomenal excellence. Very able speakers from all sections of the country will address the Convention. From eight to nine-thirty a.m. each day will be county horticultural commissioners' hour. The commissioners asked for a school of instruction at each convention. This hour will be programmed in obedience to this request. On Saturday the hour will be devoted to new pests and troubles the present season, and the commissioners will be asked to take an active part.—A. J. Cook.

PROHIBITION AGAINST THE IMPORTATION OF ANY AND ALL KINDS OF CITRUS INTO FLORIDA.

Rule 43. That in order to prevent the introduction of the new citrus disease, known as Citrus Canker, prevalent in the principal citrus growing sections of the Gulf States, but not widely prevalent in Florida, the importation into Florida from all the states of the United States, its territories and possessions, and all foreign countries of any and all kinds of citrus trees and parts thereof, including bud wood and graft wood, and all other host plants of this disease as soon as any are discovered, except fruit intended for eating, and seeds, is hereby prohibited.

Provided, that importations of limited quantities of new or rare varieties may be allowed by special permit of the Board of Control. Applications for such permits must be made to the Inspector of Nursery Stock.

Provided, further, that this prohibition does not apply to shipments made by the U. S. Department of Agriculture.

Adopted by Board of Control of Tallahassee, Florida, April 13, 1914.

(Signed) E. W. Berger, Inspector.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent of the State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plants as near as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

Foliage-Eating Caterpillars.

There are a number of species of caterpillars which eat the foliage of our deciduous fruit trees and often occur in such numbers as to strip the leaves from the large branches. Some of these caterpillars spin webs or tents from which they emerge at times to feed on the leaves. Take a torch and burn these tents when the caterpillars are inside. Other species of caterpillars feed on the leaves in colonies when very young, and if the leaves covered with these young worms are destroyed further damage can be easily prevented. However, if the caterpillars have become scattered over the trees, spray the foliage with arsenate of lead, 3 pounds to 50 gallons of water. Cover surface of leaves thoroughly. The tussock moth caterpillars are gray in color with numerous colored spots and many tufts, prominent among these being four whitish ones on the upper side and two distinct black ones on the head. Use zinc arsenite 4 to 6 pounds (it is stronger than arsenate of lead) to 200 gallons of water against these caterpillars as they are capable of eating large doses of poison, apparently without much injury. The tent caterpillars are hairy and black and yellow in color. The red hump caterpillars have a prominent red hump on the fourth body segment, and the webworms are hairy caterpillars with dark stripes and of a yellowish-green color.

Plant Lice.

The plant lice are small soft-bodied, sucking insects, generally of a greenish or dark color. They cluster on the tender shoots and leaves, deforming them and curling up the leaves. In order to kill these insects it is necessary for the spray to hit them. Spray before they have curled up the leaves, as spraying is difficult at that time. Use an angle nozzle so that they may be reached from all sides. One of the best sprays to use consists of black-leaf 40, three quarters of a pint, soap three to four pounds, water 100 gallons. This spray may be used in connection with the arsenate of lead spray for the codling moth (apple worm).

The Codling Moth.

The codling moth causes wormy apples. The larvæ are poisoned by an arsenate of lead spray. The second application is made three to four weeks after the petals of the blossoms have fallen. Use five pounds of the arsenate of lead to 100 gallons of water. Do a thorough job, even if some of the spray finds its way to the ground.

The Cherry and Pear Slug.

The pear slug is the young of an insect which belongs to the same order as the honeybee. We know the slug as a dark, olive-green, slimy worm with the anterior portion enlarged. It strips the upper green surface of the leaves which later turn brown. This pest feeds on the pear, cherry, plum, quince, etc., and it is very easy to control by blowing lime and dust upon the infested leaves, or by spraying with the ordinary soap and emulsion sprays; also arsenate of lead, four pounds to 100 gallons of water. The latter spray is slow in action as the slugs must eat the poison to be destroyed.

CITRUS FRUIT INSECTS.

Plant Lice.

Plant lice are also injurious to citrus trees. The black citrus plant lice are probably the most common of the aphids on this host. They will be found principally on the most tender growth on which they may do much damage. Curled leaves result from their attack and serve as a forceful indication of their presence. The black-leaf spray recommended above will do efficient work if applied properly. A *Braconid* fly parasite is controlling these aphids absolutely, in many of the groves of Sacramento and Placer counties.—A. J. Cook.

The Citrus Red Spider.

The red spiders are minute web-spinning reddish mites with eight legs. They are generally found on the under surface of the leaves and produce a spotted effect. Dry flowers of sulphur blown on the trees may be used, or the commercial lime-sulphur solution diluted to 2 or $2\frac{1}{2}$ per cent. This latter arachnicide is replacing the flowers of sulphur. Use a fine misty spray with strong pressure. Apply spray when mites are numerous.

Orange Thrips.

The orange thrips are minute active brownish or yellowish insects which are so common in the orange blossoms on the leaves and tender foliage. There are several species which produce different effects on the host: one causes a leathery distorted growth to the leaves and marks the fruit in the form of a ring around the stem end or down in streaks. Another thrips produces a mottled pale color in the leaves and causes the surface of the fruit to turn silvery. Other species attack the parts of the flower. The spray recommended by the United States Bureau of Entomology consists of commercial lime-sulphur 33° Baumé, $2\frac{1}{3}$ gallons; black-leaf extract, 2 gallons of $2\frac{3}{4}$ per cent, or 14 fluid ounces of 40 per cent; water 200 gallons. Always maintain as strong a pressure as is possible. It may become necessary to make several applications, the first being applied usually just after most of the petals have fallen; the second, ten to fourteen days after the first, and the third, three to four weeks after the second.

MISCELLANEOUS INSECTS.

The Cabbage Worm.

Cabbage leaves full of holes and covered with dark excreta call our attention to the velvety green worms of the cabbage butterfly. The adults of these caterpillars are the white butterflies so common in the cabbage patches. Before the plant begins heading, Paris green, one part, bran 40 parts, mixed well and dusted on the leaves may be used, or after plants are heading out, use white hellebore, one ounce to two gallons of water.

The Harlequin Cabbage Bug.

The harlequin cabbage bug is known to us all as the bright yellow and black sucking plant bug. The leaves turn yellow where the insects have been feeding. If possible hand-pick adults and destroy them when clustered on a few plants, or plant trap crops which can be later pulled up and destroyed.

The Graperoot Worm.

The work of the graperoot worm consists of the eating out of chain-like strips from the leaves and shoots of the grape by the adult beetles, and the destruction of the roots by the larvæ. The beetle is brown or black in color, about three fourths of an inch in length, and appears during the last part of April on into June. Destroy the beetles by poisoning them with an arsenate of lead spray, 3 to 5 pounds to 50 gallons of water. Spray as soon as beetles appear in order to kill them before they lay their eggs. Several applications may be necessary. Jarring the adults into receptacles containing oil is also used as a means of control.

The Grape Leaf Hopper.

Another insect attacking the foliage of the grape is the grape leaf hopper. The adults are about one tenth of an inch in length, pale yellow in color and marked with red in an irregular pattern. To destroy the leaf hopper use black-leaf 40, half pint, water, 100 gallons, maintaining high pressure and thoroughly drenching the vines. An angle nozzle is necessary so that the undersides of the leaves can be well covered.

The Alfalfa Caterpillar.

The alfalfa caterpillar is the larva of the orange yellow and black butterfly frequently met with in the alfalfa fields. They are greenish worms with a white stripe on each side of the body. They feed on the leaves and buds. The best method used to combat this insect is to cut the crop low and clean as soon as the worms are nearly well grown (about one inch in length). This will cut off their food supply and consequently many of them will die. Do not leave the alfalfa standing along the roadsides, ditch banks and fences, as the caterpillars will breed uninterrupted on these plants. If the irrigation water is left off the fields for a week or so after cutting, no green growth will appear and the worms that have fallen to the ground will starve to death or will be killed by the heat of the sun.

Grasshoppers.

The importance of the problem of grasshopper control can not be overestimated. Protect your young orchard trees by broad tanglefoot bands around the trunks near the base. The bands must be thick or the stronger hoppers will pull out. Poisoned bait placed at the base of the trees will destroy many of them before they are able to ascend the trees. The poisoned bran mash is made as follows: bran 40 pounds, a cheap grade of molasses 2 gallons, arsenic 5 pounds. Stir the molasses in with the bran and then add the arsenic. Let stand over night and mix thoroughly before placing in the field. Moisten and renew bait as needed. It is advisable for growers whose orchards are surrounded by waste lands, which are grasshopper breeding places, to burn them over when the young hoppers are plentiful. This should be done at night for the reason that at that time the young insects are inactive. Spraying a strip of the green crop near the edge of the field where the hoppers are entering with Paris green, one pound to 100 gallons of water, or arsenate of lead, 6 pounds to 100 gallons of water, seems to be worthy of trial. It must be remembered that these arsenic compounds are poisonous and care must be taken to keep the stock away from the sprayed plants.

The Oak Moth.

The larvæ of the oak moth are often very destructive to the oak in California. They destroy the leaves. Poisoning them by using arsenate of lead, 5 pounds to 100 gallons of water, will be effective. In spraying the foliage of large oak trees a strong pressure and tower will be almost necessary.

Hop Aphis.

To the hop growers the hop aphis is a well-known insect. It is pale yellowish-green in color. According to W. B. Parker[1] the hop aphis injures the crop in two ways: by sucking out the juices of the plant and by furnishing a medium for the black smut fungus to grow in. The cone scales covered with the mildew secreted by the hop aphis are soon covered with the black smut fungus injuring their commercial value. The infestation of the hop aphis retards the plant's growth. The formula consisting of black-leaf 40, 1 to 2,000 of water, with flour paste 4 gallons to each hundred gallons of the spray, is effective. It must be remembered that when spraying in spring for the hop aphis the aphids must be hit by the spray in order that they may be destroyed.

The Red Spider on Hops.

The hop red spider is a general feeder on many of our field crops. It is a small reddish or greenish-yellow mite and feeds principally on the lower sides of the leaves covering them with a fine web. The yellow spots made by the mites in the leaves soon become very numerous and later the leaves turn yellow and fall. The spray recommended by W. B. Parker of the United States Bureau of Entomology consists of flour paste 8 gallons to 100 gallons of water. The flour paste is made by using a cheap grade of wheat flour with cold water making a thin batter; use one pound of flour to one gallon water, cook until a paste forms; use in the above proportions.

[1]Bull. No. 111, Bur. Ent., U. S. D. A.

The Bean Thrips and the Onion Thrips.

The bean thrips and the onion thrips are two minute active insects belonging to the same order. The adult bean thrips are blackish in color with white and black banded wings, and are about one twenty-fourth of an inch in length. The bean thrips is a general feeder damaging beans, alfalfa, cotton, beets, lettuce, potatoes, tomatoes and pears, besides other plants. Infested leaves turn yellowish or whitish, then fall. This may be continued until the entire plant is defoliated. The onion thrips is especially destructive to the onions and unlike the bean thrips the adult is pale yellow in color. The Government formula used against the pear thrips can be used against this species, the formula being black-leaf 40, 1 to 2,000, and 3 per cent distillate oil emulsion. On plants having very tender foliage a flour paste spray consisting of 6 to 8 gallons of flour paste to 100 gallons of water, thoroughly coating the infested plants, will be effective.

PARASITIC INSECTS.

Braconid Parasites.

These hymenopterous parasites are well afield at this time. One species (*Aphidius testaceipes*) preys upon the melon or citrus aphis (*Aphis gossypii*), the apple aphis (*A. pomi*), the orange aphid (*Toxoptera aurantiæ*), the peach aphid (*Myzus persicæ*), etc.

I have before me specimens of the mummified aphids of the orange aphis, in which case the plant lice were almost exterminated. The parasitized lice change color and form, becoming a dirty white and nearly spherical.

It is possible that these Braconid flies may become second in importance only to the *Hippodamia* as foes to these destructive sappers of our trees and other plants. We may well increase our efforts to introduce them to all sections of aphid attack.—A. J. Cook.

PLANT DISEASES.

Pear Blight.

This seems to be a pear blight year. Pear orchardists are having a busy season cutting out the blight which was spread, probably by insects, from the overwintering blight left unnoticed in the orchard or adjoining orchards. We have received numerous specimens of infested twigs which are evidently blossom infection. It is commonly known that this disease is of a bacterial nature and that the infested blossoms, twigs and leaves blacken and die. The method of control is to cut out infested portions below any sign of infection and to sterilize both wounds and pruning tools with corrosive sublimate, 1 to 1,000.

Apple and Pear Scab.

The apple and pear scab fungus causes scabby patches on the fruit. If infestation is serious Bordeaux mixture 5/6/50 formula may be used to advantage several times during the season.

Grape Mildew.

The fungous disease known as grape mildew is observed as a white powdery growth on the leaves and fruit clusters of the grape. The method of controlling this disease is to thoroughly dust the vineyard with flowers of sulphur.

MONTHLY CROP REPORT—APRIL.

Compiled from reports sent in by the County Horticultural Commissioners, by Geo. P. Weldon, Chief Deputy State Commissioner.

County	Almonds	Apples	Apricots	Berries	Cherries	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Plums	Prunes	Walnuts
Alameda	45	‡	80	100	45	‡	‡	‡	‡	‡	80	‡	‡	75	20	40	‡
Butte	60	80	‡	100	90	—	—	—	—	—	100	100	100	55	‡	25	‡
Colusa	100	100	100	100	100	100	75	75	100	75	75	75	75	100	100	33	100
Contra Costa	30	80	35	‡	30	‡	‡	‡	—	‡	70	70	‡	20	30	25	—
El Dorado	‡	95	‡	100	75	‡	‡	‡	‡	‡			90	85	80	‡	‡
Fresno	100	‡	75	100	‡	100	100	100	100	100	75	75	75	‡	‡	‡	100
Glenn	100	100	100	100	100	100	100	100	100	100	100	100	—	100	—	100	100
Humboldt	—	100	—	—	—	‡	‡	‡	‡	‡	‡	—	—	—	‡	—	100
Imperial	‡	‡	50	‡	‡	100	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡
Kern	—	100	100	—	—	100	—	—	—	100	100	100	100	100	100	100	—
Kings	‡	‡	110	‡	‡	‡	‡	‡	‡	‡	120	120	120	‡	100	100	‡
Lake	100	100	50	100	50	100	‡	‡	100	‡	‡	100	‡	65	‡	100	100
Los Angeles	100	90	80	100	‡	100	75	75	100	90	100	100	100	100	100		100
Madera	100	90	35	100	‡	100	‡	‡	100	‡	100	100	100	‡	‡	95	‡
*Mendocino		100		100	‡		‡	‡	‡	‡			100	80	100	100	
Merced	100	—	75	—	‡	100	‡	100	100	100	40	33	33	100	100	100	—
Modoc	‡	100	80	100	100	‡	‡	‡	‡	‡	80	‡	80	100	100	100	‡
Monterey	25	50	125	100	25	‡	‡	‡	‡	‡	‡	‡	60	70	25	25	‡
Napa	50	75	25	‡	50	‡	‡	‡	‡	‡	25	25	25	50	‡	25	‡
Nevada	100	100	100	—	90	90	‡	‡	‡	100	125	—	125	90	100	75	—
Orange	‡	80	80	100	‡	‡	100	125	100	110		25		90	25	‡	50
Placer	25	70	‡	100	70	100	‡	‡	75	75	90	90	90	90	60	‡	‡
Riverside	100	100	100	100	100	‡	100	90	100	80	100	100	100	100	‡	‡	100
Sacramento	30	100	90	100	85	100	100	100	100	100	90	90	90	75	80	20	95
San Benito	—	—	85	—	—	‡	‡	‡	‡	—	—	—	‡	—	‡	50	—
San Bernardino	‡	50	88	‡	100	‡	95	95	100	95	85	85	85	85	100	‡	100
San Diego	‡	95	100	75	‡	‡	90	30	—	75	—	—	100	—	—	—	—
San Joaquin	50	100	75	—	50	75	—	—	—	—	100	100	100	100	100	50	—
Santa Barbara	‡	105	100	‡	110	‡	‡	110	—	—	100	‡	‡	—	‡	‡	105
Santa Clara	‡	60	80	80	40	‡	‡	‡	—	‡	80	80	80	60	—	25	—
Santa Cruz	‡	70	95	95	30	‡	—	95	‡	‡	‡	‡	—	95	—	—	‡
Shasta	100	90	90	90	50	90	—	100	100	100	90	90	90	90	90	25	100
Siskiyou																	
Solano	50	‡	15	‡	30	‡	‡	‡	‡	‡	90	90	90	80	80	50	‡
Sutter	85	70	75	100	70	100	—	—	100	100	50	75	75	90	75	50	100
Sonoma	25	85	50	95	30	75	‡	‡	80	100	80	80	80	100	75	25	75
Stanislaus	100	100	100	100	100	100	100	100	100	100	95	95	100	100	100	100	100
Tehama	100	100	50	100		—	‡	‡	—	—	75	75	75	75	—	50	‡
Tulare	90	90	90	100	‡	100	—	—	—	—	100	100	100	90	75	60	—
Ventura	100	100	95	‡	—	‡	90	105	105	95	100	100	‡	‡	‡	‡	95
Yolo	60	‡	40	‡	‡	25	‡	‡	75	‡	70	60	75	50	50	40	‡
Yuba	70	70	50	100	50	100	100	100	100	100	60	75	60	60	60	60	‡

*No report since April 10th.

Figures in table indicate condition of crop in per cent on the basis of 100 per cent as normal.

‡Means that crop is not grown sufficiently in a county for a report.

— Means that the county horticultural commissioner has insufficient information for a report.

All blank spaces indicate a failure on the part of a county horticultural commissioner to report in time or in the required form.

A heavy drop of deciduous fruits has taken place since the publication of the March report. The drought of last season and very hot weather in March followed by a cold spell with frost in places are the principal factors which brought about the change. The fact that irrigated orchards suffered in many cases as severely as unirrigated, indicates that unseasonable weather in March was largely responsible.

INSECT NOTES.

Irbesia brachycerus Uhler and *I. scricans* Stahl were noticed on April 19th feeding in large numbers in the grain fields about Stanford University. These small black capsids often do considerable damage to the grain crops in this particular locality, taking the color completely out of the leaves. Other plants upon which the insects were found feeding include *Amsinckia intermedia*, dock, malva and wild mustard.—LEROY CHILDS.

A small weavil, *Tricholepis inornata* Horn,[1] has recently been received from San Luis Obispo, where it was reported by C. L. Flint as damaging the foliage of almond trees. Leroy Childs also collected the same species on fruit trees at Stanford University.—E. O. ESSIG.

Magdalis gracilis Lec., a small black snout beetle, has been recently taken near Palo Alto feeding upon the foliage of almond. The injury to the leaves on the trees noted was quite extensive, many being largely consumed. County Horticultural Commissioner Morris of Santa Clara County reports that the work of this beetle has been very conspicuous on numerous deciduous fruit trees this spring.—LEROY CHILDS.

A small reddish brown carabid beetle, *Amara stupida* Lec.[1] was recently collected in Sutter County where it was said to be injuring strawberry vines. Specimens were sent to this office by County Horticultural Commissioner H. P. Stabler.—E. O. ESSIG.

The larvæ of the **California oak moth,** *Phryganidia californica*, are not nearly as numerous in the peninsular regions this spring as noted during the past two or three years. Numerous parasites were observed to be extremely abundant in the fall broods of last year, which undoubtedly accounts for the temporary relief from this destructive pest.—LEROY CHILDS.

Xylotrechus nauticus Mann.[1] has been received in April from County Horticultural Commissioner Roy K. Bishop, Orange County, and County Horticultural Commissioner R. S. Vaile, Ventura County. In both instances larvæ and adults were taken from walnut trees.—E. O. ESSIG.

The wild ash pemphigus, *Pemphigus fraxini-dipetalæ* Essig, was noted causing considerable damage to ash trees that are grown in many places in Santa Clara County as ornamentals. The injury is very characteristic; the leaves are curled and malformed to such an extent that the trees become decidedly unsightly. This same species has also been found in Sacramento on the native buckeye, *Æsculus californicus*. The injury to the leaves is the same as that found upon ash.—LEROY CHILDS.

The small green dock beetle, *Gastroidea cæsia* Rog.,[1] has recently been collected in Yolo County on grape vines. It was reported from Sacramento County last year on the same host plant.—E. O. ESSIG.

Baker's mealy bug, *Pseudococcus bakeri* Essig, has been taken by the writer during the past month about the bay regions on English walnuts and the California buckeye. Distribution notes of this species seem to point to the fact that it occurs much more widely than has been supposed.—LEROY CHILDS.

The lesser shot-hole borer, *Xyleborus (saxeseni* Ratz.) *xylographus* Say was sent in to this office by County Horticultural Commissioner C. F. Collins of Tulare County, where it was bred from a dying prune tree.—E. O. ESSIG.

A small bronze chrysomelid beetle, *Glyptoscelis pubescens* Fab., and a weevil, *Amnesia* n. sp.[1] have just been received from County Horticultural Commissioner D. F. Norton of Nevada County, who states that they are damaging the foliage of pear trees. —E. O. ESSIG.

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[1]This species was identified by Dr. Edwin C. Van Dyke, of the Entomological Department of the University of California, Berkeley, California, to whom the writer is indebted for much valuable help.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Report of State Board of Horticultural Examiners.

Since the last report the following men have qualified for the position of county horticultural commissioner in the counties named:

Sacramento—
Fred C. Brosius
R. M. Lelong
R. L. Gibbons
Howard Kerchival

Ventura—
R. S. Vaile
A. A. Brock
J. N. French

Santa Barbara—
C. W. Beers

San Joaquin—
E. E. Welty
Harry Ladd
William Garden
R. C. Tubbs

Monterey—
J. B. Hickman
A. W. Tate, Jr.

Alameda—
Fred Seulberger
D. P. Macdonald

A. J. Cook,
Thos. F. Hunt,
Harry S. Smith.
State Board of Horticultural Examiners.

NOTES ON WALNUT APHIS CONTROL.

By R. S. Vaile, County Commissioner of Horticulture, Ventura County, California.

For several years past a number of our orchardists have felt that the walnut aphis, *Chromaphis juglandicola*, has been of considerable damage to the walnut crop throughout southern California. Very early in the season this pest becomes numerous on the leaves and also on the nuts as they are just setting. Soon a large amount of honey dew is secreted, following which the sooty fungus coats the leaves and fruit with a very heavy black covering, which must of necessity choke the respiration of the tree to a large extent. Frequently leaves droop and even fall to the ground in large numbers early in the season, before the crop is half matured, because of this pest. It would seem that this must largely lessen the percentage of nuts which reach No. 1 size.

For the past four years, to the writer's knowledge, this office has endeavored to assist in the control of the walnut aphis through the liberation of ladybird beetles in a certain limited section of Ventura County. Both the *Hippodamia convergens* and the *Olla abdominalis* have been used to quite an extent. The former has not proven very successful as a tree climber, and usually leaves the walnut for other things before the end of the season. The latter is native in the county and very frequently does effective work on individual trees. Eggs of both species may be found this season in almost all parts of the county on walnut trees. So far, however, the control by this method has proven unsatisfactory, and is hardly to be recommended as worthy of trial.

Last season the State University tried some experiments against the walnut blight with various sprays, and with high power spray outfits and nozzles. This is probably the most thorough spraying work that

has ever been done on walnut trees, and although there was comparatively little noticeable result against the blight, there was a decided tendency to control the walnut aphis. The results of this work have been published by the University in Circular No. 107. They were thought of sufficient value for the University to push the matter further this season, and as a result quite an acreage is being sprayed in Santa Barbara County, Ventura County, and Orange County.

Until recently the life history of this insect has not been definitely known. Mr. W. M. Davidson, of the Bureau of Entomology, has recently worked this out to completion. His findings are at present in press at Washington, and will soon be available.

The following notes taken by the writer in Ventura County may be of interest along this line: Eggs, small and flat without stem of any sort; rather a dull black in color; usually laid singly on young buds, or in crevices on larger branches; occasionally found in groups of from three to seven. In 1912 careful inspection in the middle of February showed plenty of eggs, but no evidence of stem mothers; the first stem mothers were found on the fifth of March. In 1913 a very few stem mothers were found as early as February fifteenth and no eggs were found later than March tenth. In 1914 the first stem mothers were found on March sixth and eggs have been found as late as March sixteenth.

The experimental control work for this season has been largely with a five per cent solution of commercial lime-sulphur spray, with which has been used in many cases a certain amount of additional lime to serve as an indicator. The work last season was sufficient to show that the aphis can be completely controlled by this spray. The work this season has been planned to show whether or not spraying is practical from the standpoint of cost, and how much actual damage will be prevented where the aphis is held in check.

This office is conducting spraying experiments on three different orchards. On two of these the trees were approximately seven years old and of medium size for the age. In figuring the costs we have charged $13.00 per day for labor, team and rental of outfit, which is possibly somewhat higher than is necessary. On orchard No. 1, approximately ten gallons of spray were applied per tree. The cost per gallon of spray applied, 1.08 cents for labor, 1.3 cents for material, make a total cost of 22.3 cents per tree. In orchard No. 2 the trees were slightly larger, using approximately 11 gallons to the tree, making an average cost of about 25 cents. The third orchard contained some of the largest trees in the county. On these trees we used an average of 65 gallons per tree; at a cost of 7 cents per gallon of spray applied, for labor, and 1.3 cents for material, make a total of $1.30 per tree. The work on these large trees was done with a long distance M.A.C. nozzle, which has been used in the East for spraying shade trees for browntail and gypsy moth. The pressure was from 200 to 225 pounds. A slightly higher pressure would have been better, but this was the capacity of the rig which we were using; a Bean Giant pump with 2½ horsepower engine. For the smaller trees the Friend drive-spray nozzles were used alternately with the M.A.C. and seemed to be equally satisfactory.

This spraying was done just before the buds started to open, and at the time of spraying both eggs and stem mothers could be found on the trees. It is thought that the lime sulphur spray will be equally efficient against either of these stages. As stated above, the work last season demonstrated fairly conclusively that the lime-sulphur spraying will control the aphis. This season the work has shown, in my judgment, that with an ordinary orchard power spray rig, with 3½ or 4 horsepower engine, it is entirely practical to spray walnut trees until they reach a very large size; certainly young and medium size trees can be satisfactorily sprayed with such a rig if the M.A.C. nozzles are used. We hope to be able to give some rather definite data this season on comparative yield and quantity of nuts on the sprayed and unsprayed orchards. When we have this data on hand we will know definitely whether or not the process is a financial success.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF MARCH, 1914.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, California.

Recognizing that in a state as extensive as California many of the importations of nursery stock from foreign countries destined for interior points and arriving by rail from the Eastern seaboard must of a necessity be inspected by the state quarantine guardians located at the point of delivery, the Federal Horticultural Board, through the courtesy of Dr. C. L. Marlatt, has placed all such quarantine guardians on their mailing list, and in future all regulations and quarantines issued under or concerning the Plant Quarantine Act, as also the series of News Letters, issued by the Federal Horticultural Board, will promptly find their way into the hands of these officers. The News Letters are of special value to horticultural inspectors in that they contain a list of the pests and diseases found in and upon imported plant products, together with the name of the host plant and the country in which the material was grown; and a study of the same will soon enable inspectors to intelligently examine horticultural material arriving from any foreign source. The publication of this list of pests, hosts and localities of infested shipments into any part of the United States is a policy that is destined to be a far reaching one and one that will ultimately produce results that will be permanent. California quarantine officers should consider it incumbent upon them as a matter of added protection, both to the counties of which they have charge as well as to the state at large, to facilitate this work of the Federal authorities by promptly furnishing the information requested on the report forms which are always sent in advance of the arrival of any shipment of foreign nursery stock at points within their jurisdiction.

SAN FRANCISCO STATION.

		Parcels.
Horticultural imports—		
Ships inspected	50	
Passed as free from pests		133,268
Fumigated		3,453
Destroyed or returned		294
Contraband destroyed		9
Total parcels horticultural imports for the month		137,024
Horticultural exports—		
Inspected and certified		1,578

PESTS INTERCEPTED.

From Australia—
Aspidiotus camellia on *Clethra arbona.*
Saissetia oleæ on *Myrica buxgolia.*

From Florida—
Phomopsis citri on grapefruit.
Lepidosaphes beckii on grapefruit.

From Honolulu—
Hemichionaspis minor and *Pseudococcus* sp. on green cocoanuts.
Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Calandra oryzæ in seed corn.

From Japan—
Parlatoria theæ on maples.
Aulacaspis pentagona on *Prunus* sp.
Pseudaonidia duplex on tea trees.
Chionaspis sp. and unknown fungus on fruit of pear.
Lepidosaphes newsteadii on umbrella pines.
Thyridopteryx sp. on juniper.
Aspidiotus cryptomeriæ on cedars.

From Mexico—
Heliothis armigera larvæ in tomatoes.

From Nevada—
Heterodera radicicola in potatoes.

From New Zealand—
Unidentified lepidopterous larvæ in peaches.

From Oregon—
Aspidiotus perniciosus on apple tree.

LOS ANGELES STATION.

Horticultural imports—

		Parcels
Ships inspected	19	
Passed as free from pests		65,351
Fumigated		406
Destroyed		3
Returned		2
Contraband		1½
Total parcels horticultural imports for the month		65,763½

SAN DIEGO STATION.

Horticultural imports—

		Parcels.
Ships inspected	23	
Passed as free from pests		3,712¾
Fumigated		--
Destroyed		4
Returned		¼
Contraband		4¼
Total parcels horticultural imports for the month		3,722

PESTS INTERCEPTED.

From Mexico—
Anastrepha ludens larvæ in guavas from Mazatlan.

From Nebraska—
Pseudomonas tumefaciens on apple trees.
Heterodera radicicola on grapevines.
Heterodera radicicola on peach.

From Missouri—
Heterodera radicicola on peach.
Heterodera radicicola on grapevines.

EUREKA STATION.

Horticultural imports

	Parcels.
Ships inspected	4
Passed as free from pests	7

SANTA BARBARA STATION.

Ships inspected ____ 1

No horticultural imports.

PESTS INTERCEPTED.

From Florida—

Chrysomphalus aurantii and *Lepidosaphes gloverii* on mango.
Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From France—

Lepidosaphes ulmi on apple tree.

From Isle of Pines—

Lepidosaphes beckii on grapefruit.

From Japan—

Pseudococcus citri on azaleas.
Chionaspis wistariæ, *Pseudococcus citri* and *Agromyza schineri* on wistaria.
Lepidosaphes newsteadii and *Pseudococcus ryani* on umbrella pines.
Pseudaonidia duplex on camellia.
Odonaspis secreta on bamboo.
Pseudococcus ryani and unidentified borer on cedar.

From Louisiana—

Chrysomphalus aonidum on unidentified plant.

From Ohio—

Parlatoria pergandii on ponderosa lemon.
Aleyrodes citri on ponderosa lemon and otaheite orange.

From Pennsylvania—

Chrysomphalus aurantii on kentia palms.
Pseudococcus longispinus on dracæna palms.

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MRS. N. MITCHELL	Stenographer

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California
State Printing Office
1914

VOLUME III No. 6

THE MONTHLY BULLETIN

The white-lined sphinx moth, *Celerio lineata*, which is proving to be a serious pest in several localities this year. (After Riley.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA JUNE, 1914

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STATE COMMISSION OF HORTICULTURE

June, 1914

THE MONTHLY BULLETIN

VOLUME III No. 6

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

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1914

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THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

June, 1914.

REPORT OF INVESTIGATION OF THE FRUIT-FLY SITUATION IN THE TERRITORY OF HAWAII

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, Cal.

In pursuance of instructions received from Dr. C. L. Marlatt, Assistant Chief of the Bureau of Entomology in charge of citrus fruit investigations, and with the consent of Dr. A. J. Cook, the State Commissioner of Horticulture for California, and working in conjunction with both of the foregoing departments, I proceeded to the territory of Hawaii on October 22, 1913, for the purpose of investigating the present status of the Mediterranean fruit-fly situation in all of its several phases, and with special reference to the results and value of the clean culture campaign in force at Honolulu, as viewed from the mainland standpoint, and of its bearing upon retarding the possible introduction of the fruit-fly into California, and the United States in general. As a result of this investigation, the following is respectfully submitted as a report of the findings:

CLEAN CULTURE CAMPAIGN.

Organization.

What is known at Honolulu as the clean culture campaign was originated by the Territorial Board of Agriculture and Forestry under the management of W. M. Giffard. Later California made an appropriation for cooperation in the work, and H. A. Weinland was detailed to represent California in the Islands and took charge of the operations. Finally, the United States Department of Agriculture assumed control, Dr. E. A. Back, as agent, taking charge in September, 1912. At the time of my visit the workings of the clean culture campaign had been in continuous operation for a period covering approximately thirty months.

System.

The plan of operations was admirably conceived at the inception of the work, and great credit is due to Mr. Giffard for the thoroughness with which, under the peculiar circumstances, most of the details were originally provided for. The territory under supervision was divided into eight districts, and these again into twenty-four precincts. A map showing the boundaries of each of the precincts, together with the subdivisions and owners of the same, is on file for reference in the central office now in charge of Dr. E. A. Back, representing the United States Bureau of Entomology. A remarkably complete system of records of the progression of the work has been kept compiled from the inspectors' daily reports, and these have enabled the management to keep in intimate touch with the conditions of the food plants

of the fly throughout the entire district. This system as originated was continued and developed by the agent representing California during the period of his incumbency, and was taken over, extended and further developed in many of its details by Dr. E. A. Back upon his assuming control of the work, and it was being diligently pursued in all of its details at and during the time of my investigation.

Force employed.

Inspectors ranging in numbers from seven to eleven, and averaging nine for the season, have been kept continuously at work patrolling the precincts allotted to their charge and have occupied themselves in seeing that all infested fruit upon the ground was gathered up and destroyed. In some instances they have removed from the trees and caused to be destroyed all fruit showing evidence of attack by the fruit-fly and before the same had time to develop. This means that all fruit coloring up or maturing has to be removed. Any and practically all host fruits remaining on the trees until the same are sufficiently matured to have a commercial or an edible value, even after all of the drastic measures employed during the past thirty months, are found to be infested with the eggs or larvæ of the fly. To the workings of a practical mind—recognizing that all is ultimately destined to attack—it would appear as a better policy to remove the entire crop of fruit from the tree at one operation. However, the present system has one feature of local interest in that it furnishes continuous employment for the inspectors.

Territory covered.

The area embraced within the confines of the clean culture district includes all of the city of Honolulu and its environs. There are no commercial fruit orchards in this area, and the work of attempted control of the fruit-fly has been confined to the fruit, berries and nuts growing on the house lots and unoccupied lands within these limits. The infinite variety of food plants of the pest under consideration found within this area is equalled only by the remarkable number of racial types that occupy either as owner or tenants the premises upon which these same host plants are growing. These are factors that have proven insuperable obstacles to successful control, even in the policed district; continuous period of maturing of fruit on one hand, and indifference, often antagonism, to prescribed regulations and sanitary measures on the other.

But little if any supervision or attempts at control have been directed towards the hosts of the fruit-fly in the vegetable gardens or truck farms. The greater portion of all the fly-infested material that has reached the mainland and been detected and destroyed before leaving the docks, since the inception of the clean culture campaign, has consisted principally of hosts grown in the vegetable gardens and other localities not covered by the inspection system maintained in the past or in force at the present time, and is here offered in support of the statement that the clean culture campaign has not reduced the amount of infested material arriving at the mainland.

No attempt whatever has been made to control—by mechanical means—the fruit-flies in the wild areas; in fact, it would be farcical to make any such attempt. The wild guavas abound on the inaccess-

ible mountain sides, on the lower slopes adjacent to the cultivated grounds, on the inland plain, and the fruit is generally attacked and infested by the fly. In the Nuuanu and Manoa valleys I found large areas of wild guava trees within a stone's throw of the outer edge of the district in which clean culture regulations had been enforced, and found both eggs and larvæ of the fruit-fly in guavas upon the trees and on the ground in these same locations. It may as well be recognized and accepted as a fact now, as at any future time, that the Mediterranean fruit-fly is ubiquitous on Oahu, with abundant natural resources for the reproduction of its kind, and it is not to be denied the opportunity of increasing and multiplying by the application or enforcement of any regulations or mechanical means employed upon a defined or restricted local area.

Present conditions in clean culture area.

In company with Mr. Maxwell, who has charge of the inspection force engaged in enforcing clean culture regulations, I visited many different parts of the area that has been under continuous supervision for the past thirty months. Within this area I had no difficulty whatever in finding specimens of the following hosts infested with maggots: Oranges, Chinese oranges, grapefruit, coffee, cultivated guavas, kamani seeds, carambolas, betel nuts, in fact, wherever a host fruit was found approaching maturity it was invariably found to be infested, and it is a further fact that despite all the enforcement of regulations ripe host fruits were common in the area under supervision.

General opinion as to results obtained and value of clean culture.

From those most competent to judge, I diligently sought expressions of opinion as to the results and estimated value of the work, and while I am withholding the names of those with whom I conferred, the statements obtained were practically all to the same point, that the clean culture work, taken in all of its different phases, had at certain periods reduced the number of flies present in particular localities, but had not in any sense maintained a control or saved the fruit from attack, and could not be considered as of any permanent value.

Having had an extended experience in cleanup work for insect pests, and particularly in connection with such work when applied to municipal conditions and environment, I was prepared to look clearly into the many factors that have entered into this problem, and feel justified in making the statement that the work was well planned and has been diligently pursued at all times since its inception, but there were natural features and physical difficulties always present that made successful local control of the fruit-fly impossible. As to the multifarious details of the campaign which have made justifiable the conclusions herewith drawn, they will no doubt be recorded in their proper place and form by those whose patient, diligent and conscientious work has made such a record possible, and it is not the purpose of this report to anticipate in any way the official record of these proceedings. Suffice it to say that from my personal study of these records and from my observations of the actual conditions here on the scene of action, I am of the opinion that as an experiment pure and simple the clean culture campaign has been a success, in that it

has demonstrated clearly to all concerned the futility of attempting to control the Mediterranean fruit-fly or its ravages by the application of mechanical means; and further, that the money expended for this purpose has not reduced the amount of infested material detected upon its arrival at the mainland.

EXPORT BANANA SITUATION.

As a premise I wish to state clearly that I was much comforted—immeasurably so—by the conditions I found governing the acceptance for shipment of bananas from the various plantations on the Island of Oahu. It is doubtful if full credence would be given to a plain, simple relation of the ordinary facts in the case as I found them.

Growers and acreage.

The banana crop destined for export to California is grown almost exclusively by Chinese. There are a few but very rare exceptions in which bananas are grown for export by Japanese and Hawaiians.

It is very difficult to obtain even an approximate estimate of the acreage, due to the irregularity of the small patches in some of the districts, but in the aggregate 280,000 bunches of bananas are annually sent from Honolulu to California. These are grown in eight districts located in different parts of the Island of Oahu, and the methods of cultivation are governed by the conditions obtaining in each different locality.

Present condition of plantations.

I am unable to record what progress has been accomplished in the matter of improving the general conditions of the banana plants in the field, as having no knowledge of the original conditions existing before clean-up work commenced, I have no standard of comparison by which to judge. In the Kahili district, however, I saw very plainly the result of clean-up regulations. In this district the banana plantations are numerous and of small individual area, and practically each one, as well as the roadsides, are bordered or surrounded by a growth of wild guava. As an additional condition of acceptance for shipment of bananas from this district, each grower is required to cut and keep cut the guava bushes bordering his individual patches of bananas, as well as the guava bushes along the roads upon which he carries or hauls the cut bunches of bananas. This rule is not enforced in any hopes of reducing the number of flies present in the area contiguous to the banana plants, but has been adopted and enforced as a matter of assurance that infested guavas falling from the bushes will not roll in among the banana leaves lying upon the ground and become associated with the material that might be used for wrappers. Also, no bananas are accepted even for inspection from fields in which coffee trees are associated with the banana plants. Control of these regulations is maintained by the use of certificates of inspection, which govern acceptance for final shipment.

Condition of wrapping material.

When a bunch of bananas is cut the individual tree or plant is destroyed. The foliage of the plant is first removed; part of it is used as a protection to prevent the bananas coming in contact with

the soil and part of it as a covering to keep off the sun's rays during the time the severed bunch remains in the field. When the bunches of bananas are carried to the packing shed the foliage is left on the ground in the field until thoroughly dry. It is then gathered and stacked at the packing shed if intended for use as wrappers. I do not think any forms of coccids that may have infested the living plants are alive or present at the time it is used for wrappers, and I was unable to detect any other features that would cause the use of banana leaves as wrappers to be considered objectionable.

When rice straw is used as wrapping material the straw is found in large compact stacks adjacent to the packing sheds, where it had been piled upon receipt from the threshing machines at harvest time. In no instance did I see any freshly cut straw being used, or any trees carrying host fruits of the Mediterranean fruit-fly overhanging or in the immediate vicinity of these straw stacks.

Conditions at packing-houses.

The packing-houses in all of the districts are sheds with two or more sides open, often merely a roof. During my stay in the island I visited the following packing sheds and witnessed the methods employed in preparing the bunches of bananas for inspection: 3 sheds at Moanalua, 5 at Waikiki, 4 at Kawauhapia, 5 at Mokuleia, 3 at Puu Ki, and 1 at Kalouau.

The cut bunches of bananas are carried in the usual Chinese manner from the field to the shed. Each bunch is hung up at a convenient height and a Chinaman with a specially constructed knife removes all the yellow, split or broken, or decayed bananas from the bunch. Following this preliminary preparation, different methods are employed at different sheds to remove all broken leaves, débris, or other foreign matter between the bananas in each hand and from around the main stem. At some sheds the bunches are washed entire, at others each banana is wiped with a cloth, while in some instances brushes of various designs are used.

At all packing sheds the preparation of the cut bunches of bananas for inspection is very painstaking, almost beyond credence until actually observed, and probably could not be maintained with any class of growers other than Chinese.

System and basis of inspection.

The bunches of bananas comprising each shipment are prepared by the grower and placed in a shed for inspection at fixed times.

Each bunch of bananas is handled and inspected individually by a Federal officer. The number passed are counted and inspection tags corresponding to the number are issued at the time to the shipper.

Upon inspection the finding of any bunch failing to comply with prescribed regulations disqualifies that bunch for export. This is consummated as follows: Each commercial buyer employs an expert who inspects the plantation and marks upon the stem of each bunch of bananas that he considers in a fit condition for marketing the brand of his employer with a sharp steel instrument. This brand must be present when the bunch is finally offered for shipment. In case of a bunch of bananas being disqualified for cause by the Federal

inspector, he simply slices the brand off the stem with his knife, and the bunch can not then be exported, but must be sold locally or allowed to decay and its value become lost to the grower. It is largely the knowledge of this possible rejection and loss that maintains the present standard of care and efficiency in the preparation of export bananas for inspection.

Wrapping the bananas.

Immediately following the inspection and passing of the bananas the bunches are wrapped. No mechanical devices are used for this purpose. Banana leaves or rice straw, whichever is to be used, is laid upon the floor of the shed; upon this is spread the newspaper or muslin that is to serve as an inner wrapper, and then follows the bunch of fruit. A few dexterous movements on the part of a Chinaman and the operation is completed. The bananas of each bunch are now protected from the effects of any rough usage that may occur in transit to the market, and in my opinion are also protected from any possible attack of fruit-flies.

Routing and storage.

The entire operation of cutting, cleaning and packing is gauged with a nicety to comply with the date of sailing. Close connections are made, and the bananas are about the last freight to be put into the ships before sailing. Bananas from the Waialua district are transported to the docks in closed cars and unloaded direct from the cars aboard the ships. From Waikiki, Moanalua, Manoa, Kalihi, and Kalouao districts the bananas are hauled in wagons to the docks. No bananas were stored upon the docks during the time of my visit.

Technical work on bananas.

I have the assurance from Dr. E. A. Back that no fruit-flies have been bred from bananas under normal conditions by the agents of the United States Department of Agriculture in a series of experiments that have been continued over a period covering fourteen months, and made with thousands of specimens obtained from the different banana-growing districts situated on the Island of Oahu. This, together with my own observations, has given to me a sense of much comfort and relief concerning the commercial shipments of bananas as a possible means of introducing the fruit-fly into the orchards of the mainland.

No better object lesson of the necessity and desirability of establishing and maintaining Federal supervision of all horticultural products destined for export from Hawaiian ports could be asked for or found than the state of perfection to which the preparation of the commercial banana shipments have been brought by the efforts and skill of the agents now in charge of this work. It has the full endorsement of the buyers, who recognize its true significance, it is now accepted by the growers as a necessary feature of the industry, and to permit the details of the operation to lapse into a state of perfunctoriness as a result of relaxation of the present methods of inspection, or the relegation of the same power into the hands of less interested parties, would be suicidal and should not even be contemplated, much less permitted.

EXPORTS OF FRESH PINEAPPLES.

Location of fields.

The commercial production of pineapples on the Island of Oahu is centralized in three districts: Wahiawa, where the industry originated, is located midway of the central plateau, Waimea, on the north side of the island, and on the east or windward side in scattered plantings from Punaluu to Kaneohe. The product of the fields in all of these districts (excepting the minor export of fresh pineapples) is sent to Honolulu, either by rail or water, and worked up into finished products at the canneries and does not concern the purpose of this report.

Fresh pineapples for export.

These are produced in the Wahiawa district, are cut green and packed in the town of Wahiawa, loaded on cars, hauled direct to the docks at Honolulu and loaded into the ships from the car.

Packing material.

My information upon this phase of the subject was obtained directly from Mr. Thomas, the principal shipper of fresh pineapples, during a visit to his plantation.

Excelsior is used exclusively as packing material, and the same is imported for this purpose from Seattle. The unbroken bales of this material are taken direct by rail from the docks at Honolulu to the packing-house at Wahiawa, as are also the shook from which the shipping crates are made. No old or used material enters in any way into the packing or boxing of pineapples exported in the fresh state.

Conditions of surroundings.

A United States government reservation adjoins and divides the Wahiawa pineapple district. In this reservation are many old pineapple fields that have been abandoned, due to the expiration of the tenure of lease. In these the guava bushes are common, as also upon the surrounding plain. I found eggs of the fruit-fly in guavas in this district and larvæ in strawberry guavas growing in a house yard at Wahiawa. No evidence of the Mediterranean fruit-fly attacking pineapples has been observed by the growers nor recorded by the agents who have been studying and experimenting with this fruit as a possible host under both natural and artificial conditions for some time past.

Inspection or regulations.

No official inspection whatever is made of the fresh pineapples either before or during preparation for export, nor could I learn of any regulations covering the removal or control of host plants of the fly contiguous to the fields or packing sheds. At San Francisco all fresh pineapples destined for points in California are always fumigated with hydrocyanic acid gas before being released from the dock.

FRUIT AND VEGETABLES AS SHIPS' STORES.

Upon this subject I was unable to obtain any positive information whatever. No official appeared to have any knowledge of the extent of this traffic, the source of supply or the methods employed in handling the same. I observed the fruit and vegetables displayed for

sale in the markets closely. The only Hawaiian fruit to be found were the Vi apples, pineapples, bananas, and Kona oranges; all other fruit was of California origin. Vegetables were numerous and of many varieties. From a superficial observation, evidence of the attack of flies was commonly apparent in cucumbers, string beans and peppers, and present but less common on the Kona oranges exposed for sale. I did not see any adult fruit-flies upon the fruit or around the markets at any time during my visit.

Pursuing this matter of ships' supplies, I eventually got in touch with Ah Chew, the Chinese comprador, who has long held and still retains a monopoly of the business of furnishing vessels with fruit and vegetables for use as stores. The conference was not profitable. The Chinaman was subtle and not to be inveigled into any confidences concerning the details of the business, his only point of interest being the possible raising of the embargo placed upon the material by California; all other phases of the topic he dexterously avoided answering. Of one thing only regarding this matter am I confident. There is no inspection or control of this material nor any attempt made to so do by any official in Honolulu. The burden of Ah Chew's song would lead me to believe that the ships are purchasing much less than formerly, but the traffic still prevails to some extent, as was demonstrated by the presence of several host fruits on the menu and tables of the steamer upon which I returned to San Francisco.

The records of the San Francisco station of the quarantine service furnish proof that the fruit and vegetables comprising ships' stores are the most prolific means of bringing the fruit-fly in its immature stages to the mainland. It is held that this material, even if undetected, would never reach the shore, but to those who have intimate knowledge of the entire situation, ample evidence has been furnished that even its association in the ships' vegetable lockers with other articles supplies a means for the undetected transportation of the larvæ or pupæ of the fly across the quarantine lines into areas where reproduction might be possible. It is my opinion that one Federal inspector devoting his time to the supervision of ships' supplies purchased in Honolulu, not for the purpose of detecting infested or attacked specimens but for the prevention of all known host fruits or vegetables from being taken on board, would furnish a far greater source of protection to the producers of the mainland than the combined efforts of the entire force that are devoting their energies to the gathering up and destroying of fruit from which most of the maggots have already escaped as a natural result of impact with the ground upon which it had fallen, and I sincerely hope such a system of control can be brought about.

HORTICULTURAL EXPORTS BY EXPRESS.

There is no official inspection whatever of horticultural products carried by the Wells Fargo Express Company as express matter from any island port to the mainland. From Mr. Williams, the general manager of Wells Fargo Express Company in charge of this business in the islands, and at present located at Honolulu, I learned that the volume of such material offered for shipment is very small indeed. This corroborates our own records at the port of San Francisco.

As a result of advice from the quarantine station at San Francisco to the effect that the Wells Fargo Company as a corporation would be held responsible and prosecuted for violation of the provisions of quarantine regulations in the event of their bringing as carriers to consignees on the mainland any articles against which a horticultural quarantine had been declared, they have adopted and put into practice, for their own protection, the following regulation: All consignors of horticultural products from island ports must provide the express company with a signed duplicate statement of the contents of each package offered for shipment. One of these signed statements is attached to the package and the other filed in the office of the express company. Packages containing specimens of fruit or vegetables included in the list of quarantined articles are not accepted for shipment until the contraband material has been removed.

All such packages are of course opened, inspected and fumigated upon arrival at San Francisco as a matter of added insurance, and the value of the procedure inaugurated by the express company consists of preventing the possibility of mature maggots escaping from infested fruit during the six or seven days of transit, and becoming secreted in the packing material or in the crevices of the container.

HORTICULTURAL EXPORTS BY MAIL.

Certificates of inspection are demanded on plant material offered for mailing at the post office at Honolulu, in compliance with the provisions of Order No. 6675, Postal Regulations. Mr. Ehrhorn and his assistants attend to this matter and make such inspections whenever called upon to do so.

At a conference on November 5, 1913, at Honolulu, and in which Postmaster Pratt, Mr. Ehrhorn and myself took part, it was recognized that dry cocoanuts sent as souvenirs could not be classed under the term "nursery stock" any more so than walnuts shipped as merchandise, and consequently inspection of such was not demanded by Order No. 6675.

In connection with the mail I was, and still am, very much exercised over pertinent remarks made to me while in Honolulu concerning the sending of fruit-fly material through the mails. All of this was hearsay evidence and not susceptible of proof, but the substance of the statements was reiterated in so many instances as to create a feeling that some basis of truth existed for the assertions. Coffee berries in situ appear to be the material that causes this alleged surreptitious transgression of the quarantine regulations. Very few people in the United States have had the privilege of seeing growing coffee. A cluster of coffee berries on the stem as they are coloring up is a thing of beauty, and the desire of friends to enhance their description of the plant by a real sample of the product is reputed to be not only a great temptation, but to some extent a fact accomplished. A coffee twig carrying many berries can be packed in a small compass, and the package bear no external appearance that would elicit at the post office any inquiries as to the nature of the contents; but it should be constantly borne in mind, and every effort

made to give publicity to the fact, that the coffee berry is a preferred host of the Mediterranean fruit-fly. In practically all the house yards I visited in Honolulu I found coffee bushes growing. These were generally located along the fences or dividing line between the lots, and invariably in such instances I found maggots common in the colored berries. No measure can be too drastic, no restrictions too severe, or no punishment too great to be applied to prevent this practice should such ever be proven to actually occur.

It is with such possible contingencies constantly present to my mind that I make a plea for a plan of permanent Federal inspection covering all horticultural exports leaving the territory of Hawaii for the mainland. A menace second only to the actual pest itself is the universally held and very generally expressed opinion that the Mediterranean fruit-fly could not exist even if introduced into the mainland, and that our actions concerning its possible establishment are largely a matter of local hysteria. This feeling in far too many instances that came to my attention has progressed until it has reached the stage of an obsession, and has permeated very deeply into official circles. Recurrent statements satisfy me that the old principle of "Caveat emptor" dominates to a certain extent both popular and official sentiment in the island concerning the matter of minor horticultural exports, and while I am a firm believer in the policy and value of inspection at the point of entry, the gravity of this situation and the contingencies that are at present inseparably connected with it are such as to make imperative Federal supervision of all horticultural exports at the point of origin.

The work of the Mediterranean fruit-fly is the most disgustingly disastrous of any I have met with in the work of half a life time. We have not a counterpart of it in any insect as yet established in the orchards or gardens of the United States. No one of the states in the Union whose horticultural and other industries are directly or indirectly threatened by the constant commerce between the islands and the mainland can make operative any protective or defensive action until the pest or its hosts have reached their borders. The Federal Government is the only power on the mainland in possession of the prerogative to make and enforce such measures as will prevent any host of this pest from leaving the infested territory. An investigation will soon satisfy the legislative powers that no established commercial industry on the islands at the present time would suffer from such action. There is no hope of the pest being reduced to such a point that danger of infestation by unrestricted trade in its host fruits will cease. The mainland will have to remain on the defensive for all time from now on, and this very factor should prove sufficient argument for the foundation of the preventive work on such a basis as will render it immune to the vicissitudes of ever changing local authorities.

PUBLICITY OF QUARANTINE ORDERS.

Outside of the notices posted on the entrances to the docks by the agents of the United States Department of Agriculture, calling attention to the provisions of United States Notice of Quarantine No. 2 (domestic), no other evidence of publicity given to this matter came

to my attention during my stay at Honolulu. Passengers pass freely on to the docks and into the ships carrying with them whatever they see fit. I was not interrogated myself nor were any of my belongings investigated upon entering either the docks, or the vessel upon which I returned, nor did I see any other passengers at the different sailings treated in a dissimilar manner.

It is hardly to be expected that the Hawaiian people, or perhaps even their officials, would advertise or give undue publicity to the grievous calamity that has fallen upon most of their favorite fruits. This will always remain the function and unpleasant duty of the Federal Government.

SEALED BAGGAGE.

There is no inspection whatever of the baggage of passengers leaving Honolulu and sailing for points in the United States on board vessels that have called at foreign ports during the voyage. All such baggage is delivered to the United States customs officials, who, without searching the same, bind it about with a cord and attach a leaden seal. These facts I learned from the customs officer in charge of such work at Honolulu. This same baggage, if found upon arrival at United States ports of entry to have these seals unbroken, is immune from inspection either by the customs or horticultural officers.

In the past it has been argued and the theory held that passengers would not place host fruits of the fly in such baggage, due to the fact that the same would inevitably decay during transit and disfigure, perhaps damage, the other contents of the trunk. Findings at quarantine at San Francisco have proven that certain hosts of the fly carry the larvæ when in such a state of dryness that they may be packed in any material or in any location and carry to the mainland in security. Kamani nuts are the seeds of an exceptionally beautiful ornamental tree; they are also a much preferred host of the Mediterranean fruit-fly. One hundred and five larvæ have been recorded as obtained from the pulp surrounding a single nut. During my visit I found the ripened nuts to be universally infested. A case occurred at quarantine in San Francisco where a quantity of dry Kamani nuts were found in the pocket of an overcoat of a passenger arriving from Honolulu. Upon being questioned he frankly admitted that it was his intention to plant these in southern California. Of their condition he was ignorant. Removal of the dried skin from one of these nuts revealed eleven matured larvæ of the Mediterranean fruit-fly. These same maggots were within twenty-four hours of being planted in the ground among the citrus trees of the San Gabriel Valley. Such findings are almost uncanny; they savor too much of miraculous good fortune, and suggest possibilities that are not pleasant for a quarantine officer to think of.

I have given a good deal of thought to this matter of passengers' pockets, of trunks in the hold and of sealed baggage, in hopes of devising some way of controlling the same. It has occurred to me, and I am respectfully suggesting the same for consideration, that this situation could be greatly improved by devising and putting into effect a simple form of declaration similar to the one employed at

present by the Treasury Department whereby all passengers could be made to set forth all plants, fruits, nuts, and seeds in their possession or in any of their belongings. Such blanks could be supplied en route in the same manner as those now in use, and taken up upon arrival by the horticultural officers. If adopted, a contrast in color from those in use by the Treasury Department would facilitate collection. The use of such forms would not eliminate the searching of baggage; they would serve to make the operation more complete and protective, and I am of the opinion if the danger attendant upon bringing in such material were set forth plainly upon the declaration papers, but very few, if any, would fail to make a faithful statement of all such articles in their possession.

CONCLUSIONS.

The clean culture campaign has not controlled the Mediterranean fruit-fly even in the policed district, nor has it reduced the amount of infested material recorded as reaching the mainland.

The value or not of the clean culture campaign is purely a local problem, and the desirability of a continuance, also provision for its maintenance, is in my opinion a matter for the local authorities to decide.

The melon fly (*Dacus cucurbitæ*) is the source of great financial loss to the producers, and all of its hosts should be included in the list of material covered by the United States quarantine order.

The horticultural interests of the mainland would be far better protected by a Federal supervision of horticultural exports similar to the system in force in the gypsy moth area, than by continuing the clean-up of house yards in Honolulu and its environs.

Every article of commerce between the islands and the mainland, including vessels and persons, constitute a potential danger of introducing the fruit-fly at all times, and the commercial shipments of bananas under the present system of Federal inspection do not constitute a greater danger of infestation than other articles of general commerce.

The question of mail, sealed baggage and passengers' clothing as avenues of entrance open at present to various hosts of the Mediterranean fruit-fly is one of grave importance, and measures looking to the complete control of the same should be devised in such a manner as will withstand any attempt to defeat their legality, and authority given to the horticultural quarantine officers for their prompt enforcement.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent, State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as near as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

The Red-Humped Caterpillar.

The red-humped caterpillar causes considerable destruction to the foliage of the walnut, apple, prune, plum, and cherry. The caterpillar is easily recognized by the coral red hump on the fourth segment. The head is reddish in color, and the body is striped with slender bands of black, yellow and white. There are two rows of prominent black tubercles along the back. These caterpillars are abundant during June, July, August, and part of September. Hand pick the young caterpillars when they are clustered together on one or two leaves if possible. Of course, in large trees this would be impracticable, and it would be necessary to spray the foliage thoroughly with arsenate of lead, five pounds to 100 gallons of water.

The Cherry and Pear Slug.

The pear slug is known to the orchardist as a dark olive green slimy worm, having the anterior portion of the body enlarged. It strips the upper green surface from the leaves, which later turn brown. This insect feeds on the pear, cherry, plum, quince, etc. It is easy to control by blowing lime or dust upon the infested leaves, or by spraying with the ordinary soap and emulsion sprays; also arsenate of lead, four pounds to 100 gallons of water. The latter spray is slower in action, as the slugs must eat the poison to be destroyed. The soap spray is made by first dissolving the soap, preferably whale-oil, in hot water and then diluting it so that it is applied at a strength of one half pound of soap to a gallon of water.

Mites on Deciduous Trees.

Several species of tiny mites attack the foliage on deciduous trees, notably the almond, peach, and prune. The brown mite, which is especially destructive to the almond, is reddish in the young stages and brownish in the adult. It does not spin a web. Infested leaves present a faded-out, spotted appearance. The two-spotted mite spins a web which is easily seen. It also produces a spotted effect on the leaves. It is usually of a greenish color with two dark spots on the body. During the growing season dry sulphur is successful under favorable weather conditions, *i. e.*, when applied when dew is on the trees. The atomic sulphur spray, one gallon of the atomic sulphur to 30 or 35 gallons of water may be used. Lime-sulphur solution during the growing period on deciduous trees is liable to cause injury by burning.

CITRUS FRUIT INSECTS.

The Citrus Thrips.

The citrus thrips are minute, active brownish or yellowish insects. Four species have been recorded an injurious to citrus fruits in the United States. One species, the green-house thrips, causes the surface of the fruit to turn a pale silvery color. Occasionally scarring of the fruit may result. The species known as the citrus thrips proper causes the characteristic crinkling and thickening of the new tender foliage, as well as the marking of the fruit in the form of a ring around the stem-end or down in streaks. Thrip attacked oranges are often forced back into the second and third grades. The insects feed in both the young and adult stages. Their attack is practically limited to the exterior portion of the tree. A. W. Morrill, in the report of the Arizona Entomologist for 1911, mentions the fact that he obtained as good results with lime-sulphur solution, 36 degrees Baumé, diluted at the rate of 1 part to 85 parts of water, as with the lime-sulphur solution, 1 to 85, combined with tobacco extract 40 per cent nicotine, 1 to 1,800. The number of applications will depend upon the abundance of the thrips, and the citrus fruit growers should be able to determine whether or not the thrips are sufficiently abundant to warrant spraying. Use an angle nozzle so as to reach both sides of the leaves and maintain a pressure, if possible, of from 175 to 200 pounds. Thoroughly drench the trees, especially the outer portions.

Diabrotica soror.

Diabrotica soror is a plant-feeding beetle which eats the foliage of a large variety of plants, including the citrus. It is recognized by its greenish color and the twelve black spots on the wing cover. Numbers may be killed by jarring the beetles from the trees into tar or receptacle containing oil in the early morning, at which time they are sluggish, or by poisoning them by spraying the foliage with arsenate of lead, two pounds to 50 gallons of water.

The Citrus Red Spider.

The adult citrus red spiders are tiny reddish mites with eight legs. They are generally found on the under sides of the leaves and are much more common in the interior portions of the trees than in the outer. The leaves infested have a spotted appearance. Mr. J. A. Prizer, entomologist of the San Diego Fruit Company, has found that under certain weather conditions—a night when dew is plentiful, followed by hot days—dry sulphur will produce fine results. Lime-sulphur solution 2 per cent to 2½ per cent strength applied at a pressure of from 150 to 200 pounds is generally used if unfavorable conditions for the dry sulphur exist. Atomic sulphur 6 to 7½ pounds to 100 gallons of water may also be used and is less likely to burn the foliage than the lime-sulphur solution. Spray when the mites become numerous enough to produce injury. In very hot weather it is not advisable to spray unless the seriousness of the situation demands it.

The Longulus Scale.

The longulus scale attacking the orange is similar to the soft brown scale, but is more grey in color, less shiny, and the young appear to be more flattened to the leaf and are more transparent. This scale is causing much damage to citrus fruits in certain parts of the State. This scale has been little affected by fumigation with hydrocyanic acid gas at the time the best results are obtained in black scale fumigation. Mr. Delacourt Kell, county horticultural inspector of the Pomona and Claremont district, has found that the best time to fumigate for this scale is from July 20th to the end of August, using a three-fourths schedule. At this period the scales are in the right stage for killing by fumigation. It must be remembered not to fumigate at a temperature of 70 degrees Fahr. or above.

MISCELLANEOUS INSECTS.

Grasshoppers.

The appearance of the grasshopper is too well known to warrant a description. Growers whose orchards are surrounded by waste lands should, if possible, burn the waste areas over when the young hoppers are plentiful. This should be done at night, for the reason that the insects are practically inactive at that time. The use of the hopper dozer will destroy myriads of the grasshoppers in grain and hay fields. For a description of this machine the reader is referred to page 15 of Nos. 1 and 2, Volume II, of the Monthly Bulletin of the California State Commission of Horticulture, by E. O. Essig. The following by Mr. Weldon is worthy of note:

The Pellucid Grasshopper.

(*Camnula pellucida* Scudd.)

On May 18th the writer made a trip with County Horticultural Commissioner Vaile of Ventura County to investigate grasshopper injury to beans and beets on property of the American Beet Sugar Company, near Oxnard. The hoppers, which were identified by Mr. E. O. Essig as the above species, were found to be migrating from hilly pasture lands where the feed was getting scarce into large fields of the aforementioned crops. Many of the hoppers were winged, and during the heat of the day would rise a few feet from the ground and fly very rapidly toward the cultivated fields. Had it not been for promptness on the part of the beet sugar company in applying a remedy great devastation would no doubt have resulted. The remedy applied was a bran Paris green mixture after a formula, slightly modified, recommended by the Kansas Department of Entomology. Such excellent success was attained in the work of destroying this pest that the formula exactly as they used it follows:

Bran	50 pounds
Paris green	3 pounds
Lemons	10 fruits
Syrup	3 quarts
Water	5 gallons

The method of preparation as recommended by Geo. A. Dean, Entomologist of the Kansas State Agricultural College and Experiment Station, is as follows:

> "Mix the bran and Paris green thoroughly in a wash tub, while dry. Squeeze the juice of the oranges or lemons into the water, and chop the remaining pulp and the peel to fine bits and add them to the water. Dissolve the syrup in the water and wet the bran and pour in with the mixture, stirring at the same time, so as to dampen the mash thoroughly."

This should be scattered about while moist where grasshoppers occur. It is claimed that the addition of lemons is a great advantage in that the mixture is rendered more palatable to the hoppers. In the case of the work being done by the American Beet Sugar Company there seemed no doubt of this fact, for the poisoned bran, even when dry, was eaten ravenously. By placing poison about the fields wherever hoppers were entering from the pasture lands complete control of the situation seemed to result. The ground was covered with dead hoppers in the vicinity of the poison, and here and there where there happened to be a slight depression or a little gully they were piled one on top of another.

The great success attained in the use of this formula prompts us to recommend it to any who may be troubled with the grasshopper pest this season.—*Geo. P. Weldon.*

Hop Aphis.

To the hop growers the hop aphis is a well known insect. It is pale yellowish-green in color. According to W. B. Parker[1] the hop aphis injures the crop in two ways: by sucking out the juices of the plant and by furnishing a medium for the black smut fungus to grow in. The cone scales covered with the mildew secreted by the hop aphis are soon covered with the black smut fungus, injuring their commercial value. The infestation of the hop aphis retards the plant's growth. The formula consisting of blackleaf 40, 1 to 2000 of water with flour paste 4 gallons to each 100 gallons of the spray is effective. It must be remembered that spraying in spring for the hop aphis the aphids must be hit by the spray in order that they may be destroyed.

The Red Spider on Hops.

The hop red spider is a general feeder on many of our field crops. It is a small reddish or greenish-yellow mite and feeds principally on the lower sides of the leaves, covering them with a fine web. The yellow spots made by the mites in the leaves soon become very numerous after the leaves are infested and later the leaves turn yellow and fall. The spray recommended by W. B. Parker of the U. S. Bureau of Entomology, consists of flour paste 8 gallons to 100 gallons of water. The flour paste is made by using a cheap grade of wheat flour with cold water making a thin batter; use one pound of flour to one gallon water, cook until a paste forms; use in the above proportions.

[1]Bul. No. 111, Bur. Ent. U.S.D.A.

PLANT DISEASES.

Pear Blight.

The bacterial disease known as pear blight continues to be destructive and the work of cutting off the dead and blackened twigs and areas should be continued. At the time the organism ceases to spread rapidly there is a noticeable line separating the dead from the comparatively healthy tissues. In many cases the bark is broken and there is a gummy exudation. Sterilize the wounds and pruning tools with corrosive sublimate 1 to 1000 and cut off the diseased portions below any signs of infection.

Lemon Gummosis.

The work of H. S. Fawcett[1] on the disease known as gummosis of the lemon has demonstrated that the disease is of a fungous nature caused by two fungi, the gray fungus and the brown rot fungus, both of which cause the fruit to rot in the citrus orchard and in the packing-house. The gray fungus causes the killing of the outer layer of bark much in advance of the inner, and in which there is some softening of the bark, while the brown rot fungus causes the killing of the inner bark to lag slightly behind that of the outer and in which the bark remains hard as the area of infection enlarges. Mr. Fawcett has also demonstrated that the best treatment for this disease in the case of the gray fungus is to scrape off the outer dead bark an inch or so beyond the line of visible infection and paint the entire trunk with the bordeaux paste. In treating the brown rot gummosis, cut out the bark an inch or so beyond the discolored line before applying the mixture. The entire surface is then covered with the fungicide. If these areas are treated before infection has spread to any extent much work and money can be saved. Mr. Fawcett also advises the cutting back more or less severely on the side where the bark has been killed if this area is large. The bordeaux paste is made by dissolving one pound of copper sulphate (bluestone) in one gallon of water in a wooden or earthen vessel, two pounds of unslaked lime slaked in one half gallon of water; stir together when cool. This makes a light blue mixture about the consistency of whitewash. The paste deteriorates with age so that fresh mixture should be made every day or so. The paste can be applied with a large brush.

Dodder.

Alfalfa dodder is a thread-like yellowish vine which is parasitic upon alfalfa. Badly affected areas in the alfalfa field should be allowed to dry out for some time, in which case the dodder may often be killed without destroying the alfalfa. Often the dodder infested areas are burned over. It is sometimes necessary to plow up badly infested fields and replant later.

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[1]Vol. II, Monthly Bulletin, State Commission of Horticulture, page 601.

MONTHLY CROP REPORT—MAY.

Compiled from reports sent in by the County Horticultural Commissioners, by Geo. P. Weldon, Chief Deputy State Commissioner.

County	Almonds	Apples	Apricots	Berries	Cherries	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Plums	Prunes	Walnuts
Alameda	60	#	80	100	40	#	#	#	#	#	80	#	#	50	#	40	#
Butte	45	—	50	100	100	100	100	100	—	100	100	100	100	50	#	30	#
Colusa	100	#	#	100	#	100	#	#	#	100	75	75	#	100	#	40	#
Contra Costa	20	90	40	#	30	#	#	#	—	#	100	100	100	25	40	35	80
El Dorado	#	85	#	#	#	#	#	#	#	#	100	100	100	75	75	20	#
Fresno	100	#	90	100	#	100	100	100	100	100	90	90	90	#	#	#	#
Glenn	100	100	90	100	#	100	100	100	100	100	#	100	#	100	#	90	100
Humboldt	#	100	#		90	#	#	#	#	#	#	#	#	60	#	100	#
Imperial	#	#	40	#	#	100	#	#	#	#	#	#	#	#	#	#	#
Kern	#	60	100	#	#	#	#	#	100	100	100	100	100	60	100	85	#
Kings	#	#	120	#	#	#	#	#	#	#	120	120	120	#	#	120	#
Lake	100	100	50	#	#	#	#	#	#	#	#	100	#	40	#	35	100
Los Angeles	100	90	100	100	#	100	75	75	100	85	100	#	100	100	100	#	80
Madera	75	85	35	#	#	100	#	#	100	#	100	100	100	#	#	85	#
Mendocino	#	100	#	100	100	#	#	#	#	#	#	#	#	80	#	70	#
Merced	100	—	75	—	#	100	#	#	100	#	40	40	40	100	100	100	—
Modoc	#	100	50	100	50	#	#	#	#	#	25	#	#	50	80	75	#
Monterey	50	50	125	100	25	#	#	#	#	#	#	#	—	70	25	40	#
Napa	50	90	25	100	25				—		90	90		30		25	
Nevada	100	100	100	100	75	90	#	#	#	100	125	#	125	90	100	75	100
Orange	#	80	85	100	#	#	100	100	100	90	#	#	25	#	25	#	60
Placer	25	60	#	100	70	#	#	#	75	75	90	#	90	80	60	#	#
Riverside	100	60	95	#	90	#	100	90	100	80	90	95	#	#	#	#	100
Sacramento	30	100	90	100	85	#	100	100	100	100	90	#	90	75	80	20	#
San Benito																	
San Bernardino	#	65	85	#	80	#	95	95	90	85	90	90	90	65	100	#	100
San Diego	#	80	#	#	#	#	90	25	60	85	#	#	70	#	#	#	#
San Joaquin	30	#	75	#	50	#	#	#	#	#	100	100	100	40	75	30	#
Santa Barbara	#	100	100	#	50	#	#	100	100	100	#	#	#	100	#	#	60
Santa Clara	#	60	80	80	40	#	#	#	—	#	80	80	80	60	—	35	—
Santa Cruz	#	70	100	85	20	#	#	90	#	#	#	#	—	85	—	—	#
Shasta	100	90	#	90	#	#	#	#	100	#	90	90	90	90	90	25	#
Siskiyou	—	80	95	90	80						—	—	—	60	—	—	—
Solano	60	#	25	#	#	#	#	#	#	#	90	90	90	25	80	40	#
Sutter	75	100	85	100	75	100	—	—	100	—	50	75	—	85	100	75	—
Sonoma	30	80	50	100	25	#	#	#	90	#	90	90	90	100	75	30	90
Stanislaus	100	90	100	100	100	75	#	100	100	100	90	90	90	75	75	75	100
Tehama	100	100	5	100	#	#	#	#	—	—	#	80	60	50	#	50	#
Tulare	100	90	9	100	#	100	100	100	100	100	100	100	100	90	90	60	#
Ventura	95	100	9	#	#	#	90	105	100	80	#	#	#	#	#	#	85
Yolo	65	#	4	#	#	75	#	#	75	#	65	65	75	50	60	40	#
Yuba	70	70	4	100	50	100	—	—	100	100	60	75	60	75	70	50	—

Figures in table indicate condition of crop in per cent on the basis of 100 as normal.
means that crop is not grown sufficiently in a county for a report.
— means that the county horticultural commissioner has insufficient information for a report.
All blank spaces indicate a failure on the part of a county horticultural commissioner to report in time or in the required form.

INSECT NOTES.

The twig borer, *Polycaon confertus* Lec., was noticed during the past month in large numbers, boring in the smaller twigs and branches of the California buckeye, *Æsculus californicus.* So many were found feeding on the buckeye that it seems quite probable that this is one of the adult insect's favorite native host plants and doubtless from this has spread to the cultivated fields. The work of this insect was noticeable, also, in prunes and pears, many of the small branches bending over and dying at the point of entrance.—LEROY CHILDS.

The larvæ of the brown day moth, *Pseudohazis eglanterina,* were collected on two species of willow, wild blackberry, wild grape, wild rose and prunes in Sacramento and Yolo counties during May.—E. J. BRANIGAN.

The frosted scale, *Eulecanium pruinosum* (Coq.), was found in great numbers in Contra Costa County infesting walnuts. The scales in many instances were so numerous that they completely shingled the branches. *Comys fusca,* the common parasite of the apricot scale, was noted parasitizing these to some extent.—LEROY CHILDS.

The oak moth, *Phryganidia californica* was abundant on live oak and water oak at Palo Alto, California. It was also collected in Yolo County, but was not so plentiful.—E. J. BRANIGAN.

The fruit-tree leaf-roller, *Archips argyrospila* Walker, was noted May 19th in both the pupal and adult stages on the foliage of cherries near Walnut Creek, California. No larvæ could be found on this date.—LEROY CHILDS.

During May *Hemerocampa vetusta* was collected in Santa Clara, Napa, Alameda, Yolo, Sacramento, Yuba and Butte counties on the following host plants: two species of oak, the plum, cherry, hawthorn, apricot, apple, pear, prune and blackberry.—E. J. BRANIGAN.

The cherry slug, *Caliroa cerasi* Linn., was just beginning feeding operations upon cherry foliage in various localities about the bay region during the week of May 17th. The slugs at this time were very minute, shining black creatures.—LEROY CHILDS.

At Walnut Creek an interesting infestation of *Icerya purchasi* Mask., *Eulecanium cerasorum* Ckll. and *Eulecanium pruinosum* (Coq.) was observed. Many of these large scales were found side by side upon the branches of the native California black walnut.—LEROY CHILDS.

Catabomba pyrastri and *Syrphus americanus* Wied., two very conspicuous syrphid flies, were found at Walnut Creek feeding in countless numbers on both the walnut aphis, *Chromaphis juglandicola* (Kalt.), and the prune aphis, *Hyalopterus arundinis* Fab. Syrphids are extremely common this year in all localities and have been of much benefit in destroying many of the injurious plant lice.—LEROY CHILDS.

Irbisia brachycerus Uhler was observed feeding in large numbers in the prune and olive orchards, also in the bottom lands feeding on the undergrowth of weeds, etc., in Alameda, Sacramento, Santa Clara and Butte counties.—E. J. BRANIGAN.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy Commissioner of Horticulture.

Report of the State Board of Horticultural Examiners.

Since the last report the following men have qualified for the position of county horticultural commissioner in the counties named:

Sonoma County:
O. E. Bremner.[1]
A. R. Gallaway.
W. J. Newcomb.

San Benito County:
Leonard H. Day.

Inyo County:
A. A. Brock.

A. J. Cook,
Thos. F. Hunt,
Harry S. Smith,
State Board of Horticulture Examiners.

NOTES ON OLIVES IN TEHAMA COUNTY DURING 1913-1914.

By Chas. B. Weeks, County Commissioner of Horticulture, Tehama County, Cal.

At the present time the olive is looked upon as a very promising crop in the upper part of the Sacramento Valley, and many people are on the lookout for all the available information regarding the soil, varieties and cultural methods necessary to make olive growing profitable.

With us the old theory that any soil is good enough for olives has been killed for good, as the very best soil obtainable will give correspondingly good results with olives as any other horticultural products; however, very good results have been obtained on land that was of poor quality when irrigation and cultivation were practiced.

Let any newcomer drop into the town of Corning, which is at present the center of olive acreage in this county, and ask three of the prominent olive men of the town what variety to plant. He would be told by one that Mission olives were the best, the next probably would say that Manzanillos were preferable, and the third that the Queen olive could not be beaten. The fact of the matter is that the three varieties mentioned all have their good points and have advantages peculiar to themselves. The Mission is comparatively free from disease, a fairly regular bearer and the best keeping olive when pickled, free at the pit and will stand a bit more frost than the other varieties. The Manzanillo will ripen earlier under the same conditions than the Mission, is large sized and a regular bearer. The Queen is very large and ripens early and is a very good producer. On the other hand, the following faults are found with the above named varieties which make none of them ideal for planting: The Mission is late ripening, which renders it liable to frost danger. The Manzanillo sticks to the pit and is reported to contain an acid that will

[1]Recently appointed commissioner.

rust out the tin containers in which it is sometimes placed in less than a year. The Queen is susceptible to olive knot to quite a marked degree and the fruit is liable to soften after pickling unless very carefully handled. Good returns from all three varieties mentioned have been had this season and future planting for some time to come will consist of these alone.

Three methods of cultivation are practiced: clean cultivation with irrigation; irrigation with alfalfa as a hay crop between the trees, and irrigation without cultivation. By cultivation is here meant anything in the way of working the soil that keeps the tree in a better condition than total neglect. Clean cultivation in the summer proves very satisfactory. Irrigation with the alfalfa keeps the trees and fruit in fine condition, but the fall irrigation necessary to keep the alfalfa from drying the trees out and shriveling the olives will retard

FIG. 72.—Olive orchard at Corning, Cal., showing method of limeing soil. This procedure greatly aids in the handling of sticky soils. (Photo by H. J. Henny Co., Corning, Cal.)

the ripening period, and frost will be likely to get a large part of the crop. The olive being a shallow-rooted tree with the bulk of the feeding roots close to the surface, does very well along ditch banks and in orchards where very shallow cultivation and frequent irrigation is practiced.

Fertilization experiments are being carried on by the H. J. Heinz Company, which, by the way, have an up-to-date olive pickling plant at Corning, but it is too early to say as to the results. Lime is being added throughout the Corning section to many groves (see Fig. 72), with the result at least of putting the soil in a much better mechanical condition than it was before. As no experiments have been carried along for a sufficient length of time to determine the effects on the trees, it is enough to say that the easier working of the heavy soil after an application of lime is sufficient to warrant the expense.

No method has as yet become looked upon as standard as far as pruning is concerned, systems ranging from the tree that is never touched to clipping all of the current season's growth in half as if pruning a peach tree. Some growers go over a tree and remove large branches to admit light, others cutting out small branches of one half inch or so in diameter to attain the same end. As the advocates of each of the above plans are able to advance very good reasons for their methods, I will let this part rest here.

Twelve or fifteen years ago at Corning many acres were planted to all sorts of olives which were mostly undesirable types, which, after grafting over to the better varieties, are making fine orchards in one third of the time that it takes to plant two-year-old trees and

FIG. 73.—Photo of olive tree grafted in March, 1913. The picture shows the tree one year later. (Photo by H. J. Henny Co., Corning, Cal.)

bring them into bearing. There is a marked difference of opinion as to whether budding or grafting is the best method of working over old trees. It is very much easier to secure men who can get a large percentage of grafts to stick than it is to find budders who can get good results. With budding it is necessary to cut the tree back and get new wood in which to place the buds, while with grafting the scions can be placed and started growing the same year the tree is cut back. Bark grafting using pure beeswax is the most satisfactory method.

Good results have been obtained by transplanting trees six and eight inches in diameter, to more desirable locations. Stands of 95 per cent have frequently been obtained, very little care being exercised in doing the work. Large branches are cut back, roots cut off to within 16 inches of the stump, trees pulled out with a team, loaded

on a sled, dragged to the new location and in some cases planted after having been exposed to the weather for 48 hours, in holes sufficiently large to contain the roots without crowding. Within six weeks they have put out a fine new growth.

Olives this season have sold at very high prices. Missions eleven-sixteenth inches and up brought $200 per ton at Corning; Queen olives sold for $200 per ton on the trees. Buyers paid prices ranging from $45 per ton for oil olives to $160 for pickles.

The above statements represent conditions as obtaining in this county for the season of 1913–1914, and are not given as the results of long experiments or extensive observations. The future at present looks very bright for the olive industry, and if prospective olive growers will remember that an olive is not an abnormal freak in horticulture but an orchard tree which requires good soil and intelligent handling to produce maximum results, few will go wrong when planting them.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF APRIL, 1914.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, Cal.

SAN FRANCISCO STATION.

Horticultural imports.		Parcels.
Ships inspected	54	
Passed as free from pests		136,047
Fumigated		2,362
Destroyed or returned		409
Contraband destroyed		11
Total parcels horticultural imports for the month		138,829

Horticultural exports.	Parcels.
Inspected and certified	1,098

Pests Intercepted.

From Brazil—
Aspidiotus lataniæ, *Asterolecanium* sp., and *Cerataphis lataniæ* on orchids.

From China—
Larvæ of weevil in sweet potatoes.

From Florida—
Lepidosaphes beckii and *Phomopsis citri* on grapefruit.

From Hawaii—
Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.

From Japan—
Aulacaspis pentagona on pot plants.
Unidentified fungus on seedling citrus plants.
Pulvinaria sp., on cherry tree.
Unknown fungus, on citrus fruit.
Pseudaonidia trilobitiformis on oranges.
Aleyrodes citri, *Pseudaonidia trilobitiformis*, on orange trees.

From Manila—
Chrysomphalus rossi, *Chrysomphalus aonidum*, *Parlatoria pergandii*, *Parlatoria mangifera*, *Pseudococcus longispinus*, *Cerataphis lataniæ*, *Saissetia hemisphærica*, *Thrips* sp., Lepidopterous larvæ and pupæ, tortoise beetles, red spiders and sowbugs on orchids.

From Nevada—
Heterodera radicicola in potatoes.

From Oregon—
Carpocapsa pomonella (adults) in car containing potatoes.

From Tahiti—
Morganella maskelli and *Lepidosaphes beckii* on oranges.
Icerya seychellarum and *Lecanium* sp. on orchids.

LOS ANGELES STATION.

Horticultural imports.		Parcels.
Ships inspected	25	
Passed as free from pests		92,908¼
Fumigated		27
Destroyed		3¾
Returned		-------
Contraband		-------
Total parcels horticultural products for the month		92,939

Pests Intercepted.

From Brazil—
Pseudococcus citri on maranta.
Ceratiphis lataniæ and *Diaspis boisduvalii* on orchids.

From Central America—
Chrysomphalus scutiformis, Aspidiotus cydoniæ, Aspidiotus cyanophylli, Pseudococcus longispinus and *Pseudococcus* sp. on bananas.

From Cuba—
Lepidosaphes beckii and *Phomopsis citri* on grapefruit.

From Florida—
Lepidosaphes beckii and *Phomopsis citri* on grapefruit.
Chrysomphalus aonidum on jasmine.

From France—
Aphides on cedars.
Coccus hesperidum on camellia.

From Japan—
Aspidiotus lataniæ, Ceroplastes ceriferus and *Chrysomphalus aonidum* on aralia.
Thyridopteryx ephemeræformis on juniper.
Aulacaspis rosæ on rose.
Aphids and Lepidopterous larvæ on maple.
Antonina crawii and *Odonaspis secreta* on bamboo.
Lepidosaphes sp. on aucuba.
Aleyrodes citri on gardenia.
Orthezia sp. on azalea.
Pseudococcus sp. on holly.
Ceroplastes ceriferus, Lecanium sp. and *Aspidiotus* sp. on unidentified plant.

From Mexico—
Lepidopterous larvæ on tomatoes.
Chrysomphalus scutiformis, Aspidiotus cydoniæ, Aspidiotus cyanophylli, Saissetia hemisphærica and *Pseudococcus* sp. on bananas.

From New York—
Coccus hesperidum and *Parlatoria pergandii* on lemon tree.
Schizoneura lanigera on apple tree.

From Nevada—
Heterodera radicicola on potatoes.

From Ohio—
Aleyrodes vaporariorum on greenhouse plants.

From Pennsylvania—
Chrysomphalus aurantii, Ceratiphis lataniæ, Orthezia insignis and *Aspidiotus* sp. on kentia palm.
Coccus hesperidum on lemon tree.
Pseudococcus citri and *Saissetia oleæ* on rubber plant.

SAN DIEGO STATION.

Horticultural imports.		Parcels.
Ships inspected	21	
Passed as free from pests		2,989½
Fumigated		------
Destroyed		2½
Returned		------
Contraband		5
Total parcels horticultural products for the month		2,997

Pests Intercepted.

From Mexico—
Lepidosaphes gloverii on sour limes.

From Nebraska, Missouri and New York—
Crown gall on apple trees.

EUREKA STATION.

Ships inspected 5
No horticultural imports.

SANTA BARBARA STATION.

No report.

OFFICERS OF THE CALIFORNIA STATE COMMISSION OF HORTICULTURE

EXECUTIVE OFFICE.

Capitol Building, Sacramento.

A. J. COOK	Commissioner
GEO. P. WELDON	Chief Deputy Commissioner
E. O. ESSIG	Secretary
LEROY CHILDS	Assistant Secretary
MISS MAUDE HIETT	Clerk
MRS. N. MITCHELL	Stenographer

INSECTARY DIVISION.

Capitol Park, Sacramento.

HARRY S. SMITH	Superintendent
E. J. VOSLER	Assistant Superintendent
E. J. BRANIGAN	Field Deputy
HENRY L. VIERECK	Entomological Explorer
MISS A. APPLEYARD	Stenographer

QUARANTINE DIVISION.

San Francisco Office: Room 11, Ferry Building.

FREDERICK MASKEW	Chief Deputy Quarantine Officer
GEO. COMPERE	Chief Quarantine Inspector
B. B. WHITNEY	Quarantine Inspector
L. A. WHITNEY	Quarantine Inspector
ARCHIE CHATTERLEY	Quarantine Inspector
LEE A. STRONG	Quarantine Inspector
MISS CLARE DUTTON	Stenographer and Clerk

Los Angeles Office: Floor 9, Hall of Records.

A. S. HOYT	Deputy Quarantine Officer
C. H. VARY	Quarantine Inspector

San Diego Office: Court House.

H. V. M. HALL	Quarantine Inspector

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THE MONTHLY BULLETIN

The adult moth of the carpenter worm, *Prionoxystus robiniæ*. Life size. (Photo by Leroy Childs.)

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CONTENTS

STATE COMMISSION OF HORTICULTURE

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VOLUME III No. 7

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

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This pronouncement of the chemists as to the fertility of land, though all chemists now hold a greatly modified view of the relations of the chemicals in a soil to the fertility of the soil, was first vigorously combated by a theory of soil-fertility advanced by soil-physicists. The physicists hold that the quantity of mineral foods in a soil is of far less importance than the quantity of water, and that the cultivator should largely devote his energies to controlling the moisture in the land so that the mineral salts may be readily dissolved and be made available as a plant food. They insist upon the very great importance in soil-fertility of such other physical factors as temperature, aeration and the texture of the soil. The most radical advocates of the physical theory declare that chemical fertilizers are of little or no value for the food they add to the soil.

It seems to an onlooker that the chemists have not sufficiently recognized the importance of the physical condition of the soil in their teaching. At any rate it is now certain that in practice in every field of agriculture, following instructions from chemistry, far too much importance is attached to putting chemicals into the soil and far too little to the physical means of making available for food the unavailable material now there. While many of the differences between chemists and physicists are more suited to controversy than to real practice in soil-fertility, yet much good is bound to come from the discussions now going on between the sciences they represent.

It is not quite a quarter of a century since the writer received instruction in what was called agricultural chemistry. The teacher, a pioneer chemist, gave, or supposed he gave, instruction regarding the fertility of soils. He had received his light from the flood of light which began with Liebig. The instruction ran, in brief, that chemistry could provide for practically all the needs of soil-fertility. To the teacher and student of that day the now important fields of soil physics and bacteriology were wholly arid and unproductive. The centuries old riddle of how leguminous crops fertilize land had then just been solved by the discovery that bacteria, the underworld of life, take nitrogen from the air and store it in the roots of clover, peas, beans and their like. This revelation, one of the most important in all time for agriculture, has been followed in quick succession by one astonishing discovery after another by the bacteriologist. Now it is proved that the earth is literally alive with bacteria—a living earth, not a dead, inert one—an earth teeming with good, bad and indifferent organisms.

Now we are told that not only do bacteria store nitrogen in the roots of legumes but other bacteria change the ammonia formed by the decay of plant and animal matter into nitrates in the soil, thus saving and putting into better form nitrogen which otherwise would have escaped into the air. Still other of the soil bacteria decompose nitrates, setting free nitrogen, which unless combined with the salt of some mineral escapes and is lost. We are taught that the farmer can control the rate of nitrification and denitrification in the soil by drainage, aeration, cultivation, and by regulating the temperature of the soil. Thus, literally, bacteria can be domesticated and set to work at making nitrogen for the farm. As, often, fertility of the soil is determined by the rate at which nitrates are formed, the regulation of the bacteria of nitrification is an important factor in keeping up the fertility of

lands. It becomes very necessary to keep the soil in such condition that bacteria will thrive, and especially to preserve the top layer of soil which, according to present teachings, is literally the cream of the land. The theory that the soil which lies deep needs to be brought to the surface has been given many hard knocks by the bacteriologist for he has proved that the home of bacteria is humus, the débris of decayed organic matter, and surface soil alone contains humus.

Several years ago the supposition arose that soil-sterility is often determined by the excretions of growing plants, which may poison the land for some crops but which may be innocuous to other plants that follow. While there is much to show that plants do give off harmful excretions, or in some way cause soils to become more or less toxic, yet the statement made by some investigators that toxicity is a prime factor in soil-fertility has not yet gained general credence. The importance of toxicity of soils is denied by chemists in particular.

Just now the worldwide audiences in soil-fertility have closed their ears to the arguments of chemists and physicists over their differences to listen to the zoologist who has brought his science into play to solve the problems of soil-fertility. According to the zoologist the few inches of humus-filled crust on the earth's surface is veritably a jungle—a jungle filled with one-celled plants, bacteria, which are preyed upon by one-celled animals, protozoans. Now those voracious protozoans may devour so many of the bacteria engaged in changing the nitrogen of the air and soil into available plant food that their number is lessened to a harmful degree. The predaceous protozoans, however, can be removed by suitable treatment, as by chemicals or heat to sterilize the soil so that the protozoans, but not all the bacteria, are killed. Delivered from the mouths of their enemies, the ammonia-producing bacteria increase with tremendous rapidity and a higher level of soil-fertility is quickly attained. Here at last we have a reason as to why sterilizing the soil, an operation practiced in one way and another since before Christ's time, is beneficial to the soil—another linking of a traditional practice of agriculture with a new discovery in science. The value of soil-sterilization in flower and vegetable-growing under glass has long been demonstrated; it is possible that we shall sometimes use it in the fields in our efforts to increase soil-fertility.

Even more recent than the discoveries of the biological aspects of the soil are those which deal with the phenomenon of adsorption. The classical illustration of adsorption is made by pouring a solution of a dye in a long tube filled with chalk. The dye is separated from its solvent and is held by the chalk, the clear solvent showing at the lower end of the tube. It has long been known that when solutions of minerals are poured on soils, the dissolved salt is adsorbed by the soil particles. One sees at once that the economic use of commercial fertilizers depends largely on adsorption. But the physical chemist has discovered new and even more important phases of adsorption.

It is now well demonstrated that soil particles not only adsorb substances but also exercise selective adsorption whereby the constituents of chemical compounds are adsorbed at different rates. Thus, if Potassium chloride be added to a soil, potassium is adsorbed more rapidly than hydrochloric acid. That is, the soil particles possess themselves of the potassium and the hydrochloric acid reacts with other

mineral bases. Thus not only is the potassium made available to a plant but other substances may be brought into solution to serve as plant foods. Again, if more than one substance be dissolved in water the presence of one of the substances in the solution may affect the rate at which the other is adsorbed. As an example, if kainit and nitrate of soda be dissolved together in water the adsorption of potassium is reduced and less kainit remains in the soil than would have been the case had not the nitrate of soda been added.

I trust that this brief and fragmentary discussion of adsorption at least shows that results of great practical importance are bound to come from further study of the phenomenon. What has been said, too, of the relatively recent discoveries in adsorption may help to demonstrate the complexity of the problems which must be solved before we can fully control soil-fertility.

These lengthy statements introduce you, if you are not already acquainted with them, to some of the problems of soil-fertility. I have sought to show the changing attitude of science and the repetition of discoveries in this phase of agriculture so that no one will think that the problem of soil-fertility is solved, nor hail the latest discovery as possibly the last; that it may be seen more clearly what a complex problem of chemistry, physics and biology the study, to get back to my subject, of fertilizers for fruits becomes; how small a part of the field the few experiments now to be discussed cover; how difficult experimental work with fertilizers is; and how extremely cautious one must be in interpreting results either of experiment or of experience.

I want now to discuss briefly several comparative tests of fertilizers for fruits, made at the New York Agricultural Experiment Station. The first was carried on for twelve years in an old apple orchard in which the trees had practically completed their growth before the experiment began. The soil was a heavy clay loam, fairly typical of the majority of the orchards of Western New York. For twelve years applications of potassium, phosphoric acid and lime were made on an orchard forty-three years old at the beginning of the experiment. There were some slight gains in yield for the fertilized trees, but there were no differences in color or keeping quality of fruit between crops from fertilized and unfertilized trees. Practically, if not strictly in fact, the results were negative. The data showed that it was not profitable to apply potassium, phosphorus or lime to the soil of this Station orchard; that fifty-five years of cropping had not reduced this soil to a condition where it needs a "complete" fertilizer. Stable manure or cover-crops plowed under in this orchard showed beneficial results the same or the next season. It would be an assumption to say which it is, the food or the condition of the soil brought about by the organic matter, or both, that proved beneficial when manure and cover-crops were plowed under.

The second experiment was with young apple trees and began in the spring of 1896. Ben Davis stock set in April was top-worked to Rome Beauty in July, the buds having all been taken from one tree to avoid variations. The orchard was laid off in twelve plats of five trees each. In plats 1 and 6 stable manure was used at the rate of five tons per acre; plats 2 and 8, acid phosphate at the rate of 350 pounds per acre; plats 6 and 10, acid phosphate and muriate of potash, 350 pounds of the first and 200 pounds of the second; plats 4 and 12, the above amounts of acid phosphate and muriate of potash, plus 250 pounds dried blood

and 95 pounds nitrate of soda; plats 3, 5, 7 and 11 were checks. The first application of these fertilizers was made when the trees were three years old and fourteen applications have followed. Tillage has consisted of an early spring plowing and cultivation until about the first of August, followed by a cover-crop of some non-leguminous plant. What are the results?

The orchard bore its first crop of fruit in 1902, trees six years of age, and has borne nine crops since. An examination of the individual records of the sixty trees and of the twelve plats, for the seven crops, shows only negative results.

In any way the data is studied, it is impossible to find a decided benefit for one treatment over another. The nitrogen applied is for the most part lost. The potash and phosphoric acid are stored where "neither moth nor rust can corrupt." The storage, however, of these two food constituents in a soil such as ours, where there are already from fifty to one hundred times the quantities of them needed, is unprofitable business. One might as well "gild gold," "paint a rose," or "throw perfume on a violet."

These are the facts, but facts signify little or nothing unless they fit into a theory. Farm and garden crops on the Station grounds respond to applications of fertilizers. Why do not apples? The answer probably is, that there is an abundance of plant-food in the soil and the apple plant is pre-eminently able to help itself to what is set before it.

That there is an abundance of plant food in most cultivated soil, many chemists now agree. In a wheat field in Rothamsted, England, it was found on land cultivated for centuries and then subjected to 54 years continuous cropping with wheat without fertilizers, that there was still nutriment enough for a hundred or more full crops. Much of this food is not available but it now seems that by the regulation of the moisture and by putting organic matter in the soil whereby we secure the solvent action of humus and of the bacteria that thrive in humus, much of the unavailable plant food in a soil may be made available. How much, it would be an assumption to say, as there seems to be no experiment to prove this point. Indeed, to attempt to prove it would make a problem so complex as to be almost impossible and so variable for different soils as to require a solution for each particular soil. Notwithstanding the lack of definite proof as to how much of the unavailable plant food in a soil may be made available, it may, I think, be safely said from theoretical deductions that the yearly plowing, the continuous tillage, the well regulated supply of moisture and the addition of humus by plowing under cover-crops, have made available the plant food the apple trees in these two experiments needed.

A favorite theory regarding fertilizers used to be (it is still held by many) that the composition of the crop is a good guide to the fertilizer requirements of that crop. Very unfortunately, there have been almost no well conducted long continued experiments to ascertain what the fertilizer requirements of fruits are. In America, there have been less than a half dozen experiments, planned and carried out for more than two years, that by any stretch of imagination could be called fertilizer experiments. Therefore, having no definite data for the apple as to fertilizer requirements, practically all of our recommendations for fertilizing this fruit are based on the differences in the chemical composition of this plant as compared with the composition of grain and

garden crops. But the fertilizer requirements of fruits can not be correctly apprehended by comparing chemical composition of trees, bushes or vines, with those of grain and garden crops, because their habits of growth are entirely different from those of the other crops. These differences in growth need to be kept in mind whenever the temptation arises to draw comparisons between the fertilization of orchards and of fields or gardens. Let us sum up the chief differences.

Trees have a preparatory time of several seasons before fruit-bearing begins: farm and truck crops make their growth, bear a crop and pass away for most part in a single season. Trees begin to grow early in the spring and continue until late fall; few annual crops are in active growth more than half the time that leaves and roots of trees are at work. The roots of trees go much deeper and spread relatively farther than do those of succulent crops. Such data as is at hand seems to show that fruit transpires a greater amount of water in proportion to its leaf area than do most succulent plants, which means that the nutritive soil solution may be less concentrated than for grains and vegetables and yet feed the fruits equally well. Fruit crops are from 80 to 90 per cent water and the leaves for most part remain on the ground; in field crops the product has a much higher percentage of solids and the roughage is not usually returned to the soil. These differences in manner of feeding, and in the crop taken from the ground, to my mind, largely account for the lack of results in applying fertilizers in orchards, while in fields alongside farm crops have abundantly repaid the cost of fertilizing them.

Almost as barren of results as in the apple orchards are experiments carried on with commercial fertilizers for grapes in Chautauqua County, the chief grape region of New York. Fertilizers have been applied in six vineyards on different soils for five years. The results are confusing, contradictory, and unsatisfactory, but from them, in vineyards well tilled, only the use of nitrogen as a commercial fertilizer could be encouraged; phosphorus, potassium and lime were usually wholly inert or so nearly so as not to be profitable.

Seven other experiments, all deciduous tree fruits being included, are under way in different parts of New York, the number of seasons for each varying from one to five. It is too soon to draw conclusions, but the indications are that nitrogen is most often the limiting factor, that phosphorus is only occassionally needed, and that in these New York soils potassium and lime are very seldom needed for fruits.

What conclusions can be drawn from these several experiments? To me they indicate that in orchards and vineyards, if well drained, well tilled, and properly supplied by organic matter from stable manure or cover-crops, commercial fertilizers are little needed. The exceptions will largely be found on sandy and gravelly soils deficient in potassium and the phosphates and very subject to droughts: or on soils of such mechanical texture as to limit the root range of the plants; or in soils so wet or so dry, or so devoid of humus, or so close in texture that soil bacteria do not thrive. These exceptions mean for most part that a soil possessing them is unfitted for fruit culture. There may be some orchards now receiving good care and planted on naturally good soil that require additions of one or possibly two of the chief elements of plant food. Few, indeed, require a complete fertilizer. What these

special requirements are can only be decided by tests with the several fertilizers and are probably not ascertainable by soil analysis. These conclusions are somewhat revolutionary, but I believe that they may be properly deducted from the experiments discussed, that they are substantiated by experiments elsewhere, and that they are abundantly confirmed in fruit-growing experiences.

I can not close without further emphasizing the importance in orcharding of paying attention to all the factors which contribute to plant growth as well as to the supply of food. Such factors as moisture, soil temperature, aeration and the texture of the soil must not be neglected. Any of these, as well as the supply of food, or any combination of them, may be the factor which limits the yield in an apple orchard. Moisture is often the limiting factor, in my opinion most often the limiting factor, carrying away plant foods in open soils and restricting the root run on heavy soils; in either case the plant may starve though food be present, because there is not opportunity for the plant to take up the nutritive solution in sufficient quantity. It is only when the water supply is perfectly adjusted that there can be a fair test of the plant food resources of a soil. The same is true in a lesser degree of the other factors named.

In closing, it is my hope that this paper, much of it contrary to established teachings and practices, has not confused you. Beside giving you briefly the results of several long continued experiments with fertilizers for fruits, I have tried to present as best I could the latest teachings of science for the better understanding of the experiments. The accounts of the discoveries made by science in this field, it is hoped, will show you that fertility is a problem to be solved step by step and not a riddle to be guessed. Lastly, I hope my paper has given you, O happy gift, a desire to know more of the many interacting forces represented in a crop of fruits.

OAK PESTS—THE CARPENTER WORM.

(Prionoxystus robiniæ.)

Order—Lepidoptera. Family—Cossidæ.

By Leroy Childs, Assistant Secretary State Commission of Horticulture.

The California live oaks, as well as poplars, willows, locusts and elms, are in many localities attacked and greatly damaged through the presence of a large lepidopterous larva feeding in the trunks and larger limbs. The pest in question is known in its larval stage as the carpenter worm, so called from the fact that in carrying on its feeding operations it shows utter disrespect for hard plant tissues, where it will be found making great cavities in both the cambium and heart wood. The adult moth is known in many places as the goat moth, so named because of the peculiar goat-like odor that is given off by the insect. From the fact, however, that the adult insects are seldom seen, the former name would appear to be a better one, for many are no doubt familiar with the insect's feeding habits, and the title as given is indeed fitting.

The infestation is for the most part confined to the trunks of the trees, though occasionally, especially in trees which have been long infested, the worms will be found burrowing in the larger limbs

(Fig. 74). The presence of the pest is easily detected, from the fact that the feeding insect is continually shoving out frass from its burrow. From the open wounds the tree also discharges a dark sap-like substance, which discolors the trunk to a large degree. This condition of the bark surface is in itself a very good indication that there are present carpenter worms or some other disturber that should be attended to. In trees where the injury has been present for a period of years

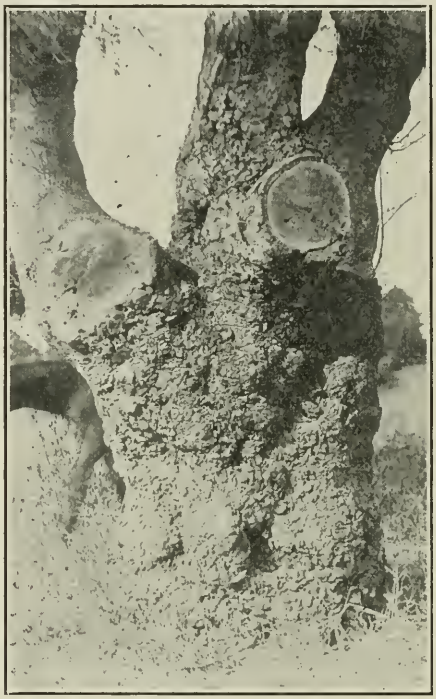

FIG. 74.—A large live-oak nearly destroyed by carpenter worms. Note the characteristic injury to the trunk and also the depth into the heart wood attained by the feeding larvæ, the burrows of the latter showing quite distinctly in the large limbs that have been removed. (Original.)

(Fig. 74) the tree trunks invariably become decidedly irregular and galled from the unsuccessful efforts undergone in attempting to heal over the many small holes.

LIFE HISTORY.

The life history of many insects is often very short, the entire cycle being compassed in a few short days or weeks at best. This is not the case, however, with the carpenter worm. According to the observations of Prof. S. B. Doten of the University of Nevada Experiment Station, nearly three years are required for the development of the larva before pupation takes place, and the emergence of the adult.

The egg. The egg of the carpenter worm is a greenish, elongated body, slightly larger than the head of a pin. The surface as seen under the lens is decidedly rough, being covered with numerous interlacing lines and ridges. The eggs are deposited by the large gray moths in the cracks and crevices of the bark or in any other position offering natural protection by the tree. A scar, the result of careless pruning, is often admirably adapted to the likings of the egg-laying female, for in such places the tender larvæ, upon hatching, can make their way with little difficulty into the cambium. Eggs are often placed, also, near the openings of the old burrows in trees where there already occurs

FIG. 75.—Exit holes of adult carpenter worms through the bark of an oak tree which has been killed by this pernicious borer. (Original.)

an infestation (Fig. 75). When so placed the young worms enter with very little trouble. Prof. Doten reports the egg-laying capacity of the moths as being quite large, as many as 200 or 300 having been counted in various individuals.

The larva. Upon hatching, the young larva feeds in the cambium, just beneath the bark, for some time, and as its mandibles increase in hardness and power it gradually works its way into the heart wood. The developing larva undergoes several moults during this period. In the early stages the general color is that of pinkish white with brown spots at the base of the hairs, which are found in numbers about the body. As the development of the insect continues it gradually establishes itself in the heart wood of the tree. The general coloration changes somewhat as the worm reaches maturity, appearing greenish-white with a shining brown head and powerful, nearly black mandibles (Fig. 76). Pupation usually takes place near the end of the third year

of its life, at which time the worm has reached a length of two and one half inches and a diameter of something more than a half inch. The burrow is cleared of all debris and the broad galleries and halls are lined with a thin coating of silk before the worm goes into the quiescent or pupal state. At this time the external opening of the burrow is capped with a delicate silken web. The worm then moves to the end of the cavity and spins a loose cocoon about itself.

The Pupa. A few days after entering this cell the worm casts the skin, passing into the pupal stage (Fig 76). The color of the pupa is dark brown, with a shining luster. It is about two inches in length, broad at the cephalic end, and tapering to a blunt point at the posterior

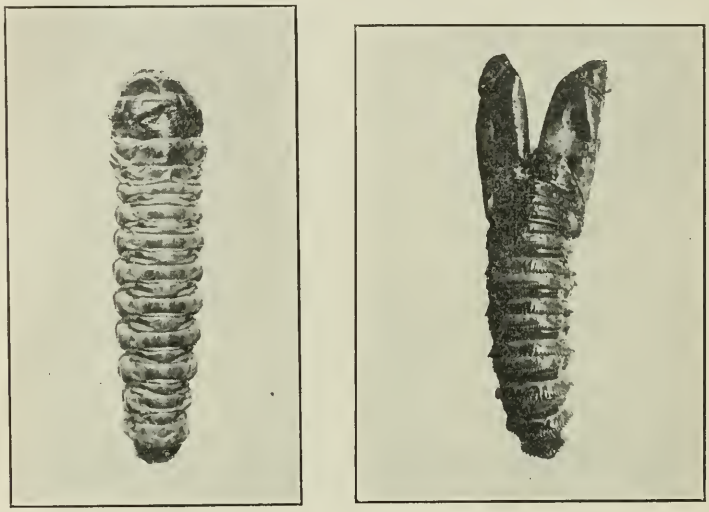

FIG. 76.—Larva and pupa case of the carpenter worm. Note the ridges of spines on the segments of the case; the use of these enables the pupa to work its way from the end of the burrow to the mouth at which point the adult emerges. (Original.)

extremity. On the dorsal surface each abdominal segment possesses a pair of toothed bands (Fig. 76), of which the posterior one is the more prominent. Comstock reports that these are used at the time the pupa makes its way to the opening of the burrow. The oval spiracle openings are very prominent; each abdominal segment, with the exception of the caudal one, possesses a pair. The insect passes about two weeks in this quiescent state, when it wriggles to the mouth of the burrow, continuing until the head and thoracic parts are showing. A split occurs in the pupal covering along the median line on the dorsal and ventral surfaces of this part of the body and the adult insect emerges. Examination of infested trees during the latter part of May and during the summer will reveal these old cases still sticking in the mouths of the burrows.

The adult. The males (Fig. 77) and female (Fig. 78) are quite distinctive in their coloration and size, the female insect being much the larger, with a wing expanse that often reaches three and one half inches. She possesses a uniformly mottled gray color pattern on both

wings and body. The male moth has an average wing spread, in specimens taken, of about two and one fourth inches. The general color is darker than that of the other sex, with the anterior parts of the hind wings colored an orange red, the borders of which are lined with black. The protective coloration is very marked in this species. The gray and brown checks of the wings so closely harmonize with the rough bark of the oak, upon which it will be found while at rest, that the moth is easily overlooked unless a close examination is made. The moths will be found flying throughout the summer.

Distribution. *Prionoxystus robiniæ* has a very wide geographical distribution, being reported from nearly all parts of the United States.

Control. Numerous experiments have been made on the control of this pest, among which have been the trapping of the adults, placing

FIG. 77.—The adult female carpenter worm, natural size. These moths possess a very decided protective coloration and so closely harmonize with the bark of trees when at rest that they are often overlooked by the collector. (Original.)

of repellants to prevent the females from depositing eggs, and the more drastic measure of cutting down the trees. These have all proven of little value in saving trees that were considered priceless by the owners. During the earlier stages in the growth of the larvæ the worms may be destroyed by vigorous prodding about in the burrows with a stiff wire, but later, as they work deeper into the heart wood of the tree a wire is of little use in the maze of winding burrows. To reach these worms in their deep burrows was a problem, and the use of carbon bisulphide was hit upon. Its use has been tried in numerous localities and the results are exceedingly satisfactory, if the solution is applied with proper care and persistence. The author's experiments with this pest in the Santa Clara Valley on infested oaks have shown that seriously infested trees may be saved by the continual application of this volatile liquid.

If the presence of the carpenter worm is suspected in the trunk of the tree, examine carefully and locate all of the burrow openings which, as a rule, will be noted to be partially closed with bits of wood, debris and a damp sap-like material. With a sharp tool cut away a small amount of the burrow down to the living wood (this will afford an opportunity for the tree to quickly heal over the wound caused by the worm). A stiff wire may be employed at this period in the operation, the thorough prodding about of which may kill the worm. The use of the wire, at least, assures the opening of the burrow and will allow the gas to penetrate more readily. With the use of a syringe place a few spoonfuls of carbon bisulphide in the open hole and immediately seal with mud or a sticky clay, which will prevent the escape of the gas. The mud cap should be removed twenty-four hours later and the hole

FIG. 78.—The adult male carpenter worm, natural size. The male is much smaller than the female, and instead of being entirely gray the anterior part of the hind wings have a decided orange-red coloration. (Original.)

allowed to remain open for a few days, during which time, if the worm is not killed by the penetrating gas, more waste material will be found at the opening. In case the worm is still found to be present, duplicate the above procedure. It is often best at this time to slightly increase the amount of the carbon bisulphide in the second dose. Continue this process until the worm is destroyed; assured of this fact, remove all the mud or clay and carefully seal the cavity with grafting wax. This precaution will in a large measure prevent a reinfestation. The use of wax should always be employed during the time that the adults are on the wing.

It is an extremely commendable procedure to remove all the trees of little importance which are known to harbor the pest. In so doing the numbers that take flight are greatly reduced, which will ultimately result in far less numbers of almost priceless trees becoming the host of this pernicious borer.

Host Plants. The following trees have been reported in California as subject to the attack of the carpenter worm: Oak, locust, elm, willow, cottonwood and carob.

THE COMPATIBILITY OF INSECTICIDES AND FUNGICIDES.

Address, California State Fruit Growers' Convention, Davis, Cal., June 1-16, 1914
GEO. P. GRAY, University of California.

INTRODUCTION.

The cost of crop pest insurance by means of spraying is no small burden to most producers, who are often confronted with the necessity of making frequent applications of various remedies to insure their products against the ravages of insect and fungous parasites. At times it must almost seem that if the necessary thought and time were given to the proper application of the appropriate treatment at the right time, little energy would be left for cultivation, harvesting or other necessary operations.

The cost of spray materials is no small item, but is usually insignificant as compared to the cost of application. One way of reducing the latter expense is by combination spraying, that is, by mixing two or more spray materials and applying them together. In mixtures of this sort, grave chemical changes may take place which render the mixture wholly unfit for use. On the other hand, the original ingredients may remain unchanged or may be improved by their new associates.

Numerous experiments have been made to determine the advisability of combination sprays, and the results have been published in the bulletins of the United States Department of Agriculture, the state experiment stations, and in agricultural journals. These reports are scattered through so many publications and the conclusions are at times so conflicting that no inconsiderable amount of time must be spent in a search of the literature to arrive at a definite conclusion as to the suitability of applying some particular remedy in combination with another.

In order to bring this information into more available form and of more easy access, it has been condensed into tabular form and a compatibility table is presented for your consideration with the hope that it will be of some assistance in warning you of obscure dangers that may lurk in apparently harmless mixtures.

COMPATIBILITY TABLE—INSECTICIDES AND FUNGICIDES.

	Fungicides			Contact insecticides				Alkalies	Acids
	Bordeaux	Lime-sulfur	Iron sulfid	Cyanid fumigation	Tobacco	Soaps	Emulsions		
Stomach poisons (arsenical)—									
Paris green	A-1	D	A-1	D	?	D	D	D	D
Calcium arsenite	A	D	A	--------	A	D	D	D	D
Lead arsenate (acid)	A-1	?	A-1	--------	A	D	D	D	C
Lead arsenate (neutral)	A	B	A	--------	A	A	A	A	D
Zinc arsenite	?	D	A-1	--------	A	D	D	D	D
Contact insecticides—									
Lime-sulfur	?	--------	--------	A	A	C	D	C	C
Emulsions	?	D	C	--------	A-1	A	--------	D	D
Soaps	A-1 or B	C	C	--------	A	--------	A	A	C
Tobacco	C or D	A	A	A	--------	A	A-1	A or B	A
Cyanid fumigation	D	A	--------	--------	--------	--------	--------	--------	--------
Acids	D	C	D	--------	--------	--------	--------	C	--------
Alkalies	B	C	D	--------	--------	--------	--------	--------	--------

KEY TO CLASSIFICATION.

A-1 Better results by mixing.
A Properties not changed by mixing. } Compatible.

B Efficient, non-injurious.
C Inefficient, non-injurious.
D Dangerous mixtures. } Incompatible, chemically.

DEFINITIONS.

The word "compatibility" or its opposite "incompatibility" may seem odd as used in this connection, but it seemed to be the best word that presented itself, in the sense to be later described. "Incompatibility or temperament" is a phrase often seen in the newspapers and its meaning may be described as a state of affairs in which trouble is precipitated whenever two opposing tempers come in contact. Incompatibility is the state of being incompatible. In pharmacy, the terms are often used and usually a whole chapter is devoted to the subject in works on the practice of pharmacy. As applied to medicine, incompatibility is of three different types and may be defined as follows:

Incompatible: (1) Chemically—Not capable of being united in solution without liability to decomposition or other chemical change.

(2) Therapeutically—Not suitable to be prescribed together because of opposing medicinal qualities.

(3) Physically—Not suitable to be mixed on account of liability to produce undesirable physical change.

In a broad sense, it seems that the word may be applied to insecticides and fungicides. The distinctions made between the different sorts of incompatibilities as applied to pharmacy might also be applied in a general way to spray mixtures. To avoid technicalities, however, it seems best to divide mixtures of insecticides and fungicides into five classes designated by letters.

CLASSIFICATION OF MIXTURES.

The key to classification is briefly given at the bottom of the table for convenient reference. A little fuller statement is desirable and is as follows:

Class A-1. Compatible. Mixtures in which the chief constituents remain practically unchanged, but are less liable to decomposition after application, or in which an undesirable constituent has been neutralized or rendered less soluble. Mixtures in which the spreading or adhesive qualities are improved are also included in this class.

Class A. Compatible. Mixtures in which no important chemical or physical changes occur.

Class B. Incompatible chemically, but compatible in respect to use ("therapeutically" and "physically"). Efficient, non-injurious.

Mixtures in which important chemical changes occur but the original killing or preventive properties and physical properties are not impaired, and no injurious new compound is formed.

Class C. Incompatible chemically, and also incompatible in respect to use ("therapeutically" or "physically" or both). Inefficient, non-injurious.

Mixtures in which important chemical or physical changes occur and render a part or all of the original ingredients inert, or less active, or physically unsuitable for use, but not necessarily injurious to the host of the parasite.

Class D. Incompatible chemically, and also incompatible on account of injurious properties ("therapeutically" or "physically" or both). Dangerous mixtures.

Mixtures in which important chemical changes occur and render all or a part of the original constituents injurious to the host of the parasite.

NOTE.—It so happens that D stands for dangerous and the table has been so arranged that dangerous mixtures are thus easily recognized by associating the letter which designates the class with the word.

INTERPRETATION OF THE TABLE.

The point must be brought out and strongly emphasized that it is not intended to recommend any particular mixture shown in the table in preference to any other. That is not the purpose of the table. For example: an A-1 mixture is not necessarily a better mixture to use than an A mixture. The comparison is not between the mixtures themselves but is intended to be made solely between the mixture and the original ingredients of the mixture; the classification is intended to show the effect of mixing only. It is seen by looking at the table that a Paris green-Bordeaux combination is classed as A-1 and a neutral lead arsenate-Bordeaux combination is classed as A. This classification is not intended to mean that the first combination is safer to use than the latter, but that the Paris green-Bordeaux combination is safer to use than Paris green alone and that neither benefit nor harm results from the mixing of neutral lead arsenate and Bordeaux.

DISCUSSION OF THE TABLE.

Arsenical-fungicide Combinations.

Bordeaux. Again referring to the table, it is seen that both Paris green and acid lead arsenate are improved by mixing with Bordeaux. This is on account of the excess of lime in the Bordeaux as now commonly made. The lime forms a fairly insoluble compound with the soluble arsenic in Paris green and acts in the same capacity after spraying if any soluble arsenic is formed by the action of the weather upon Paris green or acid lead arsenate. Calcium arsenite can not be improved in this way, as this arsenical is made with an excess of lime and the additional lime of the Bordeaux could not make it more safe to use. No safer arsenical is known than neutral lead arsenate; therefore, no added safety would result by admixture with Bordeaux. Insufficient data is at hand to warrant the classification of the zinc arsenite-Bordeaux combination.

Lime-sulfur. Lime-sulfur is now coming to be a very formidable rival to Bordeaux mixture and the other copper fungicides and is also extensively used as a contact insecticide. Hence it is often desirable to mix this valuable remedy with an arsenical. For this purpose, the choice of arsenicals is limited to lead arsenate and very likely should be entirely restricted to the neutral type. Lime-sulfur is a very unstable compound and is easily decomposed by slight influences, and is especially susceptible to change when mixed with other spray materials. This fact is evident when it is noticed that only two of its combinations are in class A. Its own decomposition products are quite harmless, but its effect on its associates is very frequently of a serious nature. Particularly is this true of its effect upon the arsenite (Paris green, calcium arsenite, and zinc arsenite). The arsenites in general are less stable compounds than the arsenates and are prone to yield soluble arsenic in either alkaline or acidic solutions. The acid lead arsenate is also unstable in alkaline solutions. Lime-sulfur is of an alkaline nature and therefore the various arsenical-lime-sulfur mixtures must all be placed in the dangerous class, with the exception of the neutral lead arsenate and possibly with the exception of the acid lead arsenate under certain favorable conditions.

Instances are known in which acid lead arsenate and even Paris green have been sprayed in combination with lime-sulfur without apparent injury to foliage, but it is thought that cases of this kind are very rare and must have been done under unusually favorable climatic conditions.

The acid lead arsenate-lime-sulfur combination is given a question mark in the table for the reason that many of the reports of experiments make no mention of the type of lead arsenate used. Where the distinction is made, however, the neutral type is favored.

Iron Sulfid. The so-called iron sulfid fungicide is prepared by mixing a solution of iron sulfate with an excess of lime-sulfur solution.

There results a mixed precipitate of insoluble iron sulfid (black), free sulfur (yellowish), and calcium sulfate (white). The excess of lime-sulfur is washed out and there is left a paste of the three precipitates which are quite insoluble and inert toward most ordinary reagents. The iron sulfid is black and is present in sufficient quantity

to mask the presence of the other precipitates. The free sulfur is believed to be the only constituent of fungicidal value, the others being merely incidental to this economical manner of precipitating free sulfur in a finely divided form. The iron sulfid and calcium sulfate also serve to prevent the minute particles of sulfur from flocculating (i. e., uniting to form coarser grains).

From the above description, the iron sulfid being composed of fairly insoluble and inert substances, it may be inferred that this material may be mixed with any of the arsenicals without fear of materially affecting their composition. In some cases, the liability of arsenical foliage injury is reported to be lessened by the presence of the fungicide in question.

Other free sulfur paste preparations. Recently there have come into the market other forms of finely divided free sulfur mixed with deflocculating agents, notably "Atomic Sulphur" and "Milled Sulphur." These two preparations are composed of free sulfur ground to an impalpable powder in the presence of a small quantity of some material to prevent the flocculation of the particles and enough water to form a paste. Sulfur in its elementary form (free sulfur) is insoluble in most liquids except the alkalies and is indifferent to the influence of most of the substances present in the various sprays. The deflocculating agents are in small quantity and are believed to have no detrimental effect. Being of so recent origin, and of the nature of proprietary preparations, these are not included in the table. So far as shown in printed reports and from personal observation, it is thought that "Atomic Sulphur" and "Milled Sulphur" may be used with safety in combination with the different arsenicals.

Potassium and sodium sulfids. (Liver of sulphur, sulphide of potash, soda, etc.) Solutions or fusions of sulfur, in soda or potash lyes, have long been known as efficient fungicides and have been more or less used as dormant sprays. Their causticity has prevented their very wide application as a foliage spray and few attempts are reported to combine materials of this nature with the arsenicals. As noted in the reports that are at hand, however, the results of such combinations have been disastrous, as might be expected, considering the susceptibility of most arsenicals to the influence of alkalies.

Interest in fungicides of this class has recently been somewhat revived through the introduction into the state of a proprietary preparation known as "Soluble Sulphur," offered as a substitute for lime-sulfur. This preparation is very similar in composition to liver of sulfur, the chief difference being that the former is combined with a sodium base while the latter is combined with a potassium base.

From a consideration of the nature of the materials in question, (potassium and sodium sulfids, variously known as liver of sulphur, or sulphide of potash and sulphide of soda; and "Soluble Sulphur") a combination spray composed of any of these sulfids and any arsenical except the neutral lead arsenate would be very injurious when applied to foliage. It is thought that the only possible arsenical to use with these alkali sulfids is the neutral lead arsenate, and even this opinion is not given with absolute certainty in the absence of definite data.

Arsenical-Contact Insecticide Combinations.

Tobacco. So far as known, the various forms of tobacco preparations are compatible with the arsenicals, Paris green being a possible exception. (See tobacco-Bordeaux.)

Soaps. As previously noted in the discussion of arsenicals-lime-sulfur, the arsenites and the acid lead arsenate are all unstable in the presence of alkalies. The alkalies of soaps, therefore, prohibit their use with the arsenicals, except with the neutral lead arsenate, which is not affected by the alkali of the soap.

Emulsions. The above remarks applying to soaps obviously may also be applied to the soap emulsions, with the added danger that the emulsion may be broken and injury result both from the soluble arsenic and the separated oil.

Contact Insecticide-Fungicide Combinations.

Lime-sulfur-Bordeaux. This combination has been used with some success for the control of apple scab, but with more or less injury to the fruit. Definite classification must be deferred until more information is available.

This subject brings to mind a "hard nut to crack" that was sent in to the Insecticide Laboratory in the form of a question by one of the County Horticultural Commissioners. The lower limbs of certain trees had been sprayed with Bordeaux mixture as a check against the brown rot, either just before, or just after spraying with lime-sulfur for red spider. It was noted that if the two sprays were applied within a week or so of each other, a brown deposit was formed on the leaves and twigs where the two sprays came together. It was assumed that the deposit was copper sulfid. Now the question was, whether this reaction would lessen the efficiency, either of the fungicide or of the insecticide.

Questions of this sort are interesting from a chemical standpoint and are of considerable practical moment. Accordingly, the literature was looked over and a few experiments were made and the reply given substantially as follows: "So far as known to the writer, this reaction has not been studied from a chemical standpoint. To predict the products of the combination with certainty seems out of the question for mixtures of such complexity. It seems very probable, however, that a sulfid of copper is one of the products. Under certain conditions, free sulfur, thiosulfates and sulfates of both copper and calcium would also be among the products. A few rough experiments made in the laboratory indicate that variations in the preparations of the two constituents made a great difference in the appearance of the final product. No very definite statement is, therefore, ventured. Various mixtures, loosely spoken of as "copper sulfids" have been made and experimented with by different workers, and they all are said to possess marked fungicidal value.

"It would seem that the two sprayings under consideration would lessen the value of the lime-sulfur by removing some of the sulfur to form new compounds with copper, but that the new copper compounds would be efficient fungicides."

In reply, the propounder of the question wrote as follows: "My field observations have certainly been that the efficiency of the combination against red spider, for which the sulfur fumes are essential, is greatly less than that of lime-sulfur alone. We have not been able to get any definite line on its fungicidal value."

Considerable time has been devoted to the discussion of this topic of lesser importance, but it brings up so many questions of interest that it is hoped the speaker may be pardoned for thus presenting the subject so much in detail.

Emulsions-Bordeaux. A foreign reference is at hand in which this combination is reported to have been used with success.

Soaps-Bordeaux. Soap has been recommended as an addition to Bordeaux mixture to increase the spreading and adhesive qualities of the fungicide. Rosinous soaps are to be preferred as the copper rosinate (insoluble copper soap) is more easily handled by the spray machinery. No injurious effects to the foliage or fruit are to be anticipated with this combination.

Tobacco-Bordeaux. This combination is advised against for two reasons: First, copper is a precipitant for nicotin and it is believed will render the alkaloid inert; second, certain tobacco extracts, containing much extractive matter, may have a solvent action upon the copper of the Bordeaux mixture, and disastrous results may attend its use, from the burning effect of the dissolved copper.

It is quite probable that the above remarks may also be applied to Paris green-tobacco combinations, although it may be that the less soluble Paris green would not be so susceptible to the action of tobacco extracts. Time was not available to determine this point by laboratory experiments in time for incorporation in this paper, nor was this combination mentioned in the reports of experiments made with spray combinations which were reviewed.

General Discussion of Soaps. In order to more fully understand the effect of soaps and soap emulsions upon other spray materials, a little of your time is asked to consider the composition of soaps.

Soaps, as is well known, are made by simple mixture or by boiling together either potash or soda lye with a fat or oil or rosin. We may then consider the composition of the fats and oils rather briefly.

The vegetable and animal fats and oils which are suitable for making soaps are rather complex compounds but for the purpose of this discussion may be considered to be composed of two important constituents of opposite chemical characteristics: (1) Glycerin, which is chemically known as a weak base, and (2) a fatty acid, the kind of acid depending upon the kind of fat or oil.

The lyes used in making soap are strongly basic compounds in which the alkali metal (potassium or sodium) is the base. They may or may not also have an acidic component. Bases possess different degrees of chemical activity and may be strong or weak bases. The stronger bases have the habit of replacing the weaker ones in a chemical compound. Other causes than the above also have to do with the replacement of one base by another, but to take up this would lead us too far from the subject. The potassium and sodium bases are very strong bases while

glycerin is a weak base, so that when the conditions are right, the potassium or sodium of a lye will replace the glycerin of a fat or oil and enter into chemical combination with the fatty acids. Now this is just what happens in the process of soap making. (In the case of rosin, oleic acid, etc., these substances have no base, but are of an acidic nature and will unite directly with the alkali bases to form a soap.) A soap, then, may be considered to be a fat or an oil in which the weak base, glycerin, has been replaced by a stronger metallic base. Now it happens that the only soaps which will dissolve in water are the potassium and sodium soaps. Soaps of the other metals (such as lead, lime or copper soaps) are also readily formed, but these are all gummy, sticky masses, entirely insoluble in water and unsuitable for the preparation of spray mixtures.

Furthermore, if any soluble form of lead, lime, copper, iron or any of the metals except potassium or sodium comes in contact with a dissolved soap, the soap is broken up and an insoluble soap is formed corresponding to the metal—that is, a lead, lime, copper, iron, or other insoluble soap. These soaps of the non-alkali metals, being insoluble in water, form a curd and are of no value as detergents or for spraying.

A familiar instance of this kind is the "curdling of water" when soap is put into hard water. The hardness of water is usually due to some soluble salt of lime or magnesia, and when these come in contact with the soluble soap, the insoluble lime or magnesia soap is formed and is the "curd" of hard waters.

Soaps-lime-sulfur. The "curdling" of hard waters, just alluded to, is precisely the same kind of a change that takes place when soap is added to lime-sulfur solution. An insoluble lime soap is formed that destroys the usefulness of the mixture. Practically all of the sulfur will be thrown out of a lime-sulfur solution by this treatment. The new compounds are not especially dangerous to use, but are apt to clog the spraying apparatus and the sulfur is no longer evenly distributed throughout the liquid.

Emulsions-lime-sulfur. If the emulsion is a soap emulsion, the soap of the emulsion will be broken up, as in the case of lime-sulfur, and the emulsion destroyed, setting free the oil and precipitating the sulfur. There is present the possibility of foliage injury, due to the uneven distribution of the oil.

Soap-iron sulfid and soap emulsions-iron sulfid. These two combinations are incompatible, for much the same reasons as are the two previous ones, but to a lesser degree.

Tobacco-lime-sulfur. Compatible.

Tobacco-iron-sulfid. Compatible.

This completes the discussion of the main part of the table. For convenient reference, however, the general effect of the alkalies and acids upon the various remedies is also indicated and will be gone over rapidly. This part of the table is given with the idea that it may be of service as a warning against some mistakes that might very easily be made, such as pouring lime-sulfur into an "empty" vinegar barrel or working up acid lead arsenate in a pot in which there is left the remains of the last batch of soap

The Effect of Acids on the Fungicides.

Bordeaux. The common acids (with the exception of carbonic acid) dissolve the precipitated copper of Bordeaux mixture.

Lime-sulfur. All acids, including carbonic acid, precipitate free sulfur from lime-sulfur solutions.

Iron-sulfid. The stronger acids dissolve the iron sulfid of the paste, liberating hydrogen sulfid.

The Effect of Alkalies on the Fungicides.

Bordeaux. Excess of the strong alkalies dissolves the precipitated copper of Bordeaux mixture and form new compounds which are suitable for use in many instances, if the necessary caution is used.

Lime-sulfur. Lime-sulfur is broken up by the strong alkalies.

Iron-sulfid. The strong alkalies will dissolve the precipitated sulfur of the paste and form caustic compounds.

The Effect of Alkalies and Acids on the Arsenicals.

All of the arsenites are more or less decomposed by either acids or alkalies, producing soluble forms of arsenic. The acid lead arsenate is unstable in the presence of alkalies, while the neutral form is unstable in the presence of acids.

The Effect of Alkalies and Acids on the Contact Insecticides.

Emulsions. Emulsions are broken up by either alkalies or acids, and the liberated oil may cause injury on account of uneven distribution.

Soaps. More alkali added to a soap will not affect its properties. If injurious effects are produced, it will be from the alkali and not from the change in composition of the soap. Soaps are decomposed by the strong acids. The fatty acids are freed from the base and are no longer a part of the soap.

Tobacco. It is believed that alkalies would have no effect on free nicotin in extracts. Nicotin sulfate, however, would be decomposed by alkalies. The sulfate part of the compound would unite with the alkali and the nicotin would be set free. In this form the alkaloid would be just as active, and probably more so, but would be more liable to loss by volatilization. Acids would have no effect upon the different tobacco preparations.

Spraying, Followed by Cyanid Fumigation.

Paris green, as well as the copper of Bordeaux mixture, is readily soluble in solutions of cyanid. Copper compounds in general form complex soluble salts with cyanids and soluble copper is injurious to foliage. Trees sprayed with any form of copper should not subsequently be fumigated with cyanid without the lapse of at least one year, on account of the solvent action of the cyanid on the copper.

So far as known, there is no danger of this character from the use of the other sprays.

THE NEED OF CHEMICAL ASSISTANCE IN THE STUDY OF INSECTICIDES AND FUNGICIDES.

During the past two years an effort has been made to arrange a card index of the references in agricultural and chemical literature to insecticides and fungicides and allied topics. As a result, many thousands of cards have been collected. But in this collection suprisingly few cards are found referring to articles which discuss the chemical composition of insecticides or their toxic action upon parasites and the hosts of parasites.

The number of references to articles on spraying experiments, when, how, and what to spray, etc., is very large. This work has been done mostly by the entomologist, the plant pathologist, and the horticulturist, whose training and viewpoints are not chemical. The effect of remedies upon parasites and hosts has been carefully observed and this or that procedure has been recommended or condemned, as the result of practical experiences. In many cases, the reasons for a decision concerning the suitability of a remedy have been very obscure and the subject of much speculation. Conflicting results have been very often obtained without apparent cause. The weather, the method, the remedy, and the time of application have all been blamed as the cause of failures. These are doubtless all great factors influencing the success of spraying practice. Chemical advice has sometimes been asked and some of the points elucidated. This advice is frequently given after making some simple laboratory tests without any very extended investigation. The chemist's time and attention is usually well occupied in the investigation of other problems, and his assistance is given by way of making a few determinations to confirm theories, and work of this character is gotten out of the way as soon as possible in order to go on with the regular work.

Of recent years the need of chemical aid has become more and more apparent to assist in the solution of some of the vexing problems that confront the worker in this line of activity. Much of the work incident to the administration of the Federal Insecticide Law, and the insecticide and fungicide laws in operation in a dozen or more states, is of a chemical nature and has created an absolute necessity for a more comprehensive knowledge of the materials which these laws seek to control. And so there are now a few chemists who are devoting considerable time to the study of insecticides and fungicides, and valuable articles are beginning to appear, written from their standpoint. Most of their time must necessarily be devoted to the origination and perfection of methods of analysis, but it is to be anticipated that our knowledge of these important agricultural materials may be greatly amplified and that the valuable work of the entomologist, the plant pathologist, and horticulturist may be supplemented by the work of the chemist.

ACKNOWLEDGMENTS.

No originality is claimed except in the manner of classification and in the arrangement of the table, which is thought to be in the most convenient form for reference. The table is given as being the consensus of opinion found in the published reports of the different experimenters throughout the United States, supplemented by personal consultation with experts in this line of work, and partially verified by investigations

made in the Insecticide Laboratory of the University of California. The information has been collected from so many sources that individual acknowledgments would involve the incorporation of an unwieldy bibliography and could not well be made complete.

Grateful acknowledgment is therefore made to all of the government and state experiment station workers who have contributed a share in investigating these problems, to the county horticultural commissioners, and to my associates who have made valuable suggestions in the classifications.

CONCLUSION.

It must be admitted with chagrin that our chemical knowledge of insecticides and fungicides is yet too imperfect to predict with absolute confidence the results to be obtained from the use of a new material or an untried combination of materials. The final decision must be made as the result of carefully planned practical field experiments.

The table of compatibilities is therefore presented with considerable hesitation for the first time and is offered for your criticism, in order that if any of the classifications are incorrect, or do not correspond with your experiences, the matter may be discussed and the faults corrected.

THE OAK FUNGUS DISEASE OF FRUIT TREES.

Address, California State Fruit Growers' Convention, Davis, Cal., June 1–6, 1914, by Prof. W. T. Horne, University of California.

The oak fungus disease or fungous root rot caused by the fungus *Armillaria mellea*, is a very common and a very serious disease of orchard trees in California. Its most striking characteristics are its marked localization and slow progress. The fungus which causes it probably existed in the roots of wild trees, attacking living roots, but working so slowly that vigorous trees were not killed, and also persisting in the dead wood, causing roots to decay. It appears that many wild trees are infected in nature, and I do not have sufficient evidence to say that oaks are more subject to infection naturally than other trees. Not all roots in the soil are infected, so that we can not say that because an oak tree grew in a given place oak fungus will appear there.

When the roots of a fruit tree come sufficiently near to infected wood in the soil the fungus grows over and attacks the living roots. We must believe that this may happen long after the original clearing, because the fungus will not die out of the soil until the root in which it lives is very completely decayed. It is probable that new infections have appeared ten years after planting an orchard.

The course of the disease is now well understood by fruit growers. Often several trees have died before particular attention was given to the trouble. It was then found that two or three trees nearest those which have died were dying or diseased. The trouble can be recognized with certainty only by an examination of the roots. Usually two or three years will elapse after the first signs of weakening have appeared before the tree dies, and after the first collapse some part of the tree may start up and continue to grow for an indefinite time, finally to be blown over by the wind or to die completely if it does not first exhaust the grower's

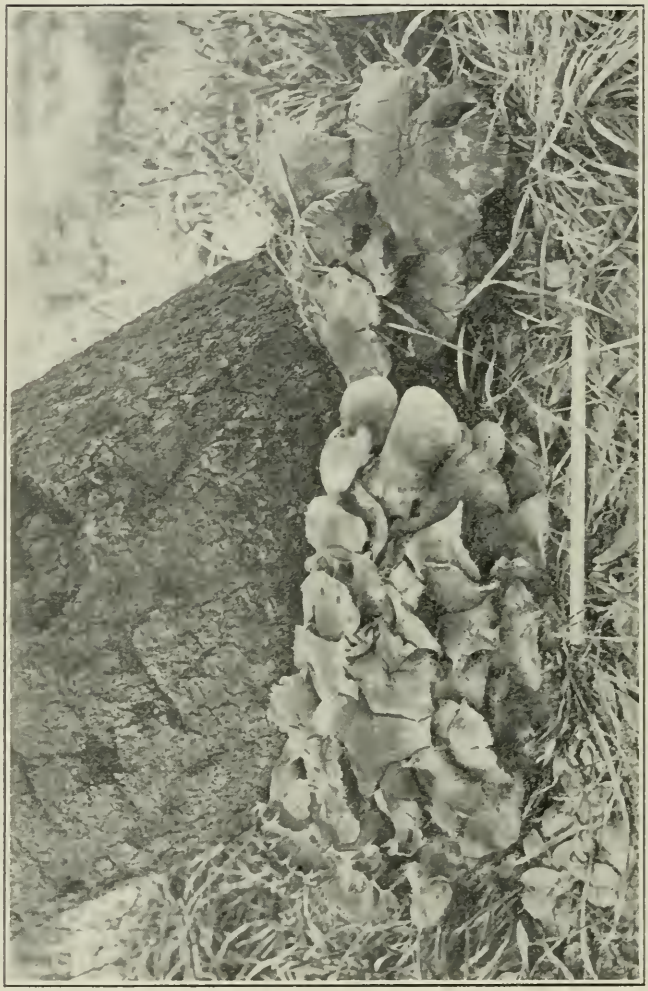

FIG. 79.—*Armillaria mellea*, well developed toadstools about the base of an old oak tree at Berkeley. The rule in front is a centimeter rule (twelve and one half inches long, but owing to perspective effect the tree appears larger than natural. Cracks in the bark at the left show that the mycelium of the fungus is working below the surface.

patience and get pulled out. Two or three years or more may pass before the disease spreads to the next tree. It is thus seen that the rate of spread is slow, but we have maps of spots in citrus orchards fifteen years old where 25 to 30 trees have been lost. In some cases practically whole orchards have been swept over. Some have not been replanted. Others have been replanted, part of the replants living and others dying, so that the result is very discouraging. After the disease has become well established occasional new centers of infection appear. It is believed that probably such new infections arise from a diseased root being carried along, and, before it dries, plowed under near a healthy root. I have picked up from the moist cover-crop a piece of diseased root which had fallen from the cart in which a dead tree was being hauled from the orchard. If this root had been plowed under so as to come near a healthy root the fungus would almost certainly have grown over into the healthy root and in a few years another tree would have died and a new center of infection would have been established.

Toadstools or mushrooms appear during early winter about most of the sick and dead trees. These toadstools may continue to come up on some stumps for at least five years. They are light tan color and are found in large clumps. They arise directly from the diseased roots and are the fruiting bodies of the fungus. White spores are found on them in immense numbers, but probably these spores do not cause new infections in living trees, although we have repeatedly grown them artificially. They might easily infect a decaying stump.

If we examine carefully a root newly killed by this fungus we see that its bark is somewhat puffed and when cut into is soft and moist. By care we can separate it into layers exposing white plaques of fungus, which are soft, felty, and tend to radiate out in fan-shaped bodies. The appearance will vary somewhat according to the kind of tree. The odor is a sharp, sweet mushroom odor and not putrid or sour. Precisely such bodies are found in artificial cultures. Sometimes the bark is cracked and fungus bodies pushed out into prominent ridges which are black on the surface but white below. Roots which have been attacked for some time will be found to have the wood with a white decay working in from the surface. After a time the wood becomes very soft and moist and finally almost completely disappears.

Dark brown to black shining root-like structures coming out of the diseased bark and running along its surface are often found. These are the rhizomorphs; they resemble roots but have a different structure, the center being composed of soft, white fibers. They give the fungus the power to go several inches from one root to another. When the tip of the rhizomorph comes to a healthy root the very small microscopic threads of which it is composed seem to loosen like the cut end of a rope and the individual threads penetrate into the bark and start a new infection.

Treatment for Oak Fungus.

Prevention. It is often recommended to take great expense to get out all roots from new land before planting. Evidently, the fewer roots left in the soil the less chance there will be of infection. However, it is not within the limits of practicability to get out all roots from wooded land. A good practice would be to clear the land, cultivate thoroughly,

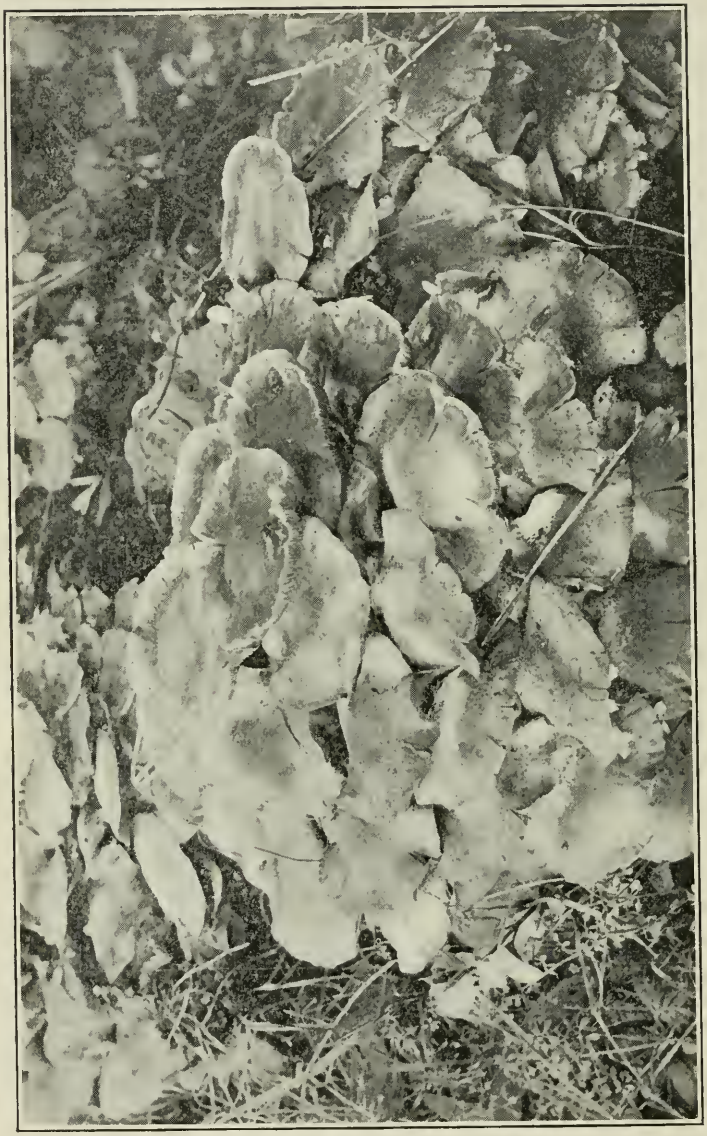

FIG. 80.—Group of toadstools on an old oak stump at Berkeley, showing well developed specimens of *Armillaria mellea*, taken in December. In the lower central part of the picture white spore masses can be clearly seen below the overlapping tops. Three crops of these toadstools have been under observation in successive years on this stump. These have developed under favorable conditions in a very moist time. (Photo by California Agrcl. Exp. Station.)

then keep it several years in alfalfa before planting the orchard. However, in view of the scattered nature of infections and the impatience of planters, it does not seem worth while to insist on such a program.

Treatment of individual trees may have a certain value, but usually will be disappointing and is doubtfully worth while for orchard trees. If the crown of an affected tree is uncovered and by a generous amount of digging all diseased roots are removed, or the diseased bark scraped off and the wood treated as recommended in my paper on wood decays, and the place allowed to dry out well, the remaining roots will grow freely, provided the tree has not been girdled by the fungus. By repeating such treatment and by keeping the crown as dry as practicable, it is entirely possible that a tree may be kept alive for many years.

Treatment of Spots. We have insisted that two problems are involved: 1st, checking the outward advance of the fungus so that new trees will not become affected, and, 2nd, treatment of area already infected.

Treating the margin of the spot has been practiced, I understand, in German forests by digging a ditch about the affected area so as to enclose all the fungus. The fungus travels along the roots and a ditch makes a space which it has no way to pass. We have some experiments under way to test this method. Our orchardists object to an open ditch, so we allowed the ditches to be refilled. One spot ditched was in an orange orchard in good, mellow soil, trees good and more than ten years old. There were two dead trees and two infected at the root but with the tops still fine. The ditch was made 3 to 3½ feet deep, no wider than necessary for digging. It seemed to have cut all the roots. Infected roots could be readily recognized. As finished it was believed that no diseased orange roots crossed outside the ditch. A layer of tarred building paper of good quality was put against one side of the ditch to prevent new roots from crossing back into the diseased area.

After a little more than two years the ditch was reopened. The building paper was worthless for stopping the roots, as they grew through it very readily. The rest of the experiment was highly encouraging. In repeated cases a root from which a piece had been cut out could be recognized unmistakably on the two sides of the ditch. The piece within the diseased area would be in an advanced condition of decay with the fungus, while the end toward the unaffected tree and outside the diseased area would be entirely unattacked and putting out numerous new roots. There could be no reason to doubt that if the ditch had not been made the fungus would surely have followed the root and there would have been no hope of saving the tree. Around this area, which included four diseased trees, no less than five good trees were saved from infection. If once opening the ditch will save the sound trees from infection for two years, there is no reason why the thing can not be done again in the same place and the spot permanently restrained to its present area.

Several points in the work should be noted. In one case unintentionally a diseased piece of root was thrown back into the ditch. The new roots which had grown out from the healthy side had come in contact with this and were already diseased, but this infection had not gone far back toward the good tree. I believe we succeeded in removing all of this infection.

It should be pointed out that many new roots were getting close to the infected areas and would soon have become infected, so that if the ditch is made once and not reopened the trouble will be only slightly delayed and the work will hardly be worth while. Some orange roots which were cut off in working the ditch remained alive in the soil for more than two years and were pushing out growth from the cut end which might have become a leafy shoot. This is an important matter because it shows that a long time must elapse before roots will be entirely decayed in the soil.

Treating the Diseased Area.

Soil sterilizing. Carbon bisulfid. It would not seem to be a difficult matter to find some substance which could be put into the soil and entirely kill everything. Carbon bisulfid is the most promising material thus far suggested. If used properly and in sufficient quantity I feel sure it will do the work. It is simply a matter of studying out the method and counting the cost. I feel rather doubtful if it will be possible to kill the fungus and not kill good roots lying in the soil, because the fungus penetrates into the wood and part of it is deeply buried, while the living part of roots is the cambium layer, just between the bark and wood. The way carbon bisulfid spreads and works in the soil may be illustrated by one experiment. A row of holes was bored with a small soil augur one foot apart and about fourteen inches deep. One ounce of carbon bisulfid was poured into each hole and it was filled and tamped with the heel at once. This row of holes passed just at the edge of the branches of a good orange tree.

After a little more than two months, part of this row of holes was dug out. Roots near the surface of the ground were found dead a little more than a foot on each side of the holes while the deepest roots (less than three feet) were killed nearly three feet from the holes. There was no way to guess how deeply the material was effective but evidently it would be for a good way. Wetting or covering the soil after injecting the carbon bisulphide will probably be more important than the amount used. We have taken a treatment of injecting 1½ ounces at 1½ feet each way as a sort of standard for experimental purposes. I am convinced that the treatment is worthless if the material is injected into dry, loose soil. I do not yet have a precise method worked out which can be depended on, but there is much hope of getting such a treatment in the future.

Ways of utilizing the infected areas are by planting annual crops or resistant trees, if they can be found. Such areas have sometimes been used by well meaning growers for nurseries. The nursery would probably grow very well so far as could be observed, but it will be clear that such planting is highly undesirable. I have found spring replants badly infected the following fall. Of resistant trees the pear is decidedly the favorite in California, and I have no definite data to oppose to this view. However, I understand that the pear is not entirely immune in the states north of us nor east of the Rocky Mountains. Black walnut, cherry, apple and fig probably all possess decided resistance. I can only advise caution in replanting diseased areas with supposedly resistant trees. The strain of heavy fruit bearing and occasional bad seasons may reduce resistance in some cases. I would

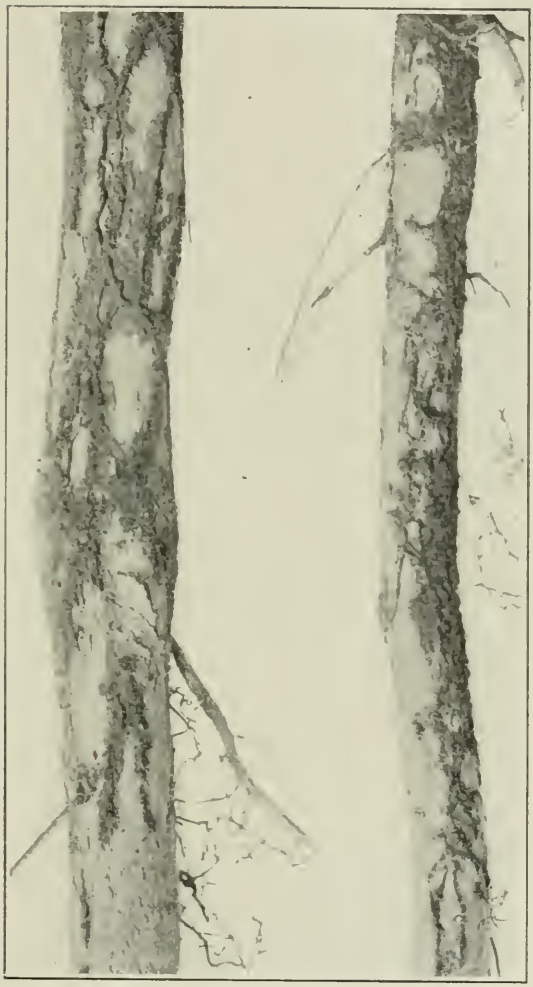

FIG. 81.—Citrus roots being attacked by the black strands or rhizomorphs of *Armillaria mellea*. If the affected roots are cut open the bark will be found to be rotten and filled with white, felty fungus. (Photo by California Agrcl. Exp. Station.)

urge at least that a large hole should be dug and the soil not used to fill the hole but spread out to dry around it and all roots gathered up. The best quality of soil, free from pieces of sticks or wood, should be used to fill the hole in which to plant the trees. The fine roots I believe are less liable to infection than the larger ones, so that in this way resistant roots will be given the best chance to escape infection.

I can not close this paper without calling to your attention that here has been suggested, on the basis of experimentation, one definite way, the ditch method, for stopping the spread of oak fungus disease. The work suggested is not unduly difficult nor expensive and should be practicable under some conditions. We hope in the next few years to be able to suggest treatments more adaptable for large trees, such as walnuts.

In starting in to treat an oak fungus area, first, make sure that the oak fungus is present and that you can recognize it on the roots. A piece of suspected root may be sent to the University if there is any uncertainty. Next, make a map of the area and locate every tree which has the disease and indicate these on the map. Condition of the trees should also be indicated. Then the map can be studied and it can be decided exactly what should be done. I advise deliberation. The problem is one which may take years to solve, but if worked at consistently I believe may be solved in time and without extraordinary expense.

GENERAL NOTES.

EMERGENCY POTATO CONVENTION.

An emergency potato convention will be held in Stockton September 8th and 9th.

In June, 1913, the following was received from official sources in Oregon:

"I am today giving notice to all agents of the Southern Pacific Railroad Company that all shipments of potatoes originating at California points must be held for inspection. This order has been given because a shipment of potatoes from California was found to be infested with the potato tuber moth (*Phthorimæa opercullella*)."

I at once communicated with all of our State quarantine guardians, urging the most thorough inspection of all potatoes shipped to other states. Large shipments of potatoes from California to Washington were also destroyed for the same reason. The Chief Deputy Quarantine Officer of the Port of San Francisco wrote again in October to all State quarantine guardians to take the utmost care that no affected tubers be shipped out of the State. Notwithstanding our efforts, affected potatoes continued to be shipped to northern states and to British Columbia. Later Idaho and British Columbia issued quarantine orders against California potatoes. Other states are contemplating similar action.

We have extensive areas where potatoes are grown. These quarantines are very damaging to our potato growers. Yet as long as we ship infested tubers to other states, endangering their horticultural interests, just so long will we be menaced by these expensive quarantines. Our only protection lies in such absolutely thorough inspection that no infected potatoes will be sent out of our State. I am now awaiting a response from the Attorney General of the State to an inquiry as to the legal authority to require such inspection.

In view of the serious loss that is likely to come to our growers, the emergency convention is called at Stockton September 8th and 9th. The first day will be devoted to visiting the great delta region and inspecting the large plantings. On the 9th ways and means will be discussed whereby the danger and loss may be mitigated. It is hoped that delegates will be present from all potato growing sections of California and from surrounding states.—A. J. Cook.

FORTY-FIFTH STATE FRUIT GROWERS' CONVENTION.

This convention will be held at Los Angeles November 9th to 14th inclusive.

The Davis convention was phenomenal in both interest and value, pronounced by many to be the banner for the whole United States. I have heard only two criticisms: Attendance disappointing, though more than 1,600 were present, over 800 at one time; and too ample a program, its magnitude being bewildering, yet its exceptional excellence was universally conceded.

We are promised 1,000 at the opening of the convention at Los Angeles, and while the program will lose nothing in excellence, for the

most part only one address will be given at one time, and at the most not more than two, possibly three.

Doctor Webber has the assurance that the entire force of the Riverside Citrus station, both of Government and State experts, will be at the service of the convention. Rich results of valuable research work will be announced for the first time. Such able assistance from the United States Department of Agriculture and the University Experiment Station is greatly appreciated by all. Important papers will also be read by members of the staff of the State Commission of Horticulture. Several ladies who have made brilliant records in horticultural lines have promised aid. Special sessions for ladies will be held each afternoon, and women will be generously awarded places on the general program and among evening speakers. Our leading growers, men who have reached highest eminence, will give us their experiences and methods.

The first two days of the convention, Monday and Tuesday, will be exclusively for the county horticultural commissioners, their deputies and inspectors. Each forenoon will be devoted to experience recitals and conferences, the afternoons to addresses from authorities and the evenings to "round table" discussions. The convention proper will hold from Wednesday, November 11th, to Saturday, November 14th, inclusive. The first two days will be given to the consideration of general topics that concern all fruit growers and horticulturists, while there will be divided sessions the remainder of the time, the one devoted to problems concerning citrus production and the other discussing topics bearing on the growing of deciduous fruits.

Will not all county horticultural commissioners, all fruit growers and especially all our editors commence at once and continue to urge attendance upon this convention. It will be a fitting prelude to the great Panama-Pacific International Exposition of 1915.—A. J. Cook.

A LIGHT TRAP FOR CATCHING CUTWORM MOTHS.

Frequent attempts have been made in the past to control night-flying moths, of which there are a number of destructive species, by means of light traps. The various species of cutworm moths belonging to the family *Noctuidæ*, are preeminently night flyers and are readily attracted to lights.

The American Beet Sugar Company, which operates a factory at Oxnard, Cal., and which has extensive plantings of beets in that section, has been troubled to a considerable extent the past season with cutworms. The idea of trapping the moths at night was conceived, with the result that eight such light traps as the one shown in Fig. 82 were used with quite phenomenal success, as far as catching great numbers of moths is concerned, and that their efforts will result in great good can scarcely be doubted.

The trap shown in the picture is constructed of a shallow galvanized iron pan about 4 feet in diameter, set on a platform a few feet above the ground. Over the pan is hung a gas burner enclosed in globe and connected with a tank within the frame, in which acetylene gas is generated.

On the morning of May 18th the moths that were caught in this particular trap were seen, and it was estimated that there were from 1,200 to 1,500 of them.

Another trap, placed on a beet dump with an electric light to attract the moths, is said to have caught as high as 7,000 moths in a single night.

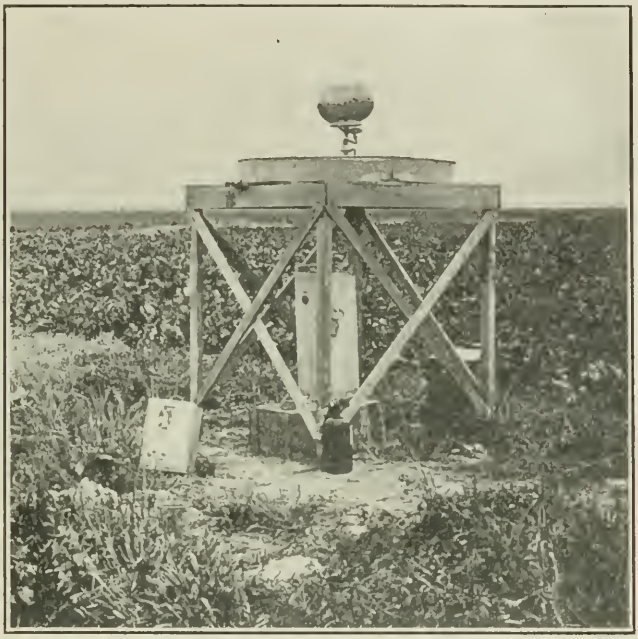

FIG. 82.—One of eight large light traps used by the American Beet Sugar Company at Oxnard with much success in attracting cutworm moths. A pan containing oil is placed below the light into which great numbers fall and are destroyed. (Original.)

According to J. E. Graf most of the moths were the common cutworm species, *Peridroma saucia*.

The abdomens of many of the trapped females were distended with eggs.—GEO. P. WELDON.

MISCIBLE OIL SPRAY FOR FRUIT-TREE LEAF-ROLLER.

(*Archips argyrospila.*)

In Vol. II, No. 9, of The Monthly Bulletin, the writer published an article on the fruit-tree leaf-roller in which the miscible oils were recommended as being very effective in killing the eggs of this pest. The article dealt with experiments that had been conducted in Colorado by Prof. C. P. Gillette and the writer. Since its publication some striking results have been attained in a small way in California. A supply of egg masses on pieces of bark cut from apple trees was secured in San Diego County. Ten such masses, representing at least 50 eggs per mass on an average, were placed in each of a number of test tubes, the contents of some being treated and others left untreated as checks.

The miscible oils used in this case were the two grades manufactured by Balfour, Guthrie & Co. of San Francisco, and known as No. 1 and No. 3. These were used at strengths varying from 1 part of miscible oil to 15 parts of water to 1 part to twenty-four. Treatment was made by dipping pieces of bark and attached egg masses into the solution.

The figure shows two test tubes (Fig. 83), the one above containing ten egg masses treated with miscible oil, 1-20, and below one containing ten egg masses untreated; the tiny black specks in this

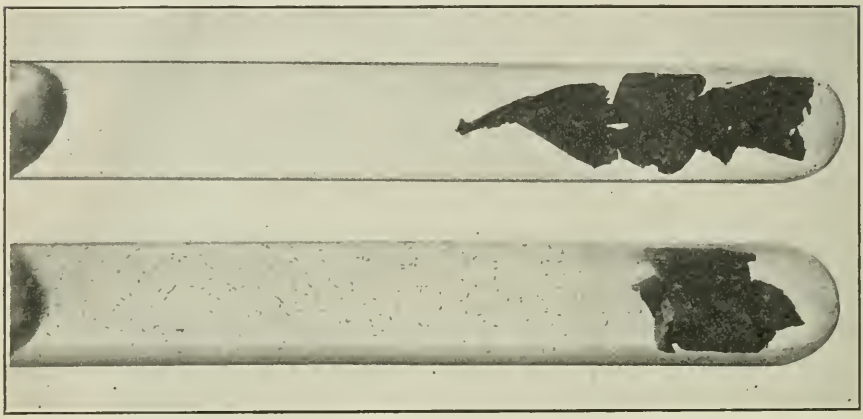

FIG. 83. Test tubes containing egg masses of the leaf-roller. The one above contains ten egg masses treated with miscible oil, 1-20, and the lower one contains ten egg masses untreated; the tiny black specks in this tube are pictures of little worms which hatched freely. (Original.)

tube are pictures of little worms which hatched freely. Eight such tubes were left without treatment and in every case results were the same. On the other hand, six tubes treated with miscible oils presented the same clear appearance as shown in picture, absolutely no larvæ having hatched from them.—GEO. P. WELDON.

QUARANTINE NEWS FROM JAPAN.

The national law to prohibit the importation of all kinds of plants and fruits infested by insect pests and fungous diseases into Japan has been passed by Congress, and the National Quarantines are established at the main ports of entry of the Island Empire. The executive office of the quarantine divisions of the Department of Agriculture and Commerce of the Japanese government is in Tokio, and S. I. Kuwana, the entomologist of Imperial Agricultural Experiment Station at the head of the Federal Quarantine, will direct national quarantine officers and inspectors, who are ready to begin the inspection from July 1, 1914, at the ports of entry already established in Yokohama, Nagasaki, Kobe, and Moji. Mr. Kuwana is a graduate of Stanford University with the class of 1899, and two years later the degree of Master of Arts was granted him from the same university.—S. NAKAYAMA, Stanford University.

THE PEACH TWIG-BORER.

(*Anarsia lineatella.*)

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

In the August number of The Monthly Bulletin, 1913, an account was given of the above pest in hibernaculæ as early as July 4th, at Hanford, Cal. This season on May 19th larvæ were found in freshly constructed hibernating cells in crotches of young peach trees, near Fillmore, Ventura County. Again on June 23d in San Joaquin County near Stockton an abundance of tiny larvæ were found in hibernaculæ. In this case they were in crotches of peach trees which were probably five years of age and upon which there was considerable fruit. These observations indicate the presence of only one strung-out brood of this insect instead of three, or even four, as has been previously reported.

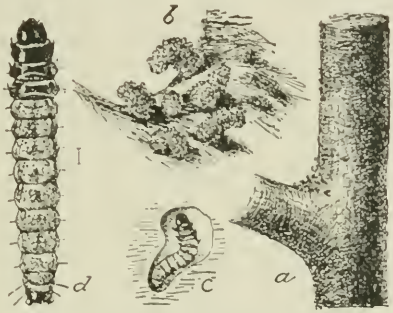

Fig. 84.—The peach twig-borer in winter quarters or hibernaculæ; *a*, twig showing in the crotch minute masses of chewed bark above the larval chambers; *b*, same much enlarged; *c*, larval cell enlarged; *d*, larva greatly enlarged. (U. S. Department of Agriculture.)

REPORT OF THE RESOLUTIONS COMMITTEE TO THE FORTY-FOURTH STATE FRUIT GROWERS' CONVENTION AT DAVIS, JUNE 1 TO 6, 1914.

Through the Forty-fourth California Fruit Growers' Convention the horticultural interests of the State have been presented with the most comprehensive programme covering the different crops and the different activities of the fruit growers that has ever been presented to the State.

Distinguished investigators from other states, as well as from California, have instructed our growers on the most modern and up-to-date methods of horticulture, on handling of insect pests, fungous and other diseases, and on the solution of the most important social and economic problems confronting the fruit grower.

This convention, therefore, desires to express its appreciation to the State Commissioner of Horticulture, Dr. A. J. Cook, for the comprehensive programme presented to the Convention, for his efforts in securing the many distinguished men who have taken part in the discussion, and for the general efficiency of his office, as shown in the handling of this convention and in the various other matters with which he has to deal.

The convention desires to express its appreciation also to the Yolo County Horticultural Commission, Board of Trade, and especially to the people of the town of Davis, and to the College of Agriculture, University of California, for the part which they have played as hosts in entertaining the convention and in furnishing the facilities through which the success of the convention could be accomplished.

The convention also desires to express its hearty appreciation to Dean H. E. Van Norman of the University Farm and to the committee that cooperated with him in handling the details of the convention at Davis.

This convention recognizes the splendid work which is being accomplished by the University of California, in the upbuilding of the College of Agriculture, the experiment stations, both in northern and southern California, and in the various lines of extension work, which the College of Agriculture has carried out to the farmers of the State.

This convention recognizes that the development of the College of Agriculture is the most far-reaching influence in building up a better country life and a better agriculture and horticulture in California.

The convention, therefore, desires to express its appreciation to the University of California, for the work which is being done through its College of Agriculture and its strong approval of the policy which the State has adopted toward a larger development of its agricultural institution.

The convention also desires to express its appreciation to both branches of the legislature and to the Governor of the State for their cooperation in providing funds through which the recent enlargement of the work of the College of Agriculture has been made possible.

The State Fruit Growers' Convention desires to express its gratitude and its high appreciation of the efforts of the speakers who have attended this convention from other states in bringing to our fruit growers their experience gained in other fields of horticulture and in their investigations.

Our industries have been enriched by receiving the information which they have so generously given us. They have contributed suggestions and ideas of the highest practical value and points of view which in their working out will be of advantage to the future development of the horticultural interests of the State.

This convention, therefore, desires to thank the following speakers for the papers and discussions which they have presented to the convention, and to express its appreciation and regard for the personal influence that each has had on the convention.

Dr. A. W. Morrill—Phoenix, Ariz.
Prof. E. D. Ball—Logan, Utah
Prof. P. J. O'Gara—Salt Lake City, Utah
Dr. A. E. Vinson—Tucson, Ariz.
Prof. R. H. Forbes—Tucson, Ariz.
Mr. E. H. Shepard—Hood River, Ore.
Paul B. Popenoe—Washington, D. C.
Prof. O. B. Whipple—Bozeman, Mont.
Prof. C. I. Lewis—Corvallis, Ore.
Mr. C. P. Wilson—Washington, D. C.
Prof. U. P. Hedrick—Geneva, N. Y.
Mr. C. W. Mann—Washington, D. C.
Mr. W. W. Weir—Washington, D. C.
Prof. L. R. Jones—Madison, Wis.
Mr. H. J. Stackland—Kent, Washington

This convention desires to express to the State Commission of Horticulture appreciation of the efficiency of all its departments, including especially the quarantine service, the scientific investigations conducted

by the Insectary Department, the building up of a complete and reliable insect collection for identification purposes, and the publication of timely articles, suggestions, and reports in the columns of the Monthly Bulletin.

This convention desires further to express appreciation of the spirit of complete harmony existing between the office of the State Commission of Horticulture, the County Horticulture Commissioners, the authority of the College of Agriculture, and the fruit growers of the State of California.

WHEREAS, the fruit growing interests of California and other states are continually menaced by the danger of the introduction of serious pests and fungous diseases that are carried on plants in the parcel post;

WHEREAS, on a number of occasions infected plants have been taken from the parcel post in California during the past year; therefore, be it

Resolved, that California State Fruit Growers' Convention, assembled in session at Davis, California, June 1st to June 6th, confer through the State Horticultural Commission with the Postmaster General and the Secretary of Agriculture with a view to determining whether regulations may be adopted that would remove the danger to which the horticultural interests of the State are now subjected.

WHEREAS, the Federal Horticultural Board has recently determined the distributions of certain serious plant diseases with enough definiteness to lead to the establishment of district quarantines; and

WHEREAS, there are other dangerous plant diseases of which the present distribution is not definitely known and which may be so carried with seeds or plants as to be impossible of detection at point of delivery;

Resolved, that this convention declare itself in sympathy with the actions of the Federal Horticultural Board already taken along this line; and further

Resolved, that we respectfully urge the completion of accurate surveys as to the occurence and distribution of plant diseases throughout the nation with especial reference to those difficult of detection at point of delivery; and further

Resolved, that a copy of this resolution be forwarded to the Secretary of Agriculture and the Federal Horticultural Board.

WHEREAS, there is a considerable amount of inferior and adulterated seed imported into California; and

WHEREAS, much good may be accomplished through the enforcement of a pure seed law;

Resolved, that this convention recommend that the committee on legislation appointed at a previous meeting, consider the matter of presenting to the next legislature a state pure seed bill;

Resolved, that this convention authorize the Commissioner of Horticulture acting as chairman to appoint a committee to investigate the state freight rates on manure, and if the facts justify it, to present the matter to the railroad authorities with a view to securing a readjustment of the rates.

WHEREAS, it is proposed that a celebration of the fortieth anniversary of the establishment of the Washington naval orange industry shall be held about the middle of April, 1915, at Riverside, California, where the

industry had its birth and where the two parent trees now are which were sent from the Department of Agriculture at Washington in 1874, and from which all of the others have sprung; and

WHEREAS, in the neighborhood of two hundred millions of dollars are invested in this industry in this State alone, and it is of vital importance to the prosperity and happiness of our people; and

WHEREAS, it is proposed that this celebration shall be state-wide, and more, in its scope and participation; and

WHEREAS, we believe that it cannot fail to be of the greatest benefit to the industry and to the fruit growers of the whole State of California, especially through the International Citrus Congress proposed to be held in connection therewith; now, therefore, be it

Resolved, that we, the fruit growers of the State of California, being assembled in annual convention at Davis, June 1 to 6, 1914, do hereby endorse the holding of said proposed celebration at Riverside, at the time mentioned, and do promise to encourage the same and assist therein to the full extent of our abilities;

WHEREAS, that valuable publication of the office of the State Commission of Horticulture, "Beneficial and Injurious Insects of California" is out of print; and

WHEREAS, the text of a revised and improved edition is now in preparation and will soon be ready for printing; and

WHEREAS, the publication of this revised and improved edition may be delayed through lack of funds; therefore, be it

Resolved, that we express to the State Commission of Horticulture the great value of the above named publication to the horticultural interests of the State and urge that provisions be made for the early publication and distribution of this revised and improved edition of the said "Beneficial and Injurious Insects of California."

WHEREAS, the principal factor which determines the size of the deciduous fruit crop of California is the setting and the subsequent dropping of the fruit; and

WHEREAS, in spite of many opinions and theories, we have no knowledge concerning why one blossom sets fruit which its neighbors do not; concerning why prunes have failed to set a crop this year in some regions, pears in others, and yet again cherries in others still, or concerning many other aspects of this most important subject; and

WHEREAS, knowledge that would enable us to control the setting and dropping of fruit would be of inestimable value to the deciduous fruit growers of the State; and furthermore

WHEREAS, the College of Agriculture of the University of California aims to investigate problems which are of importance to the fruit industry, and has always shown its willingness to undertake such investigations; therefore, be it

Resolved, that the Department of Agriculture of the University of California be requested to undertake a series of investigations on the setting and dropping of fruit, with the object of bringing these processes under the control of the fruit growers.

WHEREAS, the present facilities at the California State Fair Grounds are inadequate for the proper display and exploitation of the products and resources of California, more particularly in the horticultural department, where but one building is provided for the display of horticultural, viticultural, agricultural and other products; and

WHEREAS, the legislature of the State of California at the session held in 1913 has enacted a bill to submit to the voters of the State a proposition authorizing the issue of "State Fair Grounds Bonds" to the amount of $750,000, for the purpose of completing a plant at the State Fair Grounds for the proper exploitation and exposition of all the products of California, making an institution equal in extent and facilities to those provided for state fairs in the eastern portion of the United States; be it

Resolved, that the California Fruit Growers' Convention approves the proposition as submitted by the legislature to the voters of the State of California and urges their support for the measure at the general election to be held in November, 1914.

Respectfully submitted.

G. HAROLD POWELL, Chairman.
GEORGE HECKE,
C. C. TEAGUE,
GEO. H. CUTTER,
R. S. VAILE,
Committee.

MR. LEROY CHILDS RECEIVES NEW APPOINTMENT.

It is with regret that we announce that Mr. Leroy Childs, for the past year Assistant Secretary of the State Commission of Horticulture, and also Assistant Editor of The Monthly Bulletin, has just accepted a position with the Oregon Agricultural Experiment Station as Research Asistant, with headquarters at Corvallis, Oregon. Mr. Childs will assume his new duties July 15th.

During his services in the Commission Mr. Childs has shown an unusual ability for the kind of work his new position requires. His loss will be keenly felt by the Commission force as a whole. In going to Oregon we wish him the very best of success, with the assurance of the complete co-operation and backing of this office in every way.—E. O. ESSIG.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent, State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

The Apple Worm.

It is often necessary to spray a third time in order to control the destructive apple worm. This application is made from four to six weeks after the second, or six to ten weeks after the first spraying was applied before the calyx cups had closed. Use arsenate of lead, five pounds to one hundred gallons of water.

The codling moth larvæ also attack the green, soft shelled walnuts on the tree. S. W. Foster in Part V, Bulletin 80, Bureau of Entomology, U. S. Department of Agriculture, states that the majority of the worms bore through the soft shell and feed upon the kernel inside. Some, however, feed only in the green hull. These worms are usually the young of the belated individuals issuing from the first brood of the codling moth which had infested the apples and pears. The worms appear in the nuts in August and September. Spraying with arsenate of lead, five pounds to one hundred gallons of water, in August will probably check their ravages on walnuts.

The Cherry and Pear Slug.

The pear slug is a dark, olive-green slimy worm, the fore part of the body being enlarged. It strips the upper green surface of the leaves causing them to turn brown and die. This pest is easily controlled by blowing lime and dust on the infested leaves, spraying with the ordinary soap and emulsion sprays, or by using arsenate of lead, four pounds to one hundred gallons of water. The poisoned spray is slower in action than the soap sprays, as the slugs must eat the poison to be destroyed.

Red Spiders.

Several of our deciduous fruit trees, notably the almond, peach and prune, are subject to the attack of the red spiders. One of these is the so-called brown mite. This species is reddish in the younger stages and brownish in the adult, and is very minute. It does not spin a web. Infested leaves have a faded-out, spotted appearance. The two-spotted mite in contrast with the brown mite spins a conspicuous web. It also produces a spotted effect on the leaves. This mite is usually of a greenish or yellowish color with two dark spots on the body. Dusting with flowers of sulphur under favorable weather condition—a night when dew is plentiful, followed by hot days—is advocated by many growers. Lime-sulphur solution is liable to produce injury by burning at this time of the year. The atomic sulphur spray: 10 pounds of the atomic sulphur to 100 gallons of water, is another aracnicide.

CITRUS FRUIT INSECTS.

The Citrus Red Spider.

The red spiders are especially destructive to the citrus. Like the two-spotted mites, they are very minute and have eight legs when adult. They are generally reddish in color. They feed principally on the undersides of the leaves and are more abundant on the interior foliage of the tree. The infested leaves have a yellow, spotted appearance. Dusting the trees with flowers of sulphur on a night when dew is plentiful and followed by hot days, has produced fine results, according to J. A. Prizer, of the San Diego Fruit Company. Lime-sulphur solution, 2 per cent to 2½ per cent strength, applied at a pressure of from 150 to 200 pounds, is generally used if unfavorable conditions exist for the dry sulphuring. Atomic sulphur, six to seven and one half pounds to 100 gallons of of water, is less likely to burn the leaves than the lime-sulphur solution. Spray when the mites become numerous enough to produce injury. In very hot weather it is not advisable to spray unless the situation demands it.

The Soft Gray Scale.

In certain parts of the State the soft gray scale is doing considerable damage to the citrus. The scale differs from the soft brown in that it is more gray in color, less shiny, the young appear to be more flattened and more transparent. As the scale has been little affected by fumigation at the time the best results are obtained in fumigating for the black scale, it seems necessary to make a separate fumigation for this pest. Mr. Delacourt Kell, county horticultural inspector of the Pomona and Claremont district, has found that the best time to fumigate is from July 20th to the end of August, using a three fourths schedule. At this time of the year the scales are in the right stage for fumigating with cyanide. Do not fumigate at a temperature of 70° Fahr. or above.

MISCELLANEOUS INSECTS.

The Hop Aphis.

The hop aphis is a pale, yellowish-green member of the destructive plant louse family. W. B. Parker states in Bulletin 111, Bureau of Entomology, Department of Agriculture, that the hop aphis injures the hop crop in two ways: By furnishing a medium (honey-dew) for the black smut fungus to grow in, and by sucking out the juices of the plant. The cone scales covered with the honey-dew secreted by the hop aphis are soon covered with the black smut fungus, thus lowering the commercial value of the hops. The aphids stunt the plant to a greater or less extent, depending upon the seriousness of the infestation. The formula consisting of black-leaf 40, one to 2000 of water (6½ ounces to 100 gallons) with a spreader, consisting of either soap, about four pounds to 100 gallons of mixture, or flour paste, four pounds to each 100 gallons of the mixture, is recommended. The plant lice must be hit by the spray in order to be destroyed.

The Red Spider on Hops.

The red spider is a general feeder on many of our field crops, and often does serious damage to the hop vines. This mite is very small, reddish or greenish-yellow in color, and feeds principally on the undersides of the leaves, covering them with a fine web. The leaves infested with the mites develop yellowish spots, later turning yellow and falling. The sprays recommended by W. B. Parker of the U. S. Bureau of Entomology, consist of flour paste, 8 gallons to 100 gallons of water, or lime-sulphur (33 deg. Baumé) 1 to 100 of water, with flour paste 4 pounds to 100 gallons. The flour paste is made by using a cheap grade of wheat flour with cold water, making a thin batter. Use 1 pound of flour to 1 gallon of water, cook until a paste forms; use in the above proportions. Agitation is essential.

Grasshoppers.

An excellent formula for a poisoned bran mash to be used against the grasshoppers consists of bran 50 pounds, Paris green 3 pounds, lemons 10 fruits, syrup 3 quarts, water 5 gallons. The method of preparation as recommended by Geo. A. Dean, Entomologist of the Kansas Experiment Station, is as follows:

"Mix the bran and Paris green thoroughly in a wash tub while dry. Squeeze the juice of the lemons into the water and chop the remaining pulp and the peel to fine bits and add them to the water. Dissolve the syrup in the water and wet the bran and pour in with the mixture, stirring at the same time, so as to dampen the mash thoroughly."

This mixture should be scattered about while moist where the grasshoppers occur. Mr. George P. Weldon while on a recent trip in Ventura County to investigate grasshopper injury near Oxnard had an opportunity to note results with the formula, and reports it to be a decided success.

The Oak Moth.

To destroy the larvæ of the second brood of the oak moth use arsenate of lead, 5 pounds to 100 gallons of water. The larvæ of the oak moth destroy the leaves. In spraying the foliage of large oak trees a strong pressure and tower will be necessary.

PLANT DISEASES.

A Disease of Tomatoes.

At this season of the year many tomato vines fail to set fruit. The vines blossom well and appear thrifty. However, the blossoms after hanging on the vines for a short time fall off, leaving part of the peduncles attached to the stem. One cause of this trouble is a fungus which causes late blight of the potato and the fruit spot of the tomato. Several growers have been rewarded by a good crop of fruit after having sprayed with atomic sulphur, 10 pounds to 100 gallons of water. Bordeaux mixture has also been advised by Mr. H. S. Fawcett of the California Experiment Station in an experimental way.

MONTHLY CROP REPORT—JUNE, 1914.

Compiled from reports sent in by the County Horticultural Commissioners, by Geo. P. Weldon, Chief Deputy State Commissioner.

County	Almonds	Apples	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Prunes	Walnuts
Alameda	70	#	#	#	#	#	#	80	#	#	40	50	#
Butte													
Colusa	100	#	100	#	#	#	75	75	75	#	100	35	#
Contra Costa	35	80	#	#	#	—	#	#	100	100	30	35	80
El Dorado	#	85	#	#	#	#	#	100	100	100	75	20	#
Fresno	100	#	100	100	100	100	100	95	95	95	#	#	#
Glenn													
Humboldt	#	100	#	#	#	#	#	#	#	100	60	#	100
Imperial	#	#	100	#	#	#	#	#	#	#	#	#	#
Kern	#	60	#	#	#	100	100	100	100	100	60	85	#
Kings	#	#	#	#	#	#	#	120	120	120	#	120	#
Lake	100	100	#	#	#	#	#	#	100	#	40	35	100
Los Angeles	100	100	100	75	75	100	80	100	#	100	100	#	90
Madera	75	75	100	#	#	100	#	95	95	95	#	100	#
Mendocino	#	100	#	#	#	#	#	100	100	100	80	50	#
Merced	100	—	100	#	#	100	#	40	40	50	100	100	—
Modoc	#	60	#	#	#	#	#	25	25	25	50	#	#
Monterey	25	50	#	#	#	#	#	50	#	50	75	35	#
Napa	70	100	#	#	#	#	#	90	90	90	40	25	#
Nevada	100	100	90	#	#	#	100	125	#	125	90	75	100
Orange	#	70	#	100	120	—	80	#	#	25	#	#	60
Placer	25	60	#	#	#	75	75	90	#	90	70	#	#
Riverside	100	60	#	100	90	100	75	90	95	#	#	#	100
Sacramento	30	100	#	100	100	100	100	90	#	90	75	20	#
San Benito	—	—	#	#	#	#	#	—	—	—		50	—
San Bernardino	#	55	#	95	85	65	80	80	80	80	65	#	80
San Diego	#	85	#	90	25	75	85	#	#	70	#	#	#
San Joaquin	30	#	#	#	#	#	#	100	100	100	40	35	#
Santa Barbara	#	100	#	#	100	100	100	100	#	#	100	#	60
Santa Clara	#	60	#	#	#	#	#	80	80	80	60	35	—
Santa Cruz	#	70	#	#	90	#	#	—	—	80	95	80	#
Shasta	#	90	90	#	#	100	#	90	90	90	75	20	#
Siskiyou													
Solano	60	#	#	#	#	#	#	90	90	90	25	35	#
Sutter	75	75	100	#	#	100	#	60	90	75	60	75	#
Sonoma	50	80	#	#	#	90	#	90	90	90	100	30	100
Stanislaus	100	90	100	#	100	100	100	90	90	90	50	75	100
Tehama	100	100	#	#	#	100	#	#	80	60	50	40	#
Tulare	90	85	100	90	90	100	90	100	100	100	80	60	#
Ventura	95	100	#	90	105	100	80	#	#	#	#	#	80
Yolo	65	#	75	#	#	75	#	65	65	75	50	40	#
Yuba	70	70	100	100	70	100	70	60	75	60	70	50	#

Figures in table indicate condition of crop in per cent on the basis of 100 per cent as normal.
#Crop is not grown sufficiently in a county for a report.
—The county horticultural commissioner has insufficient information for a report.
All blank spaces indicate a failure on the part of a county horticultural commissioner to report in time or in the required form.

INSECT NOTES.

A brown scale occurring on elms at Davis, Cal., has been determined by Geo. B. King of Lawrence, Mass., as *Eulecanium canadense* (Ckll.). The writer has taken this scale at Clements, San Joaquin County, Sacramento, and received it from Tulare and Fresno counties.—E. O. Essig.

Both adults and larvæ of the alfalfa butterfly, *Eurymus eurytheme* (Boisd.), are at present very conspicuous in the alfalfa fields about Sacramento.—Leroy Childs.

Serica alternata Lec. is reported as working upon the foliage of fruit trees in Ventura County by R. S. Vaile.—E. O. Essig.

Tetranychus bimaculatus Hard., one of the common red spiders of fruit trees, is doing great injury to the foliage of maples this year in the city of Sacramento. The leaves on trees attacked by this pest are losing all of their green color, resulting in the decided marring of the beauty of this popular shade tree.—Leroy Childs.

A small, gray leaf beetle, *Myochorus longulus* Lec., was reported to Dr. E. C. Van Dyke as having ruined thirty acres of cotton at Mexicali in April.—E. O. Essig.

The yellow striped cutworm, *Prodenia prœfica*, was found damaging alfalfa fields in Shasta County, near Redding. It is locally called the army worm, and has excited considerable alarm by its devastations.—Geo. P. Weldon.

A hairy scarabæid, *Phobetus comatus* Lec., has been received from H. H. Bowman, who states that the adults feed upon the foliage of fruit trees in Placer County.—E. O. Essig.

A species of army worm was collected during the month of June in great quantities at Forest Hill, Placer County. It was apparently omnivorous in its food habits, as it was found feeding upon a large number of species of weeds, grass, clover, bushes, and trees, many of which were defoliated. A considerable amount of damage was reported to have occurred to vegetable gardens. Two species of parasites were reared, a Tachinid and an Ichneumonid. Also a black species of *Calosoma* was found feeding on the larvæ.—E. J. Branigan.

The thistle butterfly, *Pyrameis cardui*, was noticed in large quantities along the Sacramento River, feeding upon malva, bull thistle and smart weed. Large patches of these plants were completely defoliated during the month of June.—E. J. Branigan.

Chionaspis salicis-nigræ was found heavily infesting sweet birch at Forest Hill, Placer County.—E. J. Branigan.

The red-humped caterpillar, *Schizura concinna*, has not been so abundant this season in Sacramento and Yolo Counties as usual. It seems to be held in check by parasites of which there are several, the commoner being a species of Ichneumonid, a Tachinid and a Brachonid, apparently *Apanteles*.—E. J. Branigan.

Eulecanium robinarium was collected on mountain holly very commonly at Forest Hill, Placer County.—E. J. Branigan.

About seven hundred pounds of *Hippodamia convergens* were collected early in June at Forest Hill, Placer County.—E. J. Branigan.

The European elm scale, *Gossyparia spuria*, was found abundantly infesting elm trees at Colusa, Colusa County. In some instances large limbs were dead from the effects of this scale.—E. J. Branigan.

NOTES FROM THE COUNTY COMMISSIONERS.

ORCHARD SURVEY.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Commissioner Garden of San Joaquin County is busy making a careful orchard survey to determine the bearing and non-bearing acreage of fruits in his county. This work is of great importance in connection with the work of compiling crop statistics, for which there is an increasing demand. It has always been a difficult matter to get accurate figures on what the normal crop production of a county should be. In many cases this can only be estimated from the acreage, making the securing of same of great importance. Other commissioners have also begun this orchard survey work, and reliable figures on acreage and production may soon be expected from all of the fruit producing counties.

H. P. Stabler is instituting a campaign against the red spider (*Tetranychus bimaculatus*) in Sutter County. For the first time this season the pest was found to be quite abundant in certain orchards, on June 22d. Previous to this date the brown mite (*Bryobia pratensis*) has been at work and considerable damage has resulted from its attack.

REPORT OF STATE BOARD OF HORTICULTURAL EXAMINERS.

Since the last report the following men have qualified for the position of county horticultural commissioner in the counties named:

Santa Clara County—
G. E. Merrill.
*Earl Morris.
L. R. Cody.

El Dorado County—
J. E. Hassler.

Merced County—
W. D. Butler.
J. J. Fox.

San Diego County—
Robert R. McLean.
H. A. Weinland.
John A. Prizer.
H. M. Armitage.
E. L. Prizer.
Murray Ferguson.

Colusa County—
L. R. Boedefeld.
E. F. St. Louis.

Tehama County—
Chas. B. Weeks.

A. J. Cook,
Thos. F. Hunt,
Harry S. Smith,

State Board of Horticultural Examiners.

June 30, 1914.

*Has been re-appointed County Horticultural Commissioner.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF MAY, 1914.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, California.

With the first of May went into operation all the provisions of Notice of Quarantine No. 13, with its attendant regulations devised by the Federal Horticultural Board, under instructions from the Secretary of Agriculture, for the better protection of the United States mainland from the possible introduction of the Mediterranean fruit fly. It is well worth the while of every fruit grower in California to obtain a copy of this document and satisfy himself that every precaution that could be conceived of as applicable to the purpose has been incorporated into this order. The quarantine officers, acting in their dual capacity as federal and state inspectors, have been endowed with almost unlimited power in the matter of dealing with actual infestations of ships and their contents, and the searching of baggage is now no longer a concession on the part of the passengers but an authorized function on the part of the inspectors, ordered by the provisions set forth in Regulation 8.

Ten vessels arrived during the month, all of which had cleared from Honolulu subsequent to the date upon which the new regulations went into effect, and in this number were ships representing all of the great transpacific steamship lines, as also the lines plying between Hawaii and the mainland direct. The managing directors of these lines have shown the widest interest in the new regulations, and the inspection of their ships and passengers proves that this expressed interest has developed into practical action. Commanders and their subordinates are responding to the companies' orders to cooperate in every way with the inspectors, and especially so in the matter of facilitating the inspection of baggage.

SAN FRANCISCO STATION.

Horticultural imports

		Parcels.
Ships inspected	56	
Passed as free from pests		114,690
Fumigated		817
Destroyed or returned		225
Contraband destroyed		23
Total parcels horticultural imports for the month		115,755

Horticultural exports

Inspected and certified	589

Pests Intercepted.

From Belgium—

Aspidiotus britannicus, *Coccus hesperidum* and *Pseudococcus* sp., on bay trees.

From Honolulu— Parcels.

Omphisa anastomosalis larvæ, *Cryptorhynchus batatæ* and *Cylas formicarius* in sweet potatoes.
Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.

From Japan—

Unknown fungus on citrus fruit.
Aulacaspis pentagona on ornamental plant.
Aspidiotus cryptomeriæ on *Araucaria* sp.

From Nevada—

Heterodera radicicola in potatoes.

From Oregon—

Epochra canadensis (larvæ) in gooseberries.

From Sydney—

Lepidopterous larvæ on stag-horn ferns.

From Tahiti—

Morganella maskelli on oranges.

LOS ANGELES STATION.

Horticultural imports

Ships inspected	31
Passed as free from pests	84,771¼
Fumigated	14
Destroyed or returned	302
Contraband destroyed	2½
Total parcels horticultural imports for the month	85,089¾

Pests Intercepted.

From Costa Rica—

Chrysomphalus scutiformis, *Aspidiotus cyanophylli* (?) and *Icerya* sp. on bananas.

From Florida—

Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From Honduras—

Aspidiotus cyanophylli (?), *Aspidiotus cydoniæ* (?), *Chrysomphalus scutiformis*, *Saissetia hemisphærica*, *Pulvinaria* sp. and *Pseudococcus* sp. on bananas.

From Iowa—

Pseudococcus pseudonipæ on kentia.

From Maryland—

Chrysomphalus aurantii and *Saissetia oleæ* on *Ficus*.
Pseudococcus longispinus on *Roscheria melanochætes*.
Aleyrodes sp. on *Psidium molle*.
Pseudococcus sp. on *Coffea laurentii*, *Gonolabrus cbulis*, *Passiflora macrocarpa* and *Persea meyeniana*.

From Mexico—

Lepidopterous larvæ in tomatoes.
Aspidiotus cyanophylli (?), *Aspidiotus cydoniæ* (?) and *Saissetia hemisphærica* on bananas.

From Nevada—

Heterodera radicicola on potatoes.

From New Jersey—

Hemichionaspis aspidistræ on palms.

From New York—

Lepidosaphes beckii on citrus trees.

From New Zealand—

Howardia biclavis on senecio.

From Ohio—

Pseudococcus sp. on coleus and asparagus.

From Panama—

Aspidiotus cyanophylli (?) and *Chrysomphalus scutiformis* on bananas.

From Pennsylvania—

Pseudococcus sp. and *Lecanium* sp. on croton.
Aspidiotus lataniæ, *Pseudococcus pseudonipæ*, and *Lecanium* sp. on robelinia palm.
Pseudococcus longispinus on banana.
Saissetia oleæ, *Chrysomphalus aonidum* and *Lecanium* sp. on aralia.
Saissetia oleæ and *Pseudococcus* sp. on *Stephanotus floribunda*.
Pseudococcus longispinus and *Chrysomphalus aonidum* on *Alpinia sanderæ*.
Parlatoria pergandii, *Pseudococcus longispinus* and *Aspidiotus* sp. on *Pandanus veitchi*.
Coccus hesperidum, *Pseudococcus longispinus* and *Aspidiotus* sp. on *Bactris major*.
Asterolecanium bambusæ on bamboo.
Parlatoria sp., *Chrysomphalus aonidum*, and *Pseudococcus longispinus* on kentia palms.

From Washington, D. C.—

Pseudococcus citri on citrus trees.

SAN DIEGO STATION.

Horticultural Imports.

		Parcels.
Ships inspected	19	
Passed as free from pests		6,364¾
Fumigated		2
Destroyed		0
Returned		0
Contraband		15
Total parcels horticultural imports for the month		6,381¾

Pests Intercepted.

From Arizona—

Bruchophagus funebris in alfalfa seed.
Coleopterous borers in cedar poles.

From Germany—

Lepidopterous larvæ in seeds of *Musa ensetæ*.

From Pennsylvania—

Parlatoria pergandii, *Pseudococcus pseudonipæ*, *Chrysomphalus aonidum*, *Eucalymnatus perforatus* and *Pseudococcus* sp. on kentia palms.

From Central America via New Orleans, La.—

Aspidiotus cyanophylli (?), *Aspidiotus cydoniæ* (?), *Lecanium* sp., *Saissetia oleæ* and *Pseudococcus longispinus* and *Pseudococcus* sp. on bananas.

From Mexico—

Anastrepha ludens in oranges.

EUREKA STATION.

Ships inspected 6

No horticultural imports.

GRASS VALLEY STATION.

Pests Intercepted.

From New York—

Aleyrodes sp. on fuchsia.

SANTA ANA STATION.

Pests Intercepted.

From England—

Lepidosaphes beckii and *Coccus hesperidum* on citrus trees.

SANTA BARBARA STATION.

No horticultural imports.

O

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California
State Printing Office
1914

VOLUME III No. 8

THE MONTHLY BULLETIN

The Black Tartarian Cherry
(After Lelong)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA AUGUST, 1914

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STATE COMMISSION OF HORTICULTURE

August, 1914

THE MONTHLY BULLETIN

VOLUME III No. 8

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

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STATE PRINTING OFFICE
1914

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE,

Vol. III. August, 1914. No. 8.

POLLINATION OF PLANTS.

By Dr. A. J. Cook, State Commissioner of Horticulture, Sacramento, Cal.

Address before the Fruit Growers' Convention, Davis, California, June, 1914.

You will each and all recall the mechanism of a flower in its best development. As you know each part of the floral envelope is a modified leaf. The close student often sees positive proof of this in a petal that is also at the same time a stamen. A double flower results from a reversion of stamens in a multi-staminate flower, like the rose, back to petals.

The outer circle of floral leaves—the sepals—are still leaflike as they usually retain the green color of the normal leaves. These sepals, except as they unfold and protect the bud, function solely as leaves. The next whirl of the floral envelope just within the calyx forms the corolla which is made up of three of more variously colored leaves known as petals. These are what give beauty to the flower and are of real service to it in attracting insects to the important work of pollinating the flower, which is our theme at this time. Often the flower is very irregular, the separate petals varying greatly in form. This peculiar conformation, as Darwin explained years ago, has directly to do with pollination and so interests us greatly in this discussion.

Within the corolla are the stamens, the male equipment of the flower. These may be the same number as the petals when they are opposite or alternate with them. There may be a great number as in most rosaceous flowers. Each stamen has a stemlike stalk, often threadlike, hence called the filament, and a head known as the anther. The anther bears the male element, the pollen, a fine dust of varying color, though more frequently yellow. Each pollen grain is a cell and corresponds to the sperm cell in animals. In the very axis of the flower we find the pistil, usually only one but sometimes as many as there are petals, and rarely, as in the strawberry, many. The pistil is the female organ of the flower. Its bulbous base is known as the ovary which bears a slender appendage, the style. The latter is tipped with an unctious enlargement known as the stigma. In the ovary grows the ovules—the plant eggs, if we may so speak—the female elements of the plant. Like the pollen grain and the egg these are cells which when fecudated by the pollen grain develop into the seeds. The sticky, unctious stigma captures and holds the pollen grains. From each pollen grain there developes a thread which pushes down the entire length of the style and enters an ovule. This is fecundation and is absolutely necessary to the formation of a seed. The seed is the partially developed plant—an embryo—and as the animal egg can not usually develop without the sperm cell, no more can this

ovule or plant egg without the presence of this pollen thread. We thus see that no fecundation, or in other words no pollination, is the equivalent of no seeding, usually no fruitfulness.

Many plants are diœcious; that is, each flower is either male or female, or both. Of such are the oak, the walnut and some varieties of strawberries. In some cases, as the pepper tree, the sexes are on different trees or plants. In all such cases of course even though a flower is fertile to the pollen of its own species there must be marriage priests, as Darwin styled the bees, to carry the pollen from flower to flower or from tree to tree. In rare cases, as in some varieties of strawberries, all the plants are pistillate. Here pollen must be brought to them from other staminate plants.

In many monœcious plants where the flowers are perfect with both stamens and pistil in the same flower the flowers are infertile, or will fail to fruit, or at least to produce seed unless cross-pollinated. We say such flowers are self-sterile, or sterile to their own pollen. Our clovers and many, probably most, of our fruits are of this class. Most irregular flowers are so formed as to require cross-pollination. The conformation of the flowers prohibits self-pollination and insures cross-pollination through the visits of nectar-loving insects. Often plants like the Bartlett pear are self-sterile in one locality and fertile to their own pollen in another. I have reason to believe also that plants may at one time be self-fertile and the same plants at another time be self-sterile. It is also interesting to note that the pollen of some varieties is more potent than others of the same species. Thus among cherries the Black Republican, Black Tartarian and seedlings are found in some sections at least to be strong pollinizers. The same may be said of Drake's seedling among almonds. The experiments of the Oregon Station show that the Bing, Lambert and Napoleon (Royal Ann) are intersterile. Of course in our planting it would be most convenient to set varieties in solid blocks, but it would not be wise or scientific. We should always mix varieties, being careful to select varieties that bloom at the same time, also to secure those that are interfertile. Suppose the Bing or the Lambert or the Napoleon is thought to be the most profitable variety, then a few sour cherries, or Black Tartarian, or other efficient pollinizers, should be sparingly intermingled with the more desirable varieties. The same is true of our almonds. If we wish the Ne Plus Ultra and the IXL, we may well mix in liberally here as the Drake's seedling is a very desirable variety for it has been found to be an efficient pollinizer. Very likely locality is important in this matter, and it is wise in planting to note what varieties are desirable for market and at the same time are interfertile each with the other in each locality. At present we are not sufficiently informed as to the potency of pollen from the best varieties of our fruit, but we know enough to make us sure that it is wise in all cases to mix varieties, and it may be wise in some cases to plant sparingly of undesirable varieties to make sure that we provide for efficient pollination.

Bees as "Marriage Priests."

From what we have seen above we note that efficient agents in this work of pollination must be good flyers, must desire and seek often the nectar of flowers and must be very numerous, as the flowers to be

pollinated are multitudinous. In such flowers as the strawberry each blossom has several ovules to pollinate, and if any are missed the berry may be deformed. Of course all free-flying, sweet-loving insects are valuable to the horticulturist or agriculturist as collaborators in the pollination end of seed and crop production. All bees, honey, bumble and other wild bees, most if not all wasps, ants, though handicapped by the absence of wings, many moths and most butterflies, such diptera as syrphus flies, nectar-loving beetles and not a few homoptera aid in this work of pollination.

In purely natural conditions there is a pretty safe balance so that this service is provided for. The native insects suffice to pollinate the wild flowers of plain and forest. In our alfalfa fields and great orchards we have so massed the plants that the native insects are all powerless to perform this necessary function. Australia had no bumble bees and red clover would not seed until the bumble bees were introduced. The long flower tube placed the nectar beyond the reach of most insects. Even in Europe and America bumble bees are very scarce in the early season, and so we depend on the second crop for seed. Our alfalfa bloom is worked on by honey bees, and so any crop is fruitful of seed if honey bees are present in great numbers, but here the bloom is like the sands of the sea, and this is why we need the apiary close by the alfalfa field if we are to produce seed. It is usually wise to save the second, third or fourth crop for seed, not only to escape damaging rains but also that we may be sure that swarms of bees may properly pollinate the bloom. What a wealth of bloom of beauty crowns the orchard trees as they fling out their signal cry to all passing insects to come and dine and extend to them a life-saving service. How often our fruit trees bloom full, only to set no fruit. No pollination, no fruit; no bees, practically no pollination. We see then that we must not only mix our varieties wisely, but we must secure bees in the near precincts of our orchards if we would secure large and profitable crops. As we have seen generous cross-pollination is not only required for full crops, but perfect fruit often requires the same interpollination in field, garden and orchard.

We have a strange abnormality in the navel orange. The stamens produce no pollen; the fruit bears no seeds. Did the secondary orange which results in the navel estop the pollen thread in its way to the ovule and thus cause seedlessness? In this case why does the tree still fruit? Occasionally other citrus trees exhibit the same behavior, and a few vegetables are known to fruit without seeding. In these cases absence of pollination doubtless explains absence of seeds, but why the exceptional result of fruiting is yet to me at least a real puzzle.

As bees are the friends of the fruit grower and of the rancher in general, we should foster their presence and well-being at or close by the ranch. This as well as the best success in spraying for the codling moth will preclude spraying for this insect until the blossoms (petals) of apple, pear and quince fall from the tree. This is the proper time, and earlier spraying often kills not only the adult bees but also the brood. We ought all to adopt the motto: "Never spray our orchards with arsenites until the blossoms fall," and preach this to all our neighbors. We must remember that bees are the good and necessary friends to the successful pomologist. We should also remember that

bees never injure sound fruit, but are fond of ripe fruit and are quick to attack it when other insect, bird or weather wounds it.

A word regarding pear blight. It is quite certain that fire blight and twig blight of pome fruits are spread rapidly by insects, and bees of course aid in this dispersion. We have all observed how rapidly pome blight spreads at the season of bloom in pear, apple and quince orchards. That bees are the most numerous visitors of the flowers at this time is of course true. That the germs of the disease are thick in the nectar is also unquestioned. Yet other insects are just as able to carry the blight germs as are bees, and are sufficiently abundant to do most serious harm. If the bees were removed, the blight would spread very likely as rapidly and work as fatally as with the bees swarming on the bloom. Other insects abound sufficiently to spread the blight, but not in numbers requisite for proper pollination of the bloom or full production of fruit.

In years like the present we shall always find it necessary to fight this insidious bacterial disease in case it is present in our neighborhood. The great and effective cure is very thorough pruning, so thorough that every vestage of the diseased tissue is removed from twigs, branches, trunk and roots, and we must be equally insistent that after each cutting chisel, knife or shears is thoroughly disinfected by use of a one to one thousand solution of corrosive sublimate—bichloride of mercury.

THE APRICOT.

By J. C. Shinn, Niles, Cal.

Address before State Fruit Growers' Convention, Davis, Cal., June, 1914.

I have been requested to write a short paper on the apricot, and I shall confine what I write to my own experience and to what I have observed as boy and man about apricots or, as they are familiarly and perhaps affectionately called, "cots." What I shall write is based in the main on what I know of conditions in the central coast valleys, but much of it applies, of course, equally well throughout the State.

My earliest recollections of apricots have to do with climbing up into some trees of the small Hemskirke variety on this place at Niles and gathering and eating the delicious, pulpy fruit. As I remember these trees they seem to have been immense, about as large as the largest apricot trees now in the valley, but I realized yesterday when I went down to look at them that one can not always depend on boyish memories after a lapse of forty-five years or so, for the few trees left are quite dwarfish, having been grafted on the old Damson plum root, and are no larger than eight-year-old trees should be, in height at least, though they were bearing trees when my father came on to the place in 1856. I still maintain, however, that those apricots that I ate with so much pleasure so many years ago were a fruit fit for the gods, and if any one doubts it let him come to my orchard about the end of July and I can make a very fair demonstration with apricots from the very same old trees.

We are gradually learning in California to grow in each section the one or more varieties of fruit that are best adapted to that given

locality, if possible, better there than they can be grown anywhere else, and the apricot is the one kind of fruit that is being most planted in the section where I live. Now, I do not wish to offend the sensibilities of any apricot grower from some other section by suggesting that we grow the best apricot there is. There are a good many kinds of "best," and if there are other sections, as there are, that are planting heavily of apricots, the apricots from these sections must excel in some qualities; but in the points for which the apricots of the central coast valleys are sought there can be no better I am sure. These qualities are large size and rich flavor, with firm, well colored pulp, so that they may ripen on the tree and still be shipped to the canning factories. They give very small shrinkage in drying and make large dried fruit of the highest quality and appearance.

To attain these high standards in quality one must have a rich, deep, loam soil, and, as the apricot is an early bloomer, the orchard must be located in a spot that is practically free from frost. Some parts of the orchard on this place have been free from frost for twenty or thirty years while other spots, low sags, have been more or less injured every few years. Other parts have been hurt only in such years as 1898, when there was so much damage throughout the State. In good locations the apricot will give an immense tonnage of fruit and so, as I said, the soil must be deep, as it is in favorable locations throughout California, and I should say never plant on soil less than 10 feet deep, for I have seen the roots of apricot trees fully double that depth in the soil.

This deep soil is of little value to the tree if it is not kept moist, for the roots can get nothing out of it in the way of nourishment when it gets very dry, as it was during the two years just past in many orchards. In old orchards, where the roots fully possess the soil for many feet down, and the tree tops are big and there is a heavy draft on the soil for moisture and nourishment, the water is soon pumped out in dry years, and I have found that the ability to put water on your trees at any time you judge they need it, that is, to have a sufficient and reliable irrigation plant, is one of the very best investments an orchardist can make, and in a properly located orchard will go far toward insuring regular and abundant crops of fine quality.

I would flood the land of bearing orchards in the winter unless rains are very abundant, then I would irrigate in deep furrows, or in blocks, in May and again in the early fall, soon after the fruit is gathered. The summer irrigation may tend to draw the roots to the surface, but the winter watering will go down deep in the soil and enable roots to reach greater depths than would have been possible under natural conditions, perhaps.

Having got our soil and location and plant for irrigation, the next thing is varieties. A number of years ago when I was in the nursery business with my father, the late James Shinn, we thought at first, that out of many kinds we had tested, there were six that we could thoroughly recommend for market planting. They were the Sacramento peach apricot, obtained, I think, from Mr. Williamson, a pioneer nurseryman of that place; the large and small Hemskirke, Moorpark, Royal and Blenheim, or, as we then grew it, the Shipley. Now, I would cut the recommendation down to the one variety last

named, *i. e.*, the Blenheim. The first three named are certainly grand apricots of the Moorpark type, which gives us the immense size and rich musky flavor in which no other class can equal them, but they are too irregular in bearing and they often ripen in an irregular way, that is, one end or one side will be ripe, and soft indeed, while the other end is still too green for proper working in canning or drying. They seem to be somewhat more subject to skin injury from fungus or especially climatic adversities, and furthermore they ripen so late on young trees, and in certain years as late for the clean-up picking as August 31st, that they lap over into the season of other important fruits that the canner must handle. Still, under favorable conditions, these apricots are truly as near perfection as we are likely to get, and ripen evenly, with a rich, firm, golden-yellow flesh that will be thoroughly ripe and sweet long before it begins to soften, and in a few locations they have borne very heavy crops with great regularity for a number of years. I have a theory that if one could find just the right soil and climate for the apricots of this type they would be the most profitable still, and some of my own experiences seem to prove this, for I have had trees that were in an especially favorable situation that bore heavy crops for a number of years in succession and then became irregular in bearing when the conditions of their growing became a little less favorable. The general conclusion of planters at large is shown by the fact that almost no apricots of this type are being planted, and indeed, in my own locality many of them have been dug up or top grafted to Blenheim, while practically all the new orchards are of that variety. Most of the older orchards of the Santa Clara Valley are of the Moorpark class or type, and this causes a good deal of the irregularity in the supply of dried and fresh apricots, so that it has become a saying in the trade that we never have two good crops in succession.

There are two chances of the loss of crop for these varieties, the first is just before the swelling of the blossom buds in the spring, when, owing to some lack of favorable conditions during the year past, the blossom buds themselves will many of them drop off. That is, many of them, sometimes most of them, will drop off the tree without opening. There may be a good many of those on the newer wood that will stick, so the practice has grown of leaving the trees untrimmed, and the first of the growth of the year before may give a late or second bloom that will make a partial crop, but it is a poor dependence.

The Blenheim seems to be a little larger than the old Royal, which is the type of this class or section of the apricot. It is flatter in form and I think has a little smoother skin. Neither of them will come up to the sizes demanded by canners without a good deal of care in all details to give them the most favorable conditions of growth and development. The sizes in demand are ten and twelve to the pound and larger, and while it is easy enough to get Moorparks to ten to the pound, or even six, these other kinds will give you too large a proportion of fruit that is smaller than that on old trees with a heavy crop if anything is neglected throughout the year. Moreover, there are certain years when conditions are unfavorable, too cold and cloudy when the young fruit should be growing along or too hot and dry

when it should take its last swell just before it ripens, and in either case it will be under sized in spite of all you may do, and in the case of the hot spell it will ripen up soft and mushy.

If, however, we have normal weather conditions such as we expect and generally get in the coast valleys with mild, bright days and cool nights with, perhaps, high fog, your fruit will grow and swell to large size and ripen slowly with the firm, high-colored flesh that the canners preserve in perfect condition, with the minimum of "pie," and the drier can cure with a shrinkage sometimes much below 5 to 1. Indeed, I have known Moorparks to run as low as 4½, but Blenheim and Royal apricots average about 5 to 1.

As to roots, I would use peach on open well drained land, but if you plant on heavy land use good Myrobolan. My experience with apricot root is that it is very brittle and tender and that gophers are very fond of it.

Prune your yearling trees low at time of planting and the next year leave a pretty good length on the limbs selected for the main branches, but cut the new wood shorter and shorter each year until on big trees you are cutting off most of the new growth. Thin out the branches so that every part of the tree will get plenty of sun and leave open places where a ladder may be set in to thin and gather fruit without breaking spurs and knocking down fruit.

In thinning consider which spurs are strongest and most able to bear a heavy crop and thin accordingly. A spur that is stout and not too long and grows from a branch that is stout and healthy can grow fruit almost touching and yet bring it up to size, especially if other spurs or branches near by have little fruit; but a long, weak spur on a weak branch must be severely thinned out. If one side of your tree has been injured by rain or otherwise so that there is no fruit on it you can leave that on the other side somewhat thicker and still get size. In thinning your fruit take off the apricots that are small or defective and leave the good ones, and remember that an early start and hence an early ending of the thinning helps much in the sizing of the fruit. Very late thinning is of almost no benefit.

There are several very serious diseases of the apricot, and while it is possible to control them fairly well they cause a heavy expense each year. One of the worst of these is the scale bug, the black and brown, or Lecaniums as they are called. They become very plentiful sometimes and sap the trees' vitality to noticeable extent. They exude a sticky honeydew on leaves and fruit, in which a black fungus commonly called smut spreads rapidly, and I have seen orchards so bad with scale and smut that the pickers would look like coal heavers who had been shoveling dusty, soft coal, and the fruit was almost useless for any purpose. Farmers get much advice first and last, and we are often advised by the constituted authorities to let the natural, or planted, enemies of the scale kill it off. They will do it to some extent, and such a patch as the one described will probably be much better the next year, and may be practically free from scale, but some other part of the orchard will be bad and sooner or later it gets back again all over.

The only safe way I have found is to spray with distillate or, perhaps better, crude oil emulsion each year in the spring, and while this will never exterminate the scale, it will reduce it to the minimum, and

the injury to trees and fruit will be very slight. I do not state the following as a proved fact, but it seems to me, from several years' experience with these sprays, that they assist in holding in check one of the worst diseases the apricot grower has to contend with, *i. e.*, the brown rot. I have made a great many elaborate experiments with recommended cures for this troublesome fungus by the use of fungicides in winter and spring and on the ripening fruit, but the results were absolutely negative, while since I have used the above emulsions I have at least escapes any serious injury to either the little setting fruitlets or to the mature and ripening fruit, and as a consequence I have had more than average crops for several years.

This brown rot, as well as what I am told are other rots, often attack the little fruit, especially in the dense clusters, just as it is, or should be, casting off the calyx of the blossom. If we have a moist, warm, rainy or cloudy period at this critical time the casting off of the ring of the calyx is too slow, it seems, and rot develops often to such an extent as to materially reduce the crop. Sometimes just about enough drop to thin out the bunches and actually save work later. However, the brown rot disease seems more likely after a spring attack to develop in the ripening fruit with sometimes very serious results, causing a loss of from ten up to fifty per cent in very bad years. The only way to guard against this injury to mature fruit that I know of is to pick as closely as you can each time over the trees and rush it off without the slightest delay, to canner or drier, as the case may be. A prompt destruction of fruit that shows the spores of the fungus and the burning of the mummified fruit, if any, in the trees, at the time of pruning, I have always insisted on, and probably with some benefit. Shot-hole fungus is sometimes troublesome, but the oil sprays in winter probably do some good and the recommended fungicides are efficient.

Borers are a very serious pest where they get started and the cutting, if done carelessly, often causes much injury to trees. A preparation of asphalt that might be handled without the difficulty of the ordinary commercial brands would go far toward eradicating this serious menace to our orchards.

There is another fungous disease we call die back. It will suddenly attack a seemingly healthy tree and in a week or two a whole limb, or possibly most of the top, will wilt and die. Severe cutting below the injured fiber in the limb is the only remedy I know, but I tried a preventive that seemed to work. I had observed that the peach trees did not have that disease so concluded to get as much peach wood as possible in my apricot trees. I took good yearling peach trees and planted them early in the winter, so that they rooted early, and then in February grafted the stems about two feet from the ground to apricots. The grafts took well, and in a few years made fine trees that have been practically immune to the attacks of the disease.

Apricot trees have suffered from no other serious disease in the section of the State of which I write, except root knots.

I figure that up toward half the apricot trees in the State are within thirty miles of Niles, and from what I can learn the planting is much heavier in this central coast region than anywhere else in the State, and all of these apricots are for canning and drying, but there is every prospect of a good market in the future for an increasing tonnage of

this grand fruit. I suppose it is entirely within the possibilities that we shall produce more apricots than we can sell for a good price. This so-called overproduction has come in many lines of fruit growing in California, but at present it seems far off for apricots, and very high priced land is being planted to these trees. A friend of mine has just planted land that sells readily at $1,000 per acre, and he must figure that he can make interest on that value and his added expense of growing the trees along to bearing age. I think that this is doubtless a blunder from a financial point of view, but he may be right and I may be wrong; but at any rate land that is well situated and of the best quality, as his land is, will pay good interest on a big valuation when it comes into bearing, if planted to Blenheim apricots and well cared for. And it will pay it regularly without much possibility of total failure in any year.

HORTICULTURAL QUARANTINE.

A BRIEF RÉSUMÉ OF ITS ORIGIN, DEVELOPMENT AND PRACTICE IN CALIFORNIA.

By Frederick Maskew, Chief Deputy Quarantine Officer.
Address Before State Fruit Growers' Convention, Davis, Cal., June 1, 1914.

Quarantine! It is a nasty word and has an ominous sound. It suggests investigation and interference with our persons and belongings, and is always associated with unpleasant experiences. It is now generally recognized as a necessary evil, and one that should be prosecuted with diligence at all seasons, excepting only when its regulations are applied to our individual selves, then it is, well—an outrage. I have found by experience that the addition of a maximum of common sense, tact, courtesy and dispatch to the actual work has ameliorated but very little the censure of the restrictions made by the individual under investigation, and the quarantine service still remains by far the most unpopular branch of the State Commission of Horticulture. Quarantine! How few of us here present know the derivation of the word or its original meaning. It is the equivalent in the French tongue for a period of forty days, and was originally applied to the old sanitary preventive system of detention of ships and persons, which was practiced at seaports on account of the plague.

It is a far cry from 1348 to 1914—from the shores of the Adriatic to the University Farm here at Davis—yet it was in Venice during the year 1348 that the city fathers of that seaport created the first board of health, and the members of which formulated the first quarantine regulations. The Venetians were maritime traders, their argosies sailed many seas, bringing back cargoes that yielded rich revenues and also on occassions the germs of strange and fatal diseases, and as a consequence earlier quarantine regulations were concerned only with the matter of public health. In the interim between 1348 and 1875 weird indeed were the experiences of those unfortunates who fell under the jurisdiction of the quarantine regulations, and while this is no time or place for a recital of the same, en passant I would remark that those who care to search for and read these records will find many

a strange tale as entertaining as the stories of Stevenson's pirates, and will learn the origin and meaning of such peculiar words as pratique, lazaretto and others in the quarantine vernacular. The application of the principles of quarantine is now almost universal, and is applied to all objects that live or contain the germ of life. It has become a custom of the period practiced by all civilized countries, even by communities in some instances, that all immigrants, human, animal or vegetable seeking an entrance into the territory and a residence in their midst, shall have each his individual health, cleanliness and general desirability vouched for before being granted admittance.

The State of California with the directness and initiative that has always characterized her actions, was the first country to make an original departure in the application of quarantine regulations, and in section 3 of an act approved March 4, 1881, to define and enlarge the duties and powers of the State Viticultural Commission, we find for the first time the mention of the word quarantine as applied strictly to horticultural material. In section 8 of the same act provision is made for the appointment of an officer to formulate and put into execution quarantine regulations for the protection of fruit and fruit trees from the spread of insect pests. Evidently interpreting the language of this section in its broadest sense and recognizing the necessity of a division of interests, the Board of State Viticultural Commissioners appointed on April 5, 1881, eleven typical exponents of the practice of horticulture under California conditions to serve as the first Board of State Horticultural Commissioners, and the members of this board on the same day elected by ballot Matthew Cook as Chief Executive Horticultural Officer. This officer as a part of his duty presented to the board at their next meeting on June 30, 1881, a system of quarantine rules and regulations for adoption. These, however, were not acted upon at the time. At the regular meeting of the board held on September 30, 1881, the quarantine rules that had been laid over at the preceding meeting were read, altered and adopted by section, the whole was approved, and under the caption "Horticultural Quarantine Rules," were signed, printed and issued on November 12, 1881, by Matthew Cook, Chief Horticultural and Health Officer, who proceeded promptly to enforce the same after January 1, 1882.

With an enthusiasm worthy of the cause the Health Officer commenced to put into execution the provisions of these quarantine rules in many different parts of the State, and as a result, in just a short time, found himself in court and under orders to abandon the enforcement of a quarantine. Poor Matthew Cooke! he had made a good fight for many years—out in the open against all comers since 1879—and he must have been chagrined beyond expression when the supreme court declared this consummation of his hopes unconstitutional in January, 1883. This decision proved a Waterloo for Matthew Cook, but only the opening gun in a campaign for the protection of horticulture in California. This was a constructive period in which the future historian, writing of the foundation of horticulture in California, will find a wealth of material from which to draw. Strong characters abounded and expressed their convictions in no uncertain terms concerning matters, horticultural, quarantine, and otherwise, and were not to be

deterred in their purpose by a single setback. Many elements were stirred in the matrix that molded public opinion and generated the pressure that forced the passage of the act that created the State Board of Horticulture on March 13, 1883.

In looking for some of the causes that brought about the foregoing we find the San Jose scale causing a reduction of assessment values in many parts of the State; the codling moth in the north; the cottony cushion scale in the south; and a close student of these times will also find that the matter of a "free package" with its many commercial aspects, played no small part in this matter of applying the principles of quarantine to horticulture. To me, perhaps, the most significant signs of the times is found in utterance of C. H. Dwinelle, president of the Board, to the following effect: "Meanwhile rates of interest have fallen so much on this coast that capitalists are more inclined to loan money in the country and not a few of them are themselves investing in orchards." Here entered into the art of horticulture in this State the spirit of business with all that it portends—system, keen analysis of cause and effect, attention to details, maximum production, and markets for the produce. These principles abided, and have proved largely instrumental in placing the products of California in the enviable position they hold in the markets of the world today.

Analyzing the provisions of the act that created the State Board of Horticulture, three facts stand out with distinctness. First, it is set forth clearly that "the members of said board shall receive no compensation whatever." No better voucher could be asked for of the sterling qualities of the nine sagacious men who composed this board than the fact that without exception they cheerfully undertook the task imposed upon them under these conditions, promptly organized for business on April 5, 1883, and during their term of service, in addition to much other constructive work, laid the foundation for the system of quarantine regulations and inspection service in force throughout the State today. Second, we find authority conferred to appoint such quarantine guardians as may be necessary to carry out the provisions of the act; and a third fact, more pertinent to the subject of this paper, is that all quarantine procedures were still a matter of rules and regulations formulated by the board, no penalty being provided for their violation, and they were concerned chiefly with existing internal conditions rather than with importations of plant material from abroad. These conditions obtained until March 10, 1885, when "An act to prevent the spread of fruit and fruit tree pests and diseases and to provide for their extirpation" was approved and became a law. In section 2 of this act the legislature clearly set forth the duties of the inspector of tree pests and the quarantine guardians, especially so in relation to horticultural material imported or brought into this State, and provided a penalty for any violation of the provisions of this act. This was decided progress, and the provisions of this act appear to have been the warrant for the procedure of the quarantine officers for the following five years.

During the year 1891 we find much agitation concerning the principles and application of horticultural quarantine. At that time, even as it is today, those whose merchandise was included in the ruling set up the cry that our quarantine restrictions were for purely com-

mercial rather than sanitary reasons. Just prior to this period, two strong characters had been added to the service—B. M. Lelong, as secretary, and Alexander Craw, as quarantine officer. These were both capable officers, indefatigable workers, and also men who clearly comprehended the purpose of their own ideas. Lelong had stirred up not only the State of California but all of the United States east of the Mississippi River by his insistent efforts to bar out of this State nursery stock susceptible to the disease known as peach yellows from all localities where this disease was known to exist, and Craw was equally insistent in the matter of more authority in the determination to maintain a quarantine. Largely as a result of the efforts of these two officers the State Board of Agriculture issued in November, 1891, amended regulations. The new and important features in the amendment under this date appear to me as follows: All importers of horticultural material into this State were ordered to notify the quarantine officers of the arrival of the same; a quarantine period of fourteen days was established, during which infested imports could be held for the purpose of determining the effect of the treatment to which the pests found upon them had been subjected; and all nursery stock and propagating material susceptible to the disease known as peach yellows from the territory outlined as known to be infested with this same disease was denied admittance into this State. However, no penalty was provided for failure to comply with these regulations. In December, 1893, the State Board of Horticulture again amended their quarantine regulations, the change apparently in this instance consisting of striking out the restrictions on the matter of bringing in, selling or giving away infested fruit in this State, and adding to the regulations a clause whereby any nursery stock or plants infested with insect pests or fungus diseases not known to exist in this State were prohibited from landing. The vigorous prosecution of quarantine regulations, especially at the port of San Francisco, during the year of 1894, developed a situation that imperatively demanded further additions to these regulations, and in August, 1894, the Board of Horticulture once more amended and amplified the horticultural quarantine regulations by reinstating the restrictions on infested fruit and denying the admittance into this State of any flying fox, Australian or English wild rabbit or other animals injurious to horticulture.

Alexander Craw, as the quarantine officer charged with the duty of putting into execution the foregoing regulations, learned by bitter experience what a difficult undertaking it is to endeavor to enforce police regulations without adequate punishment is provided for all violations of the same, and for the next four years he labored incessantly to bring about legislation that would endow these necessary principles of protection to our horticultural interests with statutory dignity and the enforceable compliance which the same insures. All of those who knew Craw will agree with me that it must have been a source of great comfort to him when what was known as the horticultural quarantine law became effective in March, 1899. The prime features of this act were the placing of a statutory quarantine on peach yellows, and making violation of any of its provisions a misdemeanor.

On March 25, 1903, we find approved an act to create a State Commission of Horticulture. The wisdom or not of this radical departure

from a policy which embraced a board of nine commissioners, each expert in the practice and conversant with the needs of his particular branch of the horticultural products of California, to the policy of a single commissioner equally expert in all, does not come within the province of this article. At this time we are concerned with the quarantine features of the act. Evidently the experiences of the entire situation accumulated during the preceding twenty-three years were very thoroughly digested by those who drafted the provisions of the bill. In section 4 we find extraordinary powers given to the commissioner in that he may, with the approval of the Governor, establish quarantines at the boundaries of this State, or elsewhere within the State. The nomenclature of the different positions in the service become changed; the commissioner becomes under the new act the State Horticultural Quarantine Officer, as set forth in act of 1899, and the former quarantine officer is afterward known as the Chief Deputy Commissioner, although his functions still continue to be putting into active operation all the provisions of the quarantine law. Also in this act was omitted the authority granted in the act of March, 1883, to create and commission quarantine guardians.

It would appear that all possible contingencies had been provided for in the several provisions of the two acts last enacted for these purposes, but such was not the case. During the month of February, 1903, an event occurred in San Francisco which necessitated the insertion into the provisions of section 3 of the horticultural law of that famous sentence "reasonable cause to presume." Simple as it seems, those four words made the protective system impregnable, and have proved the despair of many a would-be contestant of later quarantine rulings.

The act creating the State Commission of Horticulture was amended June 26, 1911. Many new features were added to the bill, perhaps the one of most real importance being the restoration of the authority to appoint and commission state quarantine guardians. The importance of this feature can not be over-estimated as it provides for the putting into execution of the provisions of the state quarantine law at all interior points of delivery.

The arrival at the docks in San Francisco of live larvæ of the Mediterranean fruit fly during the late summer of 1911 again necessitated the amending of the quarantine regulations of the State of California, and the culmination of the efforts of all those interested in devising adequate ways and means for preventing this pest from becoming distributed in the State is to be found expressed in the provisions of section 5 of the state quarantine law. Taking for a text a learned decision that the essence of the quarantine law is the prevention of disease, and that in consequence the law applies not only to what is actually diseased, but also to that which has been exposed to disease, the entire provisions of this bill were carefully compiled and the language of each section thoughtfully constructed with a view to have the same, when put into execution, withstand any test of the law that might be brought against them; and this law as it stands upon the statue books today is generally accepted as a standard of this class of legislation.

By virtue of the authority conferred upon the State Horticultural Quarantine Officer in section 2319-*b* of the Political Code of California, the first quarantine order was issued in October, 1905. At intervals since that date twenty-two other such orders have been issued from time to time as necessity demanded for the purpose of preventing the introduction into this State of insects or diseases injurious to horticulture, or to prevent those already established in some sections of the State from becoming distributed in otherwise clean sections. These quarantine orders have been provocable of much criticism, and many ingenious means have been employed at times to evade them, but in the main they have accomplished their purpose and have kept out of our orchards and farms many organisms that are not only undesirable but dangerous and destructive to profits.

The passing of the Plant Quarantine Act by congress in August, 1912, and the creation of the Federal Agricultural Board, was a fitting climax to these pioneer efforts of California and other states to introduce and maintain the principles of quarantine procedure as applied to horticulture and its products, and the same is introduced here to show that while California in general with all other states in the Union is being greatly benefitted by the Federal regulations covering the importation of nursery stock from foreign countries, California is especially and immeasurably benefited and protected by the Federal quarantines against the Mediterranean and Mexican fruit flies. Notice of Quarantine No. 13, with its accessory regulations, issued by the Secretary of Agriculture, the United States Treasury Department and the Postmaster General, is without doubt the most full, complete and drastic document ever issued for a similar purpose. With its provisions in full operation it furnishes to California in particular, and to the United States in general, the greatest measure of protection that could be devised against the possible introduction of the Mediterranean and the melon fruit flies.

Now I must ask your patience to go backward a little with me for the purpose of considering in detail the present State quarantine law. Good, bad or indifferent, as its provisions may be considered by those whom it concerns from different angles of contact, the fact remains it is the law under which the quarantine officers operate and the provisions of which importers must comply with to enable them to obtain the goods they desire to bring into and distribute throughout this State. As a result of long practice in putting these provisions into execution, I consider the prime protective feature of this law to be the provision for inspection at the point of delivery. This appears to be the shippers' principal bone of contention—the refusal on the part of California inspectors to accept at face value certificates of health and cleanliness based on an assumption that one inspection of the stock growing in a given nursery guarantees its cleanliness for a year, the same inspection being usually made while the trees and plants are still in the ground with eighteen inches of soil covering the roots and also hiding such forms of root infesting insects or diseases to which these trees may be susceptible. Again, some nurserymen who specialize in a few standard varieties of two or perhaps three classes of commercial fruit, and which same represent almost exclusively the horticultural productions of their own state, overlook the fact that we

import such material from every available source in the world, and that our inspection laws were made and provided with the intention that they should be broad enough to meet any contingency of host and pest that may develop in this world-wide source of origin. Such people viewing the matter from their limited horizon cry out against and condemn our present practice when the same applies to their goods, and claim exemption, but it is well to remember that exceptions always lead to ever widening, never ending difficulties, and should not be granted. Another factor that justifies our principle of inspection at point of delivery is the fact that rarely, if ever—outside our own State—does this inspection cover the ornamental trees and plants growing under glass. If these critics of our inspection laws could only grasp the fact that in California can be grown out of doors almost every variety of plant life in the world, excepting perhaps the lowland flora of the tropics; that our State stretching its golden length along the Pacific Ocean for a thousand miles through nine and one-half degrees of latitude is practically a continuous series of botanic gardens and commercial orchards between which the line of demarcation is indistinct, often nonexistent; that horticulture is not an incident to the general business of farming but the leading industry in the State, and that some of the insect enemies of orchard trees which we dread the most are often found on these indoor grown exempt from inspection plants they ship to us; if these exporters could clearly grasp these facts, could clearly comprehend our situation, their strictures and censure of our inspection laws would cease, or at least, become greatly modified. But then if they could only comprehend the entire situation they would be here with us in California, here to stay, and helping us to uphold and continue for all time and against all comers this protective principle of inspection at point of delivery. In tabloid form, this entire matter of infested trees means simply this: When the sale is made the seller gets rid of those plants and their pests forever. The buyer adopts the bugs and a burden of expense as long as the trees exist. That formula should be easy for California producers to digest, and cause them to continue to act in consonance with the facts.

The foregoing diagnosis of one feature of the state quarantine law concerns chiefly shippers, purchasers and planters of trees from outside the state line. The next feature I desire to analyze concerns all producers of agricultural and horticultural products in California, and is in my opinion worthy of their full consideration. Under the provisions of section 1 of this law all persons who bring or import into this State any trees, plants or plant products must notify the nearest quarantine officer of their arrival and hold the same for inspection. The legislature made this act obligatory on all importers, and provided a severe penalty for failure to comply with the same. This is only a partial solution of this problem of protection. If the law provides that certain material must be held for inspection, it naturally follows that prompt inspection should follow such detention, otherwise the intent of the law would be nullified. To provide for this inspection at interior points of delivery throughout the State, authority was given to the State Commissioner of Horticulture to issue commissions to the County Horticultural Commissioners and by this act make of them quarantine guardians, which carries with it full jurisdiction over all

horticultural importations into the State, and power to put into execution all the provisions of the State quarantine law. In a state of such imperial dimensions as California this procedure is imperative to a working system of quarantine, and the findings and prompt actions of the quarantine guardians have demonstrated the wisdom of this policy in unnumbered instances. Whether or not the present force is adequate to meet and handle with safety the growing demands of this service is a matter that I hope will receive full attention at this convention. There are 44 quarantine guardians in the State; at the same time there are also approximately 700 stations to which agents are attached on the six great railroad lines that have direct interstate connection with California. These are main line stations. at all of which horticultural imports into this State can be delivered without transfer, and at all of which the agents are amenable to the provisions of section 1 of the state law. The methods and policies at present employed in dealing with this vast situation are to be related at this convention by the quarantine guardians themselves in a later address.

In the coast division of the service we have been able to maintain a very complete quarantine along the seaboard, largely as a result of the capable co-operation we receive from the transportation companies. At the outset of the present administration of the central quarantine office in San Francisco a special effort was made to obtain this co-operation. It was demonstrated to the directors of the various lines that carriers equally with producers were ultimately benefited by the purpose of the quarantine law; that the fundamental principle underlying quarantine regulations was larger crops of better products as a result of keeping insect pests and diseases out of the farms and orchards of California. The prospect of larger crops—in other words more freight—interested the common carriers more quickly than it generally does the producers, and the orders issued by the transportation companies to their agents in this matter of compliance with quarantine regulations were in many instances more drastic than the regulations in question. The carriers were assured that compliance with regulations upon their part would meet with prompt attention on the part of the inspection service, and that no interference with commerce would occur as a result of delay. This get-togetherness of agents and inspectors has developed a system which works with precision, and has resulted in almost doubling the amount of material held and inspected at the coast ports during the past twelve months, in fact, the record shows that the receipts at the San Francisco station alone during the year of 1913 exceeded by 152,000 parcels those of the entire coast division during the year of 1912. This has taxed the powers of the present inspection force to the limit, and added to this matter of commercial imports of horticultural products is the factor of searching the baggage of passengers and the quarters of ships arriving from outside ports. Four thousand would be a fair average of the total number of passengers landing in San Francisco each month who must submit their belongings to inspection. In the search for plants and plant products in all vessels and baggage that have come from foreign ports we are ably assisted by the Customs officers and thus enabled to keep up with this work, but in the steamship service with Hawaiian ports direct the burden of this work devolves entirely upon the State

quarantine officers. An average of 7 ships and 650 passengers arrive from Honolulu and Hilo each month. The handling of these passengers and their baggage is a task that admits of no procrastination, and the question of the larger ships with a full complement of passengers is the crux of the inspection situation and one that must determine the number of inspectors needed at the port. Up to this time we have been able to meet the situation, but it is fast outgrowing the abilities of the present force of inspectors to handle this phase of the quarantine work with the safety and dispatch that the importance of the work demands.

In connection with this matter of maintaining a quarantine on fruit fly material at all ports of entry on the Pacific coast, and the interception and inspection of all horticultural imports entering the State, I wish to digress a little at this point. On the statute books of the State of California are two laws, the purpose of which is more or less parallel—the State quarantine law and the Fish and Game law. The general scope of these laws is to protect and improve the condition of these two industries. For the purpose of putting into active execution all the police regulations of these two acts we find the following force of officers available for service:

Fish and Game.		Horticulture and Agriculture.	
Game wardens	73	Quarantine officers	9
Special deputies	400	Quarantine guardians	44
Rangers	300	County inspectors	144
	773		197

Proper digestion of these simple statistics can not fail to engender a feeling of marked respect for those whose interest, energy and determination brought about this splendid organization in the interest of the fish and game of this State. Having decided to accomplish a certain purpose, and having obtained legislative sanction and provision for the same their efforts were continued until adequate means for enforcement were provided. Such persistent and successful effort to protect their special interests is not alone worthy of consideration but of emulation on the part of all those interested in the agricultural and horticultural productions of this State.

Reviewing the foregoing laws, rules and regulations, the actions of the Federal Horticultural Board, the authority conferred upon the State Commissioner of Horticulture and the drastic provisions of our state quarantine law, as also the numerical strength of the inspection force available for putting into execution all of the same, it would appear that California had effectually closed or guarded every opening available to the entrance of insect pests and diseases, but such is not the case. Notwithstanding all this legislation, all this diligence and thought, every quarantine officer in California knows that outside of his jurisdiction, beyond his control, yet freely available to every man, woman and child in the State, there are 1,937 avenues of entrance standing with wide open doors through which these pests may freely pass every day in the year. These are the United States post offices. A great deal of energy and ingenuity has been expended in attempting to gain control of horticultural material reaching California points by this method of transportation, for the purpose of examining the same, yet little of permanent value has so far been accomplished. In San Francisco and

at Los Angeles we have been able to obtain a fairly complete control of the situation, but this was accomplished by the personality and persuasive powers of the two inspectors, George Compere and C. H. Vary—not by any legislative action on the matter. The inspection of material at these points and also others in different parts of the State results in findings that justify a continuance of every effort to obtain complete control of this means of entrance. The writer of this has been connected more or less in the past with the various attempts that have been made to interest congress in the matter of legislation on this subject, especially so in reference to the present bill introduced by Honorable John E. Raker in July, 1913. As a result of much information acquired on this matter I am doubtful if California will ever obtain her desires in this matter of inspection of plant material arriving by mail as a result of Congressional action. The inviolate nature of the mail is a justly popular character of the service. Comparatively few states are vitally interested in this matter of insect pests coming in on plants sent through the mails, as their principal industries are not affected by the same, consequently it will always be a difficult undertaking to obtain a working majority sufficient to legislate against the present time honored customs of the United States mail. There is, however, in my opinion a surer, swifter way to reach this much to be desired end. The Postmaster General has it in his power to accede to us in California all that we have been praying Congress to do for us in this matter of inspecting plant material arriving in the mails. The Postmaster General can grant this concession to us in such a manner as not to affect in any way the desires of other states or interfere in any way with the present mechanics of post office methods. All that is required is a general order covering the subject and the situation is ours. With such a precedent established for their guidance as general orders Nos. 6655, 6674 and 6675, Postal Regulations, I hope the members of this convention here assembled will devise a means for securing such an order before adjournment.

CHERRY CULTURE.

By A. C. Butcher, Sunnyvale, Cal.

Address delivered before State Fruit Growers' Convention, Davis, Cal., June, 1914.

The cherry is our earliest tree fruit to ripen and opens the deciduous fruit season in California.

Cherries are grown in commercial quantities in the northern half of the State only—mostly in the Bay Counties and the Sierra foothills. This fruit does not seem to thrive in the interior valleys, or the southern end of the State. There are about 500,000 bearing, and 330,000 non-bearing cherry trees in California—Santa Clara County leading with 160,000 bearing and 220,000 non-bearing trees. San Joaquin, Sacramento, Sonoma, Solano and Placer, are the other large producing counties. Cherries were among the first fruits planted in the State. The Bidwell orchard at Chico is well past the half-century mark, and the Geiger orchard near San Jose is about fifty years old. Both of these orchards are still bearing good crops.

There are two general classes of cherries—the sweet and the sour. Most of the cherries grown in the East are of the sour class, and are of

the Duke and Morello varieties. California raises for commercial purposes, the sweet varieties, which are, in the order of their ripening, the Early Chapman, Burbank, Black Tartarian, Black Bigarreau, Bing, Royal Anne, Black Republican and Lambert. Each of these varieties has its special commercial value, either for its period of ripening, or its own particular merit.

The early Chapman is a very early cherry and is especially adapted to early districts, such as Vacaville, Suisun and Newcastle, where it ripens in April. It is a black, watery cherry of uneven shape, and is a

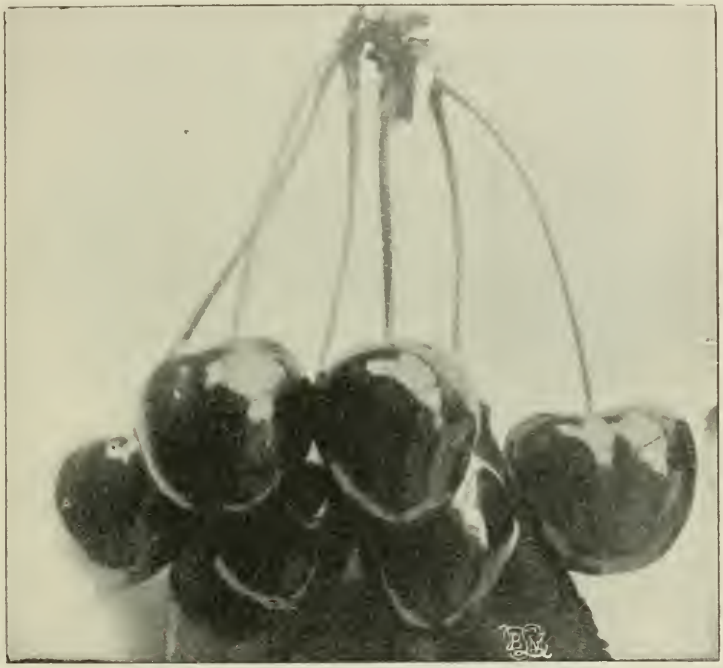

FIG. 85.—The Black Tartarian. (After Lelong.)

heavy bearer. It is the best of the very early varieties, and like the others would be a very poor cherry in midseason, but always brings a fancy price in the first eastern shipments.

The Purple Guine, Advance and Knights Early Black are three other early black varieties, but are only grown in small quantities and altogether in the early cherry districts.

The Burbank is a black cherry, very similar to the Black Tartarian, but ripens just before it. This cherry is of recent introduction and has proven satisfactory wherever grown.

The Black Tartarian is the standard black cherry of California, and is extensively planted in this State. The tree is an upright grower, comes into bearing early, and bears more regularly than any other variety. The fruit is on the market from early in May until well into June, coming from the different sections of the State. It is a good shipping cherry, and is more in demand in the local markets than any other cherry.

The Black Bigarreau is not grown in such quantities in this State as the Tartarian, nor is it as uniform a bearer. The tree is of spreading habit and the fruit is of uneven shape with a long stem. It has a firm texture and nearly always arrives in the eastern market in good condition.

The Bing is a variety introduced from Oregon several years ago and has been planted generally where cherries are raised. It is also grown very extensively in both Oregon and Washington, where it does well. The fruit is of a rich, dark mahogany color, of very firm texture and the

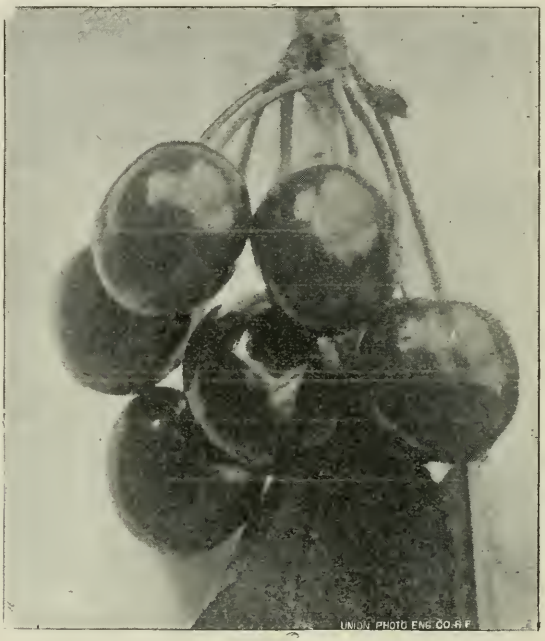

Fig. 86.—The Black Bigarreau. (After Lelong.)

largest of all cherries. It is easily the best shipping cherry and has always been in demand. It must be picked just as soon as well colored, however, to be at its best on arrival in the East, as it loses its luster if picked too ripe. The Bing has its shy years and is also damaged by rain more than most other varieties. Even a slight rain will crack it to the pit, making it worthless for shipping. The tree is very vigorous, with dark, glossy foliage. Its habit is not to branch and must be cut back when young to induce branching.

There are several varieties of white cherries, such as the Governor Wood, Elton and Rockport, but these have all been superseded in recently planted orchards by the Royal Anne, at one time known as Napoleon Bigarreau, which is excellent both for shipping and canning. This cherry is very firm, large and oblong, of a pale, yellow ground color, splashed with red and wholly red when exposed to the sun. It should not be picked until it has attained a good color, as it is very unttractive otherwise. Also it lacks the sugar and is apt to decay in transit.

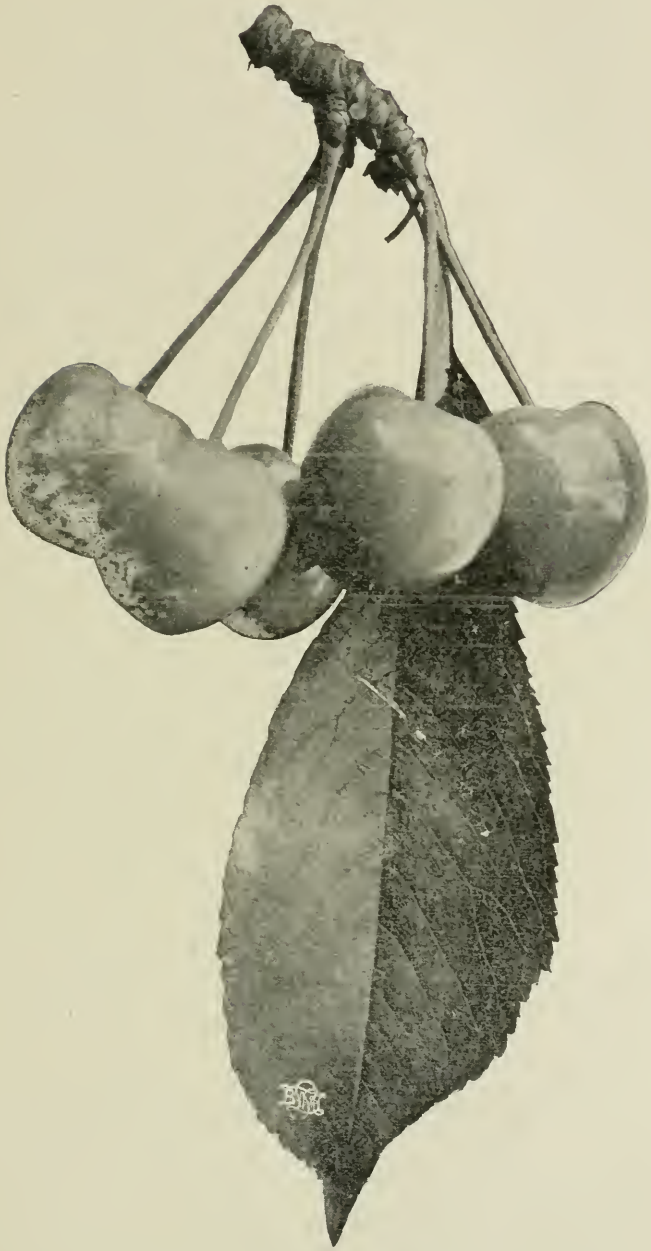

FIG. 87.—The Royal Anne (Napoleon Bigarreau). (After Lelong.)

The Royal Anne, like the Tartarian, has been extensively planted in this State, and except in years of very heavy crops, has always brought remunerative prices. This is the principal variety used by the canners and for Maraschino purposes. It is of spreading habit and makes a very large tree. It comes into bearing later than the Tartarian. It is a shy bearer when planted in large blocks by itself, and therefore should be mixed with Tartarians or Republicans to insure regular crops. In some orchards, there are trees which differ from the regular type, as they go all to wood and seldom bear a regular crop.

The Black Republican ripens after the Royal Anne and carries the cherry season into July. It is a very sweet, firm, black cherry of medium size with a short stem, and is a splendid shipper. The fruit grows in clusters and the tree is prone to weaken itself by overbearing unless heavily pruned or thinned when overladen. It is a good pollenizer for other varieties. The tree is vigorous with foliage similar to the Bing.

The Lambert is better known in the Northwest than in California, and is a still later cherry than the Republican—ripening in July. While the Lambert is a good cherry, it is not profitable in California on account of its competition with later fruits.

In planting a cherry orchard of any size, all of these varieties can be planted to advantage with the exception of the very early varieties, in the late districts, as they insure a long cherry season. This affords a better chance at the markets and at weather conditions and also enables one to offer his help work for a longer time, which means a better selection of help.

The cherry tree will grow on many soils with more or less success. In my experience, the heavy adobe is the only one on which it will not thrive at all. A deep sediment seems to suit it best. There must be a good drainage, as water standing about the roots is sure death to the cherry. It requires a new soil and does not do well on land that has once been planted to orchard, or where there has been a growth of oak trees, or where toadstool fungus is prevalent. The oak tree roots poison the ground and where each oak stood, several cherry trees will be affected. The leaves turn yellow, the tree makes a stunted growth, and in many cases, dies.

Next in importance to the selection of the soil for a cherry orchard is the selection of the tree. Plant the best you can buy from reputable nurserymen, and, if possible, know that they have been grown from buds selected from trees that bear. I think that the non-bearing of many trees comes from the haphazard selection of buds. I have Royal Annes that nearly always bear and others that seldom bear a crop. Get trees that have a good root system and have made a sturdy growth in the nursery. Between the Mazzard and Mahaleb roots there is not much choice. The Mahaleb may come to a bearing age sooner, but in other respects, I think it is not superior to the Mazzard. The latter is subject to root-knot and some trees pinch off at the union and never make good trees, the trunk being always larger than the root-stock. Both are subject to sour-sap. In some localities the Mahaleb may be giving better satisfaction, but from my own experience, I would just as soon plant the Mazzard.

In setting out an orchard, the trees should be planted at least 24 feet each way. Thirty feet is better, in which case, peaches can be planted

between, to be taken out later. The easiest way to lay off an orchard for planting is to use a steel wire from twelve to fifteen tree lengths long, marked with soldered buttons. Lay the tract off into blocks, using the wire buttons to set the stakes and to plant by. Tree holes should be 2½ feet in diameter by 2 feet deep. The best time to plant is in January. After planting, the tops should be cut off 2 feet from the ground and the trees protected from sunburn. There are several tree protectors on the market, but for the purpose, I have always used old newspapers, which I have found both cheap and satisfactory. I use the whole paper tied with a string at both ends. These stay on for three years, which is as long as they are needed.

To get a good growth, the orchard should be thoroughly cultivated and irrigated two or three times the first year. A good, uniform first year's growth is important, as stunted trees always lag behind the others. A cherry orchard comes into bearing at about seven years. The Tartarian bears a small crop at five years, but the Royal Anne and Bing bear very little until the eighth year, except on light soils, or where they are crowded by other trees.

After the trees start, thin out the shoots to four or five, spacing down the trunk if possible. The tree may be cut back the second year, just enough to cause branching. The Black Republican, however, is inclined to branch too much so should be thinned out by summer pruning.

The Tartarian is a very upright grower and should be kept down by letting some of the growths starting from the lower branches remain. This keeps the sap away from the upper limbs and builds up a large-bodied tree, but no suckers should be allowed to come from the main trunk. The Royal Anne has a habit of forming long, slender limbs without side branches, and with a heavy crop, bunches of small inferior fruit form on the ends of the limbs. Therefore it is well to cut back a foot or more of these week limbs and keep the fruit near the sap supply.

After the trees are in bearing, about all that is necessary to be done in the way of pruning is to keep the weak limbs cut out and the center of the trees open to the sun. The weak limbs will nearly always be found on the inside of the tree. After being cut out, the wounds should be covered with wax or asphaltum.

On poor soils, or those which do not retain moisture well, the cherry, unless given the best of care, is liable, after bearing a few crops, to stop making a yearly growth and begin to die back. At first only a few limbs show this, but it is only a question of time until the whole tree is affected.

Even in the best of soils, the cherry must have an abundance of water at all times, especially after the crop is harvested and during the hot summer and fall months.

As the cherry matures its fruit early, the trees are exhausted and must have good care during the summer, or they will be in a weakened condition and show die-back the following year.

Until a few years ago, the cherry grower had less to complain of in the way of pests than any one else in the fruit business. Recently, however, the thrips have become a menace and are doing a great amount of damage to the orchards. The adult thrips work on the blossoms, and while they destroy some fruit, the most serious damage is caused by the thrips larvæ. They eat the leaf buds as they unfold, and either destroy

them completely, and with them, the fruit spurs, or else so mutilate the leaves that they are worthless to fulfill their functions. Consequently, the tree is weakened. Several methods of control have been tried on this pest with more or less success. Deep plowing in the fall is one, but the most effective is spraying with a tobacco wash several times during March and April.

Sour-sap is a disease which is very bad in some cherry orchards. It is easily detected by gum exuding from the part affected. The bark dies and in some cases the whole limb or trunk is girdled. This disease is caused by uneven temperatures during the dormant period of the tree and by excess of moisture during a wet, cold winter. It appears during the spring months. There is no effective remedy so far found for sour-sap. All that can be done is to cut out the part affected at once and paint the wound with wax or asphaltum. If the disease has girdled the tree, nothing can be done. Sour sap is most prevalent in orchards planted on light, gravelly soils which change temperature quickly.

The peach borer is also troublesome to the cherry grower. It is found even in the trees as they come from the nursery, but as a rule, the orchard will not have to be gone over until the trees are three years old. From then on, they must be dug for yearly. If the holes around the trees are opened early in the fall and left open till May, the bark on the roots will harden and the young grub cannot penetrate it so easily. A mixture of very thick whitewash applied to the roots is also good.

Within the last few years, the Italian scale and the Cherry scale, which is said to be bad in Contra Costa County, have made their appearance in the cherry orchards. A crude oil spray can be used successfully against these pests.

A red spider infests some orchards. They also can be eradicated by spraying.

Caterpillars are bad in some sections, but as a rule they do little damage. They can be prevented from ascending the trees by placing sticky bands around the tree trunks.

These are about all the pests the cherry grower has to contend with, but he will find them sufficient to keep him busy.

Bearing orchards should have a yearly application of commercial fertilizer. Either use a complete formula, or supply the ingredients which are found by soil analysis, to be deficient.

A cover crop of vetch or cow peas is also good to use if plowed under late in the spring when the vines have matured. If plowed early, the humus effect is lost.

I would advocate yearly plowing of cherry orchards, and keeping the ground loose during the summer so that air can get at the roots. Some growers do not plow, but use the disc harrow instead, claiming that this method does not disturb the roots as plowing does. While there is some truth in this, a plowing depth of five or six inches, with careful work around the trees, gives a deep mulch and is beneficial in many ways which more than offset the small root damage.

The picking and packing of the cherry for eastern shipment requires a great amount of labor. To get the best results, this labor should be experienced and at the grower's command at short notice, depending on weather conditions. The fruit is quickly damaged by extreme hot weather, or by rains. In the Santa Clara Valley, the picking is done largely by Italians and Japanese. The trees are gone over every few

days and the black varieties picked just as they are colored a light red. Pails or baskets are used for picking; an inch of excelsior in the bottom covered with paper, prevents bruising. The fruit is either emptied direct onto the packing tables when the packing is done in the orchard, or into lug-boxes which should also have excelsior in the bottom if the fruit is to be hauled any distance. As the cherry is more perishable than any other fruit shipped East, an emphasis must be placed on careful handling from start to finish. Otherwise, the returns will be unsatisfactory. The fruit should be kept cool after picking. It is best to pack it the following day after the fruit has thoroughly cooled. It then is not so apt to sweat when loaded into the iced cars.

This does not apply to cherries picked for local shipments. For this purpose, they are picked ripe, or nearly so, and emptied direct into small lug-boxes, or packed into 10-pound local boxes.

The eastern cherry box of two compartments, which holds 10 or 11 pounds net, is the uniform package used in California for the long distance shipments of cherries. It makes a very attractive package, being surfaced outside, sanded inside, and having beveled edges to prevent pinching of cherries. A carload contains about 2,200 boxes.

Another package which finds favor in some localities is the cherry carton. Eight of these are contained in the 10-pound box, each one holding about a pound of cherries. The carton should never be used for inferior fruit as it is a strictly fancy pack and is sold as such. A limited quantity in each car usually sells well.

The packing of cherries is done almost wholly by women. A good packer must have a light touch and a quick eye. The packing is done at oil-cloth covered tables which have a narrow cleat around the edge and a box support down the center to rest the boxes against at an angle facing the packers.

The boxes are faced with two layers of fruit, the packer selecting uniform sized cherries to make nine, ten or more rows across the box. After the first layers are placed, the box is packed through to the back, but not in rows. To make a good pack, all bird eaten, bruised, or inferior fruit is rejected, and the sizes used on the face should be carried through the box, small fruit faced and filled separately, and each box marked, designating the size by the number of rows used across the face of the box.

After being packed, the boxes are weighed and inspected, and then are put on the nailing bench. The nailing must be carefully done to prevent bruising. After being nailed on the bottom, the top is opened and the facing of the fruit inspected. After renailing, the box is then loaded into refrigerator cars for shipment.

The chief and most profitable market for our cherries, as well as other California fruits, is in the East, where shipments are made in carload lots and sold at auction. New York, Chicago, Philadelphia, Boston and Minneapolis are the only cities which take full carloads of cherries. From these auction centers the smaller cities are reached by express.

There has been an average yearly eastern shipment of two hundred and fifty cars during the last fifteen years, ranging from eighty cars in a short year to three hundred during full crop seasons.

From California a big express business is done with the Middle West and South. Los Angeles and San Francisco are the principal local

markets, and take large quantities of cherries, selling them mostly on a commission basis. Both of these markets prefer the small so-called "Los Angeles lug-box," which holds about 25 pounds of cherries. The Los Angeles trade furnishes this box to the grower.

The canners who confine themselves mostly to the Royal Anne variety and some of the soft whites for pie fruit, formerly used a large portion of the white cherry crop, but of late years are going into Oregon for their supply, being able to buy to better advantage there. A few years ago, there was a large tonnage put up in Maraschino, but now the French cherry is imported at a lower price. A duty of two or three cents per pound might bring back this industry to California. A small quantity of cherries is also used for glace fruit.

In considering the planting of a cherry orchard the first question that arises is, "What will be the probable returns of this fruit as compared with other fruits?" Many conditions enter into the making of a successful orchard and unless these conditions are met, no fruit will pay what it should. As with other fruits, there are orchards which make large returns and others which are a poor investment.

There are years when the eastern markets are good and years of good crops, and off-years either in crop or market. Therefore, it is impossible to give exact figures on the average revenue from a cherry orchard. The average price on eastern shipments returned to the grower for the last ten years was $1.04 per 10-pound box. The early districts average better than this and the later ones, less. The lowest average was $.82 in 1904, and the highest $1.44 in 1907. Deducting $.50 for picking and for packing-house expenses leaves a net of $.54 per box, or say 5½ cents a pound for shipping fruit.

The yield per acre depends upon the age and size of the trees and other conditions. A conservative estimate after the orchard is in bearing, would be an average revenue of from $150.00 to $200.00 an acre. Some old orchards, or those situated in favored localities, will average better than this. These figures are the net revenue from the fruit; the care of the orchard must be deducted.

The cherry has been a profitable crop in the past and should be so in the future unless very heavy plantings are made.

On account of the cost of preparing and getting the California cherry to the eastern market, it has to be sold at prices which make it a luxury, in order to leave any profit to the grower. The retail price ranges from $.15 to $.30 per pound. This greatly limits the quantity which can be sold. There seems to be no hope of reducing this expense in the future as the costs for labor and material are steadily rising and freight charges are not apt to go much lower.

With our later varieties of cherries, we will soon have to meet competition with Washington and Idaho. Their fruit is of good quality, and while in the past their pack has not compared favorably with ours, they are rapidly adopting our methods and we must be prepared to divide the market with them. The Southern strawberry crop always affects the cherry market to greater or less extent, but will probably be no worse in the future than it has been in the past.

In concluding, I would say that a cherry orchard, like any other orchard, will pay in direct proportion to the intelligent care it receives and the business ability of the owner.

REPORT OF THE STATE BOARD OF HORTICULTURAL EXAMINERS.

By Harry S. Smith, Secretary.

In the July number of the Monthly Bulletin a typographical error was made in the report of this Board, making W. D. Butler and J. J. Fox eligible in Merced County, and leaving out Napa entirely. The report with reference to these two counties should read as follows:

Napa County:
W. D. Butler.
J. J. Fox.

Merced County:
Arthur E. Beers.
M. M. Madson.

Since the report for June the following men have qualified in the counties named:

Lake County:
George A. Lyon.
Fred G. Stokes.

Santa Cruz County:
W. H. Volck.

As this practically finishes the examinations for the present, some statistics of the examination may prove of interest.

Since it was decided, on receipt of the opinion from the Attorney General on this subject, that it would be necessary to qualify new eligibles at the expiration of the various four-year terms of the county horticultural commisioners, examinations have been held in thirty-seven counties. In one county, Kings, no candidates presented themselves, and in another county, Lassen, no one was successful in passing the examination. In both these cases a list of five "competent persons" was submitted, from which the supervisors were to appoint a temporary commissioner for the period of one year. Several other counties had had examinations during the previous year, so that the terms of their commissioners will not expire for two or three years.

The total number of men taking the examinations is 113. The total number passing is 87, a percentage of 78.7. This is an excellent showing when we take into consideration the difficulty of the examinations and the broad range of agricultural science which they must cover. With a single exception all incumbents were successful in passing the test.

While there was, in certain sections, some slight criticism as to the advisability of re-examination at the expiration of the four-year term, we believe now that the work has been completed, all will agree that it has been for the best interests of horticulture in our State. It is true that very few changes have been made in the personnel of the county commissioners as the result of these examinations; in fact, only one change is directly chargeable to this ruling, and this in a county where the commissioner had not passed the previous examination but was appointed from a list of "competent persons" submitted in lieu of an eligible list. In no case did a commissioner, who had passed the previous examination, fail to get the required grade, although the recent examinations were much longer and much more difficult. This is sufficient evidence that the incumbents have been keeping abreast of the developments of practical horticulture.

It has been an arduous task to examine thoroughly so large a number of men, and the secretary of the Board especially has had to devote much of the time which really belonged to the insectary to this work. Many benefits, however, have accrued through the re-examination. It has necessitated a review which nearly every commissioner has agreed was decidedly beneficial. It has in many cases given the growers and supervisors increased confidence in their various commissioners. In most counties it has given the supervisors a larger and better list of eligibles from which to select a commissioner in case of a vacancy, or from which the commissioner may select a deputy. And it has raised the standard of inspectors, as in several counties many, and in some all, of the inspectors took and successfully passed the examination for horticultural commissioner. This will add to the efficiency of the horticultural service in this State, that thing for which we are all striving.

That the present law referring to the county horticultural commissioners is not perfect we all realize. It seems unfortunate that there are at this time in the State between forty and fifty men who are eligible for the position of county horticultural commissioner in certain counties where the office is already filled, and yet other counties needing a commissioner must select him from a list of "competent persons" who have never taken the examination, or who have taken it but failed to get the passing grade. Other things being equal, a local man is probably preferable to some one from another county, although even this is debatable. But with so many good men on the eligible list, many of whom have already had years of experience as inspectors, it certainly does not seem right that some counties should have to be content with men who did not or could not pass the examination. Some way should be provided so that counties having no eligible list could select a commissioner from the eligible lists of other counties. Horticultural science has reached such a stage of development in this State that the clause referring to "competent persons" in section 2322 of the Political Code should be stricken out. Also it seems hardly right, as the law exists at present, that when only one man is successful in passing the examination the board of supervisors should have no choice in the matter, but are compelled to appoint him. He might, and of course would be, perfectly acceptable to the State Board of Horticultural Examiners, but if not acceptable to the board of supervisors, it is pretty certain that harmony will not exist between the commissioner and the appointing body, with the result that the interests of the growers will suffer. If the supervisors are to appoint the commissioner and to provide funds for carrying on his work, in the interests of efficiency they should not be compelled to take a man whom they do not want. The entire subject of legislation affecting county work is being considered by a committee of the Association of County Horticultural Commissioners which will report at the Los Angeles Convention.

On behalf of the Board of Examiners I desire to thank the various county horticultural commissioners for the uniform courtesy with which they have attended to the matter of posting notices and arranging for the examinations.

GENERAL NOTES.

PEACH ROOTS FOR STOCKS.

I would appreciate it very much if you would caution people in your next Monthly Bulletin about planting prunes on peach root or peaches on peach root, where they may be covered by seepage water for any time.

I have an orchard of 23 acres of French prunes on peach root six years old and until now was as thrifty as any orchard you have ever seen but this orchard the past season was covered by seepage water, or rather the water seeped out of the river, and it was from the middle of December until the 20th of May before I could get a team in this orchard to do any cultivating, as the ground was too wet, and as a result I have lost practically all of my trees and, in fact, every one that has even a small family orchard has lost all the apricot, peach and almond trees, all of which were on peach roots.—FRANK B. GILLIAM.

THE POTATO EMERGENCY CONVENTION.

Dates changed to September 25th and 26th.

The following letter has been received from Secretary Houston of the U. S. Department of Agriculture:

> "Your letter of July 6, requesting that Mr. W. A. Orton and Professor William Stuart, of this Department, attend the potato convention which you propose to hold in September, is received. We shall take pleasure in arranging for their attendance if it will be possible for you to have the meeting postponed until their arrival in California, which will be about September 20th. Inasmuch as it will be desirable for them to acquaint themselves with the situation before the meeting, it is suggested that September 24–25 or 25–26 would be convenient dates.
>
> Very respectfully,
>
> D. F. HOUSTON, Secretary."

We regret the necessity of a second change of the dates of this important meeting, but the advantage of securing the presence of Doctor Orton and Professor Stuart, the former pathologist in charge of truck diseases, the latter in charge of potato investigations, as also of Doctor Appel of Berlin, Germany, the leading authority on potato diseases in Europe, makes any other course unthinkable.

This convention will be one of great value. A program of exceptional interest and promise is being prepared, and will be given wide publicity in the near future.

The potato interest in California is great. Its welfare is threatened. It is hoped that this convention will clarify the atmosphere and that our markets will be restored to their old-time dimensions and will suffer no further limitations.

A. J. COOK,
State Commissioner of Horticulture.

ESSIG GOES TO STATE UNIVERSITY.

Mr. E. O. Essig, Secretary of the State Horticultural Commission, and editor of the Monthly Bulletin, has resigned his position in this Commission to accept a place in the Entomological Department of the State University at Berkeley.

Few know as well as does the writer of Mr. Essig's ability as an investigator, or his exceptional power of work—genuinely hard work—where every energy is concentrated on any labor in hand. Few appreciate so thoroughly the value of his service to science and the State, and the consequent loss to the Commission, as he takes his departure.

Mr. Essig, as an undergraduate in college, accomplished much outside his regular college duties, which were never neglected. He did especially fine work in entomology.

Immediately upon graduation he was appointed county horticultural commissioner of Ventura County, where he was brought face to face with the citrus mealy bug, which was devastating the citrus orchards to the tune of thousands of dollars. In the study and control of this pest he made a phenomenal record. This work attracted wide attention by its originality and success. His contributions to the Pomona College Journal of Entomology possessed rare merit, were beautifully illustrated by original drawings, and did much to give that periodical its wide circulation, prestige and favor. Dr. G. Harold Powell, in a recent conversation with Governor Johnson, strongly commended the scientific arrangement and management of the offices of the Commission under the present administration. The thorough organization of the office and work was in no small degree due to Mr. Essig. I need not refer to the Monthly Bulletin. That has told its own story, and has won generous praise and general favor. Mr. Essig's ability and promptitude in issuing reports and in identifying insects and advising regarding their control, has received general appreciation. We anticipated a great demand for his "Injurious and Beneficial Insects of California," and published a greatly enlarged edition, yet this was exhausted in a few months. Thousands of requests for this work could not be granted, and thus a second edition is nearly ready for the press. The University authorities have kindly consented to grant Mr. Essig time to supervise the publication of this improved edition.

Mr. Essig kindly offered to remain in the Commission unless I consent to the change, which I do with great reluctance, yet am constrained to do so, as I am assured that his duties will remain much the same, and I am sure that his energies will in no sense be abated in the line of purely economic entomology, and that he will still serve the ranchers to the limit of his strength and ability.

I have thought, ever since assuming the duties of this office, that the best economy would be served by consolidating all the agricultural activities of the State under one official like the United States Secretary of Agriculture. There would also be a great saving in handing over all research work even along purely practical lines to the State University. This determined me to suggest and consent to the transference of Prof. H. S. Fawcett from this Commission to the Department of Mycology of the State University. I believe that this transference of Mr. Essig trends in the same direction, and am thus the more reconciled to the change.—A. J. Cook.

SEBASTOPOL APPLE SHOW.

As one of the three judges at the Fifth Annual Gravenstein Apple Show held at Sebastopol August 3–8, I had an excellent opportunity to study the exhibit and form judgment as to the worth of such exhibitions. Mr. Peckham, one of the judges, was a judge at the first show four years ago. He states that at that time codling moth larvæ were common in the fruit exhibited. San Jose scale was much in evidence, while much of the fruit showed presence of apple scab. Last year we found all of these in most of the exhibits, though in very limited numbers. This year only one apple worm was found in the scores of boxes examined; three or four of the pernicious scale insects were found, and that all too common apple scab was remarkable for its scarcity. Mr. Peckham, a very able and experienced apple grower of Watsonville remarked repeatedly: "A wonderful exhibit. Its freedom from blemish is phenomenal."

Do Exhibitions Pay?

These expositions cost money and work galore, but they pay big. These have made Sebastopol famous beyond the limits of the State. They have advertised the excellent Gravenstein apples throughout the entire country, and best of all, they have taught the growers how to excel in growing and packing their fruit. They have demonstrated the wisdom of each locality studying to find the fruit best adapted to the region and then uniting to push that to the very forefront.

County Horticultural Commissioner.

This exhibition emphasizes the value of a competent county horticultural commissioner. Mr. Galloway, the ex-commissioner, and Mr. Bremner, the present official, have certainly demonstrated the value of this office. Except for wise suggestion and advice the orchards of Sonoma County could not show such exceptional fruit as was shown at the exposition just closed in Sebastopol.—A. J. Cook.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent, State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

CITRUS FRUIT INSECTS.

The Black Scale.

The black scale is our worst enemy of the citrus tree. The adult scales are black with a distinct "H" on the back, and are from one eighth to one fourth of an inch in diameter. They lay their eggs mostly during the months of May, June and July, although they may sometimes be found in all stages at this time of year. The young scales are most abundant from September to December. The young scales feed principally upon leaves shifting to the limbs as they become larger. The injury by this scale is partly that caused by the excretion of honeydew which furnishes a medium for the black-smut fungus which covers the fruit and leaves, causing much damage. Injury also results from decay, due to the vigorous washing the smutty fruit must receive in order to improve its appearance. The black scale occurs throughout the State, but is more abundant along the coast. It attacks all citrus trees, the olive, apricot, grape, oleander, almond, pear, etc. It is best controlled by fumigation on citrus trees. Fumigate with one half to three fourths schedule, between September and January, the one half schedule being used when there is an even hatch when the scales are very young. The time to fumigate will depend on the evenness of the hatching period. The orchardist should fumigate at the time that all the eggs are hatched and the young have not yet become well grown. On deciduous fruit trees and olives, spray before the scales have become half grown, with water, distillate, caustic soda, mechanical mixture or distillate emulsion. The formula for the former spray is as follows:

Water	200 gallons.
Caustic soda (95 per cent)	7 pounds.
Distillate (28 degrees Baumé)	10 gallons.

Fill the spray tank with the water and then add the caustic soda, which has previously been dissolved in a small amount of water and add the distillate; agitate thoroughly.

The formula for the distillate emulsion consists of:

Distillate (28 degrees Baumé)	20 gallons.
Whale-oil soap	30 pounds.
Water to mix	12 gallons.

Dissolve the whale-oil soap in water, heating it to the boiling point, then add the distillate; thoroughly agitate while the solution is warm. For use add to each gallon of the above mixture twenty gallons of water.

It is better to spray the deciduous trees after the leaves have fallen, and the olives after the fruit has been picked. For equipment, procedure, details of fumigation, etc., the reader is referred to pages 318 to 336 of Nos. 1 and 2, of Vol. II, Monthly Bulletin of the State Commission of Horticulture, by E. O. Essig. Do not fumigate under 36 degrees Fahr., or over 70 degrees Fahr.

The Red Scale.

Another destructive scale enemy of the citrus is the so-called red scale. This scale is reddish, circular and flat, and the females are from one sixteenth to one eighth of an inch in diameter. The young are usually produced from June to September, or even longer in milder sections. It is distributed throughout the southern citrus belt, particularly in San Diego, Orange, Los Angeles, Riverside, San Bernardino and Santa Barbara counties. Fumigate with Schedule No. 1, made by R. S. Woglum of the United States Bureau of Entomology. This dosage consists of one and one half ounces of potassium cyanide, one and one half fluid ounces of sulphuric acid and four and one half fluid ounces of water to every 100 cubic feet of air space.

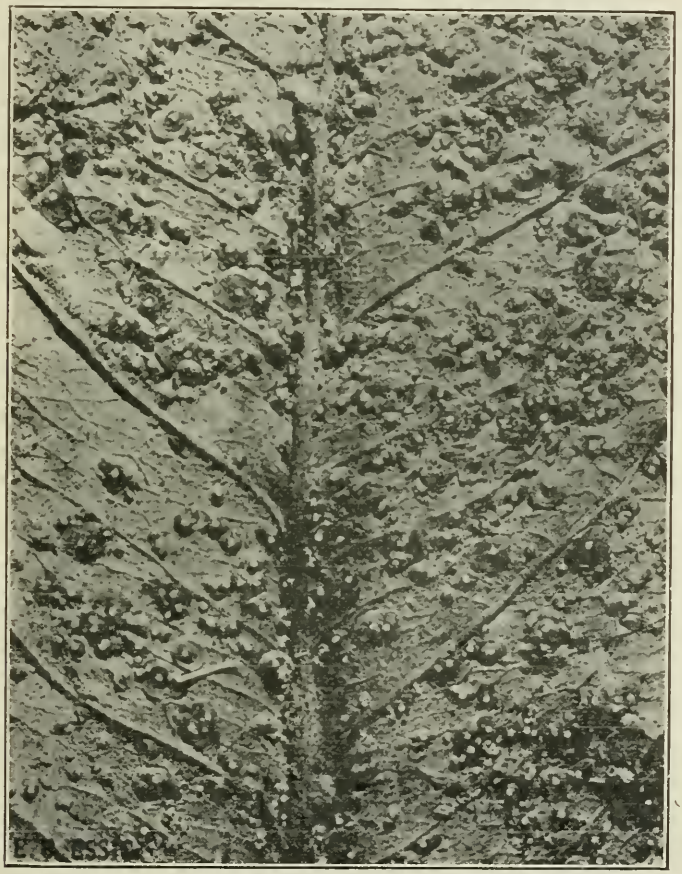

FIG. 88.—Yellow Scale, *Chrysomphalus citrinus* Coq. on orange leaf. (After Essig.)

The Yellow Scale.

This scale resembles the red scale but is more yellow in color, lies flatter upon the leaf and is sometimes larger in diameter. The red scale attacks all parts of the tree while the yellow scale attacks almost entirely the leaves and fruit. The yellow scale occurs throughout the entire citrus growing sections of the State. The method for control is the same as that for the red scale.

The Purple Scale.

The purple scale attacks the leaves, branches and fruit of the citrus tree, causing the branches to die and the leaves to drop. The female scales are long and oyster shaped, and vary from one sixteenth to one eighth of an inch in length. The covering of the scale varies from a reddish brown to purple. Fumigate with full Schedule No. 1, consisting of one and one half ounces of potassium cyanide to every 100 feet of cubic space, or three fourths of this dosage for sodium cyanide, this being done when the black scale is in the right stage to be destroyed.

FIG. 89.—The Citrus mealy bug, *Pseudococcus citri* Risso., on lemon, twice enlarged. (After Essig.)

Citrus Mealy Bug.

The citrus mealy bug is a soft bodied mealy coated sucking insect about one fourth of an inch in length in the adult stage. The female deposits large numbers of eggs in a cottony mass. It is distributed over the entire State, but is a pest in only a few localities, notably Ventura and San Diego. The mealy-bugs attack all parts of the tree, particularly the fruit. They may cluster on the fruits and even will be found in the navel ends of the oranges. The mealy-bugs give off large quantities of honeydew which furnish a medium for the black smut fungus and render it necessary for the fruit to be washed. Some of the fruit is lost through decay, as a result of the vigorous washing and cleaning which it must go through after having been covered with the honeydew. The insects are most abundant during the spring and

fall periods. The best method for controlling this pest consists of spraying the trees with a carbolic acid emulsion spray. This should be applied during the winter or in the spring when the young mealy-bugs are hatching. Fumigation will destroy many of them, but is not recommended unless the grower is endeavoring to treat the trees for the red, yellow, black or purple scales, at which time many mealy-bugs will be killed.

Errata.

On pages 293 and 294 of Volume III, No. 7, of the Monthly Bulletin, the spray formula for the hop aphis and the red spider on hops should have read "flour paste four *gallons*" instead of "flour paste four *pounds*."

THE MONTHLY CROP REPORT—JULY, 1914.

Compiled from reports sent in by the County Horticultural Commissioners, by Geo. P. Weldon, Chief Deputy State Commissioner.

County	Almonds	Apples	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (drying)	Peaches (shipping)	Pears	Prunes	Walnuts
Alameda	70	#	#	#	#	#	#	80	#	#	75	45	#
Butte													
Colusa	100	#	100	#	#	#	75	75	75	#	100	35	#
Contra Costa	30	80	#	#	#	#	#	20	#	80	35	35	80
El Dorado	#	80	#	#	#	#	#	100	#	100	75	#	#
Fresno	100	#	100	100	100	100	100	95	95	95	#	#	#
Glenn													
Humboldt	#	90	#	#	#	#	#	#	#	100	75	#	100
Imperial	#	#	75	#	#	#	#	#	#	#	#	#	#
Kern	#	60	#	#	#	100	100	100	100	100	60	85	#
Kings	#	#	#	#	#	#	#	120	120	120	#	120	#
Lake	100	100	#	#	#	#	#	#	100	#	40	35	100
Los Angeles	100	100	100	75	75	100	90	100	100	100	100	#	85
Madera	50	—	100	#	#	100	#		95		#	100	
Mendocino		100						100	100	100	80	50	
Merced	100	—	100	#	#	100	#	40	40	50	100	100	—
Modoc	#	65	#	#	#	#	#	30	30	30	75	#	#
Monterey	50	60	#	#	#	#	#	#	#	60	75	50	#
Napa	70	100	#	#	#	#	#	90	90	90	40	25	#
Nevada	100	100	90	#	#	#	100	100	#	100	100	75	100
Orange	#	40	#	100	120	—	80	#	#	25	#	#	60
Placer	25	60	#	#	#	75	75	90	#	90	75	#	#
Riverside	90	75	#	100	90	25	75	85	90	#	#	50	100
Sacramento	30	100	#	100	100	100	100	90	#	90	75	20	#
San Benito													
San Bernardino	#	55	#	95	85	65	75	80	80	80	65	#	80
San Diego	#	85	#	90	30	70	90	#	#	65	90	#	#
San Joaquin	30	#	#	#	#	#	#	100	100	100	40	35	#
Santa Barbara	#	100	#	#	100	100	100	#	#	100	100	#	60
Santa Clara													
Santa Cruz		75									90	80	
Shasta	#	90	90	#	#	100	#	90	90	90	75	20	#
Siskiyou													
Solano	60	#	#	#	#	#	#	90	90	90	25	40	#
Sutter	75	75	100	#	#	100	#	60	90	75	60	75	#
Sonoma	50	80	#	#	#	90	#	80	80	80	80	30	100
Stanislaus	100	90	90	#	100	100	100	90	90	90	50	75	100
Tehama	100	100				100			80	80	80	40	
Tulare	90	80	100	80	80	100	80	100	100	100	90	80	#
Ventura	95	100	#	90	104	100	80	#	#	#	#	#	80
Yolo	65	#	75	#	#	75	#	65	65	75	50	40	#
Yuba	70	70	100			100		75	75	75	70	50	

Figures in table indicate condition of crop in per cent on the basis of 100 per cent as normal.

#Crop is not grown sufficiently in a county for a report.

—The county horticultural commissioner has insufficient information for a report.

All blank spaces indicate a failure on the part of a county horticultural commissioner to report in time or in the required form.

CROP STATISTICS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Much time the past year has been spent gathering statistics on the production of fruits, but as yet there is very little accurate information that can be given for the entire number of fruit producing counties. The report showing conditions of crops which has been issued each month of the season should be supplemented by a report showing what proportion of the different fruits each county produces. It is found to be an exceedingly hard matter to secure these data, but with the co-operation of the county commissioners, fruit exchanges, railroad companies, express companies and others it is hoped that something of value along this line can soon be published. This month we have endeavored to complete such a report relative to almonds, and while it is not scientifically accurate it at least gives the stranger some idea of where the almonds of California are grown on a commercial scale. As fast as approximate figures on production of other fruits can be obtained like tables will be compiled. We are all inclined to over-estimate the production and while it is probably true that our orchards are not, on the whole, producing what they should, yet in compiling statistics we must take the average, even though it may fall far short of the maximum representing orchards of the better growers.

ESTIMATED PER CENT OF THE TOTAL CALIFORNIA ALMOND CROP GROWN IN EACH OF THE MAIN PRODUCING COUNTIES.

County	Per cent
Alameda	#
Butte	.12
Colusa	.03
Contra Costa	.12
Lake	#
Los Angeles	.02
Madera	#
Merced	#
Napa	#
Placer	#
Riverside	.03
Sacramento	.12
San Joaquin	.17
Santa Clara	#
Solano	.05
Sutter	.11
Stanislaus	.03
Tehama	#
Yolo	.14
Yuba	#

#Less than 2 per cent of State's total crop grown in county.

INSECT NOTES.

The minute false chinch bug, *Nysius angustatus minutus* has been sent to this office recently for identification, from Placer, Shasta and Santa Barbara counties. In the latter county they were found by County Horticultural Commissioner Beers, attacking the foliage of young peach and apricot trees. This insect quite frequently becomes troublesome at this season of the year, feeding on potatoes, tomatoes and other garden vegetables.—GEO. P. WELDON.

The pear leaf russet mite, *Epitrimerus pyri*, has been taken quite commonly on pear trees this summer. The first report of this pest in California was made in The Monthly Bulletin, Vol. II, No. 9. At that time it was known only in San Diego County. Since then it has been found in Contra Costa, Sonoma, Modoc, Yolo, San Joaquin and Fresno counties, so its range of distribution is apparently quite general. In Fresno County Mr. Fred Roullard, the recently appointed horticultural commissioner, showed the writer some mounts of this mite that he had taken on peach leaves. On July 16th a few mites were collected on peach by the writer, in the vicinity of Fresno.—GEO. P. WELDON.

Tetranychus simplex (Banks). This species of red spider has been identified for us by Mr. Banks, from material sent to him from Sacramento, where it is damaging cypress, maple and other shade trees.—GEO. P. WELDON.

Tetranychus bimaculatus, the common red spider of the orchard, has been injurious to prune and almond trees since about July 1st. Previous to this time the almond mite, *Bryobia pratensis*, was the most common species in the orchards.

The woolly aphis, *Schizoneura lanigera*. This pest is of very common occurrence on the roots of Bartlett pear trees. A recent infestation was found in Sutter County. —GEO. P. WELDON.

The black scale, has recently been reported by County Horticultural Commissioner C. W. Beers, of Santa Barbara County, as occurring in exceptional numbers on walnut trees in the Goleta district. He states that the infestation is the heaviest ever observed and that it is confined principally to the small limbs, none having been found on either the nuts or foliage. In many counts in hundreds he found that over 90 per cent are parasitized with *Scutellista cyanea* (Motsch.) both larvæ and pupæ occurring July 14th, when the observations were made.—E. O. ESSIG.

The alfalfa looper, *Autographa gamma californica* (Speyer), has been very abundant this year in the central part of the State.—E. O. ESSIG.

The Eastern peach tree borer, *Sanninoidea exitiosa* Say, has been taken in a peach orchard near Escondido, San Diego County, California, by Mr. H. A. Weinland, county horticultural commissioner. The infestation is small and appears to be the first report of an orchard infestation of this pest in California.—E. O. ESSIG.

The California peach tree borer, *Sanninoidea opalescens* Edw., has been discovered in the Upper Ojai Valley, Ventura County, California, by R. S. Vaile, county horticultural commissioner, and at Banning, Riverside County, California, by D. D. Sharp, county horticultural commissioner. Both infestations are limited to small areas.

The pubescent hoplia, *Hoplia pubescens* Lec., was recently taken (July) in large numbers in the Yosemite Valley, feeding upon the blossoms of the azalea (*Rhododendron occidentale*) and the yarrow (*Achillea millefolium*).—E. O. ESSIG.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

County Horticultural Commissioner Kerchival of Sacramento County and his assistants recently conducted a spraying demonstration with atomic sulphur, for the control of the almond mite (*Bryobia pratensis*), and red spider (*Tetranychus bimaculatus*). The orchard selected was in the Orangevale section, where the presence of these mites has resulted in considerable damage to the crop. A goodly number of orchardists was present to witness the demonstration. An examination of the sprayed trees by Mr. Kerchival and the writer, ten days after spraying, showed that the treatment had been very effective. No living brown mites were seen on sprayed trees, and only a very few immature forms of the red spider, but dead ones were abundant. Unsprayed trees in the same orchard have a severe infection of the latter pest, as well as much of the brown mite.

Farm Adviser and County Horticultural Commissioner Hecke, of Yolo County, assisted by his deputy, Mr. Searls, is carrying on a pruning experiment with apricots at Winters. In this famous apricot section there has been developed a low, wine glass shaped type of tree, which possesses several advantages. The fruit is easily picked from such trees, it ripens early because the sun has a chance to reach it, and spraying is greatly facilitated. There has, however, been some complaint of serious sun scald, too much water sprout growth, and a low tonnage because of the practice. Mr. Hecke desires to find out for certain in regard to some of the points of contention. Some trees will be summer pruned only, others will be pruned in the dormant season. Very heavy pruning will be compared with lighter pruning, and the best type of tree possible will be developed. This work is certainly commendable and results should be of interest to apricot growers everywhere.

County Horticultural Commissioner Rutherford, of Modesto, reports a melon blight to be very common on vines of his county. The trouble occurs principally on fields that have been cropped to melons for several consecutive seasons.

A recent visit to Fresno County convinced the writer that the new commissioner, Fred P. Roullard, is awake to the great opportunities for service in his county. His office has been equipped in splendid shape, reorganization of the work has begun and is being aided greatly by the supervisors.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF JUNE, 1914.

By FREDERICK MASKEW, Chief Deputy Quarantine Officer, San Francisco, California.

SAN FRANCISCO STATION.

Horticultural imports.

		Parcels.
Ships inspected	55	
Passed as free from pests		50,165
Fumigated		1,940
Destroyed or returned		274
Contraband destroyed		17
Total parcels horticultural imports for the month		51,369

Horticultural exports.

Inspected and certified	253

Pests Intercepted.

From Bogota.

Isosoma orchidearum, Diaspis boisduvalii and larvæ of *Thrips* sp. on orchids.

From Guatemala.

Diaspis boisduvalii on *Cactus* sps.

From Honolulu.

Diaspis bromeliae and Pseudococcus sps. on pineapples.
Cryptorhynchus batatæ in sweet potatoes.
Larvæ of *Dacus cucurbitæ* in cucumbers.
Hemichionaspis minor and *Pseudococcus* sps. on green cocoanuts.
Coccus longulus on betel leaves.
Asterolecanium sp. on *Hibiscus* cuttings.

From Japan.

Fungus on oranges.
Larvæ of weevil in sweet potatoes.
Parlatoria sp. on maple tree.

From Louisiana.

Lepidosaphes beckii on limes.

From Oregon.

Epochra canadensis (larvæ) in gooseberries.

From Philippine Islands.

Chrysomphalus rossi, Saissetia hemispharica and *Pulvinaria* sp. on orchids.

From Tahiti.

Ortalididæ in cocoanuts.
Lepidosaphes beckii and *Morganella maskelli* on oranges.

LOS ANGELES STATION.

Horticultural imports.

		Parcels.
Ships inspected	28	
Passed as free from pests		38,022
Fumigated		21
Destroyed or returned		4
Contraband destroyed		1¾
Total parcels horticultural imports for the month		38,048¾

Pests Intercepted.

From Costa Rica.

Aspidiotus cyanophylli and *Pseudococcus* sps. on bananas.

From England.

Hemichionaspis aspidistræ on kentia and robelinia palms.
Pseudococcus longispinus on *Taxonia exoniensis.*
Lonicera hilderbranta and *Vitis rhomboides.*

From Honduras.

Aspidiotus cyanophylli, Chrysompnalus scutiformis, Icerya sp., *Pulvinaria* sp., *Pseudococcus* sps., coleopterous larvæ, *Mantis* and mantis eggs on bananas.

From Mexico.

Aspidiotus cyanophylli. Aspidiotus cydoniæ, Chrysomphalus scutiformis and *Pseudococcus* sps. on bananas.

From Panama.

Aspidiotus cyanophylli, Chrysomphalus scutiformis and *Pseudococcus* sps. on bananas.

From Pennsylvania.

Aphids on roses.
Aspidiotus hederæ, Aspidiotus lataniæ, Chrysomphalus aonidum and *Cerataphis lataniæ* on kentia palms.
Cerataphis lataniæ on robelinia palm.
Pseudococcus sps. on crotons and cycads.

From Texas.

Alcyrodes citri and *Ceroplastes* sps. on cape jessamine.

SAN DIEGO STATION.

Horticultural imports.

		Parcels.
Ships inspected	29	
Passed as free from pests		3,798
Fumigated		2
Destroyed		1
Returned		0
Contraband		7
Total parcels horticultural imports for the month		3,808

Pests Intercepted.

From Texas.

Ceroplastes floridensis on jessamine buds.

From Central America.

Aspidiotus cydoniæ, Aspidotus cyanophylli, Pseudococcus sps., *Saissetia hemispharica, Chrysomphalus scutiformis* and undetermined *Diaspinæ* on bananas.

From New Jersey.

Pseudococcus longispinus on ornamental plants.

From Michigan.

Aphis sps., on ornamental plants.

From Mexico.

Lepidosaphes beckii, Chrysomphalus scutiformis, Saissetia oleæ and *Drosophiladæ* on oranges.

EUREKA STATION.

Ships inspected 11
No horticultural imports.

SANTA BARBARA STATION.

No horticultural imports.

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STATE COMMISSION OF HORTICULTURE

September, 1914

THE MONTHLY BULLETIN

VOLUME III No. 9

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

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THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. III. September, 1914. No. 9.

FRUIT SOILS OF THE GREAT INTERIOR VALLEY.

By J. W. Nelson, University of California.

Address before the State Fruit Growers' Convention, Davis, Cal., June 1–6, 1914.

This is a broad subject, and there are so many important details which have not been worked out yet, all having an important bearing on the relation of soil types to fruit varieties, that we can only deal with a few generalities.

When we discuss an area as large as the Great Interior Valley, we are dealing with a territory equal in extent to about three fourths of the tillable land of the entire Empire of Japan.

To get an idea of the future possibilities of this remarkable region, with its equally wonderful climate and wide range of soils, we only need to compare it with what has already been accomplished in that country. That empire has a total area of 147,000 square miles, 10,000 less than the State of California. Of the total area, only 21,000 square miles is tillable, yet that empire supports a population of 50,000,000 people and 2,600,000 horses and cattle. Taking into consideration that part of the empire which is tillable, we note that each square mile of good soil supports 2,277 people and 125 horses and cattle. Imagine this density of population in the Great Interior Valley and you have an idea of the system of agriculture necessary to support it. The time is far off when this valley will be so densely settled, but we are very slowly approaching it, and it seems wisdom to so acquaint ourselves with the finer and more business-like side of agriculture in order that we may obtain the fullest returns from nature's storehouse, the soil.

Strange to say, investigators have, in practically every instance where information on fruit growing has been given out, either completely ignored or only very briefly mentioned the soil factor as having a bearing on fruit culture. If you will observe, I think you will note that about nine tenths of the publications dealing with fruit growing do not have more than from five to twenty lines dealing with the soil factor. This is either because of a too limited knowledge of soil differences and their bearing on fruit culture, or because the soil type has not been recognized as having much influence on the qualities and yield of fruit. To this end we are outlining, mapping, and studying the numerous kinds of soil in this great valley, for it is recognized by every well informed person that there are many kinds of soils, and each soil difference has its bearing on the type of agriculture possible.

About half to two thirds of this valley has now been mapped, and we have found that the range of soil types is greater than in almost any similar region in the United States. This unusually wide range of soils permits of the growing of a much greater variety of fruits and other products than if there were only a few kinds present. The soil types are numerous enough to permit of the growing of any kind of fruit possible in the climate, but all varieties can not be expected to be equally successful in any part of the valley and on any kind of soil. In our studies in this State, and elsewhere in the United States, we have observed that each kind of fruit, like other crops, has a soil and climatic environment in which it reaches its greatest perfection, and when grown on a type differing greatly from that to which the variety had adjusted its functions of growth, failure frequently results and one or more of the essential qualities is missing or is replaced by other inferior or superior ones. So if we have a desirable variety possessing qualities which we wish to retain, we must grow the variety in a soil and climate like or nearly like those in which it obtained its desirable qualities. In the past we have been concerned with quantity mainly in fruit production, and as long as that idea prevailed, little real improvement could be made. The future demand will deal with quality, more all the time, and when this takes precedence, the influence of the soil type will be carefully studied before each planting. To illustrate: A very high quality syrup of light amber color and closely resembling maple syrup is produced in Wisconsin on a type of soil called Coloma sand. The acid nature, very low humus content, excessive drainage, high quartz content, and loose incoherent condition of this type appear essentially important to the high quality of the syrup produced, for when the sorghum is grown on other types of moderate to high humus content or even on the same type when organic matter or lime is added, the syrup produced is of dark color, different in flavor, much less desirable and commands a much lower price in the market. This is one of the many products now produced where quality entirely determines its commercial value and in which the soil type is the controlling factor.

To illustrate further I will cite you to a case in the State of Delaware. While working on the relation of fruits to soil types in that state, it was observed that certain farmers were making large amounts of money producing certain varieties of strawberries, while adjoining neighbors were losing money with the same varieties although they were equally diligent in the care given the crops.

Two soil types were present, namely, the Norfolk sandy loam and the Portsmouth sandy loam. The former is a well drained brown soil, moderate to low in humus, quickly warmed up in springtime, and occupies a position from one to several feet higher than the latter. The Portsmouth sandy loam is a low, damp, cool, black soil, very high in humus. The Gandy berry thrives and develops unusually desirable qualities on this soil, but becomes a miserable failure on the Norfolk soil. The Parson's Beauty, Chesapeake, and one or two other varieties reach great perfection on the well drained, warm, moderately fertile Norfolk soil, but fail on the low, damp, cool Portsmouth type.

Farmers did not know the cause for this and kept on trying to grow the Gandy, a most attractive market variety, on the Norfolk

sandy loam and thousands of dollars were lost every year for years in this attempt alone. After a careful observation of the soils present, it was decided to trace out the origin of the Gandy variety and see, if possible, why it was so partial to a certain kind of soil and so sensitive to others. After some time the variety was traced to New Jersey, and it was discovered that the first seedling had originated on the same type of soil on which it was thriving in Delaware. This led to the same method for several of the other favorite varieties grown there, and in each instance the variety was found thriving best on soils in Delaware which were identical, or nearly so, to those on which it was first discovered. With this information, growers in Delaware learned that it was the soil type which determined the qualities and commercial success of berry growing, and thereafter the soil was more fully considered than before.

We are living in a world of variation and it is dangerous to make strong, positive statements for general application about almost anything. It is this variableness which makes life interesting, and were it not that changed environment changes characters in the plant kingdom, there would be a veritable monotony and the earth would not be fit for the range of animal life now extant upon its surface.

Man has taken advantage of this condition in the plant world, and has encouraged and grasped the advantageous qualities until to-day we have an astonishing array of the most delicious eatables imaginable. There is nothing fixed, however, and no permanent qualities can be said to characterize a fruit universally. We are dealing with groups of characters which, when a set appears to be quite stable in a given locality, we call the fruit possessing that group a variety. All leading horticulturists and observing men are agreed that when a variety is transferred to several different locations and to soils and climate of marked difference, that there is a marked change in one or more of the characters which go to make the variety. So we come to the point: what constitutes a variety? If it is a group of constant or fixed characters or qualities, then does not the changing of one or more of them or the addition of new ones or the subtraction of known qualities constitute a change in the variety, and is it technically the same variety in all places? There are some varieties of fruit which are so changed in a number of important qualities that they can scarcely be recognized as the same kind when placed on widely different soils and with a different climate. A set of qualities is fixed only so long as the soil and climatic environment remain unchanged, and those qualities which mark the variety where first discovered are generally used as determining factors which characterize the variety of fruit.

Plant varieties propagated in the same environment by the vegetative method appear to be remarkably constant, but the qualities are noticeably changed when the propagation is made on entirely dissimilar soils. Such a change fixes the qualities so long as the environment remains unchanged, and it frequently determines the usefulness of the variety in the commercial world.

The power of man makes the variety useful by his ability to recognize and encourage the bringing out of desired qualities. He does this by placing the fruit in an environment where every condition is as favorable as possible for the bringing out of the greatest

combination of desirable qualities. In most instances nature does the opposite, for there is a survival of the fittest, and if left to nature the conditions don't remain as favorable for the continual development of the big, luscious peach or apple as they do for the small, hard, undesirable, thin-fleshed individuals, and in time the former succumbs. This is what occurs if a variety is left to go wild. We are after the desirable qualities, and we want to know every factor which bears on them so that we can combine them in such a way as to obtain the best possible results.

Of the controlling factors, climate and soil stand out pre-eminently, and of the two, the latter has only received a passing consideration. It is impossible to change the climate, but we can place each variety of fruit in a soil environment which will encourage and bring out the desirable qualities if we study the plant's needs carefully.

Very much has been accomplished in plant breeding in past years and a great amount of valuable information has been obtained relative to the development of desirable varieties of fruit and in working out the causation of those attractive qualities which most nearly approach the ideal of the most fastidious taste.

Thousands of varieties of fruit have been developed and recommended for all regions of suitable climate on the ground that fruit varieties remain constant and are little influenced by the soil type. The influence of environment has not been properly consulted in commercial plantings in the past, however, and thousands of dollars and much valuable time have been wasted for each variety. Breeding and accidental discovery are responsible for varieties, but climate and soil determine the commercial importance of the product. Of these two powerful factors, climate has hitherto been stressed most, and while no one will assert it is not the controlling influence in the latitudinal distribution of fruits, yet in the same latitude where the climate is uniform, this factor can not be said to account for the wide difference observed in the character and development of different varieties of the same species of fruit.

The soil has always received a passing consideration as a factor associated with the food and water supply of fruits, but further steps of scientific study have been difficult because of our limited knowledge of the various kinds of soil present in any region. Furthermore, when soil influences were noted in the past, it was difficult to obtain proper correlations and scientific reasoning along these lines, because the limits of certain soil characteristics were not outlined and little progress could be made.

We are now coming to realize more fully that the soil is the fundamental basis of fruit culture. It is the medium in which the organic and inorganic kingdoms meet. In it, biochemical forces are in active operation under normal conditions and the resultant of these forces in connection with the physical properties of the soil, furnishes the environment in which plant life must develop. It is the medium in which plant roots must receive their food and drink, and it is not unreasonable to suppose that when a plant has become accustomed to receiving its nourishment in a definite manner, that its functions will be upset and it will have to suffer a readjustment when that supply of food is greatly increased or diminished, or when radical changes occur in the physical properties of the soil.

It is for these reasons, and to furnish a basis for future study and experimental work, that the soil survey was started and our active operations along this line in this State now are to place fruit growing and other forms of agriculture on a more stable basis, and to make the observations of scientific discovery more valuable. We have encountered about forty series or different groups of soil in the area under discussion, each group containing several types or kinds of soil. Each of the hundred or more types or kinds of soil possesses certain mineralogical, biological, chemical, organic or physical properties peculiar to itself, and study and observation indicate that many of these factors, singly or in combination, are of sufficient magnitude in most of the types to determine the kinds of fruit to which they are best adapted. The exercise of greater intelligence in fruit production in the future will bring forth a greater demand for quality and then the influence of the soil type will become more prominent. It will be noted, as has already been done in numerous instances, that each kind of soil is best suited to a particular variety or varieties of fruit, and each variety will reach its highest quality only when grown in a definite soil environment. Hence, the necessity of knowing the limits and bounds of the different kinds of soil in order that we might work to this end.

A more general recognition of the individuality of soils and fuller realization of the true meaning of soil differences is greatly needed. Much time and money have been wasted in trying to grow the same variety of fruit on entirely dissimilar soils, and many of the seemingly unexplainable results obtained were undoubtedly due to fundamental soil differences which would have been evident had the soil factor been given proper consideration. An example to illustrate this was recently brought to my attention. An elaborate chemical examination was made in one of the states of a number of varieties of fruit to find out what influence irrigation had as compared with non-irrigation on the various qualities of the fruit. The samples of fruit were collected from all parts of the State, and certain results were obtained which were attributed solely to the amount of water given the trees and no attention was paid whether the soils on which the fruits were grown were highly calcareous, high or low in humus, highly fertilized or not, soils of naturally high or low fertility, or the amount of sunshine present in the different places when the fruit was ripening.

The soil environment in which a variety has been developed, whether it be a clay or a sand, calcareous or acid, high or low in humus and plant food, humid or arid, determines largely the quality of the fruit and the kind of habitat in which the variety may be expected to thrive best, if transferred to a new home. To illustrate: If we are contemplating moving a certain variety of fruit from a clay from one part of the great interior valley to some other part, we must first carefully examine the soil on which the variety has been growing and giving good satisfaction, and then we must find a clay of similar characteristics for the new abode. Any clay will not do, because there are calcareous clays, others with only a moderate to small amount of lime present, some unusually high in humus, others moderate to low, some with a calcareous hardpan not far below the surface, others with a funginous hardpan, and others with no hardpan at all. Some are poorly drained, some affected with alkali, some naturally well drained and which have been in a good condition for

favorable bacterial activities and oxidizing processes for long periods. So it can be readily seen that even though the variety to be introduced is adapted to a clay soil, it is very necessary to know just what the nature of the clay is on which the variety has developed its desirable qualities, and then transfer it to the new home where the soil is as nearly like that of its native habitat as possible.

The above differences mentioned for clays hold for the adobe soils, and, in fact, for all of the leading types recognized in the great valley. Hence, you will see the necessity of outlining the different kinds of soil so fruit growing and experimental work can be placed on a scientific basis. In regions where such information is not available regarding soils, it is not uncommon to see farmers planting all kinds of fruits on all kinds of soils, and much loss of time and money have resulted each year. In numerous cases, orchards have been located on poorly drained soils, or where alkali is present and on soils entirely opposite in their properties to those on which the variety was developed. If a dense subsoil were present at one or two feet below the surface, the trees would thrive for a few years or until the roots reached down into the unfavorable subsoil below when the thrifty young trees would decline rapidly, and in many instances the entire orchard would become worthless. Such experiences in many places have been the rule rather than the exception, especially in newly settled regions.

Generally speaking, our observations indicate that heavy black soils high in humus are not as well adapted to the growing of deciduous fruits, except possibly figs, and pears, as are the gray, brown and red soils. The silt loams, light loams, sandy loams and loamy sands produce the best colored and flavored peaches. Heavy loams, clay loams and clays produce a heavy growth of wood and a dense dark green foliage. Furthermore, heavy textured soils in this State are usually waterlogged during the rainy season, and such a condition from one to three months each year is harmful to peach trees. Trees on such soils tend to become shy bearers and the dense foliage keeps out the sunlight, and frequently a poorly colored and flavored peach results. The natural home of the peach is on a sandy soil, and the tree has so adjusted its functions of growth and bearing to a somewhat restricted food supply that the desirable qualities can only be best developed when the trees are grown on the lighter types. The use of root stocks which thrive in heavy soils, however, may extend the range of soils somewhat on which this delicious fruit may be successfully grown.

So it is with grapes, as is evident when the same variety is planted on widely different soils in the great valley. When so much damage was done to grape growing in France, you will remember how experts searched the United States for a phylloxera resistant stock which could be used in France. Numerous stocks were tried, but they all seemed to fail when transferred to the highly calcareous soils of France. It finally dawned that a stock must be sought which had accustomed itself to soils high in lime, and after considerable search such a stock was found in Texas. Now had the grape industry of France developed on an acid soil, a resistant stock would have been sought elsewhere which had accustomed itself to an acid soil environment. Careful study of the soils of the interior valley will reveal the fact that to obtain certain desirable qualities for table use or wine making, the

varieties will have to be grown on a certain soil and in the discussion following, I shall be glad to hear the expression of growers on this point. Our work has not progressed far enough yet to have all of the data bearing on this issue available, but we are planning a careful and detailed study of this important question as soon as our soil survey has covered the main fruit soils of the State.

For olives, the brown or reddish brown loams, gravelly loams and heavy sandy loams with good drainage, freedom from alkali, no hardpan within three and one half feet of the surface, of medium fertility and not high in humus, located within a few miles of the margin of the valley, approach most nearly the ideal soil for olive culture. Olives will grow well and produce paying crops on medium to light textured soils elsewhere in the valley, but the greatest harmony between soil and plant appears to be obtained on the soils mentioned above.

For figs, the fine sandy loams and silt loams along the stream bottoms where the soils are of moderate fertility, well drained but not doughy, free from alkali, of moderate humus content and friable to several feet deep, produce the most vigorous and long lived trees, with very satisfactory bearing qualities. The upland, or older valley plains soils, such as deep, friable, sandy loams to heavy loams, are almost equal to the river bottom soils for fig culture and give most excellent results. The black clay adobes are used to some extent in parts of the valley, and in certain instances, quite satisfactory results are obtained. The trees are generally slow to start in such soils and in many places large parts of the orchard have had to be reset three or four times to get the trees started. The industry on such soils is questionable.

For almonds, the well drained sandy loams, loams, and light clay loams of moderate fertility on moderate to good slopes, deep and friable open subsoils, moderately retentive of moisture with a leaning toward the lighter types, closely approach the ideal soil for this crop. Low, damp, cool soils, those with heavy clay subsoils, and high humus content, should be avoided for this crop if the greatest commercial success is desired.

For prunes, the loams, silt loams, clay loams, and silty clay loams, with good soil drainage and friable subsoils, both on the valley floor and foothill slopes, rank first for this crop.

Cherries do best along the valley margin where protected from unfavorable exposure to heat and wind and on sandy loams, loams, and silty clay loams and gravelly loams where the soils are deep, friable, retentive of moisture, and on fair slopes, appear to meet the most exacting needs of this product.

Pears find a good home on the river bottom, sandy loams, loams and silty clay loams. They are partial to damp soils and enjoy a moderate to good supply of humus. They will thrive on a wetter soil than most any of the other fruits, but for their best welfare, the soils should not be water-logged. The tendency of this fruit is to favor the heavy types.

The cane and vine fruits are now known quite well and need not be considered at this time. The rare fruits and many new and seemingly valuable introductions give great promise on certain soils, but further study with them is necessary. The root stock used will have an important bearing on the exact soil on which the above fruits will

thrive best, and this important feature must not be neglected in working out the range for each variety.

Our future work will take into consideration not only the species, but detailed information will be sought for each variety within the species and each influencing detail as affected by any phase of the soil factor will be sought, and its relation to the qualities of the fruit will be brought out and with each detail carefully in mind, the returns from future plantings should be nearly doubled in most places.

Another important feature which has a strong bearing on the success of fruit growing, is the nursery stock. In the past, nurserymen have sought the light textured soils for their propagations because of the ease of handling, and as soon as their stock was ready for marketing, it was advertised for all kinds of soil in the State and in many instances, for any soil in any part of the United States. A great loss has resulted from this system and reliable nurserymen are now coming to see that to avoid difficulties in the propagation of the stock, it is necessary that it be propagated on soils similar to those in which the trees are to be placed in the permanent orchard. Example: A young pear tree grown in the nursery in a loamy sand and fed well to show it to be thrifty; when transferred to a heavy clay loam is so seriously upset when transplanted to the permanent orchard that it either dies or is so checked that one or more years is lost before it has been able to adjust itself to the new conditions, and in many instances, an irregular, puny, scrubby orchard results.

A very common practice among farmers at the present time is to purchase new varieties of fruits and seeds wholly on catalogue descriptions or on the advice of some friend, without regard or knowledge of the character of the soil on which the varieties have been developed or successfully grown. The originators of such varieties seldom if ever, think or say anything about the soils from which the varieties were obtained, never thinking perhaps, that the soil type could influence the future tendencies of the plant. These different varieties are thus taken out of their original environment, subjected to a continual round or readjustment to new environments, and as a result, the yields and desirable qualities are kept permanently below a reasonable standard because of the adverse circumstances in which the trees are forced to grow. However, without a classification of the soils, no law of general application can be deduced from the many observed facts, and until soil survey work was taken up, there was no basis for systematic correlation.

During years of study in all parts of the United States on the adaptation of varieties of fruit to soil types, we have found in every case investigated, that each variety has been developed upon quite a distinct soil environment and our studies of the later history of the varieties go to show that they give best results only when grown on soils like or similar to those on which they were developed. In fact, it seems highly improbable that satisfactory results can be obtained in an orchard where there is a medley of soils. Where numerous gradations from sands to clays occur on a tract of land where each body is too small to be used for other varieties, it is desirable to use the field for plants which have a wider range of adaptation and which do not occupy the ground so long. Uniformity of soil type is essential

to the production of a uniform variety of fruit, and hence the necessity of outlining and studying the main kinds of soil in the great interior valley, separately and individually, so that wherever the soil is the limiting factor of fruit culture, it will be possible to learn its possibilities and avoid many of the mistakes of the past.

Not only must we know the performance duty of the trees from which we obtain our stock for grafting, but it must be known for each of the main bodies of soil on which any variety may be expected to be grown and also for the different root stocks used.

The future greatness of the great interior valley lies before it. We have scarcely begun to realize that its wide range of soils and favorable climate permit of the growing of almost every kind of fruit that might be desired, but in order to obtain the fullest possible returns, the most comprehensive system of agriculture available is absolutely necessary and every environmental condition required for the fullest returns from the land must be known. The varieties of plants and seeds grown will be in strict harmony with soil types and climate, and that continual round of readjustment which is now causing the loss of thousands of dollars yearly to the farmers of the State will be eliminated.

THE GREAT BASIN TENT CATERPILLAR IN CALIFORNIA.

(*Malacosoma fragilis* Stretch.)

Order—Lepidoptera. Family—Lasiocampidæ.

By Edwin C. Van Dyke, Department of Entomology, University of California, Berkeley, California

Of the nine species and varieties of the genus *Malacosoma* or tent caterpillars which are listed from North America, seven are to be found on the Pacific coast and five in this State. Our commonest species is *Malacosoma californica* Pack., a hairy, orange colored caterpillar, somewhat over an inch in length, which feeds normally on the live oaks of middle California and occasionally does considerable damage to apple trees. *M. constricta* Stretch, a somewhat larger species having a bluish appearance, because of certain blue lines along its sides, is to be found on our black and white oaks where it sometimes does a great deal of injury. *M. pluvialis* Dyer, a buff colored species of the country west of the Cascades, is the destructive species of the north. It is very injurious to apple trees, often completely defoliating them, and it congregates in such numbers on the alder, its native food tree, that it becomes a decided nuisance, and as a consequence has resulted in certain park authorities taking steps to have all alders removed. A fourth species, *M. fragilis* Stretch, closely related to the above and similar in appearance, has also and recently entered the lists as a destructive and annoying species.

This last mentioned species normally ranges throughout the northern portion of the Great Basin, extending from the Rocky Mountains to the Cascades and Sierra Nevadas, and, according to Dr. Dyer, feeds on the wild gooseberry and wild rose. During the past summer, the caterpillars were to be found in enormous numbers in the territory about Mt. Shasta. The extensive brush areas which are to be found on the southern and eastern slopes and to the northeast of the moun-

tain were throughout much of their territory completely defoliated, and presented a brown and seared appearance. Much of this was dead or dying, and, as a result, quite inflammable. The brush here is composed primarily of two species of Ceanothus, the thick or broad leaved species, *Ceanothus velutinus,* Dougl., and the so-called snow-bush, *Ceanothus cordulatus,* Kell., and these plants seemed to be the preferred food plants. These caterpillars appeared about the first of June and by the middle of the month had made so many silken tents that the brush areas presented the appearance of being covered with innumerable paper bags, sometimes as many as twenty or more being

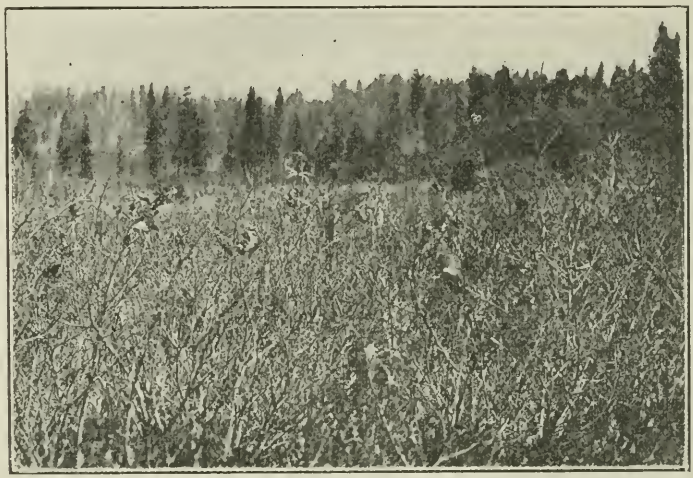

Fig. 90.—Defoliated brush showing tents of caterpillars (*Malacosoma fragilis*), McCloud, Cal. (Original.)

found on a single plant. By about the beginning of July a certain portion had completed their growth and started to migrate. These were soon joined by hosts of undeveloped specimens which had eaten up all of the available food in their neighborhood and were seeking other feeding grounds. They were to be found everywhere on the trails, roads and railroad tracks. They were a decided nuisance, invading the lumber and construction camps and getting into the tents and over everything. They seemed to have a liking for traveling along the railroad rails. Their crushed bodies made the rails so slippery that the engine could not get traction, and as a result caused many delays and much expense, and was a source of great danger, particularly with the heavy logging trains. The railroad authorities of McCloud at first stationed men with brooms on the fronts of the engines, who swept them off. This was fairly successful at first, but later on not so much so because large numbers of the caterpillars were inevitably crushed in the process. Cresol sprinkled along the sides of the roadbed retarded the migrating hosts for but a few moments. Ditches which were being dug about the camps, and were quite effective for a time in keeping out the pests, could not be used by the railroad because of the expense. At last some of the railroad managers devised an arrangement whereby

they could conduct steam from the engine through tubes and blow it forward along the tracks ahead of the train. This was very successful for it cleared the tracks without crushing the insects and at the same time so stunned or killed them that they could not return.

Figure 91 will give an idea of how this apparatus appears. In certain places along the McCloud railroad from Sisson to McCloud the dead caterpillars were so banked up that you could have shoveled them up by the bushel.

The caterpillars though primarily hatching and feeding upon the two species of bush ceanothus, an occasional manzanita and the wild rose and gooseberry where found when once they had eaten up all of their accessible normal food and had become ravenous and been obliged to travel, attacked almost everything. I found them on the "squaw carpet," *Ceanothus prostratus*, Benth., on the wild cherry, the willow, many of which were completely defoliated, and on many cultivated plants. A few of them had been able to get as far as a few apple

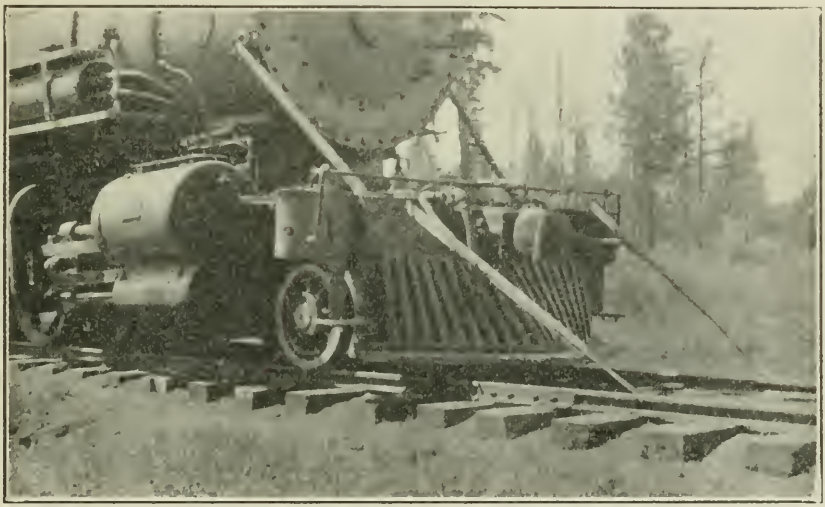

FIG. 91.—Engine with attachment for blowing off caterpillars with steam. (Original)

trees and they were devouring the leaves of these with such relish as their relatives do elsewhere. None, however, seemed to have attacked any coniferous tree. By the second week of July, the developed caterpillars were commencing to spin their cocoons and these yellow cocoons were to be seen everywhere, certain areas of the brush being so sprinkled with them that they were very evident even from the car windows. Numbers of these which I brought home with me hatched, the moths emerging between the twenty-fourth and the thirtieth of July.

The outbreak had apparently for some unknown reason gone beyond the action of the controlling factors. Many of the caterpillars had been parasitized by various species of tachinid flies, the white eggs

[1]For the pictures taken, I am indebted to my friend Dr. Robt. Legge of McCloud who very kindly put himself out for me.

of the same situated on the neck just back of the head, being evident on many. The flies themselves were also to be seen in numbers buzzing about the infested areas. They, however, had made very little of an impression upon them. Not nearly as much, in fact, as they had upon their relative, *M. pluvialis* Dyer, in Washington and Oregon. A few had been parasitized by ichneumon flies. From the thirty-eight cocoons brought home I raised twenty moths, three ichneumon flies and succeeded in getting several puparia of the tachinid flies. In the field, I found that the predaceous beetles, the caterpillar hunters, *Calosoma semilæve* Lec. and *Calosoma luxatum* Say, var. *zimmermanni* Lec. were fairly numerous. They were evidently living well. I also saw a specimen of one of the Sphecidæ or thread waisted wasps, and a large species of Psammophila, carrying off a full grown caterpillar. Other specimens of the same wasp were numerous in the region. The ants were carrying off many dead specimens but I saw no case where

FIG. 92.—Defoliated brush showing tents and cocoons of *Malacosoma fragilis*, McCloud, Cal. (Original.)

an ant had attacked a healthy living caterpillar. Birds did not seem to be attacking them either. Though these various enemies were able to make very little of an impression this year, they perhaps will show their effect in a decided manner next year.

In this same area there occurred three years ago, an outbreak of *Eugonia californica* Boisd., the black and spiny larvæ of which likewise feeds upon ceanothus and the adult of which is a true butterfly. This year only a few caterpillars of this species were to be found and the adults were equally rare. I was, however, told by my friends, Mr. C. L. Fox and Mr. J. A. Kusche, that in the country near Dunsmuir, above Castle Lake and near Mt. Bradley, the larvæ of this butterfly had stripped the bushes of the broad leaved ceanothus, over quite an area. Some few of the tent caterpillars were to be found there also.

NOTE.

There is an important fact in relation to the tent caterpillars and other insects, like the canker worm, that should always be borne in mind. They feed early in the season when the leaves of the plants are

young, vigorous and all working at their best. Defoliation at this time is always serious and may well make us more alert in our efforts to stay the mischief at its inception. Of course, the conspicuous tents make it easy to locate the foe. The hairy caterpillars in this case of the tent caterpillars are distasteful to most birds. In Michigan the cuckoos, the black billed and the yellow billed, feed on these hairy larvæ with a keen relish. Can anyone report any California bird that is not balked by the numerous coarse hairs that are the usual protection of these caterpillars?—A. J. Cook.

SIZE, COLOR AND QUALITY IN FRUIT.

By U. P. Hedrick, Agricultural Experiment Station, Geneva, N. Y.

Address before the State Fruit Growers' Convention, Davis, Cal., June 1-6, 1914.

Appreciation of fruits comes through three of the five senses—taste, sight and smell, though the last is of little importance being so intimately connected with taste as to be almost a part of it. This leaves taste and sight as the senses by which fruits are judged. We grow fruit to eat and it would seem, therefore, that taste should set the seal of approval. Connoisseurs do judge fruit by the sense of taste, but the public, in this as in many other matters, does not march with the connoisseur, and the average person, personification of the public, uses the eye more than the tongue in measuring the merits of fruits. This difference between professional and popular judgment comes about because of a very general misconception of the relative values of size, color and quality in fruit—a misconception which furnishes my excuse for calling your attention, in a popular way, to what I conceive to be the comparative value of size, color, and quality in fruit and for a very discursive consideration of how these attributes may be modified by culture.

When the nurseryman sets his net, in the shape of an illustrated catalog, for the fruit grower, he baits it with gorgeous illustrations showing fruits of heroic proportions. The most frequent descriptive phrase accompanying this alluring bait is, "of largest size." In his turn the fruit grower usually makes an exhibit, or a sale of his wares, with the apologetic yarn that he kept the largest for his own use, or he had larger last year, or he could grow bigger ones if he were so disposed. All this shows a craving after size—a craving that has been bred and is now stimulated by competitive exhibitions in which size is usually given first place. This has gone on for so long that now size is generally esteemed about the highest quality a fruit may possess. This feeling finds expression many times and in many ways at every fruit exhibit to which the public has access. What are the true merits of size in fruits?

In fruits for the kitchen, fair or large size is distinctly meritorious, saving waste in paring and coring or pitting, though even here there are exceptions for one does not want a huge baked apple, a mammoth peach for canning, nor large plums for preserving. But for all dessert purposes the medium sized fruit should be preferred and the Fameuse or the little Lady apple, a Seckel or Doyenne pear, a Crawford peach and a Green Gage plum are, or should be, as acceptable as any

varieties of their kinds. Certainly no one wants to make two bites at a cherry, strawberry, or any of the small fruits. Large size in fruit is often poor economy whether on the fruitstand, in the hotel or for the home, for a small or medium fruit frequently answers the same purpose that a larger one would.

Not always, but often, undue size in any variety is accompanied by inferior quality. This is especially true if size has been brought about by much water in which case the fruit may actually be said to be bloated. The highly flavored solids of the normally grown fruit are diluted or adulterated with water. So, too, extra large specimens of tree or small fruits in which size is attained by high feeding or by such abnormal practices as ringing, usually lack in quality. From all this we must conclude that while a good large fruit may be better than a good small fruit, yet if in the large fruit there is a falling off in quality it at once loses value.

It is true, however, that some of the varieties of our tree fruits might be increased in size to advantage and the value of many grapes and small fruits would be much enhanced by greater size. Thus, it becomes a matter of importance to know how to increase the size of fruits, should we so desire. The task is not difficult. Generally speaking, whatever increases tree growth gives greater size in the product. To be specific, the application of nitrogenous fertilizers, plowing under leguminous cover-crops, frequent and long continued cultivation, these acting singly or associatively will increase the size of fruits. Another way by attaining greater size is by restricting the top of the plant by heavy pruning, thus getting greater growth in the parts that remain. Lastly, most commonly, and best means of all, the size of almost all fruits can be greatly increased by judicious thinning, an orchard operation so generally used that it needs no further discussion here.

The comparative value of color and quality in fruits is a subject of never-ending discussion. We can all agree that both are necessary in first class market fruits, but often a choice must be made between the two. Which then? To my mind there should be no question about the supremacy of quality over color, but consumers discriminate in favor of bright colors. Thus, red apples are preferred to yellow, green and russet varieties—the latter, side by side with red sorts no better in quality, go begging for buyers. Fruit is bought to eat. What a paradox to buy that which is hardly fit to eat because it is brilliantly colored. This unjust discrimination comes about because red is more attractive to the eye of most people and because of a very general misconception that color is correlated with quality. Red apples have thus become the fashion with consumers, and must, therefore, be produced by growers. Are brilliantly colored apples of better quality than those of subdued hues?

Some say that high quality goes with high color—that is, with bright reds, crimsons, or scarlets or in patterns striped with these colors; others say "handsome but poor," indicating a belief in a correlation of high quality and low color. But a consideration of varieties shows at once that there are no correlations between color and quality. The hungry man who knows apples will say grace with just as much unction over a green Newtown, a Golden Russet or a

Grimes Golden as over a red Jonathan, a Spitzenburg or a McIntosh. Coming to individuals in a variety, it is found that apples grown in sod are brilliantly colored; those grown under tillage are of more somber hues. Nine out of ten people will choose the highly colored sod-grown fruit as the best flavored, but it needs only a taste to convince to the contrary. The tilled fruit is crisper, juicier, and richer. On the other hand, poorly colored apples in the center of a tree are often less well flavored than the brighter fruits exposed to the sun. There are many just such seeming correlations between color and quality, but a careful study of all shows that there are no real relations between color and quality.

Just now the fashion is for red apples. But fashions in colors of fruits change as fashions in colors of clothes, or hats, or ties change. At one time russet apples were in great demand—not so now. In some markets Green Newtowns or Yellow Bellflowers or Rhode Island Greenings are still preferred. The present tendency to plant nothing but red apples is bound to make them less the fashion in time and to give greater demand for green, yellow and russet fruits. That color is quite unrelated to permanent value is proved by these changes and variations in fashion.

The point I am seeking to make is, that we are following a prejudice in rating one color above another regardless of quality. This prejudice is detrimental to fruit growing and fruit growers should seek to overcome it by calling attention to the good qualities of fruits regardless of color. "Plumage proclaims the fowl," but color does not proclaim the fruit.

We are all well agreed, however, that it is very desirable to put a variety on the market in its own distinctive color, provided too much is not sacrificed in securing characteristic color. How may the color of varieties be kept normal, true and distinctive?

It is impossible to discuss color intelligently unless we know what color is. What makes the gold of the orange, or the red of the apple? To define carefully in this case takes us far afield in organic chemistry where all but those bred therein are soon hopelessly lost. It is difficult to make even a few simple statements in regard to color without becoming entangled in the jargon of chemistry. But, in brief, some of the colors of fruits are carried in small granules or corpuscles while others are dissolved in the cell sap. Thus the green, yellow, orange and some of the red colors are due to the presence of millions of brightly stained corpuscles in the cells of the skin, while other reds, especially those of a blue or violet cast, are due to stained cell-sap. The color-bearing corpuscles are derived from the chlorophyll or leaf-green of the plant; colored sap is largely the result of oxidizing agents acting on certain organic substances in the fruit.

The oxidizing agents and the substances they act upon are present in green fruits in combination. As the fruits ripen the combination slowly breaks and oxidation takes place. The formation of color corpuscles, too, depends upon the action of oxygen in the presence of light and certain food elements. This is the briefest possible statement of how a very complex process takes place in which the facts to be emphasized are that oxidation goes on as a fruit begins to ripen and that coloring is an indication of ripening, and ceases when the fruit is fully ripe.

Now a fruit is rightly ripe only when it is brought to its fullest maturity. But there are no well marked lines between greenness, maturity and decay. These stages grade insensibly into each other, but coloring, it is well to remember, continues up to the point at which the tissues begin to decay. Shakespeare might have had the ripening and coloring of fruits in mind when he wrote:

> "And so, from hour to hour, we ripe and ripe,
> And then, from hour to hour, we rot and rot."

Coming as quickly as possible to practical applications of all this, we have at once to call your attention to the fact that the coloring of fruits is largely a chemical process and that chemical processes are profoundly influenced by the conditions under which they take place. Chief of these in influencing color formation in plants are light and heat, but there are others, as food, or lack of it, moisture, chemicals in the soil and disease.

Every fruit-grower knows that the intensity of color in fruits depends largely on the amount of light. Like the complexion of Shakespeare's dusky Moor, the color of fruit is often "but the burnished rays of the burning sun." Poorly colored fruits are often due to close planting and density of treetop, whereby sunlight is excluded. Light largely determines the rate and the amount of oxidation that takes place in plant cells and bright light makes all color-production processes active. The effects of an abundance of light in producing high color are to be seen in top branches, in open-centered trees, in outside and wide apart rows and in the products of the sunlit states of the west or the high altitudes of any fruit growing region. Of the few means at the command of the fruit grower to obtain better color those having to do with securing more light are most efficient—as pruning, greater distance apart of trees and in selecting sites best exposed to the sun.

Not only does light from the sun influence the amount of color in fruits, but solar heat has its effect. One who has not given the matter thought immediately jumps to the conclusion that the warmer the weather the brighter the colors, whereas the contrary is usually the case. We found from records of twenty-five harvests in New York that apples usually colored especially well in falls when they ripened in cool weather, more particularly so if the nights were cool and the days bright and sunny. Indeed, saving numerous "just exceptions and reservations," it is not too much to say that rainy weather, by lowering the temperature, especially if it alternates with sunshine, may help to give high color to fruit.

The effects of low temperature on color may well be seen in northern climates, and high altitudes where colors are always brighter than in warm climates or low altitudes. The cool nights of the Pacific Northwest are nearly as potent as the sunny days in giving color to the fruits of that region. There is a plausible reason for the effects just ascribed to cool weather in influencing color. The chemical changes which bring about color in fruit accompany the period of ripening. Now ripening marks the cessation of cell activities—comes with the death of cells. In fact, color pigments may almost be said to be waste products—the "ashes of the vital fires" of cells. Cold hastens the death of the cell, the ripening of the fruit and so increases color.

Climate, in the three phases just discussed, light, heat and moisture, greatly modifies the bloom on fruits. The bloom of fruit does not differ from that of poppies, of which the poet says "You seize the flower, the bloom is shed." Nevertheless, it greatly adds to the beauty of the product if present in any considerable amount and modifies the color favorably despite the absurd practice of rubbing off the bloom practiced by many in exhibiting. Bloom is a valuable asset to fruit and should be increased and preserved.

Nothing is more certain than that the character of the soil influences the color of fruit. Every fruit grower with any considerable number of trees of one variety must have noticed that the fruit on some trees is better colored than that from other trees. Not infrequently most striking differences can be found in orchards located but a few miles apart. Yet what it is in soils that influences color is not well understood. From the evidence now at hand, it seems that color effects must be due to physical conditions as soil-heat, aeration and drainage, all of which would help in causing the crop to mature early and thoroughly. With the single exception of nitrogen, none of the baker's dozen of elements made use of by plants under ordinary conditions exercise a decided influence on the color of fruits. The belief is current that orchard products are poorly colored on acid soils and that adding lime will cause them to take on brighter hues, but there seems to be no experimental confirmation of such effects of acid and alkali soils. A half-dozen fertilizer experiments with fruits might be cited to show that fertilizers do not favorably affect the colors of this fruit.

In particular, the popular generalization that "potash paints fruits," common in the press and reiterated on every page of fertilizer advertising literature, finds no verification in fertilizer experiments with fruits. There is a great abundance of observational evidence to show that nitrogen, especially when applied in stable manure and nitrogenous cover-pots turned over, cause a lessening of intensity in color. If the position be well taken that color comes with maturity and the death of cells, it would be expected that nitrogen would decrease color, since its use generally promotes and prolongs growth and delays maturity of apples.

This leads to the statement that usually whatever increases the growth of fruits is antagonistic to high coloring. Nothing more strikingly illustrates this than the difference in color and size of fruits grown on tilled and sodded land. As every one knows, fruits grown in sod are smaller, more highly colored and mature earlier than those grown on tilled land. Were it not for the fact that sod culture greatly lowers the productiveness of an orchard, this means of increasing color might be recommended. So, too, fruits grown on diseased, girdled, injured or very old trees are usually smaller and more highly colored than that from normal plants. Fruit is almost always better colored on trees in which the growth is short, stout and firm and on which the leaves are neither conspicuously abundant or overly luxuriant.

A sailor drinking beer from one hand and whiskey from the other was asked why he thus mixed his drinks. His reply was that if he drank only whiskey, he became drunk too soon; if only beer, he became full too soon. But when he took a drink of one and then of the other, he got just the right proportions of fullness and drunkenness. It seems

that the desires of fruit growers to have large fruits and well colored fruits must be satisfied by philosophy similar to that of the sailor. Orchards must be tilled, fertilized, and cared for on the one hand to secure size of fruit by promoting growth, while such operations as will reduce size, retard growth and hasten maturity must be practiced to increase color.

What about the influence of other chemicals than those commonly used as fertilizers? Iron, especially in the form of iron sulphate, is supposed to be potent in intensifying the color of fruits. We can not find the least bit of evidence to prove that such is the case. Orchard soils are so abundantly supplied with iron as a rule that it is like "gilding gold" to add more iron. Neither does there seem to be evidence to confirm the oft made statement that manganese added to the soil increases color.

Some spraying materials no doubt have an influence on the color of apples and pears. This is the experience of all who have carried on comparative tests of any considerable number of spraying materials. Yet, so far we have nothing more than generalities as regards the effects of sprays on color. Materials applied as sprays may change the color either by absorbing and so intensifying sunlight, or they may so cover the apple or pear as to protect the fruit from light. These, however, are but surmises.

A great many fruit growers are hoping to improve the color of their fruits in new orchards by having young trees propagated from cions taken from trees selected for the high color of their fruit—so called "pedigreed stock." Once in a very great while strains of varieties having high color do arise and the high color is transmissible, but such cases are exceedingly rare. Differences in color in a variety are practically always fluctuating variations due, as I have tried to show, to climate, soil, tillage, or some stimulation or retardation of growth. Unless, therefore, it is certain that high color in a tree of any variety is transmissible—to be proved only by comparing fruits from trees grown from its cions—it is a waste of time to propagate from bearing trees with the hope of getting better color.

We come now to a discussion of quality. What is quality? The word is rolled under the tongue by both fruit growers and consumers alike, but like "good cheer" in the fable, is "fish to one, flesh to another, and fowl to a third." We need, therefore, to define the term. In brief, quality is that combination of flavor, aroma, juiciness, and tender flesh which makes fruit agreeable to the palate, but this is not all. The thing that gives charm to the attractions of the world, whether books, or pictures, or music, or people, or fruits, is that subtle, undefinable thing called personality. A Northern Spy, a McIntosh, a Yellow Newtown, a Seckel pear, a Crawford peach, a Green Gage plum and an Iona grape, for examples, all have distinct and charming personalities which contribute no small part to the high quality of these fruits. But many fruits do not have distinguishable individuality and the sorts named lose it when grown under some conditions. This personality may be quite aside from any tangible qualities. It is akin to the charm of a woman in which the heroine in a current play says, "If a woman has it not, nothing else in the world is of any use." A high quality fruit must have a pleasing personality.

High quality does not have the commercial value that it should, but it is coming to be worth more and more. There are two kinds of taste, natural taste and acquired taste. Only savages have a natural taste; to them crude, unrefined, tasteless foods answer all purposes. But civilized man has an acquired taste and with each succeeding stage of civilization it becomes more delicate and more refined. Once they but know where it can be obtained, people will buy and pay for fruits of high quality—fruits with delicate and refined flavors and aromas and juicy, tender flesh. Such fruits should be the food of the great mass of the American people, while coarse, turnipy fruits should go only to those who can not tell the difference between a Jonathan and a Ben Davis, a Bartlett and a Kieffer. People need only to be educated as to what varieties are of high quality, and a profitable demand will be created.

Can the quality of varieties of the different fruits be changed by cultural methods? Possibly somewhat, but not greatly. Generally speaking, whatever care and culture make trees grow and bear normally tend to produce fruits of the highest quality. As I have said before, food and water seem to have decided effects on quality, but what combination of these essentials is best for highest quality is a matter about which we know little. "Paul plants and Apollos waters," but God gives quality. In His distribution of favors He has seen fit to characterize the fruits of some regions by higher quality than those of others just as He has given large size and handsome color to the products of special regions.

In what has been said I have sought to establish the fact that high quality is the chief of all the attributes of fruit. But there is little use in this discussion if we can not come to some understanding as to how the condition that prevails can be bettered. To this end a few specific suggestions can be offered.

First—The long suit of the fruit grower is to grow varieties of high quality. A man should grow sorts for the market that he is willing to eat himself. If individuals make a reputation for the high quality of their fruits a reputation will soon be established for the region and for the fruit.

Second—Let every fruit grower deprecate above all things the oft made assertion that the public wants trashy stuff—cares only for appearance and not for quality. It is the fashion of the times to decry the public. Certain papers say the public wants only yellow journalism; some writers hold that the people will read only light or vulgar fiction; rag-time music is supposed to suit the public; theatres will present only sensational plays; following the fashion, fruit growers hold that the public has the tooth of a gorilla, the taste of a buzzard, the stomach of an ostrich, and by choice fills its maw on Ben Davis apples and Kieffer pears. It is not true that the public likes poor fruit, the better the fruit the more of it will be eaten. People are slow moving, but once they learn true worth in fruit, their appetite will be for the good varieties. They will not be content with poor or mediocre sorts. If the lover of choice viands, and who is not, must wipe the tongue about the mouth and titillate the palate in order to find the flavor of fruits, he will take to other delicacies.

Third—It is a good policy not to break rudely with the old, but to run smoothly into the new. It would hardly be wise for any man to cut down or graft over certain apples, or pears, or plums, or pull out certain grapes because they are of poor quality. But in the planting of new orchards a man should look well to the quality of the varieties he selects. Speaking broadly, fruits of fine flavor can be grown as easily as the grosser tasting ones. In planting for the future, then, plant for quality.

Fourth—Never in the history of the world have there been so many men directing their efforts towards the improvement of plants. With the recent discoveries in plant breeding and the accumulated knowledge of centuries the efforts that are being put forth are bound to result in many new introductions within the next few years. A man may be pardoned if he clings to some of the mediocre varieties we now have, for these are the elder-born to whom we have become attached in tenderly carrying them through a helpless infancy, but as the physicians and midwives of horticulture bring in the new-born let them be chary of a blessing until their character for high quality is established. Let them be "born to blush unseen," and if christened let them remain in the limbo of the nurserymen's catalog if high quality be not among their accomplishments. Let us raise the standard of excellence by accepting only new fruits which are superior in quality to their predecessors.

Fifth—Nurserymen can do much to encourage the growing of good fruit and to secure the appropriate recognition of high quality. The country is filled with men and women from city, town and country who want to grow fruit for pleasure and profit. When these embryonic fruit growers pick the shell and get ready to plant, they go to a nurseryman for trees. Now if the nurseryman will sell all unfledged fruit growers varieties of quality rather than what they can spare, fruit growing and in the long run, the nursery trade, will be helped. Some nurserymen hold it to be their inalienable right to substitute when varieties run short. If all such will only slip in a choicely good variety instead of an odd or an end, there will be less poor fruit. Nurserymen say they grow the varieties that fruit growers want. In reality, however, they very largely *force* planters to take sorts that grow readily and make good looking trees in the nursery. Trees for the orchard must be grown in the nursery; trees grown in the nursery must be sold to the fruit grower; the weal or the woe of the fruit grower is the weal or the woe of the nurseryman. If tree growers would push the sale of varieties and trees that are truly most useful to the tree planter, nurserymen, fruit growers and the public all will be gainers thereby.

Sixth—It should be the business of horticultural societies, one and all, to make the public familiar with the names and the qualities of fruits. With this knowledge fruit buyers would pay the difference between good and poor quality varieties, just as they pay the difference between a porterhouse and a pot stew. Why should they not? There are several ways of reaching the public in this matter. Fruit growers and their customers may both gain knowledge of what are the best fruits, and which of them may be grown, by a full and frank discussion of the whole matter at horticultural meetings. County and state fruit organizations ought to do more in the way of making instructive

exhibits both at their meetings and at the fairs. In these exhibits much more attention ought to be paid to fancy fruit—high quality fruit. Indeed, it seems certain that higher premiums ought always to be offered for choicely good fruits than for the varieties of poorer quality.

In conclusion, why discuss this matter? Is it to encourage growing fruit only for a select few who have the cultivated taste? Not by any means. The common taste which falls to with a vigorous appetite upon any fruit presented is now, and must ever be, the chief customer of the fruit grower. But the taste of the multitude should be educated by all possible means for better and better fruits. Why? Because in the long run it means the consumption of a great deal more fruit the country over. Is it reprehensible to grow fruits of poor quality? Possibly not, but it would mean in the course of time the wiping out, root and branch, of the fruit industry if all fruit growers grew poor varieties; besides it would present the vile and sordid spectacle of people deliberately devoting themselves to growing poor fruit when they might as well grow good fruit. Is high quality the only requisite of a good variety? No, indeed. There are a score of requisites of fruit and tree that go to make a good variety, but among these quality is not now receiving appropriate recognition, and it is for such recognition that I am pleading. Is this a matter of sentiment or of business? Both. I am not averse to putting some sentiment in fruit growing, but I hope I have not been arguing before a packed jury in trying to convince this society that it is good business as well as a fine sentiment to grow good fruit.

CULTURE AND HANDLING OF SHIPPING PLUMS.

By H. C. Blake, Vacaville, Cal.

Address before the State Fruit Growers' Convention, Davis, Cal., June 1-6, 1914.

This paper covers conditions obtaining only in California. I will not discuss the origin of the plum, as it makes but little difference to the practical commercial grower whether it was introduced here from Asia or Europe or some other place; suffice it to say that nearly all edible plums are found in the north temperate zone. Species of wild plums are to be found in most of the countries of the north and the south temperate zones.

In this paper I will not consider the prune, or especially the commonly called French prune, as it was very ably treated by Mr. Richmond at the Fresno convention in December, 1913, and his paper has been very generally copied and reprinted all over the coast.

Plums furnish us more different varieties than any other cultivated fruit, and also a greater range of flavor, texture, color, size and form. Because of the plum's great variability and the adaptation of the different varieties to different climatic and soil conditions, it is the favorite fruit for amateur propagators in developing new varieties, and the varieties are now almost without number.

For one contemplating going into the shipping plum busineses geographic location would probably be the first important consideration;

next the selection of the proper soil, and third the selection of varieties, this last consideration to be somewhat influenced by the markets one intends to patronize.

At the present time there are but three or four localities in California that are very extensively engaged in the shipping plum business. They are located as follows: The Sacramento River district, comprising that portion of the river territory located between Sacramento on the north and Rio Vista on the south, and including the section around Lodi; the Vacaville district, comprising what is known as the English Hills and Lagoon Valley and the Vaca Valley proper; and the Hill section, comprising the Newcastle and Placerville districts.

These three localities are very extensive and successful plum growing districts, but the conditions obtaining in each are entirely different from those in the others. If you should locate on the river you would find a deep, rich, sandy sediment, loamy soil, with plenty of water for irrigation. Should you locate in the Vacaville section, good judgment must be exercised in the selection of a place. Secure a deep, rich loamy soil, though if very well drained and other conditions are attractive a heavier soil may sometimes be selected, but must be treated accordingly. Should you go to the Newcastle district you will find a decomposed granite soil entirely different from either of the other localities mentioned, and requiring different treatment.

In the past the Tragedy has been the favorite plum on the river, but many other varieties succeed well. In the Vacaville district it seems that almost every variety known to mankind is being tried out to the limit. Of the one hundred and fifty different varieties of plums shipped last season by the California Fruit Distributors, Vacaville seems to have been represented in almost every one. The Newcastle district runs strongly to Burbanks, but follows very closely with any newborn favorite reported from Vacaville. Placerville confines her shipments almost exclusively to the Hungarian.

When the selection of location, soil and variety has been made, the next important problem is the root stock, and a big problem it is, and one on which I hesitate to offer advice except in a general way.

The first choice for a root stock for all locations and conditions is the Myrobalan, followed very closely by the peach, but the peach requires a very well drained soil. A most excellent stock, though little used on this coast, is the Marianna, a hybrid originating some years ago in Texas. It grows very readily from cuttings, but does not sprout or "sucker," as it is commonly called.

Great care must be exercised in the selection of root stock, as some varieties refuse to make satisfactory union on certain roots, and other varieties refuse to produce a crop, while still others do not produce satisfactory quality.

In growing your nursery stock the usual nursery practice is followed. The seedlings are budded or grafted the first season, and generally remain in the nursery until the buds or grafts are one year old and have attained a height of from 4 to 6 feet.

Before the trees are planted in orchard form the land should be well prepared by plowing about eight inches deep with a good turning plow, and this plow should be followed in each furrow by a good subsoil plow running to a depth of from 16 to 20 inches. The subsoiling is

sometimes substituted by the use of dynamite, but this must be done when the ground is absolutely dry. Thorough cultivation must be practiced during the life of the tree.

For planting the ground should be marked off to require from about 90 to 100 trees per acre, the lesser number being preferable. This is usually done with a wire about 200 feet long having a button of solder at every place where a tree stake should be located.

Holes should be dug of ample size to allow plenty of room for the placing of the roots without crowding, and the soil well settled around each tree either by tamping with the feet or by the use of water. The tree should be topped at once to a height of about 16 inches.

It seems almost superfluous to urge the use of very great care in every act, but it is absolutely necessary to success. In many localities it is necessary to protect the bodies of the young trees from the hot rays of the sun during the first season. This is best done by the use of shakes or some of the excellent manufactured tree protectors to be found on the market.

During the winter after the trees have been planted one year they should again be pruned back about one half or two thirds of the season's growth, leaving about three or four limbs in such a position as to form a good strong head on which to build your future tree. Until the tree comes into bearing the pruning must be done with the main idea of forming as strong and well shaped a tree as possible, and care must be exercised to keep from leaving the growth too thick or leaving too much wood in the tree.

After the tree has come into bearing and the crop is set the most important step is thinning. Without proper thinning you can not hope to stand the strong competition of the present day. With some of the new and improved varieties it is necessary to thin two or three times.

Unless the laborer doing the thinning is an old hand at the business, it is hardly safe to let him look at the ground under the trees after thinning or he will never get enough off. Like everything else, thinning requires good judgment and experience.

As the culls from shipping are usually a dead loss, the pruning and thinning should be done in such a manner as to reduce the per cent of culls to a minimum.

As to the state of maturity for picking for eastern or European shipment, no ironclad rules can be laid down. It is another case where the exercise of good judgment and experience is necessary, as what is proper in one locality would mean failure in another. Great care must be exercised not to disturb the bloom on the fruit in handling. Great variety of opinion exists as to the proper ripeness at which to pick the different varieties, also the same variety in different localities.

The usual practice by the inexperienced is to pick too ripe, and by those after the early markets, to pick too green. The matter of picking must be settled by experience with each variety in each locality. Take, for instance, the Kelsey plum. It will not color on the tree in the Vacaville district until too ripe for shipment, but will color well en route if picked hard. On the other hand the same variety in the Lodi section will show a handsome color and still be firm. The Climax, when picked straw color or with slight pink at the apex, will ripen and color to perfection en route. The Tragedy may be picked as soon as color

begins to show, or may be left on the tree until almost fully colored and still go the long route and arrive in perfect condition. With the long list of varieties now grown in this state it would be useless to even attempt to try to describe each.

Plums are usually packed in five-pound baskets, four baskets to a crate. The smaller varieties are usually packed in three layers 4 x 5 or 5 x 5, and in some instances with the very early ones as small as 5 x 6. The larger varieties are usually packed 4 x 5 and 4 x 4, and in some cases 3 x 4. In the extremely large sizes they are frequently wrapped in individual papers instead of being placed in layers between long strips of paper, as is the case with the smaller sizes.

The packing should be done in such manner that every plum is keyed secure in place, but not bruised, and nothing but perfect fruit packed.

The cover must not press fruit sufficiently to bruise same, but must bear firmly enough to hold fruit from being displaced by rough bumps by the train en route.

For lack of time I am compelled to omit such important features as fertilization, spraying and insect pests, and will give some time that might have been devoted to those subjects to the subject of varieties, which is one of the most important features of the plum business at the present time.

The man in business tries to follow the lines of least competition. So with the plum grower. During the last few years so much advance has been made in the creation of new and improved varieties that it has stimulated the grower's desire to get his plums in the market when it is as bare of fruits as possible. Under existing conditions this is secured by being the first on the market. Many standard varieties now considered comparatively old will always command a place in any market, such as Tragedy, Burbank, Wickson, Climax, Hungarian, Grand Duke, Giant and Diamond. But many new and valuable varieties are now competing for first place on the list of good shippers. Prominent among these are the Beauty, Formosa, California Blue or Vacaville, the Gaviota and many others, some yet unnamed, which I am not at liberty to discuss. One very promising new variety originated by my neighbor, Mr. Burton, which he has called the Earlianna, was entirely harvested by the first of June. It is a good sized plum of splendid color and shape and an excellent plum for the table, a good bearer and the best all round early blue plum. In conversation with a neighbor recently who is growing over one hundred different varieties, he remarked that he would confine his energies to but few, such as Beauty, Formosa and perhaps one or two others, and after inspecting his orchard his judgment seemed to me to be wise.

From our experience in the past we feel that the possibilities for improved varieties are almost unlimited. As we are now growing many times as many varieties as are needed, and so many as to keep the buyers at sea as to what is being offered them, I think it wise to eliminate all of the second and third rate varieties, except where absolutely necessary to retain them for pollenizing better ones. On account of the great variation in the time of blossoming in different seasons, varieties requiring special pollenization are rather unsatisfactory.

A very unsatisfactory condition obtains on this coast in the naming of fruits. It is bad enough to have to be confused with a thousand or more distinct varieties, but when we add to this trouble by insisting on calling some well defined variety by some four or five different names, we are surely in need of a guardian. If this matter could be handled through the American Pomological Society, or some state society in connection with the national society, it seems to me it would simplify one of our most perplexing difficulties.

And now in conclusion my advice to those contemplating the shipping plum business is to go slow and to investigate thoroughly first and be satisfied with nothing but the best conditions, then with care and good judgment you are sure of a success that will net you a handsome income. You now have the United States and Canada for market, as no other portion of America grows successfully the fine varieties produced on the Pacific coast. And as soon as the Panama Canal is opened you may annex the markets of Europe with an excellent refrigerator steamer service direct from your own great city of San Francisco.

GENERAL NOTES.

THE FORTY-FIFTH STATE FRUIT GROWERS' CONVENTION.

The committee on arrangements for the forty-fifth State Fruit Growers' Convention met in Los Angeles, September 2d. There was a large number in attendance. It was decided to hold the convention in the auditorium of the old State Normal School building on Fifth street, one block west of Hill street. This room will seat upwards of one thousand people. Numerous other rooms are available. The headquarters will be at the Hotel Clark on Hill street, near Fifth. The meetings of the County Horticultural Commissioners, November 9th and 10th, and the special meetings of the women in the afternoons, 11th to 14th, will be held in the hotel. All rooms in the hotel are provided with bath and will be $1.50 each per day; $2.00 if occupied by two. There is an excellent grill room in the hotel and first-class cafeterias and restaurants close by, with rates very reasonable.

The Department of Agriculture, University of California, State Commission of Horticulture, and our most successful men and women fruit growers of the State will be generously represented on the program. Very able men from the East and North will be with us. The full program will be given in the October number of the Monthly Bulletin. We hope that the auditorium will be filled to repletion at the opening session of the Convention.—A. J. Cook.

POTATO EMERGENCY CONVENTION, SEPT. 25 AND 26.

The program for this important meeting is now completed. On Friday there will be a free excursion, with lunch, to all of the islands. This will give our visitors an idea of the resources of this wonderful delta region. The meeting will be held in room 1, Court House.

The evening will open with an address by the State Commissioner of Horticulture, subject "The Case Stated." This will be followed by an address from Mr. W. H. Volck, County Commissioner of Santa Cruz County, on the work of the tuber moth. Mr. William Garden, County Commissioner of San Joaquin County, will speak of the enemies of the potato in the delta region. Mr. William Wood, County Commissioner of Los Angeles County, will continue the subject with special reference to Southern California.

Saturday Morning.—N. V. Shear, Department of Agriculture, will discuss the subject in reference to the famous delta region. Mr. John Graf, of the Department of Agriculture, will speak especially of the tuber moth. Prof. William Stuart, of the Department of Agriculture, will discuss potato culture. Dr. Appel of Germany, one of the great authorities of the world, will address the Convention.

In the afternoon, Prof. Ralph E. Smith, of the University of California, will speak on potato diseases of California. Mr. John Irish, Sr., will discuss the question from the standpoint of the grower. Dr. W. A. Orton, of the Department of Agriculture, will speak on potato diseases.

Evening Session.—Prof. E. M. Jaffa will speak of the potato in dieteties, followed by a round table conducted by Mr. Carson Cook, aided by Mr. Frederick Maskew, Mr. Geo. Shema and Mr. Geo. Atherton.—A. J. Cook.

NOTES ON THE POTATO SITUATION IN THE DELTA. DISEASES.

By N. V. Shear, U. S. Department of Agriculture, Middle Island, Cal.

Inasmuch as there seems to be a desire on the part of those interested in the potato situation in the delta for a better understanding of some of the troubles which have been causing a decrease in the yield of this crop, I take this opportunity of explaining the situation.

The delta district comprises a large area of very fertile soil. The fertility of the soil, combined with the ease with which it can be irrigated, makes it admirably adapted for the production of large crops of potatoes; and it is due to these natural advantages and the energy of the people who have reclaimed it from the waters of the San Joaquin and Sacramento rivers that it is today one of the greatest potato growing sections within such a restricted area in the United States, if not in the world. There is no other locality in this country, and perhaps not in any other country, where such large areas of potatoes can be seen growing at one time within the radius of a single sweep of the eye.

This industry has now been carried on for a considerable number of years with great profit to the individuals engaged in it and to the community at large. The large crops of potatoes which have been and still are being grown in this locality have been due not only to its fertile soil and ease of irrigation, but also to the fact that many potato diseases and insect pests which have reduced the yields of potatoes in most other sections of the United States are either not present in the delta or may be considered a negligible factor in this industry. One notable example of this freedom from potato pests is the absence of the potato beetle. Throughout the greater portion of the potato growing sections of the United States east of the Rocky Mountains the potato vines need to be sprayed several times during the season to kill the larvæ of the potato beetle. The flea beetle is another insect which at times causes considerable damage to the vines in a great many localities, but which, so far as the writer's observation goes, does little damage in the delta.

With reference to fungous diseases of the vines the potato grower in the delta has a great advantage over most other potato producing sections. The late blight, a disease which has at times wiped out almost the entire crop in Ireland, and hence is sometimes called the "Irish blight," is also very destructive to the potato crop in many portions of the United States, but in the delta is seldom seen and does little or no damage. The same statement may be made with reference to the early blight, which is a fungous disease of the potato vines and which causes considerable loss in many parts of this country, but which injures the crop in the delta but very slightly.

Owing to the absence of the above mentioned troubles, all of which injure the vines above ground, it is not necessary for the potato grower in the delta to spray his crop during the growing season. Many thousands of dollars are spent every year throughout the United States in spraying potato vines to prevent injury by one or all of the diseases mentioned above, viz: Potato beetles, flea beetles, early blight, and late blight.

However, in spite of the freedom from insect and fungous pests which I have mentioned, it would be a unique condition indeed if any crop should have been grown as long as potatoes have been grown in the delta, and on such an extensive scale within a limited area, and the crop still remain entirely free from insect or fungous diseases. What has happened in other parts of the world has taken place in the delta except that it has, perhaps, not become so aggravated, and has been brought about by slightly different causes. It has been a matter of common knowledge for a long time that the potato yields on a given tract gradually decline the longer the tract is kept under cultivation and the oftener it is planted to potatoes. There are quite a number of factors which work together and cause this decrease in yield. One of the most direct and important factors is a fungous disease which is very widespread over the United States. This fungus is known as Rhizoctonia. It does but little injury to the tubers, but can be found on most of the potatoes in the markets. It is introduced into the soil on the seed potatoes, where it develops rapidly and attacks the young shoots below the surface of the soil, seriously injuring the productive power of the plants. A conservative estimate of the damage produced by this disease in the delta in 1913 would be placed at 20 to 25 per cent of the total crop. This means that it cost the potato growers of the delta at least a million dollars the past season.

Potato scab is a fungous disease which is familiar to practically every one who has had anything to do with potatoes. All the growers recognize it and usually try in some measure to control it. It is common throughout the United States. It is introduced into the soil on infected seed and then infects the tubers grown from these seed pieces.

The so-called "leak" of the tubers during the warm part of the harvesting season is another fungous disease which sometimes causes serious loss, especially where the tubers are injured in digging. This disease causes a rapid watery decay of the potatoes, and while not common in some other sections of the country, is of such a nature as not to make it a menace to potato growing in other localities where delta potatoes are likely to be shipped.

The potato "wilt" is another fungous disease which is common throughout the United States and which injures both vine and tubers. This disease is serious in the delta because it is the original cause of injury to the plant and tubers affected, and also because it forms a means of entrance for other diseases of the tubers such as dry rot, "jelly end," and perhaps "leak." This disease also finds entrance to the soil through infected seed tubers.

The eelworm is a real worm and not a form of insect life. It is quite widely distributed through the southern and western portions of the United States and lives upon many other plants besides the potato. Thus far it has not become distributed throughout the delta, and a determined effort is being made to control it. This pest is also introduced into the soil through infested seed stock and will remain living in the soil for a long time after the potatoes are harvested.

Another potato pest which has not as yet become generally distributed throughout the Pacific coast is the tuber moth. This is an insect which lays its eggs on the potato vines or tubers and the young larvæ when hatched burrow into the tubers, rendering them unfit for domestic use.

In some sections on dry land where little water is used for irrigation this insect has proven a serious pest to potato growers. From the experience the delta people have had with this insect it does not seem probable that it will produce serious injury to marketable tubers in this section. Probably because of the great amount of water used for irrigation the larvæ of the tuber moth do not find their way into the tubers below ground to any great extent.

Those interested in potato growing in the delta should become familiar with the causes which are at work in decreasing the potato production in this important section of the state, and it is evident that this must precede any adequate effort toward a betterment of the situation. The potato industry of the delta, like any other agricultural industry of the State, whether it is the growing of pears, oranges, grapes, or nuts, in order to be placed upon a permanent footing, must be made a matter of study to learn the factors which are at work controlling the crop, and then the proper measures must be put in operation to keep the industry upon a profitable footing.

NOTE.

In view of the emergency Potato Convention to be held in Stockton September 25th and 26th, the above article from Mr. N. V. Shear is very timely. Mr. Shear is doing telling work at the station at Middle Island in the great delta region along the Sacramento and San Joaquin rivers. The importance and magnitude of the investigations which he is carrying on warrant more assistance at this station. This phase of the situation should receive careful consideration at the Stockton convention, in the hope that we may still further increase the usefulness of the station at Middle Island.—A. J. Cook.

CITRUS CANKER.

This is a serious citrus scourge, fungoid in nature, which attacks all kinds of citrus trees except kumquats. Pomeloes suffer most. The disease attacks twigs, leaves and fruit. Prof. E. W. Berger of Florida, who has studied this disease thoroughly, says "it requires no extensive mathematical knowledge to discern that this disease may cause losses aggregating millions of dollars if not eradicated." Prof. Berger finds it in Florida, Alabama, Mississippi, and Texas, and thinks it may exist in Louisiana. It was introduced from Japan and in the Gulf States it is most abundant in Texas. Our quarantine against citrus from the Gulf States because of the white fly, and against fruit because of melanose, will serve a further purpose in barring out this new enemy. Our thorough quarantine and inspection of Japan citrus will help to keep the disease from coming to us from the far off Orient.—A. J. Cook.

NEW HOST OF POTATO EELWORM.

Word comes from the Kansas Agricultural College that the Canada thistle *Cirsium arvensis* is one of the many host plants of the potato eelworm *Heterodera radicicola*. Fortunately this serious weed pest is not common in California. Here is another reason for extermination where it now occurs, and for keeping it from further introduction.—A. J. Cook.

A FOE TO GUARD AGAINST.

Doctor Morrill, the able entomologist of Arizona, gives an illustrated article in "The Southwestern Stockman-Farmer" on the western rose chafer, *Macrodactylus uniformis*. Without doubt if this beetle should come among us it would be one of our most formidable pests. For years the writer had much experience with a very near relative. In fact, they seem almost identical. This was *Macrodactylus subspinosus*. These beetles belong to the family *Scarabæidæ*, which includes June beetles, the lawn beetles, our Hoplia and the Sericas. Thus we find that it is a bad company, but I think this rose chafer of the East was the greatest pest of all. We thought for a time that Paris green did not kill it. The reason was that when we did kill thousands by use of the poison other thousands would come to take their places. Although it is called the rose chafer, it is equally bad on apple and other fruit trees. It would be a serious calamity if this beetle should become established here. Unlike most of the Scarabæids, it is very long and narrow and is quickly told by its very long tarsi, which give it its generic name Macrodactylus, or big fingers.

I greatly hope that we shall never get this beetle in California, but it behooves us all to be on the lookout, and I especially urge our county horticultural commissioners to watch out for this pest, and if it comes to our State to take all possible pains to eradicate it at its very first appearance.

It only remains to be said that the larvæ live in the ground and feed on roots. They also pupate in the earth.—A. J. Cook.

PEACH YELLOWS.

California is peculiarly interested in that juicy, delicious fruit, the peach. As in the case of oranges, lemons and prunes, California ranks first as a peach state. The United States census for 1910 gives 7,829,011 as the number of bearing trees and $4,573,775 as the income. The statistics of our State give nearly a million trees more, and of course the income would be proportionally greater. The income from peaches in Georgia and New York, which rank next to California, was less than half that of California.

Again, the peach does exceptionally well in nearly every fruit locality of California. Every county can boast of its fine, luscious peaches. The peach borer is found in but few counties. The twig borer is easily controlled, and curl leaf and other fungoid pests readily yield to well known fungoidal treatment.

Fortunately we have not as yet the virulent disease known as "peach yellows." The writer knew this well in Michigan, where it destroyed many fine orchards. It usually is fatal in four years after attack. The symptoms the first year are leaves, normal in form but yellow, and fruit, maturing early, spotted deeply with red streaks about the pit. The second year these characteristics are magnified. The third and fourth years many wiry twigs with narrow leaves are very noticeable and give quick indication that the disease is present. It is believed that trees from diseased pits are likely to be diseased.

The cause of peach yellows is unknown, though it has the appearance of a bacterial affection. As yet, however, there is no proof that it is bacterial, though our best mycologists have diligently and persistently sought for the cause. Fortunately it has been found safe to plant new trees in localities from which old trees have been removed.

The only means of control is to dig out the diseased trees and burn them as soon as the disease is discovered. This, when faithfully practiced, has saved many orchards in large part.

The disease is serious in Illinois, Michigan, New York, New Jersey, Georgia, etc. It is hoped that our strict quarantine measure and our thorough inspection service will ever keep this foe from our peach orchards, but every fruit grower should know the enemy and be ready to give no quarter should it steal into his grove. The early maturing spotted fruit, the yellow leaves and especially the wiry twigs with very narrow yellow leaves, which appear later in the progress of the disease, will reveal its advent.

Mr. George K. Atwood, Department of Agriculture, State of New York, has prepared a very interesting bulletin, No. 61, which is peculiarly helpful, as it gives wonderfully fine illustrations of the disease in all its stages. This bulletin also describes "little peach," which is probably specifically different from peach yellows.—A. J. Cook.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

CITRUS FRUIT INSECTS.

The Purple Scale.

The female purple scales are long and oyster shaped, varying from one sixteenth to one eighth of an inch in length. The color of the scales varies from a reddish-brown to purple. This pest attacks the leaves, branches and fruit of the citrus tree, causing the branches to die and the leaves to drop. Because of the resistance of the eggs of the purple scale to fumigation, it is one of the most difficult of the citrus infesting scales to control. According to Quayle, Bulletin 214, California Experiment Station, the period of egg deposition is from three to four weeks, and from the time the eggs first appear until the last ones hatch, there is, therefore, a period of about two months, so that when two treatments are made for this scale about six weeks ought to be allowed between fumigations. Fumigate with full schedule No. 1, consisting of one and one half ounces of potassium cyanide to every one hundred cubic feet of space, or three fourths of this dosage for sodium cyanide, this fumigation usually being done when the black scale is in the right stage to be destroyed.

For details of fumigation the reader is referred to pages 318 to 336 of volume II, Nos. 1 and 2, of the Monthly Bulletin of the State Commission of Horticulture, by E. O. Essig.

The Red Scale.

Another important scale enemy of the citrus tree is the red scale. The injury from the red scale is due directly to the feeding, and whether this is due to the loss of sap or to some toxic effect on the tissues of the plant is not known. The red scale does not give off honey-dew like the black. This enemy is reddish, circular and flat, the female scales being from one sixteenth to one eighth of an inch in diameter. The young are usually produced from June to September, or even longer in milder sections. It attacks all parts of the tree, being particularly abundant on the twigs and branches. It is distributed throughout the southern citrus belt, particularly San Diego, Orange, Los Angeles, Riverside, San Bernardino and Santa Barbara counties. Fumigate with Schedule No. 1, made by R. S. Woglum of the United States Bureau of Entomology. This dosage consists of one and one half ounces of potassium cyanide, one and one half fluid ounces of sulphuric acid and four and one half fluid ounces of water to every one hundred cubic feet of air space.

The Yellow Scale.

The yellow scale attacks almost entirely the leaves and fruit of the citrus tree, while the red scale attacks all parts. It occurs throughout the entire citrus growing sections of the State. It resembles the red scale in appearance, but is more yellow in color, lies flatter upon the leaf and is sometimes larger in diameter. The method for control is the same as that for the red scale.

The Black Scale.

The injury caused by the black scale is in main that caused by the excretion of the honeydew which furnishes a medium for the black smut fungus to grow in. This smut fungus covers the fruit and leaves. Due to this fungus the smutty fruit must receive a vigorous washing in order to improve its appearance, and, as a result of this washing, the fruit may be injured so that decay sets in. The smut fungus also may completely cover a leaf shutting off the light, consequently injuring the leaf functions. The black scale occurs throughout the State, but is more abundant along the coast. It attacks all citrus trees, the olive, oleander, grape, apricot, almond, pear, etc. The adult scales are black and have a distinct "H" on the back. They are from one eighth to one fourth of an inch in diameter. There appears to be but one generation a year, although one may find the different stages at almost any time. However, the young scales are most abundant from September to December, and the eggs are laid mostly during the months of May, June and July. The black scale is best controlled by fumigation on citrus trees. Fumigate with one half to three fourths schedule between September and January, the one half schedule being used when there is an even hatch and the scales are very young. The orchardists should fumigate at the time that all the eggs have hatched and the young have not yet become well grown. In spraying deciduous trees in order to destroy this pest, it is better to wait until after the leaves have fallen, and in the case of the olive, after the fruit has been picked.

MISCELLANEOUS INSECTS.

Grasshopper Control.

The egg pods of grasshoppers are generally deposited in the hard, uncultivated lands during the late summer and early fall. Plowing, harrowing and disking such waste lands to the depth of several inches in the late fall will destroy many of these pods, and consequently lessen next year's attack.

The Squash Bug.

The injury done by the squash bug is well known to all of us. The insect is brownish black with yellow spots along the edges of the abdomen and is dirty yellow in color on the underside. This bug winters over in the adult stage in rubbish and among the old vines. Burn all the rubbish in the fields, especially the old vines, and clean along the fences. Fall plowing will also aid in the reduction of this pest for the following year.

INSECT NOTES.

The Achemon Sphinx Moth, *Pholus achemon*, has been doing considerable damage to grapes, especially the earlier varieties, in the vicinity of Escalon, San Joaquin County. Mr. A. R. Humphrey reports the entire defoliation of about forty acres, and serious damage to a much larger area. Just what will be the effect on the fruit, which was not quite mature, has not been determined.—HARRY S. SMITH.

Through the kindness of Doctor F. H. Chittenden of the Federal Bureau of Entomology, the insectary has been enabled to introduce a goodly number of the Braconid parasite, *Apanteles glomeratus*, into the cabbage fields infested with the cabbage worm along the Sacramento River. Oviposition was commonly noted in the field, and undoubtedly it will become established and become something of a factor in the control of that pest. In the east, however, the pest still has to be reckoned with in spite of the abundance of this parasite.—HARRY S. SMITH.

Numerous adults of the California grape root worm, *Adoxus obscurus* Linn, were found in a canyon near Towle, Placer County, on August 12th, feeding on a large leafed plant, *Saxifraga feltata*, which occurs very abundantly along the streams in the Sierras.—E. J. BRANIGAN.

On August 20th the writer collected near Lake Spaulding, Placer County, adults of the large wood boring beetle, *Prionus californicus*.—E. J. BRANIGAN.

The pine scales, *Aspidiotus californica* and *Chionaspis pinifoliæ*, are numerous on the pines in the Towle section of Placer County.—E. J. BRANIGAN.

The woolly aphis, *Eriosoma lanigera* Hausm., is very common on the limbs and roots of apple trees in the Towle section of Placer County, especially in dooryards.—E. J. BRANIGAN.

The mealy plum louse, *Hyalopteris arundinus*, was recently sent to this office for identification by Mr. L. M. Boggs, of Susanville, where he found it feeding upon reed grass, *Phragmites communis*. The record of this louse occurring on above grass in California is of much interest, because of the fact that heretofore it has not been reported upon anything except the plum. It has been known to leave plum and prune trees as soon as wings are attained, but where it went seemed a mystery. Prof. C. P. Gillette, of the Colorado Agricultural College, discovered its habit of going from the plum to the reed grass, in Colorado, some years ago. There, this grass is abundant and is sometimes made to turn brown and even dry up by the lice, so plentiful do they become on it. In California the grass does not seem to be so plentiful, at least is not generally distributed over the State, and it would seem that the lice must have some other alternate host, as they are very commonly found on plum and prune, and remain there only until the winged generation develops, when they take flight.—GEO. P. WELDON.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

In our last issue we mentioned the fact that H. P. Stabler of Yuba City, Sutter County, was carrying on a campaign against the red spider, *Tetranychus bimaculatus*. Since that note was written Mr. Stabler informs us that in the little town of Sutter $500 was spent fighting this pest on locust trees, with the result of completely controlling it. This demonstration on a large scale should mean much to the almond growers of Sutter County, who are greatly troubled with this mite, as well as the brown mite (*Bryobia pratensis*). If it can be controlled on such a large scale when occurring on good sized locust trees, then there should be no trouble in protecting the almonds from its attack. As a matter of fact there are few pests that are more easily controlled, and yet the havoc that it plays each season, to almonds and prunes in particular, is very great. That the people will profit by this excellent piece of work is sincerely hoped.

The recent discovery of the soft gray scale, *Coccus citricola,* in both Fresno and Sacramento counties, has resulted in fumigation demonstrations by the county horticultural commissioners of these counties, to show the people how the pest may be controlled.

County Horticultural Commissioner Collins of Tulare County, assisted by R. P. Cundiff, former commissioner of Riverside County, has been carrying on a fumigation campaign against *Coccus citricola.* From all reports the work is a great success and the anticipated trouble with burning of the fruit by gas, especially during warm weather, has not been met with.

It is with regret that we mention in this department the resignation of Mr. R. S. Vaile, who for the past three years has been horticultural commissioner of Ventura County. Mr. Vaile has accepted a position with the University of California and will be located at their station in the southern part of the State. That he will make a success of his new work is doubted by none, and the best wishes of all go with him.

Recent Appointments for County Horticultural Commissioner.

John J. Fox, Napa, Napa County.
A. H. Taylor, Susanville, Lassen County.

The following figures on production and income from 100 Wickson plum trees and 32 acres of Tokay grapes were sent to us from the office of County Horticultural Commissioner of Sacramento County.

THE MONTHLY CROP REPORT—AUGUST, 1914.

Compiled from reports sent in by the County Horticultural Commissioners.

by Geo. P. Weldon, Chief Deputy State Commissioner.

County	Almonds	Apples	Apricots	Berries	Cherries	Figs	Grapefruit	Lemons	Olives	Oranges	Peaches (canning)	Peaches (shipping)	Peaches (drying)	Pears	Plums	Prunes	Walnuts
Alameda		#	h	h	h	#	#	#	#	#	h	h	h	80	h	h	#
Butte	50	90	h	100	h	100	70	45	100	70	140	140	140	40	#	30	#
Colusa	100	#	#	h	#	100	#	#	#	75	75	75	#	h	#	35	#
Contra Costa	30	80	h	#	h	#	#	#	#	#	#	100	100	50	h	h	80
El Dorado	#	85	#	#	#	#	#	#	#	#	100	100	100	h	h	#	#
Fresno	100	#	#	#	#	125	100	100	100	100	95	95	95	#	#	#	#
Glenn	100	100	h	h	h	100	100	100	100	100	h	100	#	100	#	90	100
Humboldt*	#	90	#	#	h	#	#	#	#	#	#	#	100	75	#	#	100
Imperial	#	#	h	#	#	75	#	#	#	#	#	#	#	#	#	#	#
Kern	#	60	h	#	#	#	#	#	100	100	100	100	100	60	100	85	#
Kings	#	#	h	#	#	#	#	#	#	#	125	h	h	#	#	120	#
Lake	100	100	h	#	h	#	#	#	#	#	#	100	#	50	#	35	100
Los Angeles	100	100	h	100	#	100	75	75	100	90	100	#	100	100	100	#	85
Madera	75	85	h	#	#	100	#	#	100	#	100	100	100	h	#	100	#
Mendocino	h	—	h	h	h	#	#	#	#	#	#	#	#	h	#	50	#
Merced	75	—	h	—	#	100	#	#	100	#	50	h	h	100	100	100	#
Modoc	#	60	h	60	h	#	#	#	#	#	50	50	50	90	50	50	#
Monterey	#	50	h	100	h	#	#	#	#	#	70	#	90	75	h	h	#
Napa	#	100	h	h	h	#	#	#	#	#	90	90	90	50	h	20	#
Nevada	100	100	h	h	h	80	#	#	#	100	100	#	100	100	h	75	100
Orange	#	40	h	h	#	#	100	120	—	80	#	#	h	#	h	#	60
Placer	25	60	#	h	h	#	#	#	75	75	90	#	90	h	h	#	#
Riverside	90	75	h	#	h	#	100	90	25	70	85	90	#	#	#	50	100
Sacramento	30	100	h	h	h	h	100	100	100	100	90	#	90	h	h	20	#
San Benito	100	100	h	100	h	#	#	#	#	#	100	100	#		#	50	100
San Bernardino	#	55	h	#	h	#	85	80	55	75	85	85	85	55	100	75	50
San Diego	#	90	#	#	#	#	90	30	50	90	#	#	65	90	#	#	#
San Joaquin	30	#	h	#	h	#	#	#	#	#	100	100	100	40	75	30	#
Santa Barbara	#	100	h	#	h	#	#	100	100	100	#	#	#	100	#	#	60
Santa Clara x	#	60	h	h	h	#	#	#	#	#	80	80	80	60	h	35	—
Santa Cruz	#	75	h	60	h	#	#	#	#	#	#	#	h	90	#	70	#
Shasta	h	90	h	h	h	90	#	#	75	#	90	h	90	75	h	20	#
Siskiyou**	—	90	#			#	#	#	#	#	—	—	—	60		—	—
Solano	60	#	h	#	h	#	#	#	#	#	h	90	h	h	h	h	#
Sutter*	75	75				100	#	#	100	#	60	90	75	60		75	#
Sonoma	50	80	h	h	h	#	#	#	90	#	80	80	80	80	h	20	90
Stanislaus	h	90	h	h	h	90	#	100	100	100	h	h	h	h	h	h	100
Tehama	h	100	h	#	#	#	#	#	100	#	#	h	h	h	h	40	#
Tulare	90	80	h	h	#	100	90	90	100	80	100	h	h	h	h	90	#
Ventura*	95	100	h			#	90	104	100	80	#	#	#	#	#	#	80
Yolo	65	#	h	#	#	90	#	#	75	#	65	65	h	h	#	40	#
Yuba	70	70	h	100	h	100	—	70	100	70	75	75	75	70	h	50	—

Figures in table indicate condition of crop in per cent on the basis of 100 per cent as normal.
#Crop is not grown sufficiently in a county for a report.
—The county horticultural commissioner has insufficient information for a report.
hCrop is all harvested.
*No report received since July 31st.
**No report received since June 30th.
xAbout 7 per cent of the prunes have split since last report (June 30th) from this county, thus materially injuring the crop.

CROP STATISTICS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Last month a table was published giving the percentage of the normal California almond crop shared by each of the main producing counties. This month the table has been enlarged and apples and walnuts are included. The writer solicits the aid of everyone who is in a position to get accurate statistics, in this work. Our efforts so far have revealed the fact that most of the information upon production of our common fruits has been gathered from the last census report, and to get reliable up-to-date figures has been an exceedingly difficult matter. While the information that is contained in this table has been gathered from the most reliable sources that we have, it is with a little hesitancy that it is published, knowing that such figures at best must be more or less inaccurate. If there should happen to be any bad errors it is hoped that they will but point the way toward getting more reliable data.

Estimated per cent of the total crop of the following fruits grown in each of the main producing counties of the State, during a season of normal production.

County	Almonds (per cent)	Apples (per cent)	Walnuts (per cent)
Alameda	*		
Butte	12	*	
Colusa	3		
Contra Costa	12	*	
El Dorado	*	*	
Fresno			
Glenn			
Humboldt		3	
Imperial			
Kern		*	
Kings			
Lake		*	
Los Angeles	2	4	31
Madera	*	*	
Mendocino		*	
Merced	*		
Modoc			
Monterey		7	
Napa	*		
Nevada		4	
Orange			39
Placer	*		
Riverside	3	*	*
Sacramento	12		
San Benito			
San Bernardino		6	*
San Diego		*	
San Joaquin	17		
Santa Barbara			11
Santa Clara	*	*	
Santa Cruz		48	
Shasta			
Siskiyou			
Solano	3		
Sutter	11		
Sonoma		19	
Stanislaus	3		
Tehama	*	*	
Tulare		*	
Ventura			17
Yolo	14		
Yuba	*	*	

*Less than 2 per cent of State's normal crop grown in county.

They will no doubt be of interest not only to growers of these particular fruits, but to others as well:

WICKSON PLUMS.

Yield, 980 crates, at 75 cents per crate, net		$735 00
100 trees, 6 years old; 25 trees, 12 years old.		
COST OF PRODUCTION.		
Pruning	$25 00	
Plowing, four times	47 00	
Spraying, lime-sulphur	25 00	
Picking	28 00	
Packing, at 4 cents	39 20	
980 boxes and 3,920 baskets	93 10	
Making boxes, at 2 cents, paper $1.75	21 35	
Hauling to wharf, 15 loads at $1.00	15 00	
Total		293 65
Balance		$441 35

TOKAY GRAPES.

Normal production, 7,000 crates, 26 pounds net, 91 tons.
Thirty-two acres tokay grapes, 8 years old.

COST OF PRODUCTION.

Irrigation, pumping with motor, at $4.00 per acre per season	$128 00
Pruning, one man 35 days, at $2.25 per day	78 75
Sulphuring, one man 10 days, at $2.25 per day	22 50
Five sacks sulphur, at $2.75 per sack	13 75
Two plowings, 21 days, man and team, at $4.00	84 00
Three cultivations, 15 days, man and team, at $4.00	60 00
Hauling 420 crates per day, 16 days, man and team, at $4.00	64 00
7,000 shook and making, at 12½ cents	875 00
Picking and packing, at 10 cents per crate	700 00
	$2,026 00

7,000 crates, at $1.00 net	$7,000 00
Cost of production	2,026 00
Balance	$4,974 00

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF JULY, 1914.

By FREDERICK MASKEW, Chief Deputy Quarantine Officer, San Francisco, California.

For the past two years the writer of this has published a monthly synopsis of the work and findings of the Coast Division of the Quarantine Service of the State Commission of Horticulture for California. The deliberate purpose of making a public record of the pests intercepted on imports of horticultural material was to attract the attention of the officials having charge of such matters at the various points of origin of the infested material, in hopes of stimulating their interest in better methods of inspection and disinfection of plant material for shipment to California. The effect, as anticipated, has been far reaching, and the results obtained have justified the expectations of the originator of the idea, and confirmed the policy of the maxim of the division. The Monthly Bulletin reaches all agricultural stations and the officials of several of these are now taking drastic measures to clean up, and thus prevent the constant repetition of the finding of infested plants sent out from their respective countries.

A phase of the quarantine work that has not been included in former reports is the number of passengers arriving each month whose baggage is searched for the presence of fruit fly material or other quarantined products. This is really the most important part of the work, and the extent to which it has developed is the true reason for the present numerical strength of the quarantine force. The ability to handle with dispatch the maximum number of passengers arriving on any domestic liner from Honolulu will always remain the criterion from which to judge of the number of inspectors required at the port of San Francisco. For the information of those interested in this matter the number of passengers arriving from fruit fly ports will be incorporated in future reports of the division.

SAN FRANCISCO STATION.

Steamship baggage inspection.

Ships inspected	34
Passengers arriving from fruit fly ports	3,475

Horticultural imports.

	Parcels.
Passed as free from pests	40,173
Fumigated	2,845
Destroyed or returned	126
Contraband destroyed	11
Total parcels horticultural imports for the month	43,155

Horticultural exports.

Inspected and certified	118

Pests Intercepted.

From Brazil—

Cerataphis lataniæ and *Isosoma orchidearum* on orchids.

From Ceylon—

Aspidiotus cydoniæ, Lepidosaphes sp. *Parlatoria pergandii* and *Aphis* sp. on tea plants.

From China—

Cylas formicarius in sweet potatoes.

From England—

Diaspis boisduvalii and *Isosoma orchidearum* on orchids.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus* sp. on pineapples.
Coccus longulus on betel leaves.
Saissetia nigra, Coccus longulus, Pseudococcus sp. and *Heliothrips hæmorrhoidalis* on crotons.
Pseudaonidia sp. on Hibiscus.

From Japan—

Lepidopterous larvæ in dried roots.
Weevils in chestnuts.

From Manila—

Parlatoria mangifera on orchids.
Aleyrodes citri on gardenias.
Lepidosaphes lasianthi on Camellia.

From New Zealand—

Leucaspis sp. *Lecanium* sp. and *Chrysomphalus rossi* on ornamental shrubs.
Pseudococcus calceolariæ on New Zealand flax.
Aleyrodes sp. on *Metrosideros tomentosa.*
Aspidiotus camelliæ on Veronica.

From Tahiti—

Morganella maskelli and *Lepidosaphes beckii* on oranges and limes.

LOS ANGELES STATION.

Ships inspected 30

Horticultural imports.

	Parcels.
Passed as free from pests	30,976
Fumigated	7
Destroyed or returned	1
Contraband destroyed	4
Total parcels horticultural imports for the month	30,988

Pests Intercepted.

From Belgium—

Coccus hesperidum, Cerataphis lataniæ, Diaspis boisduvalii and *Pulvinaria* sp. on orchids.
Aspidiotus camelliæ and *Pseudococcus* sp. on *Eurya latifolia.*
Pseudococcus longispinus on Dracaena.
Aspidiotus camelliæ on cycad.

From Central America—

Chrysomphalus scutiformis, Aspidiotus cydoniæ, Aspidiotus cyanophylli, Saissetia hemisphærica, Pseudococcus sp. and *Icerya* sp. on bananas.

From France—

Saissetia oleæ on feijoas.

From New Jersey—

Pseudococcus sp. on unidentified vine.

From Pennsylvania—

Eucalymanatus perforatus on kentia palm.

SAN DIEGO STATION.

Ships inspected 24

Horticultural imports.

	Parcels.
Passed as free from pests	3,407
Fumigated	0
Destroyed	0
Returned	0
Contraband	0
Total parcels horticultural imports for the month	3,407

Pests Intercepted.

From Central America—

Pseudococcus sp., *Aspidiotus cyanophylli*, *Chrysomphalus scutiformis*, *Lecanium* sp. and *Pseudococcus aurilantus* (?) on bananas.

EUREKA STATION.

Ships inspected 6

No horticultural imports.

SANTA BARBARA STATION.

Ships inspected 1

No horticultural imports.

0

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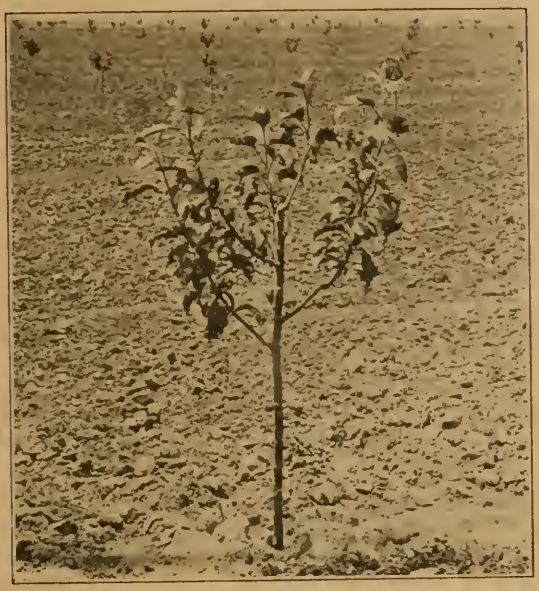
THE MONTHLY BULLETIN



Young apple tree at beginning of second season's growth, started with five scaffold branches. (Original.)

OF

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

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PRUNING THE APPLE WITH SPECIAL REFERENCE TO SUMMER WORK.

By W. H. Volck,* Watsonville, California.

Pruning fruit trees has been a much discussed subject, both among those directly and indirectly interested in such matters. Many ideas or notions are prevalent, especially with the practical growers. One of the most general of these ideas is that a great difference in treatment is necessary with the various kinds of fruit trees. According to this idea some kinds are pruned heavily and regularly, and others lightly and occasionally, and still others not at all. This notion about pruning is one of those ideas which has developed largely as a matter of hearsay and not as a result of actual experiments. We cannot point to a case where all classes of fruit trees, growing under similar conditions, have been pruned in different ways for a term of years and the results weighed and measured.

My observations lead me to conclude that had such an experiment been conducted, there would be little meaning in the title of this paper. That is to say, the available evidence indicates that the ultimate methods of pruning will be much the same for all classes of fruit trees. It is not intended to discuss such an ultimate method, obviously for the lack of experimental proof, but in this paper I wish to describe certain experiments with apple trees that form the basis of our present recommendations.

These pruning experiments are of recent date, and have not had that test of time which gives final proof, but the method evolved is in harmony with all that we know regarding the successful growth of trees in general. This method is, therefore, on a more substantial basis than the actual duration of the experiment would seem to indicate.

The pruning experiment was undertaken as a part of the apple mildew investigation. This investigation has been in progress for a number of years, and is jointly conducted by my office and that of the Fruit Disease Investigation, United States Department of Agriculture, represented by Mr. W. S. Ballard. All statements regarding the experiment refer to this investigation.

In the fall and winter of 1912 and 1913, we began pruning a four acre block of Yellow Newtown Pippins located on the C. H. Rodgers place, near Watsonville. This block was one in which much experimental spraying had been done and which had been turned over to us by the owners of the property for such work. The trees were then about twelve years old, but small for their age, due in part to the effect of a previous planting of prunes which had been removed to reset with

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

apples, and to the stunting effect of the apple mildew. The object of the experiment was to demonstrate a more perfect system of mildew control, and as such will not be discussed here, for the obvious reasons that it is foreign to the subject.

Trees Pruned in General Way.

Previous to the beginning of the experiment this block of trees had been pruned in the way customary to the district. Such pruning consists in the general shaping of the tree with reference to cultivation and

FIG. 93.—Tree pruned according to the standard method practiced in the district for many years. (Photo by Geo. P. Weldon.)

the removal of some brush to prevent too thick a growth. The suckers were also prevented from growing, so that the larger branches had become entirely bare of fruit wood for several feet above the main trunk. The thinning out and shaping process referred to is frequently not commenced until the undesirable branches have become quite large. These big cuts heal slowly, if at all, and frequently are the starting points of destructive wood rots. In this case some such cutting had been done and the wood rot was already working in several trees. It was evident, therefore, that the pruning must be confined to cutting

small branches and twigs which would heal over readily, and the necessary thinning out of excessive brush brought about by the liberal application of this method.

Pruning a tree along these lines involves considerably more labor than the method previously followed in the orchard. None of the trees in this block were large or near full bearing size and yet it required upwards of an hour to thoroughly tip back, thin out and remove mildewed shoots from a single tree. Evidently, pruning along these lines must be productive of radical improvement if the method is to be practical. Striking results were not long in coming for in the early spring these pruned trees put out a vigorous growth practically uniform over the tops as well as on the more protected sides. Also, in spite of the fact that about 75 per cent of the twig growth had been removed, there was a liberal setting of fruit. Careful comparison of the pruned trees with a check row left unpruned indicated that even more fruit

FIG. 94.—General view of a tree which has been summer pruned over its entire surface. (Photo by Geo. P. Weldon.)

had set on the former than the latter. Further comparison of crop results for that year was prevented by an untimely frost which greatly reduced the setting and in a very irregular manner.

Further treatment of the "Demonstration Plot" as we are now pleased to call it, consisted in spraying for mildew, aphids and caterpillars. The applications were timed according to the apparent requirements for satisfactory mildew control. A check row was left through the middle of the plot which received no spraying. This check represented the opposite conditions from the one previously mentioned; that is, it was pruned but not sprayed.

Summer Pruning.

The winter pruning was now supplemented by summer work along the same lines; that is, removing diseased twigs and tipping back to develcp a more sturdy growth where needed. The suckers which had started to grow from the main branches were not removed (contrary to the regular practice) but were headed back in order to develop fruit spurs on these unproductive portions of the tree. It was easy to see that the fruit bearing surface might be doubled by the proper treatment of these suckers.

Of course, the sucker growth cannot be so developed on trees which have the dense tops produced by the old style of pruning, as there

FIG. 95.—Showing the development of fruit-spurs from suckers by the summer pruning method. (Photo by Geo. P. Weldon.)

would be too much shade for the production of fruit wood and fruit. Indeed, it was only after the tops had been thinned out by our winter pruning that the advisability of so developing the suckers became apparent.

Heading Back the Suckers.

The proper heading back of suckers is a matter of considerable importance, and the first cutting should be made not more than two or three inches from the parent limb. Subsequent heading should keep this growth down to five or six inches in length. Four or five summer prunings may be required to properly restrict the suckers.

Suckers Developed Into Fruit Bearing Wood.

No doubt the question arises, just how long will it take the suckers to develop into fruit bearing wood? When the experiment started we did not expect results for two or three years, but have been agreeably surprised by the fact that many of last year's suckers have produced blossoms and set especially well formed fruit this spring.

To continue with the general pruning experiment we followed the summer pruning idea rather strenuously, and in some cases removed more than half of the new growth. It seemed impossible to check the vigorous growth, which followed as a result of the winter pruning, for more than a very short time. The trees remained in full foliage long after the regular orchards were bare in the fall, and when the time for winter pruning finally arrived we found that much more wood must be removed in order to maintain a properly thinned out top. The amount of brush removed during the second winter was quite as great, if not greater, than that taken out the first year, but a marked difference in the character of the brush was noted. The mildewed tips and diseased wood so common the first winter were scarcely in evidence at all in the fall of 1913. This spring the same summer pruning plan has been started and still more attention is being paid to the development of fruit bearing wood along the main branches.

Crop Located on Main Branches.

The crop now on the trees is satisfactory and is four to six times as heavy as that in a regulation orchard of the same age, adjoining. This crop is located on or near the main branches, in such a way that little or no propping will be required to sustain the load. Numerous props are necessary to prevent the breaking down of trees trained by the system common to the district.

The trees in the demonstration plot are now healthy to a degree which appeared almost impossible a few years ago. They appear like trees which had grown in a new district where diseases are unknown.

We do not claim this to be a new system of pruning or one embodying ideas which have not been advanced and practiced elsewhere. If it were a new system, positive statements and recommendations could not be made regarding it, for several years are required to demonstrate such matters.

Training a Young Orchard.

I have discussed the pruning of trees which have grown up under a different system, and have noted the fact that it was not possible to shape them along ideal lines since the large limbs cannot be removed. Such cutting is almost certain destruction to fruit trees in general, and particularly the apple in this district. With young trees, on the other hand, it is possible to train them in the way they should go. The growth of such trees can be developed continually along the right lines by summer and winter pruning with the shears. No undesirable limb need be allowed to grow to a size requiring the use of the saw. Three main branches starting from the trunk at reasonable distance from the ground, these branches forking into two, form the framework of an ideal tree.

Small twigs should be maintained on these main branches. Even the trunk itself may be allowed to grow such twigs for a number of years and the foliage so carried will afford a useful protection against sun burn. Of course, these twigs must be held within bounds by pruning, and removed entirely before the cut is too heavy for the hand shears.† Their places are then taken by suckers allowed to grow from the main limb.

An apple orchard so handled might easily remain in full vigor for one hundred years, as there would be no chance for wood rot to gain entrance and bring about the death of the trees. The system here recom-

FIG. 96.—Branch well studded with apples, close to the main limb and not in danger of wind damage. (Photo by Geo. P. Weldon.)

mended is one of general application except in districts where the pear blight is a serious menace. Under such circumstances the growth of small twigs from the main branches is not considered the best practice.

AUTHOR'S NOTE.

Recently, and since the delivery of the above paper, Mr. Weldon has taken some photographs in this orchard which illustrate the points in question.

WINTER PRUNING OF THE APPLE.

By GEO. P. WELDON, Sacramento, California.

In the study of pruning methods we find in our orchards the two extremes of exceedingly severe pruning and none at all. While neither extreme is best, there are few who prune too heavily and the danger lies in not pruning enough. Such work should begin when the trees are set and should continue throughout the time of their usefulness as producers of fruit.

†Such cuts may be best made with the saw in order to remove the twigs very close to the main branch and so allow of more rapid healing.

Pruning When Set.

Generally speaking a one year old whip is the best kind of apple tree to set. Such should be cut back when planted (see Fig. 97), because of the damage which has resulted to the root system in digging and the consequent disturbance of the balance between root system and top. The root hairs, the function of which is to take up the plant food in solution from the soil, have been practically all destroyed and new ones must be formed before the tree can be supplied by the roots. It is consequently dependent in starting at first principally upon the stored up plant food in the top and must grow for a short time, at least, almost

FIG. 97.—One year old whip, the best kind of apple trees to set. (Original.)

independently of root action. This being the case, the less top that there is the better chance will the root system have to make a rapid recovery and renewal of root hairs. The height at which this one year old tree should be left will depend upon the distance from the ground that it is desired to make the head. The tendency now is to head trees as low as possible and still not interfere with cultivation of the orchard. The writer can see no good reason for heading apple trees more than twenty inches above the surface of the ground. This gives enough trunk for a beautiful, shapely tree and if later pruning is properly done there will be no trouble about cultivation. As the first pruning may largely determine the height of head a short discussion on the advantages of a low headed tree will not be out of place here.

In California as well as practically every place where apples are grown there are times when the sun is very hot and sun-scald of the bark may take place to the great detriment of the trees. Such injury

makes a favorite place for the flatheaded or so-called "sun-borers" to gain entrance and do their work of destruction. Knowing this, is there any good reason for leaving a great high trunk, very often unprotected in any way, exposed to the action of the sun? The destruction wrought by sun-scald and its attendant borers in California is so great that low heading of trees cannot be too strongly recommended.

Most of our orchards are set out for commercial purposes and it is expected that the income from them will be a good one; as in every other business it is necessary to keep down expenses to the minimum in order to secure a good profit. The cost of picking fruit is greatly increased when it is necessary to climb tall ladders to get it.

A certain height of head having been decided upon at planting time, we will say twenty inches for the purpose of illustration as well as because it is believed that such is about the right height, it is obvious

FIG. 98.—Apple tree started with too many framework or scaffold branches, resulting in a bad, crowded condition. (Original.)

that all branches which form the scaffold or framework of the tree, and which determine the height of head, should not emanate from about the same point in the trunk because of crowding and consequent weakening of the framework. There should be at least from ten inches to one foot allowed for spacing these branches for the very best results. If then we desire to have our apple trees headed within twenty inches of the ground, the newly set tree should be cut back to a height of thirty or thirty-two inches. The current season's growth will be in the form of many laterals from this thirty inches or more of trunk, and if everything is favorable they should develop almost throughout its entire length. The practice of rubbing off shoots low down on the trunk is very often followed during the first summer. It is doubtful if it pays to do this, as the tree needs much foliage for its best development and

the chances of sun-scald and its attendant evils are also increased by this practice. The trees should be let entirely alone throughout the first season, after they have been cut back, and the second season there should be plenty of branches to choose from in forming the framework.

Selecting the Framework Branches the Second Season.

Only a glance is necessary into practically any of the older orchards when it will be seen that very little attention has been paid in the past to the careful selection of a proper number of branches rightly spaced. Such trees as the one shown in Fig. 98 are not at all uncommon. This type of head is decidedly bad and has no place in the recently planted orchards. A great number of weakly crotches are inevitable in such cases as this; no larger head can be formed than on a lesser number of

FIG. 99.—Trees of mature age near Watsonville, which have been started with only three scaffold branches. Note the heavy growth. (Original.)

branches and it will not be nearly so thrifty, but worst of all, the time will surely come when because of accident or otherwise it will be necessary to prune out some of the large limbs from the crowded framework. The close quarters for pruning will not permit of doing same with ease and as a consequence large stubs will be left which always mean disaster to an apple tree. The ends will not heal over, rot fungi will get in their work, borers and termites find conditions favorable, and what might have been a long lived tree is doomed after only a few short years of productivity.

From three to five branches are plenty, when carefully selected with reference to spacing and balancing the head, for any apple tree. Many prefer three because of the fact that just as large a head can be formed upon them as on five and there will not be so much chance for crowding.

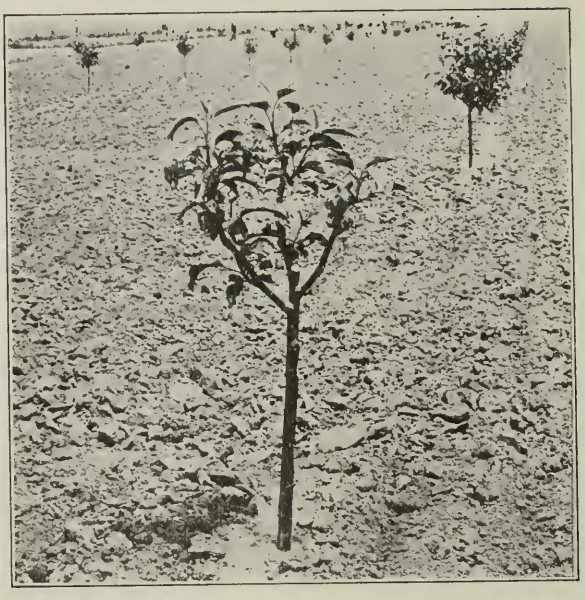

FIG. 100.—Young apple tree at beginning of second season's growth, started with three scaffold branches. (Original.)

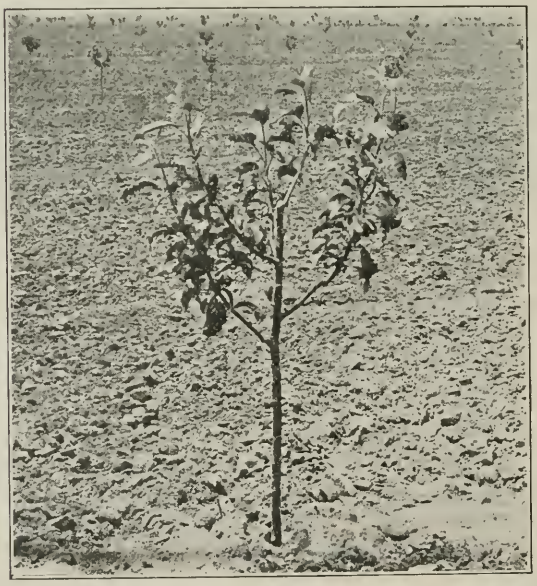

FIG. 101.—Young apple tree at beginning of second season's growth, started with five scaffold branches. (Original.)

Again the lesser number is desirable because of the extra size they will attain and the consequent ability to hold up greater loads of fruit. Occasionally four or five are left rather than three because of the liability of breaking off some branches in cultivating, etc. If one out of three scaffold branches is broken the head is very apt to be unbalanced and difficulty may be experienced in getting it shaped up well afterward, where if there were four or five and one should get broken the chances would be more favorable.

Fig. 99 shows one of the oldest orchards the writer has seen which was started with three scaffold branches. While the spacing of these was faulty in this case, the trees are much better than they would have been had more branches been left. Fig. 100 shows an apple tree after the second year's pruning, which has been well headed and which has only three branches left to form the framework. Fig. 101 shows another

FIG. 102.—Young orchard, part of which has been pruned, illustrating the value of heavy cutting back. (Original.)

well headed tree of the same age in which five have been left instead of three. Either tree will make a good growth, but the former will develop the stockiest branches and should be a little better tree at the end of the growing season. The branches selected for the framework should not be left in their entirety but should be cut back as shown in Figs. 100 and 101. If they are left without cutting back, slender willow-like growths will probably be the result. If cut back to lengths of ten to twelve inches a heavier growth and a greater increase in the diameter of the twigs will take place. Fig. 102 shows a young orchard which illustrates this nicely.

In the case of most varieties of trees at least, it is best to cut to outside buds when this second season's pruning is done, in order to spread the head. The natural spread differs greatly with different varieties, and whether outside or inside buds are left at the terminals of the twigs in pruning, will depend on this varietal factor. For instance, the Winesap has a tendency to spread and grow bushy, and in order to make

it grow upright or at least to increase that tendency, branches should be cut back just above inside buds. On the other hand, the Rome Beauty tree has a habit of growing upright, similar to the Bartlett pear, and by cutting branches in each case just above outside buds the tendency will be for outward growth and consequent spreading of the head. More attention to this particular phase of the pruning operation will be more necessary during successive seasons than during the second.

The desired number of branches having been selected and cut back as shown in the figures, the tree is now ready for the third season's growth.

Pruning the Third Season.

The third season's pruning is just as simple as the second and consists in the removal of surplus branches of the previous season's growth and the shortening in of those left. If five scaffold branches were left in

FIG. 103.—Young apple tree started with three scaffold branches, after it has been pruned the third season. (Original.)

pruning the second season, then two strong growing, healthy branches should be selected and left on each of these which with a few laterals that they support should be cut back severely. Thus we would have a tree with a trunk which has had three years' growth; from this trunk would be five branches which have had two, and in turn each one of these supports two main branches or ten in all, which have had only one year's growth. If instead of the five scaffold branch tree we develop a head with three and allow each one of these to support three there would be only nine of the one year old branches left, which is, however, enough with the laterals that they in turn will develop, to make a big tree capable of bearing just as much fruit as the former and usually having the advantage of extra strength of branches. Fig. 103 represents such a tree.

Fourth and Fifth Season Pruning.

At the end of the third season a shapely head should be formed and such a framework for the future tree developed, that pruning ought not to be a difficult matter. Too often do we find orchardists neglecting the work after this time. The first three seasons while the trees are small the task is neither expensive nor difficult, but as they grow there is a rapid increase of both expense and difficulty of pruning in general and the tendency is to be rather careless afterward. It must be remembered, however, that pruning for the best results must not be neglected for a single season. Careful, annual pruning beginning the first season when the trees are set and continued until they no longer bear crops will do more toward making a success of the apple business than practically everything else. Neglect for one or more seasons followed by very heavy pruning as a result, is not conducive to regular bearing of the trees, nor to successful apple culture.

During the fourth and fifth seasons the trees will bear a little but should not be allowed to overload themselves. The orchardist should

FIG. 104.—Five year old Jonathan trees in orchard of Jas. McCann, Beaumont, which have been well pruned back, and are very thrifty trees, for this variety, developed. (Original.)

still devote his energies toward growing trees and not fruit. All interfering branches should be removed. The balance of the head should be preserved and at least a moderate amount of cutting back of branches should be done. Fig. 104 shows a splendid type of Jonathan tree, five years old, which has been well pruned back each season. Care in cutting to outside buds during the cutting back process will have a tendency to spread the trees if such is desirable, or the reverse operation may be found necessary. Fruit spurs will have developed by the fifth season and care should be exercised to preserve these on the trunks and larger limbs where they are so often cut off by pruners. One of the mistakes

most commonly made in pruning apple orchards is the cutting away of these spurs. Unintelligent pruners will almost always begin cutting from the ground and the removal of these valuable spurs is the result. Orchardists should insist that pruning be done very largely from a ladder, as the top of the trees needs a large share of the attention in this work. In fact, if heading has been well done there should be practically no cutting except possibly of a few succulent sprouts, from the ground.

Pruning Mature Trees.

Correct heading and careful annual pruning of the apple tree for the first five years simplifies the pruning operation for the years to follow. Except in cases of accident to trees there should be no large branches to take out. The work thus far should have been done with the idea of leaving just enough large branches to form the best possible head without any interference or crowding. Just as soon as such takes place in later years all branches that have a tendency to interfere with others should be taken out before they attain a large size. More or less cutting back will be necessary each season and a study may be made of the habits of growth of different varieties and cutting to outside buds or branches or the opposite may be practiced according to the needs of the variety. In most cases fruit spurs should be preserved and it may even be necessary to encourage the development of such.

W. H. Volck, County Horticultural Commissioner of Santa Cruz County, in co-operation with W. S. Ballard of the Bureau of Plant Industry, has been carrying on some very interesting experiments for the past few years to determine the feasibility of developing fruiting spurs from the so-called water sprouts that always grow more or less in every orchard. Mr. Volck's article in this number of the bulletin tells of the work done in these experiments and the results obtained.

EXPERIMENTS WITH COVERCROPS IN SOUTHERN CALIFORNIA.

By W. M. Mertz,* Riverside, California.

The question of fertilizer is undoubtedly one of the most important issues now before the citrus grower. Were you to walk through the plats constituting the fertilizer experiment at the Citrus Experiment Station, you would note that wherever nitrogen had been used there was increased growth, better color and heavier yields. This holds true whether the nitrogen had been added through the medium of dried blood, nitrate of soda or stable manure, with the best results following the use of the organic sources.

Dried blood is a product which is produced in very limited quantities and could not be had in anything like sufficient amounts if all desired to use it. Again, it is very expensive and thus its use is becoming almost prohibitive to many growers.

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

Stable manure is also produced in limited quantities. At best, only a portion of the growers will ever be able to use it exclusively as a source of nitrogen. Nitrate of soda is at present the cheapest source of nitrogen but seems to have factors which make it less desirable than an organic source of nitrogen.

It would seem then that a nitrogen fertilizer from an organic source, inexhaustible in supply and reasonable in cost, is practically a necessity to permanent success in the citrus industry.

The use of legumes as means of maintaining soil fertility dates back to the early Roman days. Experience had taught those ancient "agricolæ" that certain pod-bearing plants enriched the soil in which they grew and it seems to have been common practice with them to rotate their crops in such a way that legumes figured in them frequently. It was finally discovered that the beneficial effects of this group of plants on the soil were due to a gain in nitrogen. In 1885, W. O. Atwater demonstrated that the added nitrogen came from the air. In 1888, Hellriegel and Wilfarth located the seat of the nitrogen fixation in the nodules on the roots of the legumes. In 1889, M. W. Beijerinch found that the causal agents in this fixation were *Bacillus radicicola.*

With a knowledge of these facts, much work has been done in regard to the value and amount of nitrogen thus added from the air.

The realization of the importance of nitrogen as a constituent of citrus fertilizers, together with the need of increasing the organic content of the soil, led the University of California to inaugurate an experiment at Riverside to determine the value of legumes as winter green manure crops.

This work was begun in 1909 and the results tabulated in this paper cover the work of the last four years.

The experiment consists of two divisions. In the first part are grown various legumes, such as vetch, peas and clover, in tenth acre plats, with check plats on which a non-legume, such as barley or rye, is grown. One check plat lies next to each legume plat.

We are now growing nine different varieties, so the experiment consists of nine legume plats and eight of the non-legume plats as checks. The seeds of these legumes are all sown during the early part of September and are treated in a uniform manner throughout the winter.

The nine legumes used are as follows: common vetch, purple vetch, *Vicia errilia*, burr clover, Melilotus clover, Canadian field peas, Tangier peas, lentils and Fenugreek.

The non-legumes used in the different years have been barley, alfilaria and rye.

At the ordinary time for plowing under such green manure crops in citrus orchards, we measure off squares twenty by twenty feet in each of the plats and determine the actual weight of green tops produced on that area. From this we can easily compute the tonnage of green tops these various legumes have produced per acre.

The tops from these squares are then spread out over the area cut and a fertilizer is uniformly applied over the entire area occupied by this experiment. This fertilizer consists of five hundred and forty pounds of finely ground raw phosphate rock, and three hundred and

twenty pounds of sulphate of potash to the acre, no nitrogen being added.

Plowing then takes place with a fourteen inch moleboard plow, turning the furrow slice well over and running nine to ten inches deep. The soil is then worked down with the disk and acme harrows ready for the planting of the summer vegetable crops.

Now follows the second part of the experiment from which we get the results of the nitrogen added by the various legumes.

Vegetables, such as corn, potatoes or sorghum, are planted in plats running the opposite direction from those previously occupied by the covercrops. Thus each covercrop plat has growing upon it during the summer the same sized plat of each vegetable used. During the growth of these vegetables, nitrate of soda in amounts varying from two hundred and seventy pounds to one thousand and eighty pounds per acre is applied in three applications to every second non-legume plat. Uniform cultivation and irrigation are given all plats.

Upon the maturity of the vegetable crops, accurate determinations are made of the number of plants per plat and the total yield of each plat in pounds and ounces.

From these figures we get the yields in pounds per acre of each of the seventeen plats and can easily compute the increases resulting from the various treatments of the soil.

Yields.

The following are the average annual yields in tons per acre of green tops produced by the various legumes and barley in their order. These averages cover the work of five years with these exceptions, the averages of Melilotus clover and the vetch, *Vicia ervilia,* cover but the last four years work; while the purple vetch was grown for the first time this past winter.

TABLE I.

Purple vetch (*Vicia atropurpurea*)	18¼ tons.
Tangier peas	14 tons.
Melilotus clover (*Melilotus indica*)	12¾ tons.
Fenugreek	12⅓ tons.
Common vetch (*Vicia sativa*)	12 tons.
Lentils	12 tons.
Burr clover	12 tons.
Barley and rye (average)	12 tons.
Bitter vetch (*Vicia ervilia*)	11½ tons.
Canadian field peas	9 tons.

The total cost of growing these legumes, including cost of seed, cost of sowing, and two extra irrigations, averages about $8.00 per acre. This expense is practically covered by the saving due to the cessation of cultivation for the period of five to six months that the land is occupied by the covercrop. Thus we arrive at the time for plowing in early March without having gone to any additional expense in handling the orchard and have grown on the land a large amount of valuable organic material.

The following chart gives the average annual yields of three of the seven vegetable crops used in the nitrogen determination made upon various leguminous covercrops.

TABLE II.

Soil treatment	Four-year average shelled corn, bushels per acre	Two-year average potatoes, bushels per acre	Two-year average sugar beets, tons per acre
Common vetch	35	171	15.3
Barley plus 810 lbs. nitrate of soda	34	191	16.0
Burr clover	35	228	17.3
Barley	29	152	13.4
Barley plus 270 lbs. nitrate of soda	32	166	12.5
Vetch, *V. ervilia*	38	231	16.7
Barley	27	166	10.7
Canadian field peas	40	243	17.6
Barley plus 1080 lbs. nitrate of soda	41	218	17.7
Tangier peas	42	227	20.5
Barley	28	163	12.3
Melilotus clover	46	252	19.8
Barley plus 540 lbs. nitrate of soda	42	204	15.7
Fenugreek	43	255	16.8
Barley	35	164	12.7
Lentils	43	204	19.5
Average yield on legume plats	40	226	17.9
Average yield on barley plats	30	161	12.3
Average increase due to nitrogen added by legumes	10	65	5.6

Yield Increase by Use of Nitrogen.

Average increase in pounds material actually produced on plats receiving nitrogen additions from covercrops or nitrate of soda over the yield of the barley plats.

Tangier peas	5,763*
Melilotus clover (*Melilotus indica*)	5,573
Barley plus 1,080 lbs. nitrate soda	4,903
Canadian field peas	4,606
Lentils	3,418
Burr clover	2,883
Barley plus 540 lbs. nitrate soda	2,503
Fenugreek	2,454
Barley plus 810 lbs. nitrate soda	1,779*
Vetch, *V. ervilia*	1,585
Vetch, common, *V. sativa*	992*
Barley plus 270 lbs. nitrate soda	462

*These plats lie next the public road and suffer certain losses for this reason and so in reality cannot be compared with the others.

Use *V. ervilia* when comparing the vetches with the other legumes as to their effect on the crop following.

From these charts one can easily see the increases in the yields of the field crops on the legume plats over those on which barley was grown. This increase could only be due to the nitrogen added by the vetches, peas, etc., as the actual organic material turned under was as great on the barley plats as on those growing legumes.

Another proof of this statement lies in the fact that the barley plats required large additions of nitrogen to bring up the yield of the crops following to the standard of those plats where legumes had been grown and incorporated into the soil.

Our results show that from a twelve ton yield of Melilotus clover, we have obtained an effect equal to that resulting from an application of from five hundred to one thousand eight pounds of nitrate of soda to the acre, costing from twelve dollars to thirty dollars. This fact certainly warrants the careful consideration of the agriculturist, and in particular he who is interested in citrus culture, where intensive fertilization is so generally practiced.

One other important item is covered by this experiment. That is in regard to the comparative merits of the various legumes used.

New Legumes.

Several new legumes have lately been introduced by the Bureau of Plant Industry of the Department of Agriculture, two of which are very promising. These are the Tangier pea and the purple vetch. The Tangier pea is of very vigorous growth and in the five years average exceeds all others in tonnage of green tops produced. It has also given marked increases in yield of field crop following incorporation of tops with soil, and is in many ways a valuable acquisition to the green manure crops. It has, however, one great fault. The seed is very difficult to produce, as the pods burst and shatter the peas very badly when ripe. Professor McKee of Chico, who has been working with this variety for some time, believes the seed of this pea may never be produced cheaply enough to be used as a covercrop in citrus orchards. At present, the seed is not available in commercial quantities. The other variety mentioned above, the purple vetch, had only been grown by us for two years and but once in our regular plat experiment. It has, however, yielded a wonderful tonnage of green tops per acre and grows more rapidly in the fall than any other legume tried. It is aphis resistant and so vigorous that weeds have absolutely no chance to develop with this vetch.

Professor McKee has been working on this vetch for several years and has been able to establish the seed growing of this variety in Oregon, and this year (1914) for the first time a limited quantity of this seed will be available for commercial planting.

The fact that we have not had a field nitrogen test of this crop makes it impossible for us to say just how this crop will compare with the others we have tried, but the features, such as aphis resistance, rapid and early fall growth, and its weed proof nature, make it a plant worthy of extended trial by citrus growers and all others interested in green manure crops.

Of those varieties which we have tested thoroughly, none gives such promise as does the Melilotus or sour clover (*Melilotus indica*). This variety has given the largest increase in the crop following and for soil types similar to the decomposed granite soil of this station, we believe it will be hard to equal.

It grows very well on the heavy red soils of West Riverside and in its wild state seems adapted to quite different soil types. For this reason this clover is worthy of trial in all citrus sections. Sow about thirty-five pounds of seed to the acre (acre solid land; reduce when trees

occupy any large portion of the land). Sow the seed broadcast and harrow it into the soil. Follow sowing with a thorough irrigation, for since the seed can only be sown at very shallow depths, the soil must be wet practically to the surface if a good germination is to follow. Otherwise, the plants will not appear until the fall rains wet the surface.

Success with any clover demands better moisture conditions during the early stages of growth than are required by such plants as the vetches or peas having larger seeds, which allow of a deeper planting and furnish the tiny seedlings more nutriment from the food stored in the seed.

We believe, however, that where extra water is available, the benefits derived from the deeper rooting system and more lasting nature of the organic material will amply repay one for the slightly greater expense incurred in the handling of this crop.

Summary.

From the results of this experiment, we would give as general rules for the handling of covercrops, the following:

Plant that variety of legume which in your community gives the largest tonnage of green tops per acre.

If possible sow seed during the month of September and plow under deeply not later than March.

Determine what is the average seedage per acre in your section and add fifty per cent to get the amount of seed you shall sow. More poor results with covercrops have been due to insufficient seed than to almost any other one cause. The more seed sown to the acre, the more of the legume you will have and the less weeds, which add no nitrogen to the soil.

Sow preferably with drill on level land where the permanent furrows may be made very shallow; otherwise, broadcast the seed and cultivate into the soil.

In the case of drilling the seed, sow after a thorough irrigation. When sown broadcast, sow just preceding your September irrigation.

Never sow a covercrop in an orchard when the water is only sufficient for the trees.

In sections where the aphis attack the vetches and peas, use one of the clovers or fenugreek.

Do not over-irrigate your covercrop, as the excess water in the soil will stimulate a late growth of the trees, making them less resistant to cold.

Plow the green crop under early and plow deeply.

SELLING GREEN ORANGES.

By J. Eliot Coit,* University of California.

During the last season a great deal of interest and discussion were aroused over the effect on the market of selling green or immature oranges. Prices early in the season are usually high and the temptation to begin harvest earlier each year has resulted in the marketing of much fruit which is very sour and not fit to eat. Usually the earliest fruit shipped is handled by speculators or itinerant buyers who do not have the good of the industry as a whole sufficiently at heart. Often the first shipments bring very high prices, but the poor quality of the fruit kills the market and the order goes out "Don't buy any more California oranges till after Christmas." Then when the conservative shippers who have virtuously waited till the fruit was edible send in their first consignments they have hard work avoiding "red ink." In this case it seems that the righteous have to answer for the sins of the wicked. Something is certainly wrong when worthless fruit brings high prices and good fruit goes begging a few weeks later.

For every dollar made on green fruit by the extra early shipper, perhaps ten dollars are lost later by conservative shippers through general depreciation of the market. Low prices are caused directly by a few sales of immature fruit. When a consumer gets "stung" through a purchase he becomes suspicious and eats apples or bananas for a long while before he ventures to buy any more oranges.

Production of Oranges Increasing.

The production of navel oranges in California is increasing at a rapid rate. The climatic conditions in Northern California are well suited to navel production and this is the chief variety planted. While many varieties of citrus fruits do well, it is my belief that the navel orange will be the backbone of the future citrus industry in Northern California. It is true that there are in Northern California enormous areas of cheap land with water available where oranges may be grown to a high state of perfection and we like to build air castles and picture to ourselves the great citrus industry which is to be developed here. It is well, however, to consider the fact that there were produced this year in California and Florida something like 60,000 cars of citrus fruits which include practically all the oranges consumed in the country. Thanks to the California and Florida citrus exchanges, the distribution of this large amount of fruit has been effectively worked out and it is safe to say that today the supply meets the normal demand in every metropolis, city, and village in the land. The successful sale of a greater amount of fruit will depend upon the increase of the demand. It has been proven by actual experiments that the demand and the consumption can be increased by well planned, judicious advertising. California citrus growers are spending this year nearly a quarter million dollars advertising citrus fruit, and Florida is spending a large amount. But to advertise successfully it is absolutely essential that the article advertised be first class and thoroughly satisfactory. What is the use of spending hundreds of thousands of dollars advertising and then kill the good effects of it by shipping to

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

market a lot of sour, immature fruit which nobody can eat without burying it in sugar? It is also worthy of note in passing, that a considerable proportion of the culprits belong to a class which does not help pay for the advertising.

Early Maturity.

Oranges mature early in Central and Northern California and nature has given the northern growers the right to dominate the Christmas trade. Florida also produces early oranges in increasing amounts and if we are to successfully market the future thousands of cars of Northern California navels in the face of the Florida competition for the Thanksgiving and Christmas trade we must do two things—stop the sale of immature oranges, and increase our advertising. With cheap land, cheap water, comparative freedom from frost, and freedom from many pests which are serious elsewhere, it is difficult to foresee the magnitude to which the Northern California citrus industry may develop. Such development can only take place, however, when the consumption of one orange creates a strong desire for more. To yield to the temptation to reap a temporary gain by selling green oranges to the permanent injury of the market is equivalent to selling our birthright for a "mess of pottage."

Percentage of Sugar and Acid in Oranges.

The amount of sugar and acid contained in mature oranges varies a good deal, depending upon the variety, the season, and the climatic and soil conditions. Average mature California oranges contain about 30 per cent rind and 40 per cent juice when freshly picked from the trees. The percentage of juice increases as the fruit is cured, due to loss of water in the rind. Average mature oranges contain about 1 per cent citric acid and 10 per cent total sugars, about one half of which is cane sugar. A perfectly green orange contains a large amount of acid and a small amount of sugar. As the orange matures there is a gradual reduction in the amount of acid and increase in the amount of sugar. When a partially matured orange is picked from the tree the normal process stops and there is a gradual loss in storage of both sugar and acid due to the consumption of these substances in the life processes of the fruit. An orange is not dead when picked from the tree. The life processes go on and respiration takes place for a long time. If decay organisms do not destroy the fruit, it may live and respire for as much as four or five months off the tree if protected from excessive loss of moisture

Sweating the Fruit.

In certain localities some varieties of oranges attain approximate maturity as to size, sweetness and acidity before the color changes from green to yellow. Inasmuch as the public will not buy a green colored orange, the custom of artificially coloring the fruit by sweating has arisen. This practice is legitimate where the fruit sweated is mature and sweet. The practice of sweating has been greatly abused, however, and many have used it to deceive the public and increase the early sales of immature fruit.

The United States Government Board of Food and Drug Inspection has ruled (Decision No. 133) that oranges artificially colored in a manner whereby inferiority is concealed are adulterated and subject to confiscation when found in interstate shipments.

This decision has accomplished a certain amount of good but it has not put a stop to the shipment of worthless fruit for the reason that it applies only to fruit which has been artifically colored. No matter how sour and inedible an orange may be it may be shipped to market provided it has not been sweated. Then too as long as sweating is recognized as legitimate in certain cases it is very difficult to draw a sharp line of distinction between the legitimate and the illegitimate. We find, therefore, that this ruling of the National Board of Food and Drug Inspection is entirely too vague and indefinite to put an effective stop to the shipment of green oranges.

On June 13, 1913, the legislature of the State of Florida passed an immature fruit law which went a good deal farther than the above mentioned ruling and this law was enforced during the last shipping season. This law may have some defects, but its general beneficial effect will be at once apparent to anyone who will take the trouble to compare the prices received for California and Florida oranges during the last Christmas season.

The Florida Immature Fruit Law.

Regulation No. 1 provides that from September first till November fifth of each year all oranges or grapefruit that are green in color, while on the tree, or when detached from the tree previous to the time of inspection, shall be considered immature and subject to the "acid test."

From September first till November fifth of each year, all oranges or grapefruit "showing an average on the trees of one half yellow color, indicating ripeness," or when detached from the tree not more than forty-eight hours previous to the time of inspection, shall be considered mature and not subject to the acid test.

Provided that any oranges or grapefruit that have been detached from the tree more than forty-eight hours previous to the time of inspection and "which have been artificially colored by holding in a warm moist atmosphere for a short period after removal from the tree are colored in a manner whereby inferiority is concealed and therefore are adulterated" and shall be subject to the "acid test," though one half or more colored yellow.

Regulation No. 2 prescribes the method by which inspectors are to draw samples for testing.

Regulation No. 3 describes the acid test and sets the following limits: Oranges whose juice contains more than 1.30 per cent of acid shall be considered immature. Grapefruit whose juice contains more than 1.75 per cent of acid shall be considered immature.

Regulation No. 4 describes the preparation of the samples.

Regulation No. 5 describes the application of the acid test.

Regulation No. 6 gives inspectors the right of access to premises for the purpose of taking samples.

Regulation No. 7 directs inspectors to take samples and test the same in the territory assigned to them. When any lot of fruit offered for sale or shipment from packing houses is found to be mishandled or adulterated within the meaning of the law, inspectors are directed to seize and attach the same and place it in the custody of the sheriff of the county, subject to the order of the Commissioner of Agriculture.

Regulation No. 8 provides for the official testing of all samples drawn by growers at any time for the purpose of ascertaining the condition of the fruit.

The application of this acid test is very simple. All that is necessary is a few standard alkaline tablets obtainable at any drug store, a small piece of cheese cloth, a 25 c.c. pipette and a teacup. A standard alkaline solution is made by dissolving 100 tablets in 8 ounces of pure water. Twelve average oranges are selected, peeled, cut crosswise and the juice pressed out. This mixed juice is strained through the cheese cloth and 25 c.c. placed in the cup. Then 25 c.c. of the alkaline solution is added and if the acid content is 1.30 per cent or less the solution will show a bright pink color. If the acid is greater than the amount allowed by law the pink color will not appear.

It is a fair question for debate whether a law forbidding the shipment of immature fruit might not be a great advantage to the California industry. It is believed that on the average the juice of California oranges contains more sugar and also more acid than Florida oranges. On this account somewhat different standards would have to be adopted.

I think that all of you will agree with me and believe that something should be done to stop the irresponsible shipping of immature fruit.

By way of suggestion I may say that perhaps a committee of growers might be appointed to test the sentiment of the different citrus organizations, correspond with Florida growers regarding the workings of their law, make a large number of acid tests of the fruit in different sections and on different soils as it comes to maturity this coming fall, and formulate some kind of a law for presentation to the legislature next spring.

I may say that the division of citriculture of the University of California will be glad to co-operate with such a committee, and it offers its facilities for the testing of samples of fruit and for a systematic study of the changes in sugar and acid content of maturing oranges.

THE POTATO EMERGENCY CONVENTION.

The Potato Emergency Convention, held at Stockton September 25th and 26th, was remarkable for the number of distinguished scientists—experts in potato diseases—from Europe and the United States Department of Agriculture present, for the attendance of delegates from four other states, for the great attendance of interested growers and shippers from California, for the absolute harmony in all the discussions, and for valuable practical results which seem assured as an outcome of the convention.

The Excursion to the Delta.

The 25th was given to a visit to the numerous islands of the famous Delta region. About one hundred persons boarded the steamer at 9.30 a.m., including Dr. S. Appel of the University of Berlin and Johana Westerdyk, of the Phytopathological Laboratory of Holland, and four experts from our United States Department of Agriculture. The humus-laden soil, luxuriant vegetation of the Delta, and the wondrous system of irrigation were universally admired and commended. There was no attempt to cover up defects, but we were shown the faulty rotation, so short, only two years; the numerous volunteers, resulting from omission to pack up the scattered small potatoes, the worst examples of wilt fungus, Rhizoctonia, tuber moth and eelworm, the common practice of exposing such potatoes, and using diseased tubers for seed. The lectures, with demonstrations by such experts as Dr. Appel, Dr. Westerdyk, Dr. Orton, Prof. Stewart, Mr. Shear of the United States Department of Agriculture, and County Horticultural Commissioner Garden, were eagerly listened to by all present. The lunch and many delightful conferences on the boat were greatly appreciated.

Dr. Cook's Address.

The evening meeting, held in the court house, was opened by Col. John P. Irish, who introduced the chairman, State Horticultural Commissioner A. J. Cook. Dr. Cook commented upon the superiority of the potato as an article of food, the excellence of the Delta product, and the natural adaptation of these islands to the growth and development of this vegetable. He said that anything which had a bad effect on the prosperity of the potato industry of California would be a menace to the welfare of this State.

Too much stress, he said, can not be laid upon the importance of good seed. In the case of potatoes, as with all vegetables, grains, etc., the seed should be carefully selected. It should be from hills that produce numerous tubers of desirable size. Only perfectly smooth and sound potatoes were fit for seed. The observance of these suggestions would greatly aid in eliminating scab and other fungous troubles, as well as eelworm and tuber moth. Caution in the selection of seed has been known to advance the yield more than 30 per cent. It would always pay well to reject all imperfect seed, and to treat the seed with a fungicide as a further precautionary measure.

Rotation.

He stated that rotation of crops—like seed selection—was exceedingly important; that each grower should study with a view to ascertaining what crops are adapted to his soil conditions, and select only those crops which would pay and which would aid in freeing his soil from insect, fungoid and weed pests. He referred to the fungous troubles which have laid a heavy hand on the potato industry: The ugly scab, the too common little potato (Rhizoctonia), and the wilt fungus (*Fusarium oxysporum*). If the soil and seed were clean there would be no trouble from diseases of this class.

Tuber Moth.

Stress was laid upon the importance of the tuber moth question. Potatoes harboring this moth, he said, and shipped to other states, had resulted in a quarantine in three or four sections or states, and led to the destruction of whole carloads of California potatoes in still other states, with much loss to the shippers. Clean potatoes only should be shipped or the people must expect these quarantines and this destruction continued, and even increased.

A Timely Suggestion.

He suggested that many of our foothill valleys—as also on the plains—where the soil, sunshine and water insure large crops of ideal potatoes and where there are no insect or fungoid pests, should produce seed potatoes which would meet every requisite of the most painstaking grower. There was an opportunity for any alert rancher in any of these favored localities to produce clean seed.

The Control of the Tuber Moth.

In speaking of the tuber moth, W. H. Volck, county horticultural commissioner of Santa Cruz County, stated that the tuber moth had existed for many years in California, and that it had undoubtedly become as much of a pest as natural conditions would permit.

Hilling to Control Tuber Moth—He spoke of an experiment to control the tuber moth by hilling, which was conducted on both adobe and sandy lands. Some of the rows of potatoes in sandy and adobe lands were hilled just before the tubers were setting, or about July 15th. Other rows in both the two types of soil received the same treatment a month or six weeks later. The hilling was performed in a thorough manner, first with the plow, and then finished with a hand hoe. In the adobe soil care was taken to fill in around the stems of the plants with soil as free from clods as possible. The potatoes were harvested in September, and the percentage of worm-infested tubers was determined by weight. In the early hilled adobe land 16.5 per cent of the potatoes were wormy; in the early hilled sandy land 9.9 per cent were wormy; in the late hilled adobe land 42.3 per cent were wormy; in the late hilled sandy land 22.3 per cent were wormy. The importance of early hilling could be easily seen from the above figures. The hilling must be properly done. It was necessary, he said, to cover the tubers with from four to six inches of finely pulverized earth. In order to do this the rows should not be less than forty inches apart. The hilling must be finished with the hand hoe, as no plow could properly draw the earth in around the stems of the plants.

Treatment by Soaking—The hilling method did not, however, solve the problem of storage, where the worms might have time to mature into moths, lay numerous eggs and, perhaps, infest the greater portion of the tubers. This was the most serious part of the problem to the grower. No fumigation process had been devised which would kill the worms inside the tubers without rendering those so treated unfit for use. Some of the growers had observed that the early rains before digging had lessened the trouble from this pest. By experimenting along these lines it was found that a soaking period of thirty-six hours was sufficient to

kill all stages of larvæ in the tubers. It was also found that the marketing qualities of the tubers were not injured in any way by the treatment, provided the following precautions were taken: First, rotten and visibly wormy tubers should be sorted out before the soaking treatment; second, the water should be cool and clean; if possible, a stream of running water should pass through the soaking tanks; third, after soaking the tubers ought to be sacked at once and piled in an airy storeroom, to allow rapid drying; fourth, the tubers must not be exposed in the open, either before or after soaking, as the tuber moth might lay eggs on them, which would not be killed by the soaking process.

The speaker stated that when the tubers were soaked they became saturated with water and the worms in the burrows were drowned. Actual weighing of the tubers before and after soaking showed a gain in weight of 20 to 30 per cent, and it sometimes required four to six weeks for this extra weight to be lost by evaporation. This soaking treatment was one which could be used by potato dealers with good results, especially in the case of potatoes to distant markets. Such potatoes should be dumped from the sacks and allowed to remain in a moth-free room for about ten days, in order to allow any eggs to hatch. The tubers might then be allowed to soak for thirty-six hours, with the assured result of complete disinfection.

Thorough Inspection to Avoid Quarantine.

Mr. William Garden, county horticultural commissioner of San Joaquin County, in an able discussion, asserted that these potato troubles—with the possible exception of the tuber moth—were common to practically all our potato-growing sections, and that this pest had been taken from several of the states which were condemning California potatoes. Thorough inspection of all potatoes, both in and out of the state, would do away with the necessity of quarantine measures. The improvement of soil conditions and the elimination of rotting potato culls in this section ought to do a great deal toward reducing this pest. Some of the seed tubers shipped in from other states were found to be diseased. Mr. Garden urged that a better system of inspection be inaugurated.

Tuber Moth From Los Angeles County.

Mr. William Wood, county horticultural commissioner of Los Angeles County, pointed out that forty years ago the tuber moth was known to him in Los Angeles County, and that for many years this county had been shipping out potatoes into different states and sections of this state. It seems strange, he said, that if the tuber moth could have become a pest in those states, it had not done so before this time, considering all the potatoes shipped out; 1912 was a bad tuber moth year for Los Angeles County, as there was a heavy planting of early potatoes and when harvest time came prices were so low that many of the growers left their potatoes in the ground, making ideal conditions for the spread of the tuber moth.

In June and July of this year in Los Angeles County there was a surplus of about 550 cars of the new potato crop. Every one of these cars was inspected and passed. Fully one third of these potatoes was grown on the badly tuber moth infested land of two years ago.

Quarantine.

Mr. Frederick Maskew, chief deputy quarantine officer, stated that if a quarantine were once placed on California potatoes it could not be lifted by any legal process, and that the states which were quarantining against this insect could not be compelled to take the quarantine off. In San Francisco the quarantine station maintained twenty-one quarantines, of which thirteen are federal and eight are state. None of these had ever been broken down.

Few Potatoes Grown in Sacramento County.

Mr. Howard G. Kerchival, county horticultural commissioner of Sacramento County, said that there were very few potatoes grown in Sacramento County, and that they were already infested with the same diseases that occurred in the Delta region.

Oregon's Attitude.

In a short talk State Commissioner of Horticulture E. C. Roberts, of Oregon, mentioned the fact that there had been considerable agitation with a view to quarantining against California potatoes; he hoped that they would be able to reach an amicable arrangement, in order to avoid quarantine.

Washington's Attitude.

Washington's attitude toward California was defined by Mr. T. O. Morrison, Assistant Commissioner of Horticulture, in the following terms: Washington wanted to be just towards California shippers, but would not permit tuber moth infested potatoes in that state.

The Potato Situation in the "Delta" Region.

Mr. W. V. Shear, of the United States Department of Agriculture, spoke on the general situation in the Delta region. The Delta region, lying at the mouths of the San Joaquin and Sacramento rivers, covered an area of 25,000 acres of valuable land. The land has been reclaimed, levees have been built and pumps installed to drain the land. Several troubles, which sometimes wiped out the crops in large portions of the world, were practically unknown here. The late blight was one of these diseases. The early blight did little damage, and the Colorado potato beetle was unknown. The potato producers in this section secured greater cash returns per acre than from any other crop. As a result, potatoes were raised on the same land three years in succession. Then barley was planted, after this potatoes, then barley alternated. While this rotation did not always follow it was by far the most common one practiced. This plan had resulted in two sets of tenants, one class of which always grows potatoes, the other barley. The seed potatoes largely came from Oregon, Washington and other nearby states. This outside seed was planted late in the season, and the yields from it were used for the main part of the potato crop the following year. As the potato diseases were carried on the potato seed stock, when these were planted the soil became inoculated. In this way the Delta soils became infested with the potato diseases which were found in the localities from which the seed was imported.

Since a tenant remained in any one camp but a single season, Mr. Shear stated, he took little interest in keeping up the soil facilities. As he had no use for cull potatoes or diseased ones, he left them on the ground. Owing to the mild winters these small and diseased potatoes were not killed by the frost, and the result was a large volunteer crop, upon which the disease thrived. The tenant must become familiar with these troubles and must be taught the importance of preserving the productivity of the land. The landlord must be shown how this system of leasing to annual tenants is leading to a depreciation of the value of the lands for agricultural purposes.

Developing Peat Land in Holland.

The convention was favored with a short talk by Dr. Johana Westerdyk, who brought out the fact that the Delta region was in many ways like that of Holland, where there are two ways of developing the land: Using the peat soil for pasture land had always been the most profitable course. The main thing, she said, was to begin with the right crop. In these acid, peaty soils the farmers started by growing a certain mixture of grasses with clover. They could not begin by converting the peat into common pasture land. Grasses which stood acid soils had to be used. The clover was used, not only for its power of bringing nitrogen into the soil, but was also laid on as a soil ameliorator, as the large roots penetrated the soil deeply. In many cases before sowing clover and grasses an amount of lime was mixed with the earth, both for removing the acid and for improving the physical condition of the soil. Not before the soil had reached a certain solidity throughout were cattle or sheep driven in, and in the course of time the pastures could be maintained.

The other way mentioned was to develop the peat into agricultural land, as was the case in the Delta region. Instead of potatoes being used as a first crop after reclamation, in Holland oats, mixed with a leguminous crop, were generally used. The clover stayed over the second year, after which a crop with clover was sown and the soil might be ready at this time for potato growth. If the land was to be developed into vegetable land the cultivation of soil-preparing crops had still to go further, and care must be taken to avoid the lime, as vegetables are very sensitive to its influence. In making vegetable growing possible manure was of great value. The long experience of the Dutch peat farmers had demonstrated that potatoes on new peat land were a danger to the future development of that land.

Dr. Appel on the Potato Situation.

Dr. Appel, a famous potato expert of Germany, delivered a brief address on the potato question. He stated that the question of potato diseases was largely one of potato culture, and that in planting potatoes on new land there lay a danger, in that the uncultivated peat land was not very favorable to potatoes, because it possessed qualities that were not fit for this crop. In the Delta soil the Rhizoctonia fungus found most splendid conditions for growth. When the potatoes came in contact with the infested soil, the young sprouts were attacked by the fungus before they reached the soil surface, or the stems became infected. The stolons were often killed and the disease frequently

appeared in the tubers in the form of small sclerotia, the winter form of this disease. In Germany, he said, in preparing peat and peat land, the farmers began by growing oats, mustard and buckwheat. These crops were better fitted for the peaty conditions and changed the rough soil into a cultivated one.

Acid soils were made alkaline by adding lime. After three or four years the painstaking were rewarded by a good potato crop, that rarely suffered from Rhizoctonia.

These methods might, or might not, be adapted to the Delta conditions, and one duty of the station should be to investigate thoroughly the conditions which would change rough, uncultivated land into a good agricultural soil. The station should also be able, as time went on, to devise methods for fighting Fusarium and other diseases.

It was further stated by Dr. Appel that the question of putting lime in a soil was a prominent one in Germany. Lime changes soil from acid to alkaline. If lime were put into soils we might have trouble with potato scab, which affected soils rich in this chemical. The grower must decide whether he wished to grow potatoes or other vegetables. Some vegetables would grow better in an acid soil than in an alkaline one.

Conditions Affecting the Delta System of Agriculture.

Prof. William Stewart, of the Bureau of Plant Industry, United States Department of Agriculture, gave an interesting summary of conditions affecting the Delta system of agriculture. He stated that there had been at no time more widespread interest in improved methods of potato culture than today. The Delta lands afforded peculiar agricultural possibilities, and their present condition with respect to potato growing indicated that these had not been realized. The rational system of agriculture had not been practised in this region. The endeavor had been to get as much money out of the land as possible. This had resulted, not so much in the impoverishing of the soil, as in filling the land with disease.

The system of tenantry was all wrong. The annual tenant could have no other interest than that of getting all he possibly could out of the land. As the potato was the most profitable he grew potatoes. If a definite system of crop rotation were practised, whether three, four or five years—which may be determined—and crops were grown in this rotation which were not affected by these diseases, then conditions would be vastly better. With this system of crop rotation a more permanent tenantry must come.

In regard to harvesting the crop, the speaker stated that there would be a more economical use of labor if the digger were to confine his attention to digging alone, someone else doing the picking up. If the tubers were exposed to sun and air for an hour or two after digging, instead of being gathered as soon as dug, there would be much less danger of fungus attack by the "leak" disease.

The removal of cull potatoes from the land was also important, inasmuch as the perpetuation of the various insect and fungoid diseases was largely made possible through leaving the culls upon the land. This would entail considerable expense, and if these culls could be converted into a dried stock food—with which the Bureau of Chemistry and the

Bureau of Plant Industry are now working—perhaps the cost of gathering and conveying them to the drying plant might be covered.

By using good seed potatoes, free from mixture and disease, true to type, and produced in a soil and under climatic conditions favorable to the production of a high quality of potato, the production would be vastly increased. This year Michigan, Maine, Wisconsin and Minnesota had made provision for a field inspection of potatoes, upon the application of the growers. Usually the inspection was made by a potato specialist and a plant pathologist. The first inspection should be made when the plants were in bloom, because at this stage varietal mixtures were more easily detected. If the inspected field were found free from mixture and disease on the first examination, it was certified as to purity of stock and freedom from disease, but was also subject to a second examination just prior to harvesting the crop. This inspection consisted in digging hills of potatoes here and there throughout the field, to determine the relative productiveness, trueness to type, freedom from scab and other diseases. If the field, when first inspected, was found to contain varietal mixtures or diseased plants, the grower was requested to remove such plants from the field. Ten days or two weeks later another inspection was made and if the owner had complied with the request his field was entitled to certification, provided it met with the requirements of the third inspection. On the other hand, if he had not complied with the requirements, his crop was not certified for use as seed potatoes. Each state, as yet, had its own special requirements. A uniform standard was needed for all states. This question was to be discussed at the Annual Convention of the National Potato Association, to be held at East Lansing, Michigan, December 2 and 3, 1914.

The development of disease resisting varieties was very important, as it would require a number of years to produce such varieties. In Germany, varietal resistant stock had been developed to a certain extent.

The Tuber Moth.

In the discussion relative to the life history of the tuber moth, Mr. John A. Graf, of the Bureau of Entomology, United States Department of Agriculture, brought out several important points. In his investigations he found that all the evidence points toward the tuber moth being a native insect, and not an imported one, as was hitherto believed.

In the matter of quarantine the tuber moth was unlike any of the other insects against which we were quarantining, in that it depended for its sustenance on an annual plant, and its numbers in any year were governed by conditions and not by the numbers of the moths the preceding year. In the same way its numbers one year had no direct influence on the numbers the following year. With this in mind it seemed that careful inspection might take the place of quarantine, and give justice to everyone.

Diseases of the Potato.

Prof. W. T. Horne, of the California Experiment Station, talked on the diseases of the potato. He brought out the following points: Much work had been done on the internal brown streak of the potato, but so far the cause had not been determined. This disease was not of much importance in the Delta region. Wilt fungus was an important trouble.

If a plant were pulled up when the tubers were mature and an area cut off near the stem, a dark ring was observed on the cut surface. This disease was of a fungous nature. The effect of this fungus was, primarily, to produce a wilt. The fungus apparently gained entrance through the roots and from them spread to the stem and leaves. The entrance to the tuber was made, therefore, through the stems on which the tubers were borne. The weakened condition of the plant, due to the attack of this disease, made the tuber more susceptible to the attack of other fungi which caused decay. In controlling this disease it was important to get clean seed. It appeared that dry soil was more favorable for the spread of the organism.

Another disease prevalent was the potato scab. The rough scabs grew on the surface of the tubers and on the vines. The fungus gave rise to a scabby, corky growth. There was no considerable amount of decay following scab. The disease was a curious one, with regard to acidity and alkalinity of the soil. Alkaline soils favored the growth of the fungus. Clean seed was important in controlling and preventing this disease.

The Rhizoctonia was another fungous disease somewhat like those previously mentioned. It lived in the soil. We were not entirely familiar with its soil life. The potatoes that developed were not injured to any appreciable extent. The fungus began to grow on the young, tender stalks, and thus killed or prevented the growth of the young potato. Plants infested with this disease, instead of forming tubers underground, sometimes formed small tubers in the axils of the leaves. This fungus attacked many other plants besides the potato. In Cuba tobacco seed beds, if moist conditions were favorable, would be ruined by damping off. The plants affected by the disease presented the appearance of having been crushed and soon after the mildew-like growth of the mycelium would be seen, from which the spores were produced. The spores were almost never produced in our potato fields, the fungus probably being carried in vegetable matter. In the control of this disease general sanitary precautions were important.

The leak disease resulted from infection of wounds in the potato. As can be seen from the name, the leak fungus caused a watery-like condition of part of the potato, which leaked out. The remedy for this disease was care in handling the potato in harvesting. Such a wound as a tule wound might give entrance to the spores of this fungus.

The potato eelworm was another problem. This was a nematode. Root knot occurring on many other plants was due to the same organism. In preventing soil infestation by the eelworm it was important that seed free from this pest be planted. We might expect more trouble in the future from this nematode.

Late blight of the potato, while it occurred in California, did not do any appreciable damage, but in the Eastern States and Europe potato growers had much trouble with this fungus, and from all reports this disease was worse than all the others put together. It was controlled by spraying.

Dr. Orton's Address.

Dr. Orton, of the Bureau of Plant Industry, United States Department of Agriculture, emphasized the importance of clean seed, removal of the culls, rotation of crops, and better study of agricultural methods

in irrigation of the potato. In discussing clean seed, Dr. Orton said that nearly all of the potato diseases were carried on the seed, and that land which had been planted with eelworm infested potatoes was ruined in so far as nursery stock growing was concerned.

The importance of seed inspection was ably discussed, and in the case of the Delta region the number of leading stations was so small that the cost of inspection would be comparatively small. This cost should be divided between the state and the grower.

The necessity of finding some way of disposing of the culls, either by establishing a glucose factory and starch factory, or by feeding the culls to stock, in order to pay the growers for taking the culls from the land, was pointed out.

By cooperation between the states, between the growers and the communities themselves, these great problems would be best disposed of.

Eelworm in Nevada.

Director S. B. Doten, of the Nevada Experiment Station, gave a short account of the eelworm in Nevada, and explained how the Italian growers of that state had been educated along scientific lines, through simply phrased literature, printed in their native language, in which were outlined suggestions for the development of the potato industry.

The Landlord.

Colonel Irish, in speaking of the landlord, said that the landowners were in constant contact with the Japanese farmers, and that they found these farmers—who were variety farmers—maintained a fairly excellent system of rotation. He pointed out that what was needed was an active, friendly cooperation between the landowner and the tenant, and that it was the duty of the landlord to promote the profit earning capacity of his tenant. He stated further that he had found the Japanese farmers, as a rule, anxious for cooperation, when the landlord was willing to come half way. Another point brought out by Colonel Irish in his talk was that the tenant took all the risk of flood, insect pests and diseases, and that anything which would increase the tenant's knowledge of the control of these different pests would benefit both tenant and landlord.

The Potato as an Article of Food.

Prof. M. E. Jaffa, of the University of California, at the banquet given at the Hotel Stockton in the evening of the second day, explained that the potato, by virtue of its chemical composition, was a product of high value as food for the human race.

The West Coast Potato Association.

The organization of the West Coast Potato Association resulted from this convention. Dr. A. J. Cook, State Commissioner of Horticulture, was unanimously elected president, and William Garden, County Horticultural Commissioner of San Joaquin County, was elected secretary. President Cook was authorized to appoint an executive committee of five members, for the purpose of carrying out the recommendations embodied in the resolutions adopted during the emergency convention,

and was also empowered to call the next meeting whenever, in his judgment, occasion required. An invitation to join the West Coast Potato Association is to be extended to the potato growers of Oregon, Washington, Idaho, Utah, Nevada and British Columbia.

Report of the Committee on Resolutions.

The first potato convention of the states of the Pacific slope, held in Stockton, California, September 25 and 26, 1914, upon the call and the initiative of Dr. Cook, State Horticultural Commissioner of California, authorizes the following record:

The instruction furnished by the foreign experts and those from the agricultural department of the United States and of the State of California was by this convention made the common property of the potato growers of Utah, Idaho, Washington, Oregon, California and Nevada.

It was positively demonstrated that the potato problem presented by insect pests and fungous diseases are common to all these states. That quarantine while necessary, is no safeguard against the appearance of these pests and diseases, for wherever the tubers grow they are the potential hosts of these infestations.

Therefore the conclusion is reached that these common problems summon all potato growers to a community of determination and effort to cleanse their land and their crops by inspection and scientific treatment of seed, by a rigid rotation of non-host crops, by investigating the differential treatment of soils that differ in their characteristics, as between the peat and bottom lands and the uplands.

Further it is recorded that land owners who lease must at once enter into permanent advisory relations with their tenants to assist them if necessary by conditions in the lease in securing proper rotation and clean land and seed. It is also made evident that it is the interest of the growers in every state, in the exchange of seed, to see by official inspection that the seed is absolutely clean and fit, and then by proper rotation of crops encourage all growers by the example of success.

The success and permanence of the potato industry demands a supply of vigorous disease-free seed. This seed supply can be far more surely and efficiently obtained by inspection of the seed crop in the field. Certain sections of this state are able and anxious to supply such seed. The growers in these regions desire field inspection and certification to protect their efforts to produce such seed. We ask the Department of Agriculture of the State University, or State Horticultural Commissioner to supply such field inspection at the growers' expense.

It is the advice of this convention that for the benefit of California and therefore for the information of all growers, that experimental operations in the delta be comprehensively enlarged to include first, a searching investigation of all insect pests and their biological history, and of the conditions that incubate fungous diseases, and second, a sound and feasible rotation of crops that will sustain the profits of the land and cleanse it for potatoes as a leading cash crop. To this experimental enlargement the convention pledges financial support upon condition that the state and federal departments of agriculture will cooperate by providing such expert investigators as the problems require.

In the interest of all potato growers and shippers it is suggested and believed that the growers in every state should seek between the states a statutory cooperation of inspection, securing thereby an official inspection at the point of shipment which shall be conclusive if, at the point of consignment, no changes are shown to have occurred in transit.

This convention expresses its lasting thanks to Dr. Cook, State Horticultural Commissioner, for his initiative in assembling it and to the expert guests and instructors invited by him; to Dr. O. Appel of Germany, Dr. J. Westerdyk of Holland, Mr. W. A. Orton, pathologist, of the United States Department of Agriculture, and Prof. William Stuart, horticulturist of that department, and to Horticultural Commissioners E. C. Roberts of Oregon and T. O. Morrison of Washington, and to the able County Commissioners of California.

We thank the press and people of Stockton and the chamber of commerce for the courtesies we have received here and especially for the splendid excursion they gave us through the Delta.

Signed: JOHN P. IRISH, (Chairman).
T. O. MORRISON.
W. A. ORTON.
GEORGE SHIMA.
E. C. ROBERTS.
PHIL O'CONNELL.
W. V. SHEAR.
E. H. PIIREANER.
JONAS ERLANGER.
FREDERICK MASKEW.

CROP REPORT AND STATISTICS.

By Geo. P. Weldon.

The regular monthly crop report which has been published in this department of the bulletin for some months past has not been compiled for September, owing to the fact that the county horticultural commissioners are required to make an annual report to the State Commission, such report being due on September 30th, and as a consequence the previously mentioned report was not required.

Many interesting facts concerning the condition of orchards, new plantings, and production of fruits are contained in the annual reports parts of which will later be published in the bulletin.

The following figures, giving the production of oranges for the season in the three heaviest producing counties south of the Tehachapi, may be of interest:

Los Angeles	108,000 tons
Riverside	69,818 tons
San Bernardino	207,564 tons

The estimated percentage of the total state's output grown in these counties during a season of normal production may be found in the following table which has been compiled from reports of county horticultural commissioners, fruit exchanges and other reliable sources.

County	Almonds (per cent)	Apples (per cent)	Lemons (per cent)	Oranges (per cent)	Walnuts (per cent)
Alameda	*				
Butte	12	*		*	
Colusa	3				
Contra Costa	12	*			
El Dorado	*	*			
Fresno			*	*	
Glenn					
Humboldt		3			
Imperial					
Kern		*		*	
Kings					
Lake		*			
Los Angeles	2	4	23	22	31
Madera	*	*			
Mendocino		*			
Mereed	*				
Modoe					
Monterey		7			
Napa	*				
Nevada		4			
Orange			3	8	39
Placer	*				
Riverside	3	*	22	18	*
Saeramento	12			*	
San Benito					
San Bernardino		6	17	33	*
San Diego		*	19	*	
San Joaquin	17				
Santa Barbara			*		11
Santa Clara	*	*			
Santa Cruz		48			
Shasta					
Siskiyou					
Solano	3				
Sutter	11				
Sonoma		19			
Stanislaus	3				
Tehama	*	*			
Tulare		*	3	14	
Ventura			12	*	17
Yolo	14				
Yuba	*	*			

*Less than 2 per cent of state's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. Cook, State Commissioner of Horticulture ---------- Censor
E. J. Vosler ---------- Editor

ASSOCIATE EDITORS.

Geo. P. Weldon ---------- Chief Deputy Commissioner
Harry S. Smith ---------- Superintendent State Insectary
Frederick Maskew ---------- Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Sound Potato Seed—Why Not? We are glad to present the report of the Emergency Potato Convention held at Stockton September 25th and 26th, which Secretary E. J. Vosler gives in this issue of The Monthly Bulletin. Rarely are so many experts of the highest order at any gathering.

Mr. George Shima, the "potato king," reported that whereas three hundred sacks of potatoes were no exception a few years ago now scarce one hundred sacks are produced. There seems almost no doubt but that the cause of the decline in California rests with two fungi, the wilt fungus and Rhizoctonia, or "little potato." Two other evils confront the potato grower: one is a nematode (eelworm); the other, the tuber moth. Two points of great importance are established: If our seed is free from insect and fungous taint and our soil is equally clean, then we will grow great crops of perfect tubers. This is the problem then, clean seed and a clean soil. Yet the experts at the convention told us that seed from many localities in all the states is more or less infested, in some sections more than in others. Other states also have serious diseases not yet known to California.

Again, we must either plant potatoes on untainted soil or else free our soil from diseased germs by a long and well-planned rotation of crops. In any case we must grow our own seed, else we can not be sure that it is safe to plant. At present our greatest effort must be to produce seed free from infection. A plan is outlined as follows: Mr. George Shima said he would provide ten acres of virgin soil on which nothing but tule had ever grown, as the land had just been reclaimed. Mr. E. H. Phreaner of Placerville has also promised to secure ten acres of rich mountain valley land on which no crop has ever been grown. We believe this will give us one of the requisites for success in our undertaking, but can we procure clean seed to plant? I hope and believe we can. If not, then we must work hard to secure the nearest approach to clean seed that is possible. Mr. W. V. Shear of the United States Department of Agriculture, an expert in all phases of potato culture, reports that potatoes grown in the valleys along the Sierra

Nevada Mountains are exceptionally clean. We can secure these. In an extended trip through Oregon Mr. Shear also found in places tubers that were very perfect, which can be secured. The plan is to secure these sound tubers, plant them under strictest expert supervision and confidently await results. Mr. Shear and County Horticultural Commissioner Garden will make all needed inspection while the Delta potatoes are growing. Chief Deputy State Commissioner Weldon and the writer will be equally vigilant in inspecting the mountain experimental plot. In both cases expert potato growers will do the cultivating. If we succeed, as I believe we will, we will not only procure excellent seed that will greatly aid to restore the old-time production, but it will also present an object lesson that will induce many to the same wise course of action.

AID OF COUNTY HORTICULTURAL COMMISSIONERS.

Why may not several, or all, of our county horticultural commissioners engage in a similar experiment the coming season? Is there one who can not secure a few acres of rich well watered virgin soil which has never had opportunity to become tainted? Then procure seed absolutely smooth, with no elevations or depressions. This insures that no eelworms are present. Again, if the tubers are wholly sound within and without all danger of tuber moth affection will be avoided. Of course scab would be rejected, and if minute brown specks or larger scab-like patches are seen on the tubers, they would not serve the purpose, as these indicate Rhizoctonia, one of the worst potato diseases. This fungus is terribly destructive, and results in little potatoes the size of marbles, both below and above ground, hence the name "little potatoes." The patches can not be removed by slight brushing, hence are easily distinguished from dirt, but they can be made to disappear by harsher friction and yet not bruise the tubers, which would not be true of scab.

The wilt fungus causes early dying of the vines, and the yield of potatoes is most disappointing. In this case the potatoes must be watched to see if the tops wilt and die prematurely. The potatoes under inspection, both in our mountain valleys and in Oregon, are still green with no show of wilt. This precludes the very destructive wilt fungus.

Will not several of our enterprising county horticultural commissioners join us in this quest to provide sound seed for our potato growers? If this suggestion is followed out, it will serve two important purposes: It will not only furnish first-class seed for those who wish to grow potatoes and are troubled now to procure sound ones to plant, but would also give the people in the mountain valleys a lucrative employment in furnishing such seed.—A. J. C.

A Broader Viewpoint. With the passing of the month of September another event has been incorporated in the history of crop production in the State of California. To our mind a marked incident in the event was the broader and clearer view and grasp of the fundamentals involved, obtained and digested by the various officials whose daily duties are intimately concerned with the sanitary, hygienic and restrictive features of the situation as developed at the Potato Convention held at Stockton on September 25th and 26th. The grave danger of

permitting his viewpoint to become provincial is one against which an official must constantly be on guard, and the more the area of his jurisdiction is circumscribed the greater the need of such watchfulness. The future usefulness of the horticultural officers will be greatly enhanced and their foresight in these matters intensified as a result of the liberal exchange of information representing conclusions drawn from studies of similar conditions in different lands and by their mutual acquaintance with the experts who participated in the debates, and the potato industry of the entire Pacific slope will be permanently benefited as a result of the conference.—F. M.

The Fresno County Fair. As one of the three judges of the Fresno County Fair I can hardly refrain from giving a brief mention of the Kingsburg town exhibit; although all the exhibits were very creditable, yet this one was of exceeding interest. The excellence of arrangement, quality and variety of fruits, vegetables and grains, and especially the feature exhibit representing in miniature an entire farm, with orchards, etc., all up to date, was exceedingly ingenious and attractive. The engine, pump, irrigating furrows with running water, orchards, fields of grain, trucks, farm implements, and stock of all kinds were represented. One found himself listening to see if the rooster might not crow.

The exhibits of fruit were remarkable for excellence and variety. Especially were we pleased and gratified at the fine collections of grapes and peaches. The canned and dried fruit was also very fine. Even citrus fruits were so excellent that the Fresno people may well feel proud of such an exhibit. Such fairs should be educatory, and this one certainly was arranged with this purpose in view. We were greatly pleased at the way that fruit, green, dried and preserved, was labeled. In every such exhibit it should be stipulated that no fruit unnamed should be exhibited, except for the purpose of gaining a name.—A. J. C.

Birds Attacking Butterflies. From an interesting letter received from the Museum of Vertebrate Zoology, University of California, we have the important information that five species of birds in Shasta County in 1911 were found feeding largely upon butterflies. Butterflies are rarely taken by birds for food. It was also stated that the caterpillars and chrysalids were largely taken as food by the birds. One point I was very glad to get and that is that the Western meadow lark whose usefulness has been so much disputed had eaten largely of the hairy caterpillars. This is certainly another count in favor of this valuable bird.—A. J. C.

California Fruit Growers' Exchange. We are indebted to Dr. G. Harold Powell for his annual report, as general manager of this great organization. Whatever comes from this exchange, unquestionably the greatest and most successful cooperative agricultural association known to the world, is of surpassing importance. This exchange marketed during the year nearly eleven and one third million (11,262,185) boxes of citrus fruits. Of this, a little more than one million (1,105,461) boxes were lemons. The number of carloads was 28,183. This included 61.9 per cent of the entire citrus production of the state, and almost four (3.8) per cent more than in any previous year. The total export

by all shippers was over forty-five and one half (45,565) thousand carloads.

The exchange paid to the growers an average of $1.71 per box, or a grand total of $19,246,757.00. We wish Dr. Powell had segregated the lemons and oranges as it would seem fairer to the lemons, and would give fuller information regarding the citrus industry. The money secured was nearly thirty million dollars ($29,434,402.40), which was never exceeded but once. This shows that the total crop sold for nearly fifty million dollars.

The entire cost of the exchange, maintaining its seventy sales agents, the admirable office force, unexampled daily report of markets, all expenses of whatsoever kind, amounts to but 1.6 per cent of the gross sales. In addition to this, .6 of 1 per cent is spent in advertising. This has proved of enormous value. The total expense is but 2.2 per cent of the gross sales. Is this not a reord of economy?

The growers have received hundreds of thousands of dollars on rebates for over charges and damage in shipping, as also refund by the lemon growers, which could not have been received except for cooperative organization.

The value of advertising has been demonstrated by the exchange. In ten years the population has increased 31 per cent. The consumption of California oranges has jumped 74.6 per cent. The "Sunkist Brand" is now the favorite in all American markets.

The increase in production and amount of fruit marketed staggers belief. Yet through the admirable management of the exchange no market has been glutted, no considerable loss sustained. Great as has been the increase in production, yet greater has been the demand for consumption. This has been the proud achievement of this organization.

The total losses of this thirty million dollar business have been but $350.00. Do you say farmers can not do business?

The Fruit Growers' Supply Company, an attaché of the exchange, has done a three and one third million dollar business at a very slight cost and to the very great saving of its members. This great asset is confined to members of the exchange.

The legal department of the exchange has wrought splendidly and secured great advantage for the growers. Such service could not exist except for the organization.

A new department under a field organizer has been formed the past year. This is educatory in function and under such a competent manager as B. B. Pratt must add not a little to the efficiency of the exchange.

The value of such organization is proved in the fact that in the face of the terrible frost disaster of 1912 and the general business depression, yet the cash received for citrus fruit the past year was never exceeded but once in the history of the State.

Dr. Powell gives wise and timely suggestions as to the future. Increased production and severe competition call for maximum effort to increase quality of fruit, to secure thorough standardization, to promote widest and wisest distribution, and to use the agency of advertising to

the limit. He also asks for fullest support of the University and Department of Agriculture in their effort to aid the fruit growers in every department of production.

This report should inspire all fruit growers of other than citrus fruits to follow this organization in its cooperative achievement, until every deciduous fruit shall profit by just such an exchange as that possessed by our citrus growers. May not the organizations under the county advisers aid powerfully to this accomplishment?—A. J. C.

PROPOSED BILL FOR THE STANDARDIZATION OF CALIFORNIA FRESH FRUITS.

Following is a bill written by H. E. Butler, of Penryn, F. B. McKevitt, and Senator C. B. Bills, of Sacramento, and approved by fruit growers, packers, association managers and others, at a meeting held in Sacramento, October 7th, under the direction of State Horticultural Commissioner A. J. Cook, and presided over by Col. Harris Weinstock. It was decided by those present that Col. Weinstock and Dr. Cook constitute a committee to present this bill before fruit growers assembled in convention at Los Angeles, November 10th to 14th:

An act to establish a standard for the State of California for packing of fresh fruits for sale or for transportation for sale, for interstate and foreign shipment, and to prevent deception in the packing of fresh fruits for such purposes.

Be it enacted by the people of the State of California:

SECTION 1. There is hereby created and established a standard for the packing of fresh fruits for the State of California.

SEC. 2. That any box, basket, package or container of fresh fruit of the kinds specified in this act, which shall be packed and offered for sale or for transportation for sale, shall be packed in accordance with the specifications herein made.

SEC. 3. All fresh fruit of the kinds specified in this act which shall be sold in bulk without packing, shall be exempt from the provisions of this act.

SEC. 4. *Cherries.* Each box or package shall contain fruit of uniform quality and maturity and one variety only, excepting that if package contains more than one variety, such fact shall be plainly stamped on the outside of the package with the words, "Mixed Varieties." (Letters one half inch high.) Each box, package or container shall be stamped on the outside with the minimum weight of contents.

SEC. 5. *Peaches.* The peaches in each box or package shall be of uniform size, quality and maturity, and comply with the standard specified in section two; when packed in a box or container having perpendicular sides and ends, shall contain approximately the same numerical count in each layer; also the box or container when packed and offered for sale or for transportation for sale, shall bear on the outside of the end in plain figures the approximate number of peaches in the box which shall be within four peaches of the true count and shall also bear in plain figures on the outside of the end the minimum weight of contents. Excepting when packed in crates or boxes made up of two or more subcontainers having sloping sides for the purpose of ventilation of fruit therein, the fruit shall not vary in size more than twenty per cent and no layer below the top layer shall contain a greater numerical count than the top layer. Each box, crate, other package or container shall be stamped on the outside with the minimum weight of contents. Each box, crate or package shall bear in plain letters the name of variety contained in the package.

SEC. 6. *Pears.* The pears in each box or package shall be of uniform size, quality and maturity. Each box or container shall bear in plain figures on the outside the minimum weight of contents. Excepting when packed in crates or packages

made up of two or more subcontainers having sloping sides for the purpose of ventilation of fruit therein, the fruit shall not vary in size more than twenty per cent and no layer below the top layer shall contain a greater numerical count than the top layer. Each box, crate, other package or container shall be stamped on the outside with the minimum weight of contents. Each box, crate or package shall bear in plain letters the name of the variety contained in the package.

SEC. 7. *Plums and Prunes.* The plums and prunes in each box, crate or package shall be uniform quality and maturity and when packed in box or container having perpendicular sides and ends shall contain approximately the same numerical count in each layer. When packed in crates or packages made up of two or more subcontainers having sloping sides for the purpose of ventilation of fruit therein, the fruit shall not vary in size more than twenty per cent and no layer below the top layer shall contain a greater numerical count than the top layer. Each box, crate, other package or container shall be stamped on the outside with the minimum weight of contents. Each box, crate or package shall bear in plain letters the name of the variety contained in the package.

SEC. 8. *Apricots.* Apricots in each box, crate or package shall be uniform quality and maturity and when packed in box or container having perpendicular sides and ends, shall contain approximately the same numerical count in each layer. When packed in crates or packages made up of two or more subcontainers having sloping sides for the purpose of ventilation of fruit therein, the fruit shall not vary in size more than twenty per cent and no layer below the top layer shall contain a greater numerical count than the top layer. Each box, crate, other package or container shall be stamped on the outside with the minimum weight of contents. Each box, crate or package shall bear in plain letters the name of the variety contained in the package.

SEC. 9. *Grapes.* Grapes shall be of uniform quality and maturity and shall be well matured and show a sugar content of not less than seventeen per cent. Each crate or other package and containers therein shall bear in plain figures the minimum weight of contents. Each crate or package shall be stamped in plain letters with name of variety.

SEC. 10. *Berries.* Berries shall be packed in uniform packages of dry quart containing interior capacity of 67.2 cubic inches or dry pint containing interior capacity of 33.6 cubic inches and shall be of reasonably uniform size, quality and maturity throughout the package or container.

SEC. 11. That all boxes, crates or packages when packed and offered for sale or for transportation for sale, shall bear upon them in plain sight and plain letters on the outside the name of the person, firm, company, corporation, organization or the recognized name of the orchard and post office address, who shall have first packed or authorized the packing of same; also the name of the locality where the fruit is grown.

SEC. 12. Any person, firm, company, corporation or organization who shall knowingly pack or cause to be packed, fruit of the kinds specified herein, in boxes, crates, packages or containers to be offered for sale or for transportation for sale in willful violation of the provisions of this act, shall be guilty of a misdemeanor and subject to a fine of not less than $10.00 or more than $50.00.

Potato Production. The August number of the Bulletin of Agricultural and Commercial Statistics, from the International Institute of Agriculture, Rome, Italy, forecasts the potato harvest in Switzerland at 8,200,000 quintals, or 96.5 per cent of the production for 1913. In the United States the production is figured at 96,888,960 quintals, or 107.4 per cent of the production for 1913. A quintal is 100 pounds.—E. J. V.

Foreign Shipments. Speaking of the sea shipments from San Francisco to foreign countries for the month of August, the "California Fruit Grower" lists the following:

Product.	Total shipments.	Shipped to—	
Dried apples	54,165 pounds,	Canada	49,500 pounds
Dried apricots	383,010 pounds,	Canada	260,250 pounds
Dried peaches	304,266 pounds,	Canada	283,475 pounds
Prunes	305,964 pounds,	Canada	275,285 pounds
Raisins	414,046 pounds,	Canada	298,653 pounds
Canned fruits	$311,555	England	$265,426
Nuts	$1,409	Canada	$841
Beans	298,260 pounds,	Mexico	129,840 pounds
Canned vegetables	$40,260		
Lemons	1,333 boxes.		
Fresh apples	5,289 boxes.		
Oranges	724 boxes.		

The Walnut Crop. The first walnuts of the season were received at the Goleta, Santa Barbara, warehouse last week, Thursday. The walnut harvest at Whittier, Los Angeles County, is in full swing, the harvest being from two to three weeks ahead of the usual time. George M. Williams, president of the Santa Barbara County Walnut Growers' Association, expresses the opinion that the 1914 crop will be completely harvested by the first of October, about a month ahead of schedule. The crop, while light, is of superior quality. A report from San Juan Capistrano, Orange County, says that what it is believed will be the first carload of this season's walnuts to go East was sent from there last week, Tuesday.—California Fruit Grower, September 19, 1914.

Fruit Shipments. The following table shows the total cars shipped to September 16th:

	1914.	1913.
Cherries	166¼	230¾
Apricots	382	158¼
Peaches	2,121¼	2,325½
Plums	1,906	1,705¾
Pears	2,432¼	2,296
Grapes	3,353½	2,378½
Miscellaneous	12¼	4
Total cars	10,373½	9,098¾

—California Fruit Grower, September 19, 1914.

Farmers' Protective League. The Farmers' Protective League of California was organized on a permanent basis at a meeting of delegates from thirty counties, held at the league headquarters, Sacramento, week ending Saturday, September 12th. The officers elected were as follows:

President, Frank B. McKevitt — Sacramento
First Vice-President, G. H. Hecke — Woodland
Second Vice-President, Mrs. Emily Hoppin — Yolo

DIRECTORS.

L. F. Graham	San Jose	R. J. Cooper	Selma
George Cutter	Sacramento	James T. Boyer	Visalia
C. C. Teague	Santa Paula	George W. Pierce	Davis
C. N. Hawkins	Hollister	N. D. Wilder	Santa Cruz
K. S. Knowlton	Bakersfield	J. W. Guiverson	Corcoran

—California Fruit Grower, September 19, 1914.

Kerosene-Lime Emulsion for Plant Lice. In the Agricultural Circular No. 5, of Turkestan, May, 1914, S. Bogoliuboy, in speaking of the damage done by aphids and remedies against them, reports on the results of experiments with kerosene-lime emulsion in controlling the melon aphis and the cabbage aphis, which were infesting cucumbers, melons and cabbage. He recommends the following formula for the insecticide: Kerosene, ¼ pound; lime, ¼ pound, slacked in about 8 ounces of water; the whole to be made up to 11 quarts of water. When carefully handled the author states that no repeated sprayings will be necessary.

The cost of about 540 gallons of this insecticide—which will suffice for 200 to 250 plants—will be only 4s 2d (about $1.00). In order to avoid burning the plants the author states that the spraying must be done between 8 o'clock a.m. and after 5 p.m., before dark.—E. J. V.

The Grape. There are 330,000 acres of land in California on which grape vines are growing; 170,000 of these are planted to wine grapes, 110,000 to raisin grapes and 50,000 to table grapes.—Rural Californian.

Fruit Drying in British Columbia. Fruit drying has been undertaken on a large scale in British Columbia this season. The large fruit crop of the province last year, and the inability of many of the producers to market their products promptly, encouraged the farmers to dry the fruit, when it became thoroughly ripe and could not be marketed without damage. The success of the experiment has induced many of the growers to make extensive preparations for drying this year, and that feature of the business now promises to develop into an industry of some importance in the province.—Western Canner and Packer, September, 1914.

The Olive Outlook. The prospects for a good olive crop in Syria, according to the Western Canner and Packer, are becoming poorer and poorer, and only an inferior crop is expected. In Tripoli the conditions were favorable for a good olive crop. The indications in Spain point toward a light, or off season, for this crop, the harvest in 1913 having been heavy.—E. J. V.

The Olive Growers Organize. The Northern California Olive Growers' Association has been organized to protect the growers and standardize the product. Richard Deener, of Red Bluff, is president, W. A. Hayne of Yuba, vice-president, and G. W. Harney, of Marysville, secretary. It is expected that one hundred members will be enrolled.—Western Canner and Packer.

Plant Lice Affecting the Walnut in California. In Bulletin No. 100 of the United States Department of Agriculture, W. M. Davidson, of the deciduous fruit insect investigations department of the Bureau of Entomology, gives an account of the plant lice attacking the walnut in California. Mr. Davidson states in substance as follows: "The plant lice begin to hatch from the over-wintering eggs a week or so before the buds open on the trees in the spring. As soon as the young foliage appears the lice settle on it, and after feeding for a month or so become adults.

These stem mothers are always winged, and like the plant lice of later generations are capable of migrating to other trees and orchards. As soon as they are fully developed they begin to lay young plant lice. This second generation will become mature in three weeks, and in turn produce young.

The young of the third and subsequent generations of summer mature in about sixteen days. On early leafing varieties there are ten or eleven viviparous generations a year, while on late varieties there are eight or nine. The production of the sexual generation is prolonged over four months, these forms first appearing in July. The fertilized females deposit their eggs on the twigs and limbs of the tree. Winter is passed in the egg stage only. In general these plant lice inhabit the under side of the leaves, but sometimes those of the second, third and fourth generations attack the nuts, often seriously dwarfing them. When the infestation on leaves and nuts is severe the vitality of the infested tree is impaired. The lice excrete a sweet, gummy, transparent substance. and on this thrives a black, sooty fungus. This black fungus often covers the upper side, lower leaves, and upper part of the nuts, thereby interfering with the respiratory action of the plant tissues.

The walnut plant lice have many natural enemies, the most persistent of them being the ashy-gray ladybird beetle. The plant lice can be controlled artificially with sprays. The winter spray directed against the eggs is the easiest to apply, and high trees can be reached by a winter wash with ease, whereas in the spring and summer the foliage is so thick that a thorough application is hard to apply satisfactorily. Furthermore, far less material is required when the trees are bare. Lime-sulphur and crude oil emulsions are effective, especially the first named. These sprays should be directed all over the limbs and twigs, so as to cover every part. If it is necessary to spray in the spring or summer, a combination of 2 per cent of distillate oil emulsion and commercial tobacco extract, 1 to 1,500, will prove effective, provided it be applied under a pressure of at least 150 pounds, and the spray directed on the nuts and underside of the leaves.—E. J. V.''

Spores Carried by Birds. In the Journal of Agricultural Research, United States Department of Agriculture, it is shown that spores of the chestnut blight fungus are carried by birds. Thirty-six birds were examined, on over half of which were found the spores. This is of special interest to us here where pear blight is so destructive. Birds, as well as insects, may be the agents of pear blight dispersion.—A. J. C.

Bud Selection. We have long known of the importance of selection in breeding animals. Today plant breeding is also to the front as a means of promoting our agriculture. The work of A. D. Shamel, of the United States Department of Agriculture, bids fair to become a classic in research work. Mr. Shamel reports that fruit from selected buds three years old was not only 90 per cent first grade, but gave one half box to each picking, while trees of same character not budded—seedlings—gave only one half box per tree for the year, and of this only 25 per cent was first grade. This speaks volumes in favor of bud selection.—A. J. C.

Meeting of Pear Growers. At a meeting of pear growers of the Sacramento Valley, held in Sacramento, September 16th, under the auspices of the Sacramento Valley Development Association, the following resolution was adopted:

Resolved, That the pear growers of the Sacramento Valley in session at Sacramento on September 16th, recognizing the great injury that is being done to the pear industry, the community and the State by pear blight, endorse the efforts of the County Horticultural Commissioners in their fight for the eradication of this disease, and pledge their aid to them in their difficult undertaking.

Resolved, further, That we solicit the aid and support of our State University and the United States Department of Agriculture toward the solution of some of the problems in connection with this disease, that are yet to be worked out; also, that we ask the further support of the State Commission of Horticulture to the end that community effort may be encouraged and eventually perfected, for only through such can we ever hope for the most effective work; be it further

Resolved, That a copy of these resolutions be mailed to each Supervisor of the various boards, to the Director of the Agricultural Experiment Station at Berkeley, and to the office of the State Commissioner of Horticulture, Sacramento, and the United States Department of Agriculture.

(Signed.) G. H. Hecke, *Chairman*.
Geo. P. Weldon,
A. L. Wisker,
Howard G. Kerchival,
Hayward Reed,
Committee on Resolutions.

Errata. In the issue of The Monthly Bulletin for August, 1914, on page 314 appears the following statement: "The passing of the Plant Quarantine Act by congress in August, 1912, and the creation of the Federal Agricultural Board." This is a typographical error and should read as set forth in the copy, "Federal Horticultural Board." A similar error occurs on page 312, where "State Board of Agriculture" should read, as per copy, "State Board of Horticulture."—F. M.

On page 380 of the September issue of the Monthly Bulletin, under heading of Wickson Plums, the number of trees twelve years old should have read 225 instead of 25.

CALIFORNIA STATE FRUIT GROWERS' CONVENTION.

Following is the program for the forty-fifth annual California State Fruit Growers' Convention, to be held at Los Angeles, California, November 10 to 14, 1914, at the old Normal School Building, Fifth and Flower streets, under the auspices of the State Commission of Horticulture in conjunction with the Citrus Experiment Station of the University of California. It is also the occasion of the second annual assembly of the Riverside Experiment Station of the University of California.

PROGRAM.

Tuesday, November 10, 7:30 P. M.

1. The Literature of the Farm. — Mrs. EMILY HOPPIN, Woodland.
2. Firing. — J. E. ADAMSON, Pomona.
3. Reciprocal Relations Between the County Horticultural Commissioner and the Nurseryman, — C. W. BEERS, Santa Barbara.
4. The Thermometer in the Orchard (Lantern). — F. A. CARPENTER, Los Angeles.

Wednesday, November 11, 9 A. M.

1. Address of Welcome. — LOUIS M. COLE, President Los Angeles Chamber of Commerce.
2. Response. — Dr. A. J. COOK, Sacramento.
3. The Work of the College of Agriculture Among the Farmers' Wives. — MISS L. D. CLARK, Berkeley.
4. Packing, Growing and Marketing Along the Atlantic Coast. — J. H. HALE, Fort Valley, Ga.

Wednesday, November 11, 9 A. M.

(In Hotel Parlor.)

1. Semi-Tropical Fruits Which Give Promise in California. — F. O. POPENOE, Altadena.
2. Semi-Tropical Fruits. — C. P. TAFT, Orange.
3. Combating the Parlatoria Scale. — A. J. SHAMBLIN, Mecca.

Wednesday, November 11, 1:30 P. M.

1. Standardization. — Prof. C. I. LEWIS, Corvallis, Ore.
2. Report on Standardization. — Col. H. WEINSTOCK, San Francisco.
3. Uniform Horticultural Laws. — M. McDONALD, Portland, Ore.
4. Marketing. — Dr. G. HAROLD POWELL, Los Angeles.

Wednesday, November 11, 1:30 P. M.

(In Hotel Parlor.)

1. (*a*) Jelly Making.
   (*b*) Syrup Hydrometer.
   (*c*) Home Production.
   (*d*) Building a Market.
   (*e*) How to Exhibit. — Mrs. HILDA B. NIELSON, Sebastopol.
2. (*a*) Home Canning of Fruits and Vegetables.
   (*b*) Equipment.
   (*c*) Method of Packing.
   (*d*) Marketing in Foreign Lands.
   (*e*) Money in Marmalade. — Mrs. SARA ROBERTS, Grass Valley.

Wednesday, November 11, 7:30 P. M.

1. Decay in Fruit. — Prof. B. B. Pratt, Los Angeles.
2. Farm Credits. — Col. H. Weinstock, San Francisco.
3. The Mango (Lantern). — F. W. Popenoe, Washington, D. C.
4. The Scale Insects (Lantern). — E. O. Essig, Berkeley.

Thursday, November 12, 9 A. M.

1. Soil Hygiene. — G. E. Bailey, Los Angeles.
2. Trend of Opinion as to Soil Fertility. — Dr. C. B. Lipman, Berkeley.
3. Review of Fertilizer Experiments at the University Station at Riverside. — Dr. H. J. Webber, Riverside.
   (*b*) Cover Crop Experiments. — W. M. Mertz, Riverside.
   (*c*) Root Stock Experiments. — W. B. Bonns, Riverside.
4. The County Horticultural Commissioner and the Farm Adviser. — H. A. Weinland.

Thursday, November 12, 1:30 P. M.

1. Soils. — C. A. Jensen, Riverside.
2. Water Requirements of Plants. — J. W. McClane, Riverside.
3. Fertilizing Citrus Crops. — C. W. Leffingwell, Pasadena.
4. Review of Practical Experiments in Fertilization. — Prof. R. S. Vaile, Riverside.

Thursday, November 12, 1:30 P. M.

(In Hotel Parlor.)

1. Women in Horticulture. — Miss Kate Sessions, San Diego.
2. Opportunities for Women in Horticulture. — Mrs. Myrtle Shepard Francis, Ventura.

Thursday, November 12, 7:30 P. M.

1. Summer Cover Crops in Southern California Orchards. — C. S. Milliken, Riverside.
2. Pruning (Lantern). — G. P. Weldon, Sacramento.
3. How to Develop Our State. — Dr. T. F. Hunt, Dean, Berkeley.
4. Horticultural Quarantine and the Parcel Post. — A. S. Hoyt, Los Angeles.

Friday, November 13, 9 A. M.

1. The Orange. — C. C. Chapman, Fullerton.
2. Chemical Studies of Oranges. — H. D. Young, Riverside.
3. Production of Available Nitrogen in Citrus Soils. — I. G. McBeth, Riverside.
4. Citrus By-Products. — C. P. Wilson, Riverside.

Friday, November 13, 1:30 P. M.

1. The Future of the Lemon. — C. C. Teague, Santa Paula.
2. New Fumigating Machine. — G. P. Gray, Berkeley.
3. Fumigation. — R. S. Woglum, Pasadena.
4. Newer Insecticides. — M. R. Miller, Berkeley.

Friday, November 13, 1:30 P. M.

(In Hotel Parlor.)

1. How Can a City Woman Make a Living in the Country? — Mrs. Emily Hoppin, Woodland.
2. Home Economics for the Woman in the Country Home. — Miss Ednah Rich, Santa Barbara.

Friday, November 13, 7:30 P. M.

1. Citrus Insects in the Mediterranean Countries (Lantern). — Prof. H. J Quayle, Riverside.
2. Melazuma of Walnuts and Citrus Gum Diseases in California and Florida. — Prof. H. S. Fawcett, Whittier.
3. Field Experiments. — J. E. Prizer, Chula Vista.
4. Walnuts. — Carlyle Thorpe, Los Angeles.

Saturday, November 14, 9 A. M.

1. Orchard Data. — G. W. Hosford, San Dimas.
2. Mexican Orange Fly. — D. L. Crawford, Claremont.
3. Pear Blight. — E. A. Gammon, Hood.
4. The Pear Orchard. — Hayward Reed, Sacramento.

Saturday, November 14, 1:30 P. M.

1. Work of the State Insectary. — Harry S. Smith, Sacramento.
2. Bud Selection. — A. D. Shamel, Riverside.
3. Report of Committee on Legislation. — C. C. Teague, Santa Paula.
4. Report of Committee on Resolutions. — R. C. Allen, Bonita.

Saturday, November 14, 7:30 P. M.

1. The Fruit Awakening of the East. — J. H. Hale, Fort Valley, Ga.
2. Observations on Citrus Culture in California and Cuba. (Lantern.) — Prof. H. S. Fawcett, Whittier.
3. Types of Chlorosis in Plants. — J. T. Barrett, Riverside.
4. Mendel's Laws of Inheritance and Their Relation to the Breeding of Citrus Fruits (Lantern). — Dr. H. J. Webber, Riverside.

SPECIAL POTATO PROGRAM

Tuesday, November 10, 1:30 P. M.

(In Hotel.)

1. Cultivation of the Potato. — E. H. Phreaner, Placerville.
2. Fungous Diseases of the Potato. — W. V. Shear, Middle Island.
3. Insect Pests of the Potato. — William Garden, Stockton.
4. Suggestions Called Forth at the Stockton Convention. — Prof. S. B. Doten, Reno, Nev.

PROGRAM.

CONVENTION OF COUNTY HORTICULTURAL COMMISSIONERS.

Hotel Clark, Los Angeles.

November 9-10, 1914.

Morning Sessions.

H. P. STABLER, *President.* — R. S. VAILE, *Secretary.*

Depot Inspection. — F. W. Waite.
Depot Inspection. — A. S. Hoyt.
Law Enforcement. — C. W. Beers.
Relation of Farm Adviser to County Horticultural Commissioner. — W. B. Parker.
Inspection Methods. — H. A. Weinland.
Future of County Horticultural Commissioner. — G. H. Hecke.
Timely Hints. — H. P. Stabler.

Afternoon Sessions.

Crown Gall and Hairy Root. — R. S. VAILE.
Distribution of Injurious Insects. — E. O. ESSIG.
Fumigation Methods. — R. S. WOGLUM.
Pointers in Fungi. — Prof. H. S. FAWCETT.
Spraying and Fumigating—County Owned Machines *vs.* Contract Work. — W. H. VOLCK.
Is Double Inspection Desirable. — GEO. P. WELDON.

Evening sessions to be devoted to round-table discussion of subjects suggested during the day.

OFFICERS OF THE CONVENTION.

Dr. A. J. COOK, *President.* — E. J. VOSLER, *Secretary.*

COMMITTEE OF ARRANGEMENTS.

C. B. MESSENGER, *Chairman,*
115½ N. Broadway, Los Angeles.
B. R. JONES, *Secretary,*
Hall of Records, Los Angeles.
WM. WOOD,
Los Angeles County.
W. E. PACKARD,
Imperial County.
R. C. ALLEN,
San Diego County.
JAMES A. ARMSTRONG,
San Diego County.
A. D. SHAMEL,
U. S. Department of Agriculture.
Dr. H. J. WEBBER,
University of California.
CARL S. MILLIKEN,
Riverside County.
D. E. HUFF,
Orange County.
J. S. JONES,
San Bernardino County.
W. E. LAIDLAW,
San Bernardino County.
C. C. TEAGUE,
Ventura County.
PHILIP RICE,
Santa Barbara County.
GEO. C. ROEDING,
Fresno County.
E. B. ANDERSON,
Contra Costa County.
F. B. MCKEVITT,
Solano County.
G. H. HECKE,
Yolo County.
W. S. GUILFORD,
Glenn County.
Dr. A. J. COOK, *State Commissioner of Horticulture,* Sacramento.

The headquarters will be at the Hotel Clark, on Hill Street, near Fifth. The meetings of the County Horticultural Commissioners, November 9-10, special potato program, and the special meetings of the women in the afternoons, November 11-14, will be held in the hotel.

Automobile excursions to points of interest are planned.

Hotel Rates.

All rooms in the hotel are provided with private baths.
Meals, 50c each.
Rooms, for one person, $1.50 per day.
Rooms, for two persons, $2.00 per day.

Railroad Rates.

A fare of one and one third round trip is promised, on certificate plan. Each person should purchase a ticket to Los Angeles and secure a certificate from the ticket agent. This will insure a one-third rate home. All should go by rail—not by auto or trolley—to help secure these reduced rates.

Steamer Rates.

If fifty will go by the Yale or Harvard from San Francisco on Saturday or Tuesday, a round-trip rate can be secured for $12.70; if one hundred will go by the same route, the round-trip rate will be $10.70. (These rates do not include meals or berth.) The Oakland, Antioch and Eastern Ry. Co. promise a round trip rate of $3.35, Sacramento to San Francisco, to connect with these boats.

We must hear at an early date from all who would prefer to go by boat. Write State Commissioner of Horticulture, Sacramento.

COUNTY COMMISSIONERS' DEPARTMENT.

Conducted by Geo. P. Weldon.

COUNTY HORTICULTURAL COMMISSIONERS, THEIR DEPUTIES AND INSPECTORS.

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Deputy Commissioner:
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W. H. Tyson----------Niles
Edlif Peterson ----------Hayward
C. H. Acker ----------Livermore

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Earle Mills ----------Oroville
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Chas. Little—Modesto
E. Sanders—Modesto
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C. A. Lowe—Turlock

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H. E. Higbey—Pixley
H. W. Evans—Tipton
J. D. Munson—Goshen
N. Schilling—Angiola
J. H. Roeder, Sr.—Terra Bella
H. S. Miller—Richgrove
T. C. Mayhew—Tulare

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G. H. Hecke ..... Woodland
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H. Hartwig ..... Esparto
August Janes ..... Rumsey

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STATISTICS ON OLIVE PRODUCTION.

The following statistics gleaned from the 1913 Yearbook of the United States Department of Agriculture, by F. C. Brosius, deputy horticultural commissioner of Sacramento County, will be of interest to olive growers.

The ten principal olive producing countries, excepting the United States, averaged only 1,361 pounds of fruit per acre, in 1911. Their production was as follows:

Gallons, oil	223,798,000
Gallons, pickles	51,035,000
Acreage	9,260,853

Following are the imports of olive products into the United States for the past four years, with total production in United States during the same period:

IMPORTS.

	Gallons, oil	Gallons, pickles	Value
1911	4,984,804	3,044,947	$7,960,556
1912	5,472,528	5,076,857	8,863,154
1913	5,840,357	3,946,076	8,636,154
1914	7,081,484	5,316,364	$10,687,027

TOTAL PRODUCTION IN THE UNITED STATES.

	Gallons, oil	Gallons, pickles	Value
1911	290,800	1,105,970	$1,760,270
1912	912,000	1,232,000	3,274,000
1913	1,200,000	1,500,000	4,200,000

Of the above production in the United States, over 99 per cent of both oil and pickles was produced in California, with the following acreage, in 1914:

	Bearing	Non-bearing	Total
Southern California	4,850	2,661	7,511
Central California	1,743	4,704	6,447
Northern California	5,433	2,785	8,218
Totals	12,026	10,150	22,176

It has been definitely determined that the olive requires, during the growing period, a sum total heat of 7,200 degrees above freezing, to properly mature the latest varieties. The following figures give the average total degrees of heat, covering a period of thirty-six years, in the principal towns of the olive growing districts of northern California from May 1st to November 30th, inclusive, or 214 days in all:

Town	County	Elevation	Total degrees heat
Folsom	Sacramento	252 feet	8,346 degrees
Auburn	Placer	1,360 feet	7,704 degrees
Oroville	Butte	250 feet	8,453 degrees
Tehama	Tehama	220 feet	8,560 degrees
Red Bluff	Tehama	307 feet	8,346 degrees
Orland	Glenn	254 feet	8,774 degrees
Vacaville	Solano	175 feet	7,704 degrees

Florida and Arizona are the only other states of the Union that can grow the olive commercially, owing to its susceptibility to the low temperatures of the North, and its non-bearing in the humid atmospheres of the Gulf States, which factors restrict its future expansion in Florida, and while it thrives very well in southwestern Arizona, owing to the limited water supply for irrigation the planting in that state is probably limited to a small area.

In Southern California the districts suitable for olive growing are fast being filled with citrus, date, and walnuts, and as it is not adaptable to the humid atmospheres of the coast counties, it follows that the future plantings in this country must be done in the warm interior valleys of California, where the climatic and other conditions are found to be ideal for its best performance.

COST OF PRODUCTION OF OLIVES IN SACRAMENTO COUNTY.

By F. C. Brosius.

NUMBER OF TREES.

Mission, 15 years old	22 trees
Manzanillo, 15 years old	249 trees
Nevadillo, 15 years old	29 trees
Total	300 trees

CULTURAL COSTS.

One team, 50 days cultivating and hauling @ $1.00 per day	$50 00
12½ pounds fertilizer per tree @ 2 cents per pound	75 00
One man's labor, during year, cultivating, pruning, etc.	120 00
Irrigation, per year	9 00
Total cost of production	$254 00
13½ tons of pickle olives, picked, @ $100.00 per ton	$1,350 00
2 tons of oil olives, picked, @ $30.00 per ton	60 00
Total receipts	1,410 00
Total cost of production	254 00
Balance	$1,156 00

COST OF PRODUCTION OF ORANGES IN SACRAMENTO COUNTY.

By F. C. Brosius.

Yield of sixty tons of oranges, 1,764 boxes, 498 trees, fourteen years old:

CULTURAL COSTS.

One team, cost of feed 130 days, cultivation and hauling, @ $1.00 per day	$130 00
15 pounds fertilizer per tree @ 2 cents per pound	149 40
Irrigation water @ $3.00 per acre	15 00
One man, cultivating, pruning, irrigating, etc.	240 00
Picking @ $2.00 per ton	120 00
Total cost of production	$654 40
Receipts, $1.00 per box net, delivered at packing house	$1,764 00
Deduct cost of production	654 40
Balance	$1,109 60

ENTOMOLOGICAL.

A GOOD ANT EXTERMINATOR.

By D. L. Crawford, Claremont, California.

The Argentine ant is a troublesome household pest. The little red fellows come into the pantry by thousands and carry away anything sweet that is portable or eatable: syrup, honey, cake, raisins, and a great many other good things. Many patent exterminators are on the market, but most of them do not exterminate the ants—they merely drive them away for a while. Powders to scatter in the corners and cracks where the ants travel, and poison pastes for them to eat and carry into their nests are good, usually, to drive the ants away temporarily, but sooner or later they come back or else move to another house—and other colonies from other houses move in, in their place.

Ants nearly always select a dry and elevated place in which to nest. Small mounds and elevations are favorite places for most ants. The Argentine ant, however, is not so particular. In very many cases they choose such sites for nesting, but may very often be found in such locations as the following: In boxes or tin cans, in freight shipments, in decaying matter (for the warmth), under shingles of a roof, and in many other locations of a peculiar nature. They shun light and seek warmth.

It is moderately easy to trail ants from the pantry to their nest, for they always travel on tiny roads and are rather easily followed. They may enter the house through cracks between boards, but when their trail outside on the ground is once found, it is little trouble to locate the nest.

The most effective and cheapest means of exterminating the colony, when it is in the ground or in a box of refuse, etc., is by pouring into the nest a quantity of dilute creoline sheep-dip. Dilute the liquid about one part to twenty parts of water and shake or stir thoroughly. It should make a milky or soapy liquid.

Before beginning the operation have ready at hand a heavy hoe, a sharp pointed crow-bar and a large bucket in which to dilute the creoline liquid. Begin the operation by sprinkling some of the fluid around and in the hole. This will kill the few ants that may be outside. Next,

loosen the soil with the crow-bar (unless the soil is not very hard) for a distance of two feet on each side of the hole. If the colony is a very large one, it will be necessary to loosen the soil for even a larger radius around the hole. With the hoe scrape out all the loose dirt and immediately afterward pour some of the liquor over the dirt that has been scraped out. This is necessary, for there are sure to be some queens and workers in this dirt and they will burrow their way out sooner or later and start a new colony.

After this has been done, loosen the dirt in the hole as deeply as possible with the crow-bar and pour in about three or four gallons of the dilute creoline liquid. As the ground softens under the action of the fluid, loosen it still more deeply with the crow-bar to enable the creoline to percolate further down. Vigorous punching with the crow-bar into the bottom of the hole while the insecticide is still in the hole will send the liquid much deeper.

The ant colony is usually large and housed in a large and extensive nest, often several feet in diameter and several feet deep. The top of the nest is very near to the surface and from there down it consists of an intricate series of galleries and narrow passages. The eggs and young may be found in small pockets in all parts of the nest. The above description is, of course, of a well established colony.

The creoline is very destructive to ants and if it is applied thoroughly according to the directions above, the colony will be exterminated. The more rapidly one works, the more successful the operation will be, for fewer ants will escape. It may happen sometimes that a small portion of the colony together with one or two of the queens may escape being killed in the operation, by being covered in the dirt first scraped out of the hole. In one instance known to the writer this occurred and a feeble attempt was made by the remnant to establish a new colony. The same procedure, on a smaller scale, was followed against this remnant a few days later and the colony was then wholly exterminated and no signs of them were visible thereafter. Careful watch was kept for some time, but nothing reappeared.

The trouble connected with this process is slight and the expense is small. One quart of creoline sheep dip is enough to make five gallons, sufficient for a large colony. The whole operation need not take over a half hour. It is worth this to be wholly rid of the little pests.

If the ant hole is very near to a plant or a tree, dilute the creoline with thirty parts of water, in order not to injure the roots of the plant.

Creoline is a cheap liquid and may be purchased at almost any drug store. It is a combination of crude carbolic acid, soap, and a little crude oil and water. It is very effective against many kinds of insects. An equally effective substitute for the commercial creoline sheep dip may be made as follows:

Crude carbolic acid	1 pint
Soap (dissolve in hot water)	1 pound
Water	2 pints

Shake and thoroughly mix the above ingredients and then dilute with about thirty parts of water to one part of the stock solution. If it is to be used very near to a plant, dilute with fifty parts of water. It is some trouble to mix these properly, and therefore it is usually more advantageous to purchase the sheep dip whenever that is possible.

When the ant colony is in some location in which this remedy cannot be applied, the only solution of the difficulty is to resort to stomach poisons as recommended in several bulletins. However, this creoline remedy can be applied in very many, perhaps the majority of cases, and is well worth the attention of any who are troubled by this household pest.

Do not try to kill all kinds of ants in the yard. Many kinds do not come into the house at all, but live on weed seeds. They pick up seeds all over the yard and carry them to their nests to eat. In this regard they are a positive benefit to us. Such are the large red ants, and the black ants, a little smaller, and others. Unless these ants are nesting in an undesirable place it is unwise to try to kill them.

The Argentine ants are very small, about one-sixteenth of an inch long or a little longer, and bright red in color. They cannot sting. Their nest opening is small with a small mound of soil grains around it.

THE DATE SCALES.

By A. J. Cook.

The date industry of Riverside and Imperial counties is rich with promise. Date trees are very productive and dates are toothsome indeed. A recent visit to Mecca and Indio gave us convincing proof of the truth of both the above statements.

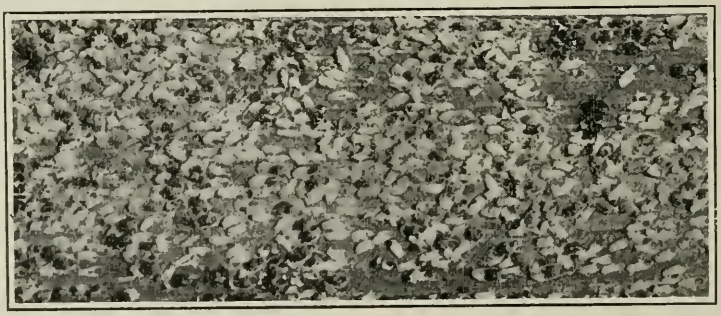

Fig. 105.—The Parlatoria scale, *Parlatoria blanchardii* (Targ.). (After Essig.)

There seems but one impediment in the way of a substantial and lasting success in date culture in parts of California and Arizona. I refer to the two date scales, Blanchard's scale (*Parlatoria blanchardii*), and the Marlatt scale (*Phœnicococcus marlatti*). I believe the impediment may be pushed aside, and if it is to be done, now is the time. The work cannot commence too soon.

The Parlatoria works like most of our scales on the exposed leaves and stems—the males grayish white, the females black—and is so immensely prolific that, if introduced, it soon covers the plant entirely. This surely dooms the crop. Of course, fumigation, or severe pruning and firing with torch soon spells extirpation with this scale. The Phœnicococcus is far different. It works on the sheath beneath the leaf stems, under a thick webbed matting of the palm fibers, often more than

two inches beneath or within the surface, which, of course, gives great protection to the insects. This is an unarmored scale and is also possessed of a woolly secretion which fringes the body. Mr. Bruce J. Drummond of the Department of Agriculture, who has had much experience with this scale, feels certain that it can be eradicated by the carbolic emulsion and use of pruning tools and the torch.

It goes without saying that *extirpation* is *all important* in our California date groves, and *now* is the time. Even if this required total destruction of affected plants, it would be the wise course. But from the experience of Mr. Drummond and Mr. A. J. Shamblin, extirpation does not require destruction. Most energetic means then should be employed to eradicate these two pests at once. There are off-shoots now in nursery rows, which are infested with these scales. These must not

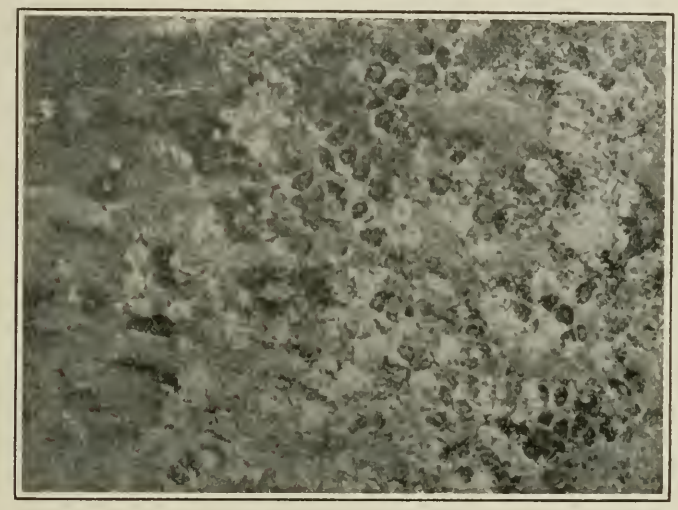

FIG. 106.—The Marlatt scale, *Phanicococcus marlatti* (Ckll.). (After Essig.)

be allowed to move till every semblance of the insects is destroyed. A drastic quarantine by state or county must corral all infested plants now in orchard or nursery. An equally drastic inspection law must be enforced that the scale shall not be further introduced. There will be a session at the Los Angeles convention, November 11th to 14th, in which the subject will be considered. This session ought to result in action that would prove immensely valuable to the date industry and to our State, in safeguarding what is destined to become a very important industry.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

The Brown Apricot Scale.

The adult brown apricot scale is oval in form, about one fourth of an inch in length and of a reddish brown color. About this time of the year the young scales, which hitherto have been feeding on the leaves, migrate to the twigs and settle there. The scales excrete large quantities of honeydew, the injury resulting therefrom being well known. They also suck out the juices of the trees. The prune and apricot are the principal favorites, but the plum, cherry, peach, pear and grapes are also attacked.

Spray with caustic soda, distillate or other mechanical mixtures, distillate emulsion or crude oil emulsion, when the trees are dormant. Sometimes it is advisable to spray before all the leaves fall. The formulæ* for the different sprays are given below:

Caustic Soda, Distillate Mixture.

Water	200 gallons
Caustic soda, 95 per cent	7 pounds
Distillate, 28° Baumé	10 gallons

Fill the spray tank with the required amount of water, add the caustic soda, which has been dissolved in a small amount of water, then add the distillate. Keep the agitator going rapidly while applying the spray.

Crude Oil Emulsion.

Water	175 gallons
Liquid soap	3 gallons
Crude oil direct from the wells	25 gallons

Fill the spray tank with 175 gallons of water, add the liquid soap, agitate thoroughly for one minute, after which add the crude oil. Continue to agitate while the spray is being applied.

Distillate Emulsion.

Distillate, 28° Baumé	20 gallons
Whale oil soap	30 pounds
Water to mix	12 gallons

Dissolve the whale oil soap in the water, heating it to the boiling point, add the distillate and agitate thoroughly while the solution is heating. For use add 20 gallons of water to each gallon of the above mixture.

Both the prepared crude oil and distillate oil emulsions can be secured from several of our insecticide dealers.

The Fall Canker Worm.

The wingless females of the fall canker worm emerge from the middle of October to about the middle of December, and lay their eggs on the

*From Injurious and Beneficial Insects of California, by E. O. Essig.

bark of the apple, prune, cherry and apricot. The number of eggs per mass vary from approximately sixty to two hundred. The use of bands around the tree trunks, placed during September and October—to be renewed occasionally on account of rains—will trap the females as they ascend the trunks to deposit their eggs.

MISCELLANEOUS INSECTS.

The Alfalfa Caterpillar.

The adults of the alfalfa caterpillar are the common yellow butterflies, numerous in the alfalfa fields. The worms are green, with a white stripe on each side of the body. They feed on the leaves of the alfalfa plants and on the young growth. The resting stage of this insect is the pupal stage. These hibernating chrysalids are to be found upon weed and alfalfa stems. Renovating the alfalfa fields during the winter months will not only materially benefit the alfalfa itself, but will destroy many of these pupæ. Pasturing the alfalfa fields will also keep down the alfalfa butterfly, by destroying the chrysalids.

Cutworms.

The cutworms pass the winter in the ground. Fall plowing will destroy a large proportion of the cutworms. This is particularly true in those sections of California that have a freezing temperature. The writer once observed, in a field of beets of which several acres were planted on soil plowed the previous fall, and the rest on land which was plowed several weeks before planting, that practically 75 per cent of the beets on the spring plowed land were killed by the cutworms, while on the fall plowed portion of the field the plants were practically untouched.

PLANT DISEASES.

Peach Blight.

In Bulletin No. 191 of the California Experiment Station it is recommended that spraying, between October 25th and November 25th, be performed, in order to prevent an infestation of the peach blight the next year. The spray used is Bordeaux mixture, the formula being 30 pounds bluestone, 35 pounds lime to 200 gallons of water. The peach blight fungus begins its work in the winter and the peach tree must be sprayed at that time.

The disease causes dead spots to appear on the younger shoots during the winter months, particularly near the buds. The buds are killed, together with much of the younger growth.

Pear Blight.

Pear blight is a bacterial disease. It is more conspicuous in the early part of the season, when it appears in the form of twig blight during the blossoming period on both pears and apples. A few weeks later, after the period of pollination, the blossoms and tips affected begin to wilt and blacken. This results in the complete blackening and death of all affected branches and spurs upon which the flower clusters have been borne. Upon the pear the blight may continue to extend down the twigs into the branches, later from the branches into the larger limbs

or into the trunk of the tree. Water shoots are often attacked. The disease is usually indicated by the appearance of the bark: the soft bark presents a water-soaked appearance and finally becomes blackened and shriveled. *The organisms may, however, extend to a distance of several inches or even a foot below the water-soaked area.* If the disease ceases to spread rapidly there is a line between the dead and the apparently live wood. Sometimes the bark becomes broken and a gummy exudation appears. The pear blight bacteria winter over in relatively few affected branches, under conditions where moisture is sufficient and protection is furnished from drying out. The essential steps in pear blight control, according to Duggar, consist in the following:

"In pruning out the blight in situations where it may winter over, if all blight could be thoroughly pruned out of the orchard during the fall and winter, there would probably be no opportunity for infection the following season, except from other orchards. In practice the pruning of the blight during the winter is not so easy, as it requires care and the keenest eyesight. It may be necessary to go over the orchard several times. Pruning during the growing season is also practised, but it is not so effective. This pruning has not proven such a great success, on account of the fact that infection may be constantly taking place. Moreover, when the blight is rapidly extending in the limb or trunk, it is difficult to determine the extent of the region affected. Carelessness in pruning of nursery stock may actually result in spreading the disease to practically all the trees. The knife should be promptly applied wherever a limb or trunk may be saved. Disinfect both pruning tools and cuts with corrosive sublimate, 1 to 1,000."

INSECT NOTES.

The maple louse, *Drepanaphis acerifolii* (Thomas), has been found abundant on large-leaved maples at Berkeley, Cal., Sept. 30, 1914.—E. O. Essig.

The paper birch louse, *Calaphis betulaecolens* (Fitch), is especially abundant upon the leaves of the paper birch trees in Oakland and Berkeley this year.—E. O. Essig.

The tobacco flea-beetle, *Epitrix parvula* Fab., and the Western striped flea-beetle, *Phyllotreta ramosa* Crotch, are common at Berkeley, attacking many cruciferous and solanaceous plants.—E. O. Essig.

Specimens of cabbage, turnip and cauliflower plants were recently received from George B. Weatherby, County Horticultural Commissioner of Humboldt County, infected with the **cabbage maggot,** *Phorbia brassicæ* (Bouché). They were collected at Eureka, Cal., September 1914.—E. O. Essig.

The fruit tree bark beetle, *Eccoptogaster rugulosus*, was recently found to be doing considerable damage to apricot and cherry trees near Banning and Beaumont. The trees upon which they were found contained no dead wood but were materially weakened by the attack of the pest. Its presence was easily detected by masses of gum which had oozed out and hardened wherever the beetles had attacked the twigs and trunks. In most cases the injury occurred at the base of a bud, causing a copious flow of gum.—Geo. P. Weldon.

The writer recently inspected several orchards which have been fumigated for the control of *Coccus citricola*, near Lindsay and Porterville. Present indications are that the work has been exceedingly effective.—Geo. P. Weldon.

The citrus mealy bug, *Pseudococcus citri*, is showing up quite badly on citrus trees in Marysville. A vigorous campaign to abate this pest is being started by County Horticultural Commissioner G. W. Harney.—E. J. Branigan.

The Western twelve-spotted cucumber beetle, *Diabrotica soror*, Lec., is reported as doing considerable damage to truck gardens and also to the tender foliage of young citrus trees in and around Sacramento.—E. J. Branigan.

A chrysomelid, *Disonycha 5-viattata* Say., has been found to be very numerous on the willows along the banks of the Sacramento River, in many cases completely defoliating the trees.—E. J. Branigan.

The salt marsh caterpillar, *Estigmene acræa*, Dru. is doing some damage to the madaro potato vine and shasta daisy blossoms in Sacramento. This pest is controlled largely by a Tachina fly parasite.—E. J. Branigan.

The writer has collected in Marysville seeds which were heavily infested with a species of Bruchid, *Bruchus pruininus* Horn. These were taken from the seed pods of locust trees. The same species of weevil has also been taken from acacia seed on trees in Sacramento.—E. J. Branigan.

The larvæ of the grape leaf folder, *Desmia funeralis* Hbn, were recently sent into this office by Mr. B. V. Sharp, county horticultural commissioner of Kings County. Mr. Sharp writes that a few of the muscat grape vine leaves were affected.—E. J. Vosler.

Insects of the Coleopterous family Silphidæ or carrion beetles, *Silpha ramosa* Say., have recently been reported as doing considerable damage to garden truck in the vicinity of San Francisco. This is a rather unusual occurrence as the family has been considered to feed entirely upon decaying organic matter. It is hardly probable that this species feeds entirely upon growing vegetation.—Harry S. Smith.

Twigs of Alligator pears or Avocado, infested with wasps, *Crabro* sp., were recently sent to the insectary from the Butte County Foothill Nurseries, with the statement that they were damaging the young trees to a large extent.—Harry S. Smith.

Coccophagus lecanii Fitch, has recently been reared from *Saissetia oleæ*, feeding on *Solanum jasminoides* at San Jose, California, by County Horticultural Commissioner Earl Morris.—E. J. Vosler.

Saissetia oleæ Bern, was found to be heavily infesting asparagus, by County Horticultural Commissioner Frank T. Swett, of Contra Costa County, at Oakley, California.—E. J. Vosler.

For the benefit of those who are not familiar with the **West India peach scale,** *Aulacaspis pentagona* Targ., I will attempt to give a brief outline as we have found it in the inspection of nursery stock and other shrubs from Japan and China.

Puparium of adult female approximately circular, ovate, convex, opaque. white and frequently mixed with the epidermal tissues of the plant. Exuviæ towards, or at the margin, in front, but not projecting. Puparium of second stage females circular with the exuviæ of a bright orange yellow.

Male puparium snowy white, and about three times as long as it is broad; (uncarinated). Pellicle pale straw color. The male scales are usually in thick clusters.

This scale has a large range of hosts, peach, cherry, walnut, grape, persimmon, geranium, Hibiscus, etc., and is found upon the trunks, branches and fruits in the open, and between the buds and branches, and is often found under a fungus which grows upon some of the shrubs from Japan and China. This fungus appears as a blackish soft leathery mass forming irregular patches from one inch to six inches long, and often reaching entirely around the branch. This fungus is known as Thelephora sp., and is usually found near the base of the shrubs, or if they are grown in a damp, shady place, it may be found upon any part of the branches. I have seen this scale alive in all stages under the fungus, although we must not infer that it will always be found there.—B. B. Whitney.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF AUGUST, 1914.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship baggage inspection

Ships inspected	36
Passengers arriving from fruit fly ports	3,878

Horticultural imports

	Parcels.
Passed as free from pests	91,344
Fumigated	3,204
Destroyed or returned	114
Contraband destroyed	10
Total parcels horticultural imports for the month	94,672

Horticultural exports

Inspected and certified	3,669

PESTS INTERCEPTED.

From Balboa—

Aspidiotus hartii on yams.

From China—

Larvæ of weevils, *Cylas formicarius* and *Cryptorhynchus batatæ* in sweet potatoes.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Hemichionaspis minor and *Chrysomphalus aonidum* on green cocoanuts.
Coccus longulus on betel leaves.
Howardia biclavis, Pseudaonidia clavigera and fungus on *Aegele marmelo* (cuttings).
Parlatoria ziziphus on Kusæ lime (cuttings).
Lepidosaphes beckii on Shaddock (cuttings).

From Isle of Pines—

Lepidosaphes beckii and Parlatoria sp. on limes.

From Japan—

Fungus on small citrus trees.

From New Zealand.

Pseudococcus sp. on palm tree.
Lecanium sp. on *Sophora microphylla.*
Aleyrodes sp. on *Pittosporum tenuifolium.*
Larvæ of Thrips on *Metrosideros lucida.*
Pseudococcus sp. on *Libertia grandiflora.*
Poliaspis sp. on *Styphetia fasiculata.*
Ceroplastes sp. and Lecanium sp. on ferns.

From Oregon—

Pseudococcus longispinus and *Saissetia hemispharica* on poinsettias.

From Tahiti—

Lepidosaphes beckii on oranges.
Fungus on limes and citron.

LOS ANGELES STATION.

Ships inspected 35

Horticultural imports

	Parcels.
Passed as free from pests	59,544
Fumigated	3
Destroyed or returned	1
Contraband destroyed	1
Total parcels horticultural imports for the month	59,549

Pests Intercepted.

From Central America—

Aspidiotus cyanophylli, Aspidiotus cydaniæ, Chrysomphalus scutiformis and Pseudococcus sp. on bananas.

From Kansas—

Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From Nassau Island—

Lepidosaphes beckii on limes.

From New Jersey—

Aspidotus hederæ, Cerataphis latania and *Diaspis boisduvalii* on orchids.

From Pennsylvania—

Aspidiotus hederæ, Aspidiotus lataniæ and *Cerataphis lataniæ* on kentia palms.

SAN DIEGO STATION.

Ships inspected 27

Horticultural imports

	Parcels.
Passed as free from pests	2,531
Fumigated	14
Destroyed	1
Returned	0
Contraband	1
Total parcels horticultural imports for the month	2,547

Pests Intercepted.

From Central America—

Pseudococcus sp., Lecanium sp., Aspidiotus sp. and *Saissetia hemisphærica* on bananas.

From Ceylon—

Aspidiotus cydoniæ, Parlatoria sp. and Aphid on tea plants.
Lepidosaphes beckii on orchids.

From Mexico—

Lepidosaphes beckii and *Chrysomphalus aonidum* on limes.

From Pennsylvania—

Pseudococcus and Orthezia sp. on Coleus sp.

EUREKA STATION.

Ships inspected 5

No horticultural imports.

SANTA BARBARA STATION.

No horticultural imports.

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California
State Printing Office
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VOLUME III No. 11

THE MONTHLY BULLETIN

Cotton seed and cotton boll carton which was shipped into California by parcel post. This illustrates how serious pests may be introduced into this state through this carrier in spite of our otherwise rigid quarantine. (Photo by A. Chatterley.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA NOVEMBER, 1914

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THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. III. November, 1914. No. 11.

STOCKS FOR FRUIT TREES.

By U. P. Hedrick,* Agricultural Experiment Station, Geneva, N. Y.

Nearly all fruit trees are consorts of two individuals. We distinguish the parts of the consorting tree as stock and scion—terms which need no definition. Fruit growers refuse to believe that the stock has any influence on the scion—at least the industry of growing fruit is carried on with little or no regard to the interactions of stock and scion. Yet there is no doubt but that stock and scion do react the one upon the other and that all fruits propagated by budding and grafting are influenced for better or worse by the stocks upon which they are worked. Experiments, experience and observation show that the physiological functions at least of both root and top are modified the one by the other. To this fact most of those who have given study to the question now agree, though they are not in accord as to the degree of the influence and the explanations offered by all are more or less hypothetical.

It is not a matter of wonder that fruit growers do not believe that the stock affects the scion, for we know little about it and "nothing is so firmly believed as that which a man knoweth least." Nowhere can one find clear cut definitions and careful analyses of the effects of the stock upon the scion. Everywhere, there is much misconception and not a little deception in the use of stocks in the propagation of fruit trees, so that fruit growers do not know what the best stock for a particular fruit is, or, if they do know, they can not be sure that their trees are on the stocks of their choice. To complicate the situation further, results in the use of all stocks are profoundly modified by soil and climatic conditions, causing man to draw widely varying conclusions and more than all else, bringing about the state of "confusion worse confounded" that we now have in the whole matter of stocks for fruits.

Were one to discuss the mutual influence of stock and scion in detail, citing examples of the manifold phases the subject assumes, he could easily fill a volume, a large one, and as interesting as large. In the time at my disposal, however, and for the topic under consideration, "Stocks for Fruits," I can but briefly touch upon such parts of the subject as show the influence of the stock on the scion. Avoiding details and all taint of theory, let us consider the ways in which the stock influences the scion.

First—The stock modifies the form and stature of a plant. Pears on quince, apples on Doucin or Paradise roots, and cherries on the Mahaleb are familiar examples of the dwarfing effects of stocks. Increased size less often, if ever, occurs. The altered size and forms of

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trees resulting from grafting can not be said to be due wholly to diminished vigor and not at all to debility. Rather, the scion takes on the size, form and somewhat the peculiarities in habit of growth of the stock. Thus, the scraggly Red Canada and Winter Nellis worked on Northern Spy, assume, somewhat, not wholly, Spy characteristics of growth; the pear on quince takes the size of the quince; the apple on Paradise or Doucin, the size and form of these stocks; a Montmorency cherry worked on a Mahaleb simulates the form of the Mahaleb; on a Mazzard, the form of the Mazzard.

Second—The adaptability of a species or a variety to a soil may be changed by the stock. Thus peaches when worked on plums may do well on heavy soils where on their own roots they would be worthless. Conversely the plum can be adapted to light soils by working on the peach, thriving still better on the Myrobalan in most soils. The almond is often preferable to the peach as a stock for peaches in irrigated lands. The Mahaleb is sometimes better than the Mazzard for cherries in shallow or in wet soils. These are but a few illustrations; many more might be cited if multiplication served a purpose. Possibly this is the most important of the favorable influences of the stock on the scion, for through it many fruits can be grown in unfavorable soils which would not thrive, in some cases would not live, on their own roots. The use of stocks to overcome adversities of soils, in my opinion, demands much more attention from fruit growers than it has had.

Third—Through the stock a plant may be made to endure an incompatible climate. It would be quite too much to say that hardiness as an inherent quality is transmitted from the stock to the scion, but it is very certain that the increase in vigor imparted by some stocks to the scion gives greater hardiness to the grafted plant. In the case of late growing apples worked on Hibernal or Oldenburg stocks, greater hardiness results from the fact that the scion matures earlier that it would upon its own roots and is thereby better able to withstand the winter. So, too, there is earlier ripening of wood and greater hardiness when the sweet orange is worked on the sour orange. Again, the slight obstructions to the flow of sap imposed more or less by the union of the different tissues of stock and scion may cause the scion to ripen earlier and thus bring about greater hardiness. Some plants, as the peach, must have a warm soil bottom heat—and therefore in cold climates the peach does better on the plum, which thrives in cold soils, than on its own roots. There are still other adaptions to climate for which we can offer no explanation.

Fourth—The stock, if diseased, may impart the disease to the scion. Such is the case when peach stocks infested with peach yellows or little peach are budded with healthy buds. The classical illustration of the conveyance of disease by grafting is that of variegation in foliage which usually passes from the scion to the stock. Variegation is a phenomenon possibly brought about by mal-nutrition, or, according to some, by the formation of some chemical substance which passes from scion to stock.

Fifth—The productiveness of the tree is often increased by the stock, paradoxically enough, either by increasing the vigor of the plant or by decreasing it. Trees sometimes fail to fruit well because of too much wood growth, in which case grafting on a less vigorous stock checks growth and makes the plant more productive; thus we may

explain the greater fruitfulness of some dwarf apples and pears. On the other hand, a species or a variety may be too weak in growth to be fruitful, in which case grafting on a stock which imparts vigor may make them more productive.

Sixth—The time of maturity of both wood and crop may be changed somewhat by the stock—hastened on the one hand or retarded on the other, according as to whether the stock ripens earlier or later than the scion. It follows, of course, that the keeping quality is affected in the same degree as maturity. Thus, it is found that oranges on Trifoliata ripen earlier than on other stocks. The statement is common in literature that many late fruits budded on early ones ripen earlier and that some early fruits on late varieties, ripen later. It seems from what is known on this subject that we are warranted in saying that earliness is promoted in the scion only, however, when the stock ripens its wood earlier than the scion; lateness, when the stock ripens its wood later.

Seventh—The color of a fruit may be changed by the stock. There is little evidence to substantiate the claim often made that the characteristic color of a fruit is changed by the stock, but, as all know, color is heightened by earliness and lessened by lateness in the maturity of a variety. In the cases, then, in which the stock influences the time of maturity the color may be more or less changed. The speaker knows of an orchard of McIntosh apples which are grafted on Oldenburg, the fruits of which mature nearly two weeks earlier than McIntosh on standard stocks and are much higher in color.

Eighth—The size of a fruit is often increased by the stock. I need only to cite the pear on the quince as an example, though many other illustrations might be adduced.

Ninth—Rather reluctantly, from my point of view, we must accept the testimony that *the stock affects the flavor of the fruit borne on the scion.* It is not hard to believe that larger, crisper, juicier fruits of a variety can be grown on some stocks than on others and that, therefore, the flavor is improved. But how a sour variety grafted on the stock of a sweet one, or the reverse, can change the degree of sweetness or sourness is past understanding, yet an abundance of evidence seems to prove such changes sometimes to be the case.

Tenth—Some stocks shorten the life of the trees of which they are a part. Apples on pears and pears on apples are short-lived trees. Common pears, *Pyrus communis*, are short-lived on the Chinese pear, *Pyrus sinensis*. It may be laid down as a rule to which there are but few exceptions, that grafting a weak-growing species on a vigorous stock will result in a short-lived tree.

So far we have been discussing tree fruits. Much more is known about the influence of the stock on the scion in grape growing, as you in California with your reconstructed vineyards should know. To briefly epitomize: Experimenters hold, and I quote only from those of established reputation, that there are very appreciable differences to be noted between the chemical and physical composition of grapes grafted on various stocks and the fruit of vines on their own roots. Among the effects claimed for grafting, I note but do not vouch for the following: The fruit of the grafted vines is larger, has bigger seeds, thinner skin, the berries are less numerous, the juice is more copious, is usually both

more acid and sugary, is less rich in phosphate, more highly charged with nitrogenous matters, has little tannin, less color, and the color is less stable; the vines are more fruitful; the fruit matures earlier. These differences vary in different cases. From the fact that the color is less stable and the proportion of the nitrogenous matters in the must is greater, the wines from grafted vines are said to mature more rapidly and are more sensible to injurious fermentations.

In an experiment with grape stock for American grapes, carried on for eleven years at the New York Station, we found material differences between grafted and ungrafted vines, all included in the above summary.

There is no doubt, I must say in passing, a reciprocal influence of the scion on the stock. We know certainly, for example, that the form of the roots is much changed by the scion. Thus, in starting apples in a nursery we graft or bud on seedlings which ungrafted would have root systems much the same but at digging time the roots are as diverse as the varieties; Red Astrachan, for instance, has an exceedingly fibrous root system with few tap roots, while on either side of the Red Astrachan row Oldenburg and Fameuse are almost destitute of root fibers, having instead a deep tap-root and two or three prongs. So it is with practically all fruits, though not as noticeable with any as in apples and pears. Nurserymen tell me, the weaker the top-growth and the sparser the foliage of a variety, the more deficient is the root-growth.

To the general rule that allied species grafted together retain their identity, there are a few exceptions in which the scion acquires characters from the stock or the stock from the scion—the graft-hybrids of experimenters. There are on record a sufficient number of such hybrids, or pseudo-hybrids, to make out a case for hybridism through grafting. It would be interesting and profitable to consider in detail the several supposed graft-hybrids, but as none have practical value they are more suited to controversy than to real life—mentioned here simply to show the possible extremity of the mutual influence of the stock and graft.

What are the explanations for these various reciprocal effects of stock and scion? Plant physiology does not help us much in the elucidation of the influences of grafting. Theoretically, from the anatomy of plants, we can expect nothing more in grafting than the adhesion of the graft to the stock. The tissues below the union are those of the stock; above it, those of the scion. Yet there is some reason to suspect that definite substances pass from one to the other in the consorting parts of a grafted plant and produce specific effects. Thus, as we have seen, when a scion with variegated foliage is grafted on a normal stock, shoots which spring from the stock below the graft are variegated. Or, if the deadly nightshade be grafted on a tomato the poison, an alkaloid (atropine) passes down into the stem and root of the tomato. But curiously enough, if the variegated plant or the nightshade be used as a stock the variegation in the one case and the atropine in the other do not pass upward into the scions.

An ingenious and not at all improbable reason for some of the influence of the stock upon the scion was offered by a speaker in the French Academy of Science. He had made analyses of pear trees two years old from the graft on quince and pear stocks to determine the relative quantities of hydrocarbons stored in the stems of the two sets of plants. It was found that during the autumn and winter the reserve matter

was markedly more abundant in the stem on quince stock. In the spring, therefore, the pear-plant on quince is enabled to furnish a greater quantity of food matter for the formation of fruit and crop production is greatly increased. Then again, the reserve food in the stem is nearer the fruit than in the root and is thus possibly more ready.

Unquestionably, some of the effects of stocks are due to altered nutrition—possibly to insufficient nutrition of stock or scion. All evidence points to the disturbance of nutrition as the chief cause of the effects of grafting. It may be that the food elaborated by the foliage of the scion is different from that which the stock would have had with its own foliage. It has been suggested that the differences in the specific quantity of the sap in stock and scion may be the disturbing factor.

But these explanations are not sufficient to cover all the phenomena arising from grafting. Truth is we have in the matter of grafting for most part only certain isolated facts to explain which we must rely, for the present, upon inferences which have the greatest amount of probability in their favor from the knowledge in hand. The poet says:—

> "And still upon the thorniest stock,
> The sweetest roses love to blow."

It remains for some one to tell us why.

Important though the effects of stocks as we have just discussed them are on the scion, any and all are but incidental to the true explanation for a two-part tree for practically all orchard plants. At the proper seasons in every nursery an army of expert workmen are found grafting or budding so dexterously, precisely and rapidly that their work is little short of marvelous. What are the reasons for all of this seemingly extra work of grafting? Why do not nurserymen sell us plants on their own roots? An intelligent body of fruit-growers scarcely needs an answer to this question. You all know that in no other way can fruit trees true to name be propagated so rapidly. In some cases there is no other possible method of multiplying a variety. But unfortunately, the stocks chiefly chosen by nurserymen are those which can be worked most easily and soonest give a presentable nursery tree. The fruit grower in buying chooses a stock, if he gives the matter sufficient thought to make a choice, one that does not sucker, or one that best suits his soil, and in a few cases a stock that will give a dwarf tree. All other of the effects of the stock on the resulting tree are wholly ignored alike by nurseryman and fruit grower.

It does not follow, however, that whatsoever stock one wants can be used. Even when the botanical kinship is close some plants resist all of the appliances of art to make a successful union, while on the other hand there are quite distinct species of fruits that seem foreordained by heaven to be joined. Thus, a pear will not grow well on an apple nor an apple on a pear, closely related though they are; but the pear readily unites with the quince or the hawthorn. So, too, the peach and the apricot are grafted on each other only with difficulty, but both readily unite with the almond and the plum. Sweet and sour cherries grow well on the Mahaleb cherry, but the Mahaleb will not grow on any of the cultivated cherries. Sour cherries upon sweet ones succeed not so well as do the latter on the former. The gooseberry will not grow on any of the edible currants, but thrives on the golden currant, *Ribes aureum*. Something more is necessary, then, than botanical kinship,

but just what no one knows, beyond of course, the knowledge that there must be some conformity in habit between stock and scion; that the two must start in growth at approximately the same time; and that the tissues must be sufficiently alike that there be proper contact in the union. Yet these facts do not sufficiently explain the affinities and antipathies which plants show. Thus, the propagator has little to guide him in selecting stocks and can choose only after making repeated trials, near relationship being the only guide, even though often an untrustworthy one.

Nor is the tale of tribulation yet told for we shall find that not only are all grafted plants affected by the kind of stock used but also by the manner of propagation whether from seed or from cuttings. There is no question, for example, that stocks propagated by cuttings do not produce the deep tap and prong roots that seedlings do and seedlings lifted and root-pruned the season before they are budded or grafted have a thicker and bushier root system than if they are not so transplanted. And so at the risk of stirring up more hares than we can possibly run down in this matter of stocks, it seems necessary to say that we can not neglect for the best interests of fruit growing the way in which stocks are grown. Undoubtedly for some conditions we shall find stocks from cuttings preferable; under others, and generally, however, we shall find seedlings the better when, of course, we have a choice. So, too, usually, when nursery practice permits, a stock is better for having been transplanted before budding or grafting.

In passing it may be said that a retrospective glance in horticulture shows that the use of stocks for fruits and ornamentals is no new thing. The Latin poets, Cato, Columella, Virgil and Pliny could wield the grafting knife as well as the pen as every school boy knows from his Latin. It could be wished, however, that the statements of these old Romans were as accurate as the meter in their verse for their inaccuracies prepared the ground for a crop of misunderstandings which even yet we are not rid of. It is probable that the Romans, and possibly the Greeks, propagated some fruits—the Romans certainly did roses—by grafting on stocks much as do our nurserymen today. The Paradise and Doucin stocks for dwarfing apples, dwarf pears on quince, the Mahaleb to dwarf cherries, all have been in common use in the Old World for several centuries as we learn from the old herbals. Shakespeare's familiar quotation:

> "You see, sweet maid, we marry
> A gentle scion to the wildest stock;
> And make conceive a bark of baser kind,
> By bud of nobler race; this is an art,
> Which does mend nature; change it rather; but
> The art itself is nature."

So much to show that we have the practice and experience of centuries to guide us in the matter of stocks though the accumulated wisdom seems to be of little present use.

The selection of stocks leads straight to the center of another problem. We are hearing much about the individuality of orchard trees and the necessity of propagating from individuals having the best characters. The speaker does not believe in the inheritance of acquired characters, finding but little in either theory or fact to substantiate it. Present knowledge makes more forceful every day the old aphorism, "Like

begets like," "Race is everything," "A chip of the old block" and "Like father, like son." Heredity in the light of science, is a tight compactment into which new characters seldom find a way. The multitude of trees in any variety, all from one seed, it seems paradoxical to say, are morphologically one individual. How, then, can the differences between individual plants in every orchard in the land be explained?

Ample explanation, it seems to me, is found in "nurture" without invoking a change in "nature" to account for the innumerable variations in orchards. Soil, sunlight, moisture, insects, disease, and last but not least the stock which supports the tree, these with many other factors, give every individual plant an environment of its own from which come characters which appear and disappear with the individual. Thus, I am sure, we can bend a variety by means of a stock; but I should be the last one in the world to hold that we could permanently mold it into any new form given it by a stock. Let go the force, whatever it may be, which temporarily bends a variety, and it snaps back into its same old self.

One more generalization and I am ready to conclude. In the refinement of fruit growing that is coming we must breed the stock as we now do the variety which it supports. The stocks of apples, pears, peaches, plums, cherries—all tree-fruits—are supposed to be seedlings of wild species which we know vary much less than do seedlings of cultivated varieties. Yet it requires only a cursory investigation into the growing of nursery stock at home or abroad to find that apple and pear seed from the cider press and pits of stone fruits from canneries are commonly used in growing nursery stocks. Under present methods it is mere chance, a throw of the dice, as to whether one gets a tree on a good stock or a bad one. Would it not be a safe stroke of business for a nurseryman to select his stocks and through his catalog educate fruit growers as to the greater value of trees on selected stocks?

What is the practical application of this necessarily discursive discussion? I had thought to give you somewhat specifically the faults and merits of the various stocks for the several fruits. This I find to be impossible. No one man's experience with stocks is sufficient to enable him to speak authoritatively on the subject, and in the present chaotic condition of our knowledge of stocks it would be a job for Job to start out and classify the contradictory opinions of the multitude who have expressed themselves on stocks in the horticultural literature of the past three or four centuries. The somewhat random and rather fragmentary thoughts which I have been able to give you may be summed up briefly for practical application as follows:

The future of fruit culture is bound up with the nature of the stock. The stock modifies the stature of plants; suits them to the soil and to the climate; influences fruitfulness; changes the time of maturity, size, color and flavor of the fruit; and affects the length of life of the trees. The stock, too, is influenced by the scion. The method of growing the stock, whether from cuttings or from seeds, is important. The effects of the stock on the scion, appreciable though they are, do not change the identity of a variety and are not heritable. If these arguments are well taken we can only conclude that fruit growers and nurserymen must give the question of stocks much more careful thought to the end, I am sure, that we shall thus secure more fruitful orchards.

THE ALMOND.

By George W. Pierce,* Davis, Cal.

As far back as authentic history takes us we read of the almond. It is frequently referred to in Scripture and has played no small part in ministering to the needs and pleasures of mankind. Its food value is important and its bloom, following closely on the heels of winter, has probably appealed to the esthetic side of mankind more strongly than has the bloom of any other orchard tree.

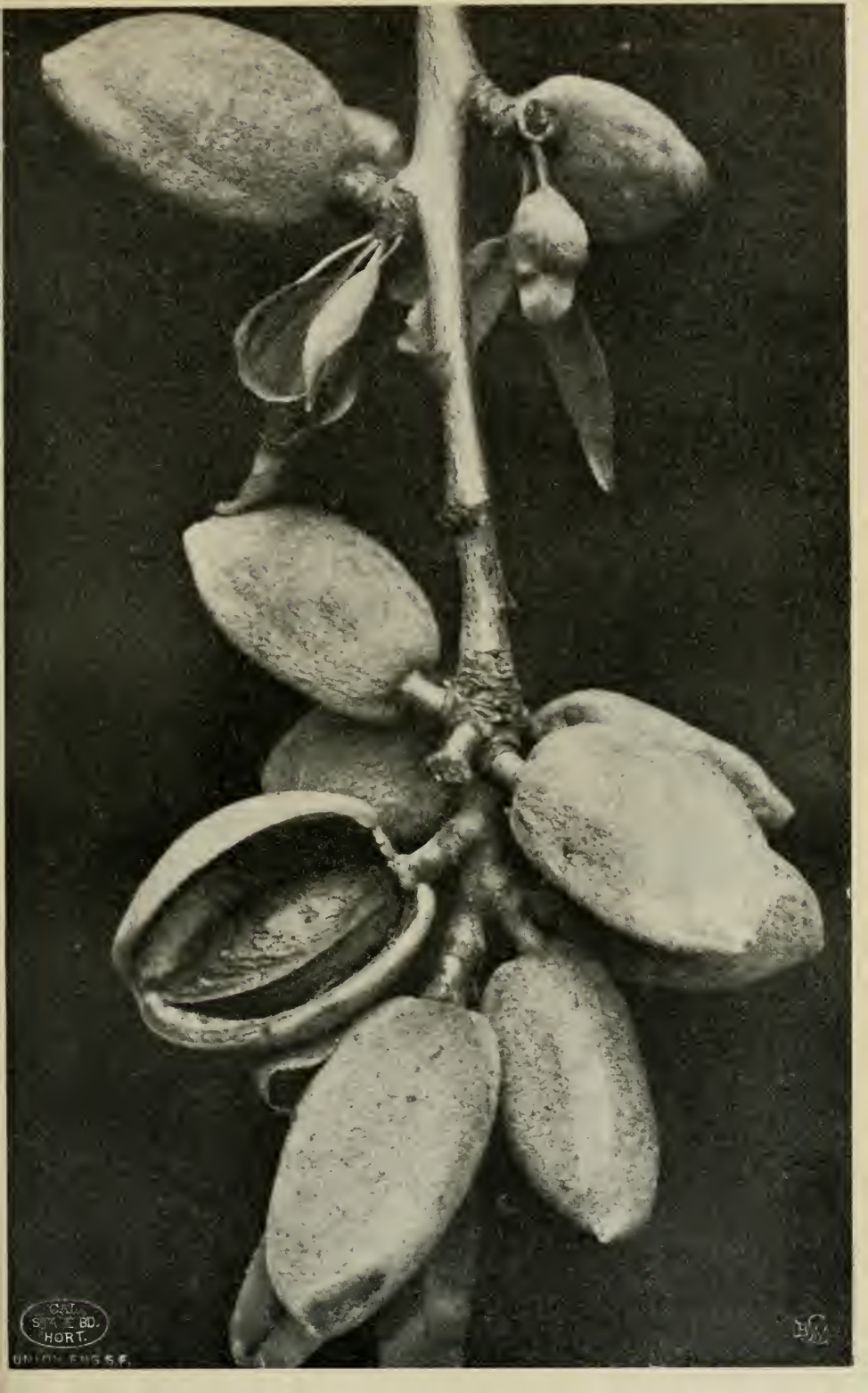
The almond is supposed to be a native of Asia, but it has been under cultivation so long, over an extensive area, in Europe, Asia and Africa that its origin is a matter of conjecture. Certain it is, however, that around the shores of the Mediterranean Sea, where a mild and temperate climate prevails, the almond, both in its wild and cultivated states, has flourished for many centuries. It was early grown extensively in Palestine and Syria. It is referred to in the Bible, we are told under the name "shaked," meaning to hasten. One might easily imagine that its extreme haste in blooming may have suggested its name. Friends of the lowly hazelnut have endeavored to appropriate honor seemingly belonging to the almond, a faulty translation detracting from the prestige of the latter. Be that as it may, there are many biblical references to the almond. The famous rod of Aaron, mentioned in Numbers, was taken from an almond tree. So too, the rod cut by Moses, that afterwards became a serpent when cast down, was an almond branch. There are also many biblical references to the beautiful pink bloom of the almond. It has long been a favorite of the Jewish people, being used extensively by them in the decoration of their synagogues.

There are two great varieties of almonds, viz: those having sweet meats and those having bitter meats. The bitter almond is not grown commercially, in extensive quantities, outside of the Mediterranean regions. These almonds are chiefly used in the manufacture of prussic acid, bitter almond oil and in perfumery. In California the bitter almond output is chiefly consumed by the nurseryman. It is claimed that nursery stock on bitter almond root is of superior quality.

The almond of commerce having sweet meats is divided into hard shelled, soft shelled and paper shelled varieties. They are again subdivided many times to meet the requirements of the trade and to gratify the fancy of supposed originators of varieties. Many of these are well known and standard. Others have names known only locally. As a business proposition for the average grower, it is best to produce standard varieties having an established market demand.

The almond is supposed to have found its way into California from Europe about 1853. It came to us after long centuries of existence with many of the imperfections that characterized its early career. To a Californian, Mr. A. T. Hatch, of Suisun, is given the credit of first having undertaken the improvement of the almond along scientific lines. So marked were the results obtained by Mr. Hatch that the leading commercial varieties of almonds grown in California today are designated as the Hatch varieties. Chief among these are the Nonpareil, the IXL, and the Ne Plus Ultra. The first two are the leading and highest priced almonds produced in California at this time.

*Address before the State Fruit Growers' Convention, June 1-6, 1914.



While Mr. Hatch greatly improved the quality of the almond, the varieties originated by him, when planted in the orchard, in solid blocks of a single variety, rarely give satisfactory yield. The quality of the product was improved at the expense of the output. To obtain cross-pollination and increased yield it has been found to be good practice to alternate the Hatch varieties with some hardier almond. Years ago hard shelled almonds were used for this purpose, but now the Texas Prolific, Drake's Seedling or other soft shelled varieties are generally used because of their higher market value. Usually two rows of the soft shelled varieties alternate with four rows of the Hatch varieties. Planting in this manner is advised to facilitate gathering which will later be explained. The rows should run, as far as may be, at right angles to prevailing winds at the time of blooming, viz: if the prevailing winds are from either the north or the south, run the rows by varieties, east and west. This matter should be given the closest attention.

Varieties.

No general rule can be given for the distribution of the several varieties of almonds that will apply to all sections. Experience is the only safe guide as to what varieties should be planted in any given locality. For instance, the IXL, an extremely shy bearer in many localities, excels all other varieties in certain localities where conditions

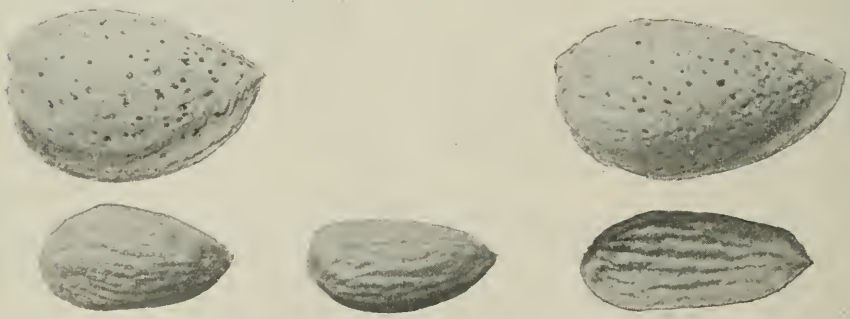


Fig. 108.—California almonds. 1, IXL; 2, Nonpareil; 3, Ne Plus Ultra. (Cal. Hort. Com.)

of soil and climate meet the requirements of that variety. When you plant, you plant for profit. Before deciding what to plant, find out what varieties have done best in your immediate vicinity, or experiment in a small way until you know what to plant. Neglect to follow this rule has caused great loss to individual almond growers in California and has been responsible for much demoralization in the industry. Apply business methods to the business you are about to engage in.

A tree following Nature's laws makes the best of existing conditions. Make the needs of the trees your study. Protect them from invasion of all kinds. These trees are your partners as well as your property. You have a right to demand of them full compliances with every term of the existing partnership. They, in return, are entitled to a full and complete performance of every detail of the contract on your part. It is your duty to make possible the greatest development on the part of the tree. If you have planted wisely and give it proper care, the trees will do the rest. Unless each member does his part the partnership will be a failure and the business unprofitable.

Where Grown.

Old as is the almond, it is grown on a commercial scale today only on the shores of the Mediterranean Sea and in California. Some attempts have been made to produce almonds in Arizona and Mexico, but the output in these and numerous other sections is consumed by the local demand.

Output.

The annual average output of almonds from California for the last fifteen years is about 2,000 tons. It has run from 450 tons in 1898 to 3,300 tons in 1910. The crop of 1913, owing to drought and frost, was but 1,150 tons. During 1913 the per capita consumption of almonds in the United States amounted to but one pound for each five people. In other words, if one in five of our population ate one pound of almonds, each of the remaining four would, like Mother Hubbard's dog, find the cupboard bare.

The almond, because of its extremely early blooming period, is the most susceptible to frost of any orchard tree of general cultivation. It is best adapted to a light, sandy soil, or a grade of land not far removed from a sandy loam. Heavy rains at the blooming period, especially if the weather be cold, are disastrous to the almond. The tree is a most profuse bloomer, but, previous to pollination, at the blooming period, requires mild weather to insure best results. After pollination has taken place, but while the bloom is still on the tree, heavy rains frequently occur without serious damage to the crop.

No soil, not well drained, will produce almonds successfully. Numerous instances are a matter of record where almond trees have been planted on soil apparently adapted to the tree yet where the waterplane during the winter months stood within four to six feet of the surface, and the trees have died.

Almonds will not do well in a section where there are frequent and heavy fogs. As a rule, they will not produce well when planted on low ground, as they will be more subjected there to the frost than at a slightly elevated location.

From the foregoing it is evident that the productive area of almond culture is limited. The requirements are exacting. Only a few sections can qualify. To the prospective almond grower, I would say, make haste slowly. Look well to the soil and climatic conditions of the section in which you propose to plant. Upon a rare combination of these two largely depends the success of the undertaking. No matter what the character of the soil may be, if frequent and late frosts prevail, almonds can not be grown. You may be able to grow a tree of goodly proportions, it may even be beautiful at the blooming period, but it will be a financial failure.

Planting.

The almond, being a long-lived tree that attains large proportions, needs more space than the average deciduous orchard tree. It requires a large area from which to draw nourishment and obtain sunlight. Its wide expanding limbs should not interlock with its neighbors. Early orchardists in California planted almond trees from sixteen to twenty feet apart. Many of these later dug out every other tree. Many who

did not do this finally dug them all out. It is best not to plant the trees less than twenty-five feet apart. Some of the wide spreading varieties should not be less than twenty-eight or thirty feet apart. There are two methods of planting. The one largely used is where the trees are equally distant in the rows and between the rows. Its chief disadvantage is a large open space between each series of four trees. Another, and more equitable one so far as the trees themselves are concerned, is the equilateral triangle method. In this the trees are equally distant from each other in the several directions. The chief objection to this method is that cultivation is somewhat hampered.

Before planting have the ground well plowed, harrowed and free from large clods. Do deep plowing and break up any hardpan that may be there as a result of previous shallow plowing. You can not do this after planting. It is most essential that this be done to induce roots to seek permanent moisture below.

Be generous with the trees in the matter of digging holes. Dig a hole large enough to give the spreading roots ample room to straighten out. Dig deep enough so that you can put some fine surface earth in the bottom of the hole to bring the tree up to about the height it stood in the nursery. Fill the hole at least half full of well pulverized surface earth before returning any soil taken from the hole. Clods in a tree hole mean air spaces that will dry out the roots.

Too much care can not be given to the nursery stock you plant. Get the best stock obtainable. A tree that has been neglected or badly handled in the nursery will prove poor property. One can not afford to accept such a tree as a gift. Get good healthy stock, but do not imagine you must get a tree full grown. A tree of medium growth is better for planting. Look well to the roots of the nursery stock; they are the dividend payers. If they are numerous and healthy you can grow a top cheaper than you can buy it. As the very existence of the tree, not to mention its productivity, depends chiefly on its root system, that system should be as near perfect as it is possible to realize. Almond nursery stock is usually on almond root, and in most instances it is the best. It gives a hardy long-lived tree with a great network of roots, some of which penetrate the soil to considerable depths in search of moisture. Almonds on peach root are shorter lived and require more moisture.

Frequently the roots are bruised or broken in digging. These damaged roots should be cut off. The remaining ones should be spread out in the hole in such a way that when they grow the tree will receive sustenance and support from all directions. In cutting the roots cut in a slanting direction from the under side of the root so that the freshly cut part may rest on moist soil. It is well to dip the roots in thin mud at time of planting to exclude air and assist in starting growth. If the soil be dry at time of planting five or ten gallons of water thrown into the hole will greatly help the tree in beginning the struggle for existence under new and frequently trying conditions.

When the tree is planted cut the top off to within about eighteen inches of the ground. Cut in a sloping direction, on the north side of the tree, to prevent exposure to the sun. Leave a bud near the top on the south side of the tree that early development may protect the wound. Shield the body of the tree from the blistering rays of the sun

and the depredations of animals and insects. Specially prepared tree protectors can be obtained easily and cheaply in the market. If these are not available, paper, burlap, shakes or whitewash will, if installed in time, prove a good investment.

Cultivation.

Cultivate thoroughly to retain moisture in the soil as well as to destroy noxious weeds. A well pulverized soil surface for the summer months is a contribution to future success that you can not afford to neglect. It retards the evaporation of moisture stored in the earth by winter rains, thus forming reservoir to be drawn upon as needed. One must not lose sight of the fact that the period of annual growth and activity of the almond extends over the greater part of the year. If the tree is to have vigorous buds from which to mature profitable crops, conditions must be such that the moisture, nature intended for the tree, shall be available at the proper time. In the wild state, in most instances, the trees find sufficient moisture to maintain existence. With the domestic tree, however, additional burdens are added. It must not only maintain its existence, but it must produce profitable crops. Co-operation between grower and tree is necessary to meet this additional burden. If opposed to cooperation, or if you can not cooperate, you are not adapted to the business and had better not undertake it.

Pruning.

Beginning with the second year, shape the tree for further usefulness. Start it low down as a matter of protection to the tree itself; also to shade the ground, to prevent evaporation and for convenience in harvesting the crop at time of maturity of the tree. Carefully train main branches so that nuts may be produced on all quarters of the tree. Do this carefully and later pruning will consist of an occasional thinning out only. Remove all water shoots or suckers. They rob the tree of much of its substance that should go to the crop.

Troubles.

The almond tree, while perhaps as free from insect and other pests as any other cultivated tree, still has its troubles.

Shot hole fungus sometimes appears. The ravages of this can be checked or lessened by spraying with Bordeaux mixture during the dormant period of the year and at the beginning of blooming.

The peach moth larva is a worm that at times causes much damage to the almond crop, if neglected. Should it appear, treat it with a mixture of Paris green and lime in the proportion of about 1 to 20. Apply with dust-spraying apparatus.

Red spider is the most persistent insect pest of the almond tree. It is effectively handled by spraying with sulphur. Any of the flowers of sulphur will prove effective. The "Anchor" and the "Rooster" brands are largely used and can be obtained readily. It is best to mix the sulphur with lime, as a carrying medium, in the proportion of twenty-five to fifty per cent sulphur.

If sulphur is to be applied at the same time that the peach moth needs attention, add Paris green to the sulphur and lime mixture and

save one spraying. These suggestions have been made on the supposition that the average almond grower will use the dry rather than a liquid spray. The dry spray is much more economical in its application than is the wet. It is far less disagreeable for the operator and has generally proved itself effective when properly applied. For a dry spray use lime 40 pounds, sulphur 5 pounds and Bordeaux 3 pounds.

A home-made mixing machine is easily constructed. Take any good heavy barrel. Bore a hole in the middle of each head and put a round shaft completely through the barrel leaving it project at each end far enough to give bearings on which to revolve. Put a crank on one end. Cut a door in middle of barrel at point of greatest diameter and fix so that it can be tightly fastened. Put in materials and turn until all are thoroughly mixed.

The best way to apply the dust spray is with a specially prepared dust spraying machine. These are made in different sizes. The smaller ones are made to run by chain geared to a sprocket which is attached to a wagon wheel. The larger ones are run by gasoline power. Those geared to the wagon wheel are cheapest and easiest to operate. They are efficient and well adapted to the needs of the average grower. The first cost is moderate and anyone having the least adaptability to machinery can run them. Add to this a man, a span of horses and a wagon, and the equipment is complete. Having this, use it. The ingredients for the mixture cost but little. The ravages of the insects and other pests run into dollars very fast.

Use the dust spray early in the morning while the dew, if any, is on the foliage. Begin on the side of the orchard from which the wind, if any, is blowing. Drive alongside each fourth row. The machine will blow the spray high into the air. In settling it will be distributed over the entire adjacent trees. Repeat this operation several times each season, each time going in different rows. It is best to select for spraying a morning when there is a dew and but little wind.

Harvest.

Provide yourself with some kind of mechanical huller and separator. Life is too short and time too valuable to hull almonds by hand. While there is some loss from machine hulling and separating, it is more than offset by the saving in expense and the lessening of the number of employees. Machines of varying capacities and more or less efficiency are in the open market. While the almonds may be left on the tree for a time after the hulls have opened without serious loss, it is best and most economical to gather them as soon as the hulls open and expose the nut sufficiently to hull easily. If left much after this time some of the hulls will begin to dry and draw closer to the nut, making hulling more difficult. Then, too, the nuts will begin to fall to the ground of their own accord. Should a heavy wind occur at this time many nuts will be blown from the tree. The expense of picking almonds up from the ground is fully three times that of gathering them in the usual manner. Promptness pays in the handling of almonds. Be ready for the harvest and have a crew of gatherers in proportion to your acreage.

Provide canvas sheets to spread beneath the trees on which to knock the almonds. The size of the sheets needed will depend upon the size of the trees in the orchard. Have two sheets for each tree. The two

sheets when spread out should cover from twenty-four to forty feet square. It is false economy to use a sheet too small for your trees. Almonds will be continually knocked off the sheet on to the ground, thereby increasing the cost of gathering, to say nothing of the many nuts that will not be picked up and thus become a total loss. The methods of using almond sheets vary with the whims and ingenuity of the users. Some spread the sheet beneath the tree, knock the almonds, and either box or sack the product of each tree, direct from the sheet. If but few nuts are obtained some drag both sheet and nuts to the next tree before sacking, to save time. Another and better way is to have a sled 16 feet long, about 40 inches wide and 6 inches high, with a tight bottom. Have one end of the sheet tacked to one side of the sled. Have boxes ranged inside sled along the side next to sheet and when sheets are emptied the almonds go directly into the boxes. Another and still better way is to have a 16-foot pole sewed into a part of one end of each sheet and have that pole on arms so hinged to the sled that the sheet may be used on either side of the sled. In this way two rows can be gathered at once and thus save time in moving. While boxes are largely used to move almonds from the orchard to the almond shed, they are expensive and deteriorate rapidly. Their hauling and the gathering up of surplus boxes consume time. Time is money in the almond business as well as elsewhere.

Many growers use grain bags. They are easily carried on the sled, cost but little to distribute and there are no stragglers to gather up. When bags are used, dump almonds into sled and have one man shovel them into a sack, using a simple device for holding the sack, while the others are knocking the next tree. If you are in the grain business as well as almond growing, use new sacks for your almond work. After the season is over put the sacks away carefully and use them for grain the following year. In that way the sacks for almond use cost you nothing save the interest on the first investment.

One good heavy horse will pull an almond sled from tree to tree and save much of the wear and tear incident to dragging sheets over the ground. If you employ labor you will find it not averse to having the horse do what men would otherwise be expected to do.

Gathering.

To knock the almonds from the tree good, tough, springy poles should be used. The poles should be as light as consistent with the service expected. A tamarack or fir pole 16 to 24 feet long and about 1½ inches in diameter at the butt is an ideal pole for knocking almonds. Take the bark off while green. If too heavy at the butt end shave it down so that it can be easily handled. Tie in bundles to keep straight and store inside the house. With proper care and careful handling, a good pole will last several seasons. Sawed Oregon pine lumber is sometimes used for poles, and if good lumber is obtained the result is a good pole. Hickory, too, is used with good results. Bamboo has been tried, but while easy to handle, cracks so badly when exposed to the sun that it can hardly be considered a success. Have your crew use poles of different lengths. One or two very long poles is all that is needed at a tree. Almonds on the lower limbs can be gathered more cheaply with short poles. If the trees be old and extremely high, have a man climb into the upper limbs with a short pole.

Do not imagine that because you have a pole you must necessarily beat the tree to loosen the nuts. Put the pole between the branches and vigorously work it back and forth, shaking the limbs and loosening the nuts. Some seasons almonds are harder to knock than others, and require harsher treatment, but remember that tree is your friend. Do not permit it to be abused. The buds you knock off this year may be the ones that next year would be fruitful. Every limb you break off means a wound to heal. Every unnecessary burden placed on the tree draws from vitality that should be expended in the production of nuts.

Hulling.

Almonds should be hulled as soon after gathering as practical. Spread the clean nuts in the sun to dry. Tip the trays slightly toward the south that the nuts may dry quickly. The time allowed for drying depends upon the condition of the nuts at the time of gathering. No almonds should be sulphured until sufficiently dry and brittle to break without bending. A good and convenient size of tray is one 3 feet wide by 8 feet long, having 2-inch sides. In the early part of the season, while the nuts are quite green, they should be raked frequently in the trays to insure drying quickly and evenly and to prevent mold.

Sulphuring.

When the nuts are thoroughly dry the outer shells should be slightly moistened, that they may readily take sulphur and be bleached in the shortest possible time. Great care must be taken in sulphuring lest the kernel be affected. Should this take place the nut will soon become rancid and ruined. Less bleaching is being done now than formerly. Stack the trays of almonds on a car and run them into a sulphur house. Twenty to thirty minutes is sufficient for paper shelled varieties. Soft shelled would take a little longer. Hard shells are rarely bleached, and never are when used for nursery purposes. After bleaching, the car containing the almonds should be allowed to stand twenty-four hours in the open to permit the almonds to become dry. Do not expose them to the direct rays of the sun after bleaching, as it will darken them. When thoroughly dry, sack and they are ready for market.

Marketing.

We have now reached a very critical stage of the almond business. It is the goal we have long had in our mind's eye. After all the months of anxiety, is our year's work to be a success? Having the crop, it all depends on the marketing. Almost anyone at all adapted to the business can attain average success as a grower. To dispose of the crop to the best advantage and at the same time to do something to build up the industry and place it on a firmer commercial basis is a task worthy of the best business ability. The latter requires a different sort of ability, a special training and time to devote to the work which the average grower has not at his command. A grower, in the disposal of his product, comes in competition with, or deals with, expert salesmen. The grower is at a disadvantage. He has not the data upon which to base conclusions and establish values. He is not familiar with the tricks of the trade. He may occasionally make a creditably fair sale, but in the long run the experience of the specially trained man

will beat him. The trade is organized. The grower must meet organization with organization. Organized producers hold the whip hand. Singly, they are easy prey. It is one thing to produce an almond. It is quite another thing to sell it.

Previous to 1910 the almond growers of California were without effective organization. In that year The California Almond Growers' Exchange was organized. Since that time the output of the state has greatly increased, foreign importations have increased at the same time, but prices have been much better, markets have been steadier and speculation in our products has been largely eliminated. Improved conditions generally prevail. Cooperative buying of supplies has proved an economy. New markets have been exploited. Further exploitation will be necessary when the recently planted orchards come into bearing. Lend a hand in the business end of the occupation. You are needed. The benefits will be mutual. Join a local association. Present your troubles, for you will have them, to the organized growers. Get the benefit of their combined intelligence and experience. Get the benefit of the expert salesmen employed by them. In other words, help develop and protect the almond industry and business. The first is the production of the almond. The second is its marketing.

A LEAK IN OUR QUARANTINE.

By Frederick Maskew.

The present administration, at the request of the crop producers of the state, greatly augmented the scope of the office of State Commissioner of Horticulture by the passage of legislative acts authorizing the extension of its activities in several directions. One of such acts is embodied in the provisions of the present state quarantine law with its justly famous protective section 5. When the author of this assumed executive charge of the Quarantine Division he determined to make the service—in all points of diligence and efficiency—equal to the conception of those who framed and passed the quarantine law. Results were soon apparent, and in consonance with this progress the present administration nearly doubled the number of the quarantine force, and they in return have more than quadrupled the number of parcels of horticultural products legitimately intercepted, examined and disposed of as provided under the law. This persistent activity in endeavoring to maintain a quarantine has led to many new and strange findings, one of which is herewith recorded and illustrated.

Notwithstanding the strengthening of the quarantine force both in numbers and with authority, the increased activities of the same force, and the passing of special protective quarantine orders, we see clearly by these illustrations that there remains, immune from state control, national avenues of entrance constantly open to the possible introduction of insect pests destructive to our crops, and which if not closed or controlled will eventually bring to naught all the constructive work of our state legislators, the assiduous efforts of the quarantine inspectors, the capable cooperation of the common carriers, and fasten upon our growers and their posterity other permanent items of expense in the matter of crop production. One of the most promising of California's industries, with all of its possible extensions and developments and

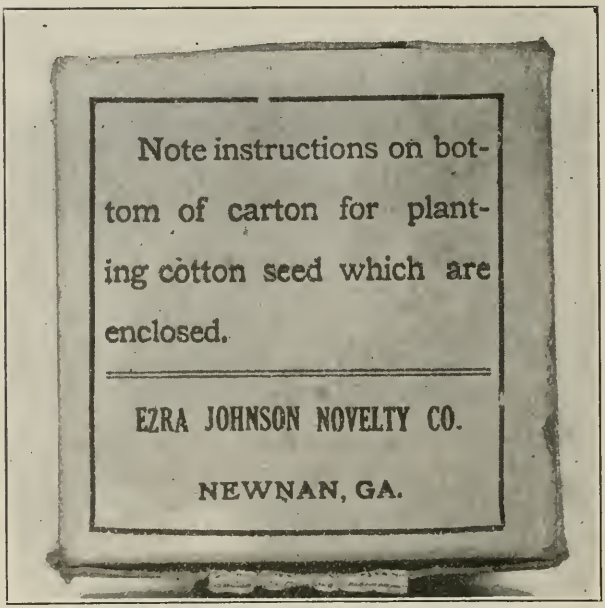


FIG. 109.—Two views of container in which the cotton seed was shipped. (Photo by A. Chatterley.)

with the wide area suitable to its requirements free at present from the insect pests and diseases peculiar to its culture, is the cotton crop of the state. With a full appreciation of what it signifies financially to keep the cotton fields of California free from the ravages of the cotton boll weevil and the pink boll worm every effort has been and is being made by the State Commissioner of Horticulture to prevent their introduction by rigid regulations providing for the control of cotton seed brought into California, and the Federal Horticultural Board maintains stringent quarantine regulations covering the bringing of foreign grown

FIG. 110.—Another view of the container, showing the cotton seed. (Photo by A. Chatterley.)

cotton seed into any part of the United States. Despite all these precautions a glance at the lower edge of Figure 110 shows clearly that cotton seed can be sent into any part of California and readily escape the vigilance of the inspectors and the purpose of the law.

In this particular matter of cotton seed the writer has been much solaced by the assurance of an international authority on the subject of cotton pests to the effect that the danger of introducing the boll weevil in this manner is remote, yet the route is open and freely available, and the prime purpose of this article is to record photographically that the route is being used, and endeavor to impress upon our crop producers how easy it must be for pests to gain an entrance in spite of all vigilance and local laws as long as the mails are available to the transmission of their host plants. The administration of California has done more than perhaps any other state in the Union to protect the crops of its producers by the passing of horticultural laws, and the provision made in men and means for carrying out the same, and it now remains for the crop producers to complete this protection by uniting in an effort to bring about the control of plant material brought in California through the medium of the United States mails.

RESPONSE TO ADDRESS OF WELCOME.

By Dr. A. J. Cook, before Fruit Growers' Convention at Los Angeles, November 11th.

Ladies and Gentlemen of the Forty-fifth California State Fruit Growers' Convention: It is a rare pleasure to respond to the hearty greeting which we have just received from the president of your wide-awake Chamber of Commerce. We were prepared for just such a welcome. It has been demonstrated over and over again that Los Angeles' other name is "hospitality." This city is famed the world over for the warm generous welcome which all visitors receive. No wonder you have the world's record for rapidity of growth in wealth and population. Courtesy and kindly thoughtfulness are always attractive, and they will always win to their possessors companionship with the world's worthies. It is said that the best gauge to prosperity today is the number of automobiles owned and paid for. Here, again, you have the world's record. The United States Department of Agriculture is responsible for the statement that Los Angeles County is agriculturally the richest county in the world.

Is there any better index to stirring enterprise than is afforded by ample means of transportation? It is reported that Los Angeles is the hub of the greatest local transportation system of the world. No wonder that social betterment, wealth and population push to the very forefront with unparalleled activity in your great city.

But I take it that your greatest reason for pride is your great and unparalleled school attendance. I am told by our State Superintendent of Education that in this you lead the world. It is said that the only way that a child can escape schooling in Los Angeles is to grow whiskers, which certainly insures educated mothers in the good days to come. Educational greatness is most to be coveted of all civic possessions. Los Angeles' growth in wealth and population can know no abatement so long as her schools are in the lead.

We are heartily glad to be with you. We feel sure that this will be the banner convention, and we pray all of you to make yourselves entirely at home in our meetings and to take active part in all discussions. Our very full program constrains me to take no formal part in this convention except in this address, so I crave your attention on two points: The work of our commission and suggestions as to desirable legislation.

My desire when taking office three years ago was to greatly increase the quarantine service, which I regard as of paramount importance; to discover, introduce and establish new parasites that would greatly reduce the vast sum of more than $1,000,000 which is now expended annually in the control of our insect pests that filch so mercilessly from our fruit growers; to provide an entirely new service that would down the fungous pests that often eclipse the insect in the work of destruction; to provide accurate, up to date treatises on destructive insects and fungi and on all the several fruits which are produced in our state; to furnish information on topics of current interest regarding fruit production and the betterment of our fruit markets; to secure reliable statistics regarding our orchards and their productions; to work in closest harmony with the county horticultural commissioners, our

splendid State University and our great National benefactor, the U. S. Department of Agriculture, that we and they might be substantial gainers thereby; to work assiduously to eradicate pests now in our state and to keep all others from entering, and lastly, to secure, if possible, a change in our mailing system that would close the open door that now threatens us unhindered from San Diego to Siskiyou.

I am proud of our record and accomplishments, but transgress no rule of modesty in holding them up for admiration and approval, for these could only come through the aid of my assistants, all of whom are indefatigable workers, very able and entirely loyal to the service.

Three years ago there were only six quarantine officers employed by the Commission. Today there are eleven, none too many. Then our entire Mexican border was unguarded. All express shipments were received without inspection. Now we are protected from Yuma, yea from Matamoras, to Eureka and on to Seattle and even Victoria. Moreover our express shipments are as vigilantly inspected as are those of the freight cars and steamers. We are now very much less disturbed by the near presence of the Mediterranean fruit fly which Doctor Webber states is the worst insect pest in the world, the Mexican orange maggot and the alfalfa weevil. We believe our quarantine service, pronounced by Doctor Marlatt as well nigh perfect—the best in the world—will continue to protect us from these grave perils. I am very proud of our whole quarantine service, which Mr. Maskew has so ably organized.

The whole quarantine force were at my suggestion made collaborators of the United States Department of Agriculture. This while in no sense infringing upon their duties in the quarantine service gives them added influence and power as quarantine officials.

Parasitic Work.

You know well the burden that the mealy bug, black, red and purple scales have inflicted upon our great fruit industry—almost a million in hard cash every year. I have great hope from the parasites which we may introduce from other lands, which gave us these pests. We no longer send out a dozen or a score of these little introduced friends, but rear them under our direct care until we can send them out by the thousands, so that they will have every chance for becoming established.

My faith in this phase of our work led me to reorganize the service, and secure Mr. Harry S. Smith to superintend the work. Dr. L. O. Howard, head of the Federal Bureau of Entomology, tells me that we could have secured no more able man for this work.

We have received several promising parasites of these destructive insects from Mr. Henry L. Viereck, now Assistant Superintendent of the State Insectary, who was collecting for us during the past year in Sicily. These are being reared in the Insectary until they increase sufficiently to warrant a colony being placed in some ideal location in the open. From South Africa we are receiving shipments of black scale well parasitized. Professor Lounsbury states that the black scale in this region is held in check by its parasites and predators. We have already planted two colonies of the internal parasite of the black scale—one in the southern part of the state and one in the northern. From these colonies we hope to distribute parasites all over the black scale infested

sections of the state. We are also receiving large shipments of mealy bug parasites from Japan. Of these, several species have been released in the field, and the results will be known later. An important ladybird enemy of the mealy bug from the Philippine Islands, which was secured by Mr. Smith last year during his trip to the Orient, has been successfully reared in the State Insectary, and a colony of several thousands has been placed in an orchard heavily infested by mealy bugs. Of course, we all understand that it will take several years for these parasites to increase sufficiently to be of any material benefit.

Everything was looking bright for success when the war cut short the service all along the line. I assure you that we are not discouraged or thwarted in our enterprise. As soon as the war cloud rises we shall go ahead vigorously, and maybe we will not be obliged to await that glad day.

Work in Mycology.

I need not rehearse here how seriously fungi eat into the profits of the fruit growers. You know how gum disease and wither tip are playing havoc with our ledger accounts. With apparently no money to meet the expense I besought the consent of the State Board of Control to secure a mycologist and hastened to win Prof. H. S. Fawcett to our aid. I need not tell you of his honest, untiring work, fairly camping in the field, or of his brilliant success in discovering the cause of and cure for the fatal gum disease. One enthusiast says this alone has saved millions to our state. Professor Fawcett completed this work as described in The Monthly Bulletin, Vol. 2, No. 8, before he left the service of the Commission. I can not refrain from words of hearty appreciation for the kindly aid of the State University in giving us laboratory facilities at Whittier, of Messrs. Boal of the San Diego Lemon Company and of C. C. Teague of the Limoneira Company at Santa Paula who not only gave room and equipment for Professor Fawcett's invaluable researches but also fed and slept him when he was working in their groves. They also permitted him to inoculate their healthy trees for the good of the industry. Without this assistance we would have been powerless to uncover these minute but mighty destroyers. I need not tell you that we saw Professor Fawcett leave the Commission with deep regret, yet we had a lack of funds to properly equip him for such service. I believe also that research work can be done with greater economy by the University, and Doctor Webber assured me that they would hold Professor Fawcett rigidly to this exclusive research work, for which he has proven himself so exceptionally capable, both here and in Florida.

Publications.

There was a lamentable lack of monographs on our various fruits when I took office, and the four or five different bulletins on hand were much out of date. Inquiries came daily for aid in this direction. We have secured fresh, up-to-date treatises on alfalfa, the almond, apricot, cherry, date, peach, pear, plum, prune, walnut, avocado and citrus fruits, and have now in the press a monograph on the apple.

Our publication on insects, injurious and beneficial, has been greatly appreciated. Believing that this would be the case we provided a very large edition. In a few months this was exhausted, and hundreds of requests have been filed to await the second edition now in the press. We were very pleased at the reception of the first edition, even experts thought it the best ever published. I assure you the second edition now in the press will be still better.

I need not speak of The Monthly Bulletin. Letters from every section of the state convince us that it speaks for itself.

Mr. Essig, the author of the insect bulletin and the first editor of The Monthly Bulletin, is no longer connected with the Commission. We could not have consented to the loss of so valuable a man except that we are assured that he will continue in the same line of work in our great University which he has so admirably carried on in the Commission.

A Bureau of Information.

Very numerous letters calling for information along our line of work, sometimes fifty a day, come to the Commission. This is why we sought such men as Messrs. Essig, Fawcett, Weldon and Smith. I wished the best, men who could speak at once with authority, that we might give prompt and immediate response to each inquiry. With our able corps of assistants this is now possible.

You will be interested in knowing that whereas there were but eleven employees in the Commission in October, 1911, the date of my appointment as Commissioner, there were twenty-two in October, 1914, yet our appropriation has not increased one cent. We have added to Governor Johnson's rule in making appointments efficiency and no politics his third insistence—greatest economy consistent with efficient service.

You all know how we have favored at every convention action that would promote organization, cooperation and better means of marketing. We must pound away with telling blows until we have such organizations as the Citrus, Almond and Walnut Exchanges and the Citrus Protective League back of every agricultural interest of the state.

Statistics.

The statistical work now in charge of Chief Deputy Commissioner, George P. Weldon, is rapidly growing in accuracy and popularity. Statistics unless accurate are valueless, but if accurate they are all important. With our hundreds of trained men daily in the field we have a rare and unique opportunity to secure reliable data in this direction. I believe that our people will insist upon legislation that will continue this phase of our work and make such legislation cover all our agricultural products.

Cooperative Effort.

There is every reason why the State Commission of Horticulture, the county horticultural commissioners, the State University and the United States Department of Agriculture should work together in fullest accord. I am happy to state that the county horticultural commissioners are now unanimously cooperating with the State Commis-

sion, and we are working together in most perfect harmony. The county horticultural commissioners are doing splendid work, and we are all pulling hard and strong together. The results are so beneficent that you may rest assured that the most perfect harmony will continue.

The cordial relations between the State University and State Horticultural Commission have been helpful and gratifying. At all our State Fruit Growers' Conventions the university has given ready, willing and very valuable assistance. This was especially exemplified at Davis and is apparent here today. Only good can come from fullest cooperation of all our state institutions. I am very grateful for the generous assistance which has been so freely granted.

You all know how the State Commission has pulled steadily with our great United States Department of Agriculture at Washington, D. C., and why shouldn't it? Whenever we in California have had a problem too difficult to solve the Department at Washington has given us telling assistance. We have only to remember their gift of our present efficient mode of fumigation, our means of preventing decay in fruit through careful handling and the method of controlling pear thrips and pear blight to make us most appreciative of their great and valuable service. No wonder that our United States Department of Agriculture has given our country great prestige and well-earned praise throughout the whole world for its happy combination of scientific research and practical accomplishment.

Weed, Insect and Fungus Control.

Today we are in the lead in the work of insect and disease control the world over. Our stir and enterprise as a people have brought to our shores fruits, grains and vegetables from every section of the world. With these importations came the special enemies of each, thus, before we were aware we had the great list of injurious insects which are only comparable in numbers with our great variety of crops grown. Unfortunately, we did not bring with the pests their natural enemies, hence the great struggle to control these numerous pests. I believe, however, that the same enterprise which brought the menace has been or will be adequate to meet it. Indeed, we are today acknowledged everywhere to be in the very lead in all this mighty work of pest control. With the agencies now at work we shall soon be even better equipped to safeguard the interests of our farmers.

Our Mails.

One of the imminent dangers, especially since the establishment of the parcel post, is the great liability of receiving serious insect and fungoid pests through the mails. We are receiving proofs of this menace daily. It is thought that the white fly came into our state through the mail. How easily a cotton boll weevil, the various scale pests not yet introduced, the Trypetid flies and the alfalfa weevil may be brought into California through the parcel post! In response to an urgent appeal from our office we received from the Government Postal Department the order requiring certificate of examination before fruit, plants, etc., can be mailed, yet absence of competent examiners lessens the value of this order. A further order that post office officials may, upon request, report to local inspectors the names of parties to whom

shipments of fruit, plants or trees, etc., have been made was later issued. This is a useless grant, for what inspector has the time or ability to seek out such shipments after delivery has been made. The present law requires that all mailed packages be delivered immediately upon reaching their destination. I am glad and gratified to report that some of our leading post offices report to us, daily, all such packages received which we have arranged to inspect so that no appreciable delay is experienced. Our experience shows that such inspection is very necessary and important. Many post offices are beyond the reach of possible inspection. We must have action by Congress, and it can not be too speedy, doing away with the law requiring immediate delivery, and making it mandatory that all nursery stock, plants, fruit, etc., be sent to one, two or three designated post offices for inspection, to be afterwards forwarded to the purchaser if, upon inspection, such shipments are found to be free of insect pests or fungous diseases, wherever any state is equipped for such inspection and requests such action. Such a bill has been introduced into Congress by Hon. J. E. Raker, but it slumbers, whereas it should be rushed to final passage. Our experience in inspecting shipments by parcel post shows that our safety from imminent danger requires that every possible effort be made to hasten the passage of this or some similar act which will safeguard our orchards from infestations through shipments by parcel post.

State Fruit Growers' Conventions and Publication of the Proceedings.

We call this the forty-fifth State Fruit Growers' Convention, but it is really the forty-seventh, as we have held during the past year two emergency conventions, one in the south on the mealy bug at Upland, and the other, the Potato Emergency Convention, at Stockton. Both of these conventions served an admirable purpose. The one cleared up a vexing question and gave great relief where much loss had resulted and where there was no little anxiety. Information was given which at once quieted alarm. The other has inaugurated a movement which promises very pronounced relief to our great potato industry.

The proceedings of all our State Fruit Growers' Conventions have been published for free distribution by the state up to the forty-third convention held last December in San Jose. Our funds would not permit further publication if we continued the Monthly Bulletin and issue a second edition of the insect bulletin, which is being loudly called for. After consultation with some of our extensive growers it was thought best to omit the publication of the proceedings of these conventions, at least for the present. We found it would have cost over $3,000 to publish the report of the Davis Convention alone. I am pleased to report to you that arrangements have been made which will insure the publication of the proceedings of the present convention, which I am sure will give universal satisfaction.

Legislation.

At the State Fruit Growers' Convention held in San Jose I appointed the following gentlemen as a committee on legislation: Mr. C. C. Teague, Dean Thomas F. Hunt, Dr. G. Harold Powell and Judge Peter Shields. By vote of the convention I was added to the committee. At the suggestion of Dean Hunt five men were added to this committee at the Upland Convention, as follows: Dr. H. J. Webber, Hon. W. A. Johnstone, Senator E. K. Strobridge, Farm Adviser G. H. Hecke and Mr. Marshall DeMott. I now add the names of Senator P. F. Cogswell and Mr. Geo. C. Roeding.

I suggested to each member of the committee by letter the wisdom of consolidating all functions of the state that bear upon agriculture and its development under one head, an officer corresponding to the Secretary of Agriculture of the United States Government. The reasons for this are convincing. It will serve economy in preventing duplication of equipment, in reducing the number of expert assistants and will eliminate interference in the work of the different divisions of the service, which is now imperative. It will harmonize the work and will follow the example of our great United States Department of Agriculture and that of most of the states.

The able committee named above are unanimously in favor of consolidation, and a bill has been prepared to submit to this convention which I believe will receive your hearty approval.

There are a few other features of our present law that call for amendment. At present the county horticultural commissioners are county officials, appointed by the supervisors of the several counties, thus the county is the unit. Many of our most successful fruit growers are of the opinion that these commissioners should be state officials appointed by the State Commissioner of Horticulture, or better, Agriculture, under civil service rules. These officers will be paid by the state, not a per diem, but a salary. This would unify work, would remove the selection of the commissioners entirely from politics, would secure a more competent appointing power and consequently more competent officials. The deputy commissioner and inspectors should also be appointed under the State Civil Service Commission. At present we have trained, competent county horticultural commissioners. These men should be continued in office but the inspectors and new commissioners should be appointed under civil service rules. The units should not be the counties necessarily, but in many cases districts, so that small counties could be united under one commissioner; thus all counties would be served. Every section would have its commissioner. At present there are fourteen counties without commissioners, hence they have no local supervision. One of these counties, San Francisco, is, because of this lack, a menace to the agricultural interests of the entire state. Our greatest interest is agriculture, and its well-being should not be in jeopardy.

But the best result of all, this unifying system would give us uniform horticultural laws. We may now have forty-four, and if all counties were organized, would have fifty-eight independent commissioners,

therefore we might have fifty-eight ordinances bearing upon the same subject. Is there any wonder that our nurserymen call loudly for reform in this direction? Would not this alone warrant a change in our horticultural laws?

Again, at present each applicant for the position of county horticultural commissioner must be examined in the county which he desires to serve. This is absurd. At present three counties have commissioners who were reported not as eligibles but as competents; that is, persons who had failed to pass the examination. This does not result in the best service. Under the state civil service rules this would be impossible. Every eligible would be competent in fact, not simply in name. Of course this would do away with the present Board of Horticultural Examiners and would secure the State Civil Service Commission in its place. If these changes were made the State Horticultural Commissioner would have the added function of appointing the district commissioners and would no longer serve as a horticultural examiner.

These suggestions are offered to the committee on legislation, as also the members of the convention, for their earnest consideration.

CROP REPORT AND STATISTICS.

SEPTEMBER REPORT.

Compiled from reports sent in by the County Horticultural Commissioners, by Geo. P. Weldon.

County	Grapefruit (per cent)	Lemons (per cent)	Oranges (per cent)
Butte	No	report	
Colusa			75
Fresno	100	100 *	100 *
Kern			100 *
Los Angeles	90	90 23	90 22
Orange	115	120 3	110 8
Riverside	90	90 22	70 18
Sacramento	100	100	100 *
San Bernardino	85	85 17	80 33
San Diego		35 19	80 *
Santa Barbara	100	100 *	100
Stanislaus	100	100	90
Tulare	90	90 3	90 14
Ventura	90	105 12	90 *

Figures opposite names of counties indicate condition of crop in per cent on the basis of 100 per cent as normal.

Smaller figures underneath condition figures show the estimated per cent of the normal crop produced in each of these counties.

*Less than 2 per cent of state's normal crop grown in county.

THE COST OF PRODUCTION OF PEARS IN SACRAMENTO COUNTY.

By F. C. Brosius.

The following cost of production and net returns on pears grown in the Sacramento River district, is presented for the purpose of showing what can be accomplished, if the grower is willing to spend time and money to combat insect pests, fungi, and plant diseases, intelligently and successfully.

This will also give some idea of the many problems that confront the river growers that are not encountered by the growers on the uplands, where thrips are little known, scab is seldom seen, pear slugs do little harm, and even blight is much easier to control.

Although it is true that the production is not so heavy in the uplands, the lessened cost of control measures will certainly equalize the larger crop obtained in the river orchards.

It should be noted that there are two special sprayings for thrips, while Black Leaf is combined with the codling moth spray, to make sure of any stragglers that may be present. Also, there is one special scab spray, and another combined with the codling moth spray, making six sprayings in all.

The grower who owns the orchard furnishing these figures went over his trees each day during the time that pear blight was being carried in the spring, so that with his intensive spraying he obtained a maximum crop, and now has a full growth of fruit spurs for next season.

Instead of a mineral fertilizer being used this year, a vetch crop has been put in, using fifty pounds of inoculated seed to the acre, which is a general practice with the successful growers of the delta, and should be practiced more by the orchardists of the uplands, where the entire supply of humus and nitrogen is seldom half as much as is found in the river soils where cover cropping is not practiced.

The cost of transportation from the growers' wharf is all deducted from the gross returns by the fruit exchange, so should not be figured in the cultural costs.

Yield of 189 tons of pears, 7,000 boxes, from 1,000 trees, 25 to 40 years old:

CULTURAL COSTS.

One man pruning 7 trees per day, at $1.75 or 25 cents per tree			$250 00
Pear blight pruning in spring, at 20 cents per tree			200 00
One man plowing one acre per day, at $2.25 per day			43 00
6¾ acres, 3 cultivations, 19 days.			
Pumping, irrigating on 6¾ acres, at $7.50 per acre, per season			47 50
One man hauling from orchard to packing shed			42 75
19 days, at $2.25 per day.			
Two tons fertilizer, at $38.00 per ton			76 00
One team, 130 days all, cultivating, spraying, hauling, etc., feeding at $1.00 per day			130 00

COST OF SPRAYING.

For Thrips—			
22 gallons distillate per tank, or 30 trees, at 18 cents	$3 96		
One pint Black Leaf per tank, or 30 trees	1 25		
		$5 21	
Or 17 cents per tree, per spraying, 1000 trees, 2 sprayings, season			340 00
For Codling Moth and Thrips—			
12 pounds lead arsenate per tank, or 30 trees, at	$1 20		
One pint Black Leaf per tank, or 30 treees	1 25		
		$2 45	
Or 9 cents per tree, per spraying, 1000 trees, 3 sprayings, season			270 00
For Pear Scab—			
500 pounds lime sulphur spray, at 7½ cents per pound			36 25
(one special spraying and one combined with coddling moth spray)			
Labor—			
Three hose men, one driver, at $2.25 per day; 5 tanks, or 150 trees per day, 6 sprayings, season, 42 days			378 00

PICKING AND PACKING.

Picking—	
One man, 30 boxes per day, at $2.25, or 7½ cents per box, 1000 boxes	525 00
Shook, nails, paper, 12 cents per box, 7000 boxes	840 00
Making boxes and packing, 6 cents per box, 7000 boxes	420 00
Total cost of production	$3598 50

RECEIPTS.

189 tons, or 7000 boxes, at $1.10 net	$7700 00
Deduct cost of production	3598 50
Balance	$4101 50

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. Cook, State Commissioner of Horticulture ---------- Censor
E. J. Vosler, Secretary State Commission of Horticulture ---------- Editor

ASSOCIATE EDITORS.

Geo. P. Weldon ---------- Chief Deputy Commissioner
Harry S. Smith ---------- Superintendent State Insectary
Frederick Maskew ---------- Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

A New Grape Disease.—Bulletin No. 289, Agricultural Experiment Station, Geneva, New York, will greatly interest the many grape growers of California. It describes quite fully a new disease, "the dead arm disease," which is supposed to be indigenous to the United States. It is fungoid in nature, very serious in its effects and seems to be prevalent everywhere in the eastern grape growing regions. Its name indicates the characteristics, and its presence may be determined by the leaves turning yellow, crimpling up and finally the long lateral canes dying. It does not seem to descend to the roots, or if so, rarely, as sprouts below the ground seem to be free unless infected by new spores. Infected canes not pruned are supposed to be the means whereby the fungus gives rise to new infestations. The disease frequently creeps down to the main stems, and the vines often die in the second or third year. We already have our share of vine diseases in California, and it is a question whether we are warranted in bringing grapes from the East, as there seems no need of doing this, and of course there would be danger of introducing this new and serious malady.—A. J. C.

Powdery Mildew of Apple.—Bulletin No. 120 has been published by the Bureau of Plant Industry, on Apple Powdery Mildew, and its Control in the Pajaro Valley. This bulletin was written by W. S. Ballard, pathologist, fruit disease investigations for the Bureau, and W. H. Volck, county horticultural commissioner of Santa Cruz County. The results of cooperative experiments are treated upon very fully in this bulletin. The authors state that this disease may be caused by either of two similar fungous organisms, namely, *Podosphæra leucotricha* and *Podosphæra oryacanthæ,* the former species being the one that is doing the damage in the Pajaro Valley, the orchards of this valley suffering more from mildew caused by this fungus than do those of any other large apple growing district of the United States. It is further stated

that the disease known as apple mildew occurs in nearly all parts of the United States, and that it is more common on nursery stock than on orchard trees. In the west it attacks only the foliage and young twigs, and not the fruit. The climate is said to be very favorable to the development of this disease; the Yellow Newtown and Yellow Bellflower varieties being most susceptible. As 80 per cent of the apple trees grown in the Pajaro Valley are of these varieties, the trouble has become very serious. Probably in a third of the orchards of the valley, 50 per cent of the terminals are diseased and show the grayish mildew covering. The following description is given of the disease:

Under the microscope the fungus presents the appearance of a much-branched and loosely interwoven tangle of very fine threads lying on the surface of the leaf or shoot. Scattered all through this tangle and forming a powdery layer on its surface are enormous numbers of minute reproductive bodies called conidia, or summer spores. Collectively the fine fungous threads are termed the mycelium. The mycelial threads branch and rebranch as they grow over the surface of a leaf or shoot, and at intervals short, saclike processes, called haustoria, penetrate the outer, or epidermal, layer of the leaf or twig and by means of these haustoria the fungus absorbs its nourishment. Thus the mildew derives its food materially from that particular portion of the leaf or twig surface upon which it is growing.

The very characteristic powdery appearance of the mildew is due, as stated above, to enormous numbers of summer spores. These are produced in chains from certain branches of the mycelium, and their function is to start new mildew infections during the summer. The chains readily break up into individual spores, which are very light and are easily carried about by the wind. When a spore lodges in a suitable place, such as the under side of the young leaf, it quickly germinates, if the moisture conditions are suitable, and sends out a small, threadlike germ tube, which is the beginning of a new mycelium, and by this means a new infection is established.

It is shown that there are two sources of infection in the spring, when the foliage begins to come out. First, there are formed in the month of July irregular dark smoky-like patches, which contain the winter spores, or ascospores, which remain on the twigs until early spring, where they may germinate and start infection. This source of infection is said to be of much less importance in the Pajaro Valley than what the authors term "dormant bud infection." The latter is due to the fact that the mildew remains dormant under bud scales during the winter season, becoming active in the spring and producing injury almost immediately upon the unfolding of the buds.

After six years of investigational work, during which time from 250 to 300 spraying experiments were conducted, and over 100 spraying materials tested, the conclusion has been reached that sulfur, in some very finely divided form, is the most satisfactory remedy, an iron-sulphid mixture being recommended very strongly, the first application to be made with the calyx spray for codling moth, the second ten days later; the third three weeks after the second, and the fourth three weeks after the third.

It is urged that the trees be kept in a thrifty condition, as when very healthy they are not so subject to mildew attack. Therefore, anything applied to them that will stimulate the growth is desirable. In this connection, the winter spray of crude oil emulsion is recommended. Pruning is found to be very effective in checking the disease, the idea being to remove all mildewed tips during the winter season, and again whenever they appear in the summer time.—G. P. W.

COUNTY COMMISSIONERS' DEPARTMENT.

Fall Treatment for Apple Aphis.

By O. E. Bremner.

A consideration of the life history and habits of an insect is the first and most important step in effecting a method of control. A fall spray campaign against the aphids we are discussing may not be found successful in other localities and under other conditions, but wherever the climatic conditions are similar to those of this coast section we predict the same results attending this treatment.

Three years ago we commenced a careful study in the apple section of Sonoma County, of aphids affecting apple trees in particular, and have also made some observations on forms affecting cherries, hops, prunes and other trees.

The subject is a hard one owing to the very complex life of the insects and at the present time we feel that we have practically mastered one, the purple apple aphis, *Aphis sorbi,* which is without question the most destructive in this county from an economic standpoint. The same treatment will partially control the woolly aphis, *Erisoma lanigera* and give good results on the green apple aphis, *Aplus pomi.*

The purple aphis hatches early in the spring, in fact just with the opening blossom cluster buds. It is a peculiar and noteworthy fact that this hatching period absolutely follows the condition of the individual tree so that on the same variety in the same row one tree may put out leaves and contain young aphids several days ahead of the other trees, or be equally as late. The same thing is more strikingly observed in different varieties. As an instance of this we found aphids hatching and attacking the opening buds of the Gravensteins, Rhode Island Greenings, and Red Astrachans on March 10th, but on Rome Beauties growing side by side with these trees the aphids made their appearance April 1st. It is thus seen at a glance that the spring treatment is a difficult but not altogether satisfactory matter. This is better understood when you consider that if the aphid is not killed within less than a week from hatching the damage to the crop is practically accomplished. The newly hatched aphid attacks the developing leaves and also pushes down into the cluster buds attacking the embryo apple even before it blooms. The toxic effect of this attack causes the leaves to curl tightly so that the insects within are perfectly protected against future doses of spray material, and the apples to be stunted, ripen prematurely, have a rough, pimply surface, and develop no flavor. In fact an attacked apple is fit for nothing except vinegar and very little good for that, as it never drops and is a tedious thing to pick. These stem mothers give rise to several generations of parthenogenetic females and during the warm weather in June winged females appear and migrate to some intermediate host. No aphids can be found on the trees from this time until about the middle of October, when winged viviparous females appear. As to the intermediate host we have been so far unable to locate it, but have found the aphids on careless weed (*Amarantus retroflexus*) at the

time the viviparous females appear. These females give birth to several young which are placed on the under side of the leaves surrounding the blossom cluster buds. These females do not all appear at once but scattered over a period of a month, some appearing late in November. Winged male forms appear soon after the winged females and copulate with the wingless females on the leaves. These females each develop three eggs and apparently reach maturity in from ten to fifteen days, but no eggs are laid until late in November.

It is very rarely the case that you can find these sexual females on the leaves at the growing buds and equally as interesting to note that the leaves around the fruit cluster buds on the fruit twigs where they occur, remain on the trees long after the leaves at the growing buds have dropped.

Egg laying begins with the first hard frosts and these usually occur from the middle to the last of November in this section. In 1912 the first eggs were laid November 28th and in 1913 about November 30th. This egg laying period lasts about a week and on individual trees may be accomplished in almost a day. It is not uncommon to observe a dozen females depositing on one limb of a badly infested tree at the same time. The eggs are at first colorless, then turn light green to purple and finally black, the complete change requiring nearly four days.

Taking these facts into consideration we determined on a fall spray which would destroy these sexual females before they laid their eggs. The time for this application, November 15th to 25th, is also favorable to the grower as it occurs just at the best possible opportunity, the weather being usually good, the soil firm and hard, while at the time of a spring application the weather is often inclement and the orchard too soft to permit the use of a power outfit. During the fall of 1912 we applied from one to four sprays to different trees beginning with the first of November for the trees sprayed four times. The trees sprayed once, the 29th of November, showed practically as complete control as those sprayed more times. In the fall of 1913 we sprayed only once, but used several different materials, some of which proved ineffective and had a tendency to cripple the experiment. The last 50 trees were sprayed on December 2d and some eggs had been laid, but in spite of this a very fine control was obtained. The material used was 4 per cent crude oil emulsion. One other material distillate emulsion 3 per cent with black leaf 40, 6 ounces to 100 gallons, used on about 200 trees also gave good results. An application of 12½ per cent crude oil emulsion late in December gave as good control as our spring treatment. For this fall our plans are to use the 12½ per cent crude oil emulsion as near the 25th of November as convenient and by this means not only catch the sexual females of the purple aphis but also the eggs of green aphis, tussock moth eggs, San Jose scale, moss and anything else that a general winter application would rid the tree of.

The same spray gave most excellent results on prune aphis and brown apricot scale last year, so we will use it again this fall. In the care of prune trees this need not be repeated for three years, and possibly only every other year in the case of apples.

Our formulæ are given below, and as a parting word we would advise the grower to make his own crude oil emulsion by all means as it is cheaper and more effective.

Crude Oil Emulsion, Liquid Soap Formula.

Place 88 gallons of water in the spray tank and add 1 to 2 gallons, depending on the softness of the water used, of liquid soap diluted with about an equal amount of water. Agitate until thoroughly mixed and then with the agitator running add 10 gallons of crude oil.

Whale Oil Soap Formula.

Dissolve 10 pounds of whale oil soap in not less than 10 gallons of water by boiling, slice the soap and it will dissolve more quickly. Place this in the spray tank which should contain about 10 gallons of water. Thoroughly agitate and add enough water to make 90 gallons, then add 2 pounds of caustic soda (concentrated lye), dissolved in water. With the agitator running add 10 gallons of crude oil, slowly.

ENTOMOLOGICAL.

A LITTLE KNOWN ORCHID PEST.

(*Isosoma orchidearum* West.)

Order—Hymenoptera. Family—Eurytomidæ.

By L. A. Whitney.

Some time ago the writer's attention was called to a small hymenopterous insect attacking orchids at a local greenhouse. A number of larvæ and pupæ were secured and on the emergence of the adults specimens were forwarded to Washington, D. C., where they were identified through the kindness of Mr. J. C. Crawford as the orchid Isosoma (*Isosoma orchidearum*).

This insect is popularly known to gardeners and florists as the Cattleya fly, as it confines its attacks solely to the family of orchids and is

Fig. 111.—Distorted orchid bulb, resulting from infestation by *Isosoma orchidearum*. (Original.)

without doubt one of the worst insect pests to which the plant is subject. Very little literature pertaining to this insect is available, the principal notes being in Insect Life.[1]

This insect belongs to the family Eurytomidæ, a group of insects that is normally parasitic. Entomologists refused to credit them with phytophagic habits for years, and the fact was established only after extensive experiments.

Other species of this genus are some of the worst pests of grains and grasses that we have, being commonly known as the grass joint worms. Prof. Webster of the United States Department of Agriculture gives

[1]Insect Life, Vol. I, page 121; Vol. II, pages 250-251.

them almost cosmopolitan distribution. In all probability it is the same with the insect considered in this paper, as it was reported from Europe as early as 1882.[2] A popular description only will be attempted in this article, as the life history and habits are not very well known.

LIFE HISTORY.

The Egg. Where the egg is deposited is a matter of conjecture. From the character of the ovipositor the egg is supposedly inserted in the tissues at the base of the bulb, and the larvæ upon hatching bore their way

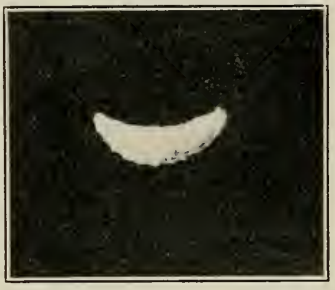


FIG. 112.—The larva of *Isosoma orchidearum*. (Original.)

into the center of the bulb and proceed to devour the entire heart. Each infested bud may contain from one to seven larvæ. As a consequence the young bud assumes a state of increased activity and infestation is soon apparent by the abnormal distorted appearance of the new growth (Fig. 111).

The Larva. The larvæ (Fig. 112) are white crescent-shaped insects and are distinctly segmented; head apparent only upon close examination. Length about 6 mm. and width through the widest segment about 1.25 mm.

FIG. 113.—Pupa of *Isosoma orchidearum*. (Original.)

The Pupa. The pupæ (Fig. 113) encased in the last larval skin are white when first formed and slowly turn to black. All appendages visible through the entire pupal period.

[2]Westwood, Tr. Ent. Soc. Lond. 1882, page 323.

The Adult. The adult female (Fig. 114) is a small black wasp-like insect about 4.50 mm. in length. Head (excepting eyes) and thorax punctate and sparsely covered with very short fine hair. Wings clear and seem a trifle small in proportion to the body. Abdomen large, shining black, last segment and ovipositor sheath covered with short light colored hair. Adults observed, when disturbed did not seem to be capable of flying very far, but confined their efforts more to springing. As far as observed the entire metamorphosis occurs inside the bud and the adult gnaws its way to freedom.

FIG. 114.—Adult of *Isosoma orchidearum*. (Original.)

Control. The eradication of this insect is a perplexing problem as the orchid enjoys a warm damp atmosphere and forcing is resorted to, which keeps the plant in a growing condition nearly the entire year. This factor favors the development of the insect and consequently the generations are continually overlapping. Control measures such as injecting nicotocide into the infested bud, also piercing the larvæ with a triangular dissecting needle have been tried from time to time but with apparently no great success. The most practical control measures are constant watchfulness, fumigation with a vaporizing insecticide for the adults, and the cutting and burning of infested buds. This seems like heroic treatment but if not taken in time this insect will quickly destroy a prize collection of plants.

Summary. In view of the wide distribution and destructiveness of this insect, persons contemplating the importation of orchids should insist on the most thorough of certifications and inspections.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

The European Fruit Scale.

The brown apricot scale, or European fruit scale, as it is often termed, is common throughout the deciduous fruit growing sections of California. Its favorite hosts are the prune, plum, apricot, almond and pear. With the advent of spring the scales, which winter over mostly in the immature stages, develop into the adult form, and deposit large number of eggs. The young emerge, settle on the leaves and begin to suck out the sap. They excrete a sticky substance known as honeydew. This honeydew on old infested trees covers the foliage, fruit and twigs, and furnishes a medium for the black smut fungus in which to work, as well as being a collector of dust. As a result the leaf functions are impaired, and likewise the entire tree suffers. Honeydew-covered fruit is unfit for use.

S. W. Foster, formerly of the United States Bureau of Entomology, states that it will be more effective to spray in the late winter, or the early spring, after the winter rains have washed the summer's accumulation of dust from the trees. He also states that the action of the atmospheric conditions during the winter has a tendency to make the insects more susceptible to the spray than is the case in the fall, and advises spraying on clear days, when the trees are dry, and when the temperature is above freezing.

The formulæ* for crude oil emulsion and distillate oil emulsion are as follows:

Crude Oil Emulsion.

Water	175 gallons
Liquid soap	3 gallons
Crude oil	25 gallons

Fill the spray tank with the water, add the liquid soap, agitate thoroughly after which add the crude oil.

If the liquid soap can not be obtained, use whale oil soap, 20 pounds dissolved in 10 gallons of hot water, to which 3 pounds of caustic soda is added.

Distillate Emulsion.

Distillate, 28° Baumé	20 gallons
Whale oil soap	30 pounds
Water	12 gallons

Dissolve the whale oil soap in hot water, add the distillate, agitate thoroughly while the solution is warm. For use add 20 gallons of water to each gallon of the above mixture.

To destroy mites or lichens on fruit trees add 2 pounds of lye to the formula of the stock solution.

The prepared crude oil and distillate emulsions can be obtained from several insecticide dealers throughout the state.

*Injurious and Beneficial Insects of California, by E. O. Essig.

The Italian Pear Scale.

The Italian pear scale attacks the pear, plum, apple, peach and currant. It occurs in Alameda County, Napa County and in the Santa Clara Valley. The female scale is dark gray in appearance, circular or oval in form, and less than $\frac{1}{8}$ inch in diameter. The male scale has a whitish covering. It closely resembles the San Jose scale, and is often mistaken for it. It works, to a large extent, under the moss on the trunks and larger limbs and consequently is not usually noticed.

Spray with crude oil emulsion as given above, or with commercial lime sulphur solution, during the dormant period.

The Fruit Tree Leaf Roller.

The fruit tree leaf roller occurs in Santa Clara, San Diego and San Bernardino counties. The larvæ of this insect injure the blossoms and destroy the fruit and foliage of many species of plants. Among the deciduous fruits the apple, pear, plum, cherry, apricot, quince and peach are subject to its attack. The leaf roller is one of the moths and passes the winter in the egg stage. The egg masses are laid almost anywhere: on the bark of shade trees, fruit trees, shrubbery and berry bushes. The egg masses are made up of from ten to one hundred and fifty eggs, covered with a sticky substance which is deposited with the eggs.

Spray with soluble oils, as recommended by Geo. P. Weldon in The Monthly Bulletin, Volume II, No. 9, on page 645. These soluble oils are used in the proportions of 1 gallon to 19 gallons of water, and are used as winter sprays.

Apple Tree Tent Caterpillars.

The two apple tree tent caterpillars—commonly known as the Eastern apple tree tent caterpillar and the Western apple tree tent caterpillar—occur in California. The former has a limited distribution, while the latter is confined principally to the central and northern portions. These caterpillars destroy the foliage and the young fruit of the apple. They are hairy caterpillars, about $1\frac{3}{4}$ inches long when full grown, blackish in color, with yellow and white stripes along the back. The larvæ of the former species spin a web or tent, in which they congregate when not feeding, all congregating in masses on the trunks and limbs of trees. Both species pass the winter in the egg stage, the egg masses being attached in cylindrical formation to the slender limbs of the trees. These egg masses may be destroyed during the winter time.

MISCELLANEOUS INSECTS.

Insects in Stored Products.

There are numerous species of insects which destroy large quantities of stored products. Among these insects may be mentioned the grain weevils, pea weevils, the flour moths, etc. Although it is almost impossible to destroy all of these insects in all stages, at the same time, carbon bisulfid is generally used, the gas of which, being heavy, will go downwards and will penetrate the material to be fumigated. A tight room is essential. The carbon bisulfid—which comes in the form of a

liquid—is poured into shallow dishes and placed in the bins, using 5 pounds to 1000 cubic feet of space. This fumigant is highly inflammable and caution must be taken that it is not placed near flames. The temperature should be 70° Fahrenheit or above, to insure the best results. Leave the products in the room about twenty-four hours.

PLANT DISEASES.

The Loose Smut of Oats.

The loose smut of oats is found wherever oats are cultivated, and annually causes a great deal of damage. Like most of the loose smuts of grain, the smut fungus matures at about the time the grain is in flower, and is widely distributed during the ripening season, so that the grain, when harvested, is well covered with the spores. Before the seed is planted, if the grain is sprinkled thoroughly with formalin, 1 pint to 30 gallons of water, then allowed to dry, the damage done will be slight.

The Loose Smut of Wheat.

Another smut, which attacks wheat, is similar to that of oats. Sometimes infection may occur at the time of blossoming. Unlike that of loose smut of oats, means of prevention will consist of treatment of the seed, together with seed selection. Select seed from a field free from smut, and treat the seed by soaking five hours in cold water, and then in water at 129.2° Fahrenheit.

INSECT NOTES.

The large narcissus bulb fly, *Merodon equestris* Fab., has been intercepted in local export shipments of narcissus bulbs at San Francisco. The bulbs in question were grown at San Leandro and Santa Cruz, California.

As this is the bulb planting season, great care should be exercised not to plant infested bulbs, as certainly no flowers could be expected from them, and the chances of spreading an injurious insect are greatly augmented.

The larvæ of this insect are dirty, white grubs, measuring about one half to three fourths of an inch in length. If traces of infestation are not apparent from outside indications, press the bulb with the fingers. If it yields to this pressure examine carefully with a knife, and if the insect is present the burrow or the insect itself will be easily revealed. For further reference the reader's attention is called to Vol. III, No. 2, page 73, Monthly Bulletin.—L. A. WHITNEY.

Morganella maskelli, Ckll. Adult female scale, pitch black, about 1 mm. in diameter, convex, and circular to broad oval, exuviæ concolorous, very inconspicuous, placed toward the side. Microscopic character of abdominal margin as follows: A single pair of lobes, inner edges straight parallel and close to each other; outer edges with one large notch. Four pair of spines on each side of the lobes; first pair short, balance long. Thirteen plates strongly serrated on each side of the lobes. No groups of circumgenital glands. Fernald records this scale from Hawaiian Islands, Mauritius and Brazil on Michelia flava and camellia. Mr. Compere collected it at Coolgardie, West Australia, in 1902, on *Melaleuca* sp. along with *Aspidiotus camelliæ*, and in 1903 Mr. Compere collected *Morganella maskelli* on fig trees at Nagasaki, Japan. The material collected on fig trees in Japan was covered with scale to such an extent that the bark was completely hidden. This scale was apparently killing the fig trees in Japan. Oranges as well as a number of native shrubs from Tahiti are infested with this scale. It thrives upon the fruits, trunks and branches of the trees, and is taken in quarantine at San Francisco on the arrival of almost every steamer from Tahiti. There is no doubt but that this scale would become a bad citrus pest if it ever became established in California.—B. B. WHITNEY.

The red house ant. *Monomorium pharaonis,* a minute species, is very bad in Sacramento and Marysville and is a very serious pest in hotels.—E. J. BRANIGAN.

The walnut mealy bug. *Pseudococcus bakeri,* is doing a great deal of damage to grapes in a few of the vineyards in Fresno County.—E. J. BRANIGAN.

The grape leaf-hopper. *Typhlocyba comes* Say, can be seen in great numbers throughout the vineyard section of Fresno County.—E. J. BRANIGAN.

The common black-spotted red ladybirds. *Hippodamia convergens,* are reported to be congregating in their hibernating quarters in the high Sierras.—E. J. BRANIGAN.

The State Insectary has released a colony of *Leptomastix* sp., a new internal parasite of *Pseudococcus citri* Bern., into the infested orchards of southern California.—E. J. VOSLER.

Coccophagus orientalis How., an internal parasite of *Saissetia oleæ* Bern., has been recovered from a colony released in the late spring at Niles, California.—E. J. VOSLER.

A colony of several thousand adults of *Scymnus bipunctatus,* a predator on *Pseudococcus citri,* and introduced from the Philippine Islands, has been sent to southern California.—E. J. VOSLER.

Diabrotica soror Lec., is an annoying pest of chrysanthemums in Sacramento County at the present time.—E. J. VOSLER.

The nymphs of the false chinch bug, *Nysius angustatus* Uhl., were common in Sacramento County during October.—E. J. VOSLER.

Saissetia oleæ Bern. is heavily infesting Rose of Sharon trees in the Capitol Park at Sacramento.—E. J. VOSLER.

Lygus pratensis Linn., has been found to be abundant in the opening chrysanthemum buds at Sacramento.—E. J. VOSLER.

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THE MONTHLY BULLETIN

Pear tree treated for pear blight. (After Gammon, Monthly Bul., Cal. Hort. Com.)

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SACRAMENTO, CALIFORNIA DECEMBER, 1914

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THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. III. December, 1914. No. 12.

THE PRESENT STATUS OF THE DIFFERENT VARIETIES OF WALNUTS.

By W. W. FITZGERALD,* Stockton, California.

This subject is about as difficult as the present status of the different makes of automobiles. Whatever make of machine a man drives, he is apt to think that is the best; so with the man who grows a particular variety of walnut, he is apt to think that variety is the best.

In speaking of the present status of the different varieties of walnuts we have to consider several things, as soil, climate and moisture conditions. It is true that we can regulate moisture conditions, but soil and climate we can not change; so in considering the different varieties we must keep in mind where they are to be grown and the character of the soil on which they are to be grown, as some of our best varieties that do well on heavy soil and plenty of moisture will not prove as good varieties on lighter soil and poor moisture conditions. Likewise, some varieties that produce good white meated nuts in a cooler climate will produce inferior nuts in a very hot climate.

The first thing to be considered in judging the different varieties of walnuts is their producing qualities. I do not mean by this a large producer of an inferior nut, but a heavy bearer of a good quality nut. A tree that produces only a few very fancy nuts is not to be considered commercially. A fancy variety may bring a few cents per pound more, and may make up what it would lack in the number of pounds it would produce providing it was not too shy a bearer. A fancy variety producing only from 50 to 100 pounds on full bearing trees at 25 cents per pound would not compare favorably with a variety which produces 200 to 300 pounds at 12 to 15 cents per pound. The relation between the quality of nuts and the quantity of nuts produced should be carefully considered in choosing a variety for planting.

One should not judge a variety by the fine appearance of a picked sample of nuts without considering the quantity in which they are produced. The best variety is one that will produce annually a large crop of the most desirable type of nuts. Unfortunately we do not have all the good qualities in any one variety or we would not be discussing this subject today. We have to choose a heavy producer with a good quality of nut. One important point is that young trees often produce larger nuts than they do after the tree becomes older, so one should judge nuts from a tree that has been bearing for a few years.

We should also consider the age in which the tree comes into bearing, as great differences exist in different varieties as to what age they begin

*Address before the State Fruit Growers' Convention, Davis, California, June 1 to 6, 1914.

bearing. Some varieties begin to produce nuts even in the nursery and give a commercial crop within three years from planting in the orchard, while other varieties are several years later in coming into bearing.

The next important consideration is that of the size and weight of the nuts. The commercial No. 1 grade walnuts are of a size that will not pass through a one inch square opening, while those above one and three sixteenths inches which are generally considered as budded nuts bring considerably more per pound and the demand is growing for this quality of nut. I have already had a number of inquiries for fancy varieties for next fall's delivery. This shows that the demand is growing for the better quality of nuts.

The weight of the nut is equally important since this varies widely in nuts of the same size. Some of the largest varieties are considerably lighter in weight than others in which the nuts are smaller. A desirable nut should be well filled with plump meat without too much air space between the shell and the meat. A comparatively heavy shell is more desirable than a very thin light one, since the nut is better protected from being mashed in handling and less susceptible to the perforation disease, which is one of the most serious troubles of the walnut grower in recent years. It consists of a non-development of the outer hard layer of the shell. The hard shell is not actually perforated, but rather fails to develop. This disease has become more prevalent in the last few years and affects principally those with thin light shells. Nuts that are prone to crack easily, and have a fine light shell, are more or less injured in handling, thus contaminating the nut.

It is also to be considered that since walnuts are sold by the pound, the heavier the shell the greater the weight and the more the returns for a given number of nuts. The leading walnut on the world's market is known as the Grenoble. Strictly speaking, the Grenoble nut means a Mayette variety. It is not a long nut, and is somewhat broader at the base than at the apex. This is not very important, however, since the smoothness, symmetry and uniformity of the nuts affect their appearance more than their shape. An ideal nut should be quite smooth, free from outside ridges and other irregularities of surface, and all nuts should be of the same general shape and appearance, giving them uniformity and individuality. A variety in which the nuts are decidely uniform so that the variety is easily distinguished and recognized even to the consumer has a marked advantage over one in which the nuts are of all sorts of shapes so that only an expert could distinguish the variety from others.

The color of the nut is not so important, as the trade demands bleached nuts even though they may have an attractive appearance without bleaching. By being bleached they are all brought to about the same color. The quality of the meat is of considerable importance, however, as nuts with the lightest colored meats are more desirable, while those that are dark, even though plump and of good color, are discriminated against. There is no doubt but that the dark meated varieties will become more objectionable as more of the lighter colored ones are produced. The flavor of the meat varies considerably in the different varieties and is of much importance in a high class fancy trade. Although commercially there is not much importance placed on their flavor except when they are bitter. Bitterness is the most

undesirable quality and should be guarded against in choosing the variety and to formulate an idea of what will constitute an ideal walnut.

The most important qualification in a variety from a strictly commercial standpoint is that it should be a uniformly large producer of nuts. The majority of the nuts should not pass through a one and three sixteenths inch square mesh, should be well sealed, even though hard shelled, and should be uniformly well filled with meat of light yellowish brown color or not darker than light brown or amber. For a fancy trade the nut should be of an attractive uniform shape and color with a fairly smooth surface and particularly high quality with agreeably flavored meat and no bitterness.

The next important consideration is the choosing of a variety that is resistant to blight, this being a bacterial disease which affects the young growth when it first puts out and requires for its development moist weather conditions. It is not very prevalent in Northern and Central California on account of the drier atmosphere, but under the same conditions some varieties are more blight-resisting than others, probably due to their vigor. As a rule the late blooming varieties are free from blight as they come into bloom at the time when the blight can make little headway, while the earlier varieties blossom at a favorable period for its development. Certain varieties are spoken of as being immune to the blight, but while there is no such thing among walnuts as absolute immunity when conditions are favorable for the development of blight, yet some trees do show quite a marked resistance and should be given precedence on this account.

While there are many seedlings of promise scattered throughout the state, both of the Santa Barbara soft shell type and the French varieties, I will only consider the prominent varieties that have been thoroughly tested.

Santa Barbara Soft Shell.

The Santa Barbara Soft Shell was originated by Mr. Joseph Sexton of Santa Barbara. It is a seedling grown from a sack of nuts which probably came from Chile. This is the prevailing type of seedling walnuts of Southern California. The nuts vary in size and are irregularly shaped. The trees come out early in the spring, and have a growth of six to eight inches by March 20th. They vary in their bearing qualities, are very susceptible to blight and are not very desirable for this reason and because of irregular bearing.

Santa Rosa.

The Santa Rosa is a chance seedling introduced by Luther Burbank at Santa Rosa. The tree is a very thrifty grower and very precocious, but the nuts are small on old trees and susceptible to blight, consequently not very desirable.

Placentia.

The Placentia, which originated in Placentia, near Fullerton, was extensively propagated by Mr. J. B. Neff of Anaheim, California. It was a seedling of the Santa Barbara soft shell type. The nut is of

medium size, averaging one and one eighth by one and one fourth by one and one half inches, runs largely to average size, has very few large or small nuts, form is regular and somewhat elongated, the surface is quite smooth and the ridges not very prominent; the nuts are uniform in size but vary considerably in shape and smoothness, some quite elongated, others nearly round, but the shell is thin and strong. The nuts are poorly sealed. The septum is almost free from the shell, so that the nut can be very easily opened with the fingers and the whole meat taken out intact. Kernel full size, quite smooth with comparatively few convolutions, averages 50 per cent or more of the total weight of the nut. Flavor mild and pleasant with no pronounced character. The tree makes a vigorous growth and the foliage is very abundant and thrifty. The foliation period is quite early, about the same as all Santa Barbara seedlings, having a growth of about six inches by the eighth of April. It comes into bearing early and is a heavy bearer and the harvest season is early. It is very susceptible to blight and the nuts are sometimes very badly perforated.

Ware's Prolific.

Ware's Prolific also originated from a Santa Barbara soft shell seedling at Garden Grove, California. This is rather a large nut even on old trees. It is oval, quite elongated and elliptical, base and apex equal breadth, pointed at both ends. It is quite smooth and has conspicuous longitudinal grooves which give it a characteristic appearance. The nuts are very uniform, but poorly sealed; meat is decidedly plump and well filled, averaging about 50 per cent, but is quite dark, ranging from amber to dark brown, and in many cases nearly black. Flavor is mild and pleasant. The tree comes out early in the spring, makes a fairly vigorous growth, forming much fruit wood, which makes the tree low and spreading. It is well filled with fruit spurs and the foliage is abundant and thrifty. The harvest season is early. It is one of the most precocious varieties we have, coming into bearing when very young. It is subject to blight the same as the other soft shell seedlings and very prone to perforation. This nut is worthy of consideration on account of its heavy and early bearing, as a tree for interplanting for a few years.

Chase.

The Chase variety originated in a tree near Whittier and has been widely propagated by Mr. Rideout of Whittier, California. This original Chase nut is medium to large in size on young trees, but small on older trees. In form it is broadly oval or rounded; apex and base of equal breadth, apex terminating in a short and pronounced point. Surface is quite smooth. Nut not so very uniform in size. They are badly sealed, the meat is plump and well filled, averaging nearly 50 per cent of total weight. Flavor is mild. This tree comes out earlier than the average Santa Barbara seedling. The growth is very vigorous and thrifty and the foliage abundant. The nuts are harvested early and it is a very heavy bearer, but is somewhat subject to blight. It is a good type of the Santa Barbara soft shell, except that the nuts are small.

El Monte.

The El Monte is a Santa Barbara soft shell seedling which originated near El Monte, California. It is a somewhat irregularly shaped nut with pronounced ridges. The nuts are well sealed and filled with light colored meat. It comes into bearing early and bears quite heavily. The tree is a thrifty grower, comes out early in the spring about the same time as the other Santa Barbara seedlings and harvests early. Its blight resistance is about the same as the other Santa Barbara seedlings. It is desirable on account of bearing early and heavily, but the nut is quite homely.

Neff's Prolific.

The original tree of Neff's Prolific is a Santa Barbara soft shell seedling in Mr. J. B. Neff's orchard at Anaheim, California. Mr. Neff selected this tree on account of its heavy bearing, and its not being so subject to blight and perforation as the ordinary seedlings. The nut is of good size, well sealed, exceptionally heavy and well filled with light colored meat of good flavor. This variety has not been propagated very extensively, and is a good variety on account of its heavy bearing, although the nuts are rather rough and irregularly shaped.

Franquette.

The French variety of Franquette has several types. The one most commonly known as the Vrooman, from the Vrooman grove at Santa Rosa, was first propagated by John Rock at Niles. The Leibs of San Jose are also large growers of the Franquette. The Oregon Nursery Company controlled the scions and nuts from the Vrooman grove for a number of years. This variety being well advertised and highly recommended has been extensively planted on the Pacific Coast of recent years, not only as grafted trees but also as seedlings. There not being enough grafted trees to supply the demand, many resorted to planting seedlings; the eagerness of planters to set out walnuts causing Franquette seedlings to be planted. Of course, the result of this, as with all other seedlings, is going to be variable and disappointing.

The Vrooman Franquette nut is medium to large and retains its size on old trees; decidedly elongated, but pointed; base much broader than the apex; surface medium smooth with sutural ridges. The color is a light yellowish brown. Their uniformity is strong and their characteristic shape makes them easy to identify. The nuts are well sealed but thin shelled and are readily cracked. The meat is moderately plump and the shell well filled except at the point of the nut. Flavor is sweet with a characteristic nutty flavor. The consistency of the meat is also soft or oily. The buds begin to swell about April 15th. The harvest season is late, often being caught by the fall rains. It is a fair, vigorous grower. The precocity is not pronounced. It is one of the slowest of the varieties to come into bearing. It has a thick husk and abundant foliage which protect the nuts from sunburn. It is one of the best proven varieties for Central and Northern California and has been considerably tested. The quality of the nut is the best. With its uniform shape, pretty color, white meat and firm sealing, the Franquette is of the very highest quality, and were it a heavy bearer it would be an ideal nut. I have several good types of imported Franquettes, however, which are much more precocious than the Vrooman strain.

Mayette.

The Mayette, like the Franquette, is a French nut. Like the Franquette, there are several types of Mayette, due probably to being originally propagated in France by seedlings. They differ widely in character, but have a general resemblance. The Mayette, like the Franquette,

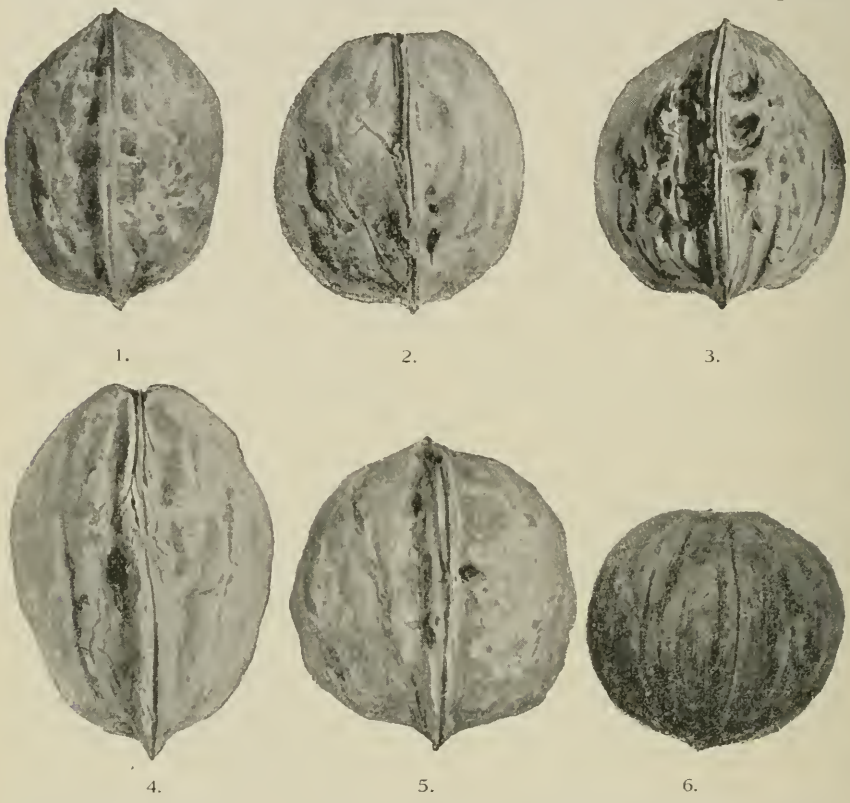

Fig. 115.—Some common varieties of walnuts. 1, California papershell; 2, English (so-called); 3, Mayette; 4, Franquette; 5, Improved Softshell; 6, California Black (*Juglans californica*). (After Lelong.)

is characterized by the shape of the nut. In the true Mayette type the base of the nut is decidedly flat and square, cut so that it can be set on the basal end without falling over. The nut rounds broadly to a point at the other end, giving it sort of a flatiron shape. In a good Mayette the meat is plump, white and well developed and of good flavor. It averages about 50 per cent of the total weight. The shell is thin and strong and well sealed. The Mayette comes out late in the spring, about a week or ten days before the Franquette, but ripens at least three or four weeks earlier in the fall than the Franquette. The different types vary considerably in their rapidity of growth and the amount of foliage, also in their bearing qualities, most of them being very light producers. Mr. S. F. Leib of San Jose has some imported trees. There are several types that were imported by the late Mr. Gillet. Tribble Brothers of Elk Grove also propagate two or three types which were imported from France. Mr. Leonard Coates of Morgan Hill has propagated quite ex-

tensively the San Jose Mayette, which is one of the most attractive and handsome walnuts grown in California. It is of large size, above the average of most varieties; has a typical Mayette form with smooth surface and uniformity. The nuts are not any too well sealed, have thin shells and the meat is small in proportion to the shell. This type is of slow growth and scant foliage and not a heavy producer. I have a Mayette imported from France which is most promising, as the nut is a good type, precocious and a heavy bearer. If it continues its present standard it will be a leader.

Bijou.

The Bijou is also a French variety having the characteristics of those varieties, that is, coming out late in the spring. As a rule they are very rough and poorly filled with meat and are not considered commercial nuts. There are, however, Bijou seedlings which have smoother and better nuts, such as the Acme, which is fairly smooth, rather elongated at the apex than at the base and almost square in end view. The shell is heavy and is fairly well filled with meat averaging about 40 per cent of the total weight. It is not of any special value for commercial purposes.

The Klondyke is another walnut of the Bijou type. The Willson Wonder, propagated by F. C. Willson of Sunnyvale, is perhaps the best Bijou type we have. The nuts are very large, but smoother and better filled than those of the Bijou. It is extremely precocious, coming into bearing very early. The nut is smooth and symmetrical, being broader at the apex than at the base and nearly square in end view. The flavor is mild and sweet and the meat white. These nuts are very large. They sometimes measure two by three inches. The tree is a slow grower and of scant foliage, probably due to its heavy bearing qualities. It is like the other late varieties, quite blight-resistant in dry climates.

Payne.

The Payne is an accidental seedling discovered by George C. Payne of Campbell, California. It is of the Franquette type and is an excellent nut. It comes out rather early in the spring. It is a very heavy bearer but blights badly.

Parisienne.

The Parisienne is a French variety introduced by the late Felix Gillet. The nut is rather long and pointed, somewhat resembling the Franquette but broader in the center. The shell is light, the meat is fairly well filled, light color and a good flavor. Like the other French varieties, it is late in coming out in the spring. This is a very good nut, its greatest drawback being that it is a light producer.

Concord.

The Concord variety originated in a seedling tree on Mr. George M. Westcott's place at Concord, Contra Costa County, the original tree coming from Felix Gillet. It has been propagated by Leonard Coates of Morgan Hill. The nuts are not large, are broad and short with a square cut base, slightly wider than the apex and fairly smooth; are fairly uniform and are well sealed. The meat is plump, white and well

formed, filling the shell completely. The tree comes out medium late, midway between the Placentia and the Franquette. The growth is thrifty, although the tree ultimately does not become very large. The nuts are harvested early in the fall. It is a good bearer and comes into bearing early. Like all late varieties, it is fairly immune to blight. This variety seems well adapted to hot sunny regions and light dry soil. It is a very good variety although the nuts are small.

Eureka.

The Eureka variety originated in a seedling tree at Fullerton, California, from nuts obtained near the Meek place, Hayward, California. The desirable quality of this variety was first appreciated by Fischer and Ware of Garden Grove. The nut is of large size, decidely elongated, with parallel sides, apex and base of equal breadth or a little thicker at the apex, rather rectangular or square in end view. It has quite a smooth surface and the sutural ridges are not prominent. They are very uniform in size and easily distinguished from any other variety. The shell is rather hard, medium thick, heavy and very well sealed. The meat is white, plump and easily extracted after cracking, averaging 45 to 50 per cent of total weight. While the shell is extra heavy, the flavor is very good. The growth is extremely vigorous and rapid, making a large tree with heavy and abundant foliage, and has a characteristic of growing its nuts in and under the leaves, thus protecting them from the sun. In first looking at a tree it would seem a poor bearer, but when you get under the tree and look up through the foliage you will find it heavily loaded. This tree comes out in the spring, about the same time as the Mayette, the buds beginning to swell about April 10th. It harvests its nuts early in the fall before the Mayette and considerably earlier than the Franquette. It is an early and heavy bearer, surpassing all other varieties in this respect. From my observations it is the most blight resistant of any of the walnuts, not only because it comes out late in the spring, but also I presume on account of its extreme vigor. It actually resists the blight. The Eureka has scarcely a touch of blight. I do not believe there is any variety of walnut that is not touched lightly by it under the blight conditions. While the late blooming varieties are resistant in dry localities, in most districts and under poor soil conditions they are cometimes touched.

The Eureka is naturally free from perforation, probably on account of its strong shell. It is also free from sunburn on account of its abundant foliage and thick husk, as well as bearing the nuts under and among its foliage. It comes nearer to filling the requirements of an ideal walnut than any of the other varieties. It should, however, be grown on heavy soil with good moisture conditions. As the tree is such a vigorous grower and heavy bearer, without sufficient moisture and nutrition it would be impossible for it to be sustained and produce large crops of No. 1 nuts.

The leading varieties for Southern California are the Placentia, Neff's Prolific, El Monte, and Ware's Prolific. For Central and Northern California the Eureka is undoubtedly, all things considered, the best variety on heavy soil with good moisture conditions. Then come Mayette, Franquette, and Concord, these being better on the lighter soils than the Eureka.

REVIEW OF PRACTICAL EXPERIMENTS IN FERTILIZATION

By R. S. VAILE,* Riverside, California.

The remarks which I have to make on this subject are entirely non-technical and are the result of personal observations and discussions with various growers regarding certain definite tests which they have made in their own groves, of various fertilizer mediums. I do not pretend to go into the scientific cause of the results which I am to describe to you, but merely state the facts as they have been presented to me. It has occurred to the Citrus Experiment Station that in an industry as well established as is the citrus industry in Southern California, there must be a vast amount of valuable knowledge that has been gathered by the men who are making their living from this industry. With this point in mind it is the purpose of the Citrus Experiment Station to gather together, in so far as possible, the results of growers' experiments and experiences along various lines and publish the completed results of our findings. This present report is based on a partial survey of this nature.

In this survey there are at present three points which stand out with decided clearness. First, there is a great lack of carefully planned and systematically carried out experiments along the line of fertilization. A few days ago a letter came to my desk from a man who desired information regarding the correct fertilizer to be applied for maximum results. I found on looking into the matter that this man had been in charge of citrus orchards for nearly twenty years. He had been recognized for a number of years as a very successful grower and had given advice regarding this very matter to the writer personally some ten years ago. When questioned, he admitted that he had used all types of fertilizer, but was not at all sure which had given results and which had not. During this convention several men have come to me and have said practically the same thing; that they have used all kinds of fertilizers at various times but have not as yet determined which ones have returned, in increased crop, the money invested in them. Second, the experiments which we have been able to check up all show quite clearly the absolute necessity of the addition of nitrogen for optimum results. Third, there is very little actual evidence, if any, of the value of addition of potash or phosphoric acid, at least in the first several years of the growth of an orchard.

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*Address before the State Fruit Growers' Convention, Los Angeles, California, November 10-14, 1914.

Owing to the almost universal eagerness for information as to soil treatment we feel more than warranted in publishing this review of actual field work in the use of fertilizers, though it will be also published in the transactions of the convention.—A. J. COOK.

Effect of the Use of Potash, Nitrogen and Phosphoric Acid.

The first of the experiments to which I will call your attention has been conducted for the past six years by one of our largest lemon companies. There are eight plats in this experiment containing approximately six acres each. The purpose of the test was to estimate, if possible, the tendency resulting from the addition of an excess of each one of the three so-called "essentials," potash, nitrogen, and phosphoric acid, and also to test the value of the so-called "simples" versus mixed commercial fertilizers. All of these plats have had a certain amount of nitrogen added and part of the time all of them have had manure added. The first plat has had only manure at the average annual rate of nearly twenty-five tons per acre. I would call the attention especially of those who are afraid of barnyard manure to this plat. With the exception of one year when there was considerable frost damage, the plat has produced as much fruit of as good a grade as any of the other plats. Three of the eight plats have had no potash added, while other plats have had from one half pound to three pounds per tree per year. There is no evidence either in the quality or quantity of the fruit to show that this potash has been of advantage. The addition of phosphoric acid has varied from one pound to four pounds per tree per year without appreciable difference in the crop. Two of the plats located side by side have been treated exactly the same except that one derived its phosphoric acid from superphosphate and the other from bone meal. This experiment so far shows no resulting difference in the two sources.

Other Experiments With Different Amounts of Fertilizers.

A second experiment in an entirely different district, on a radically different soil, and in this case with oranges, brings out somewhat the same points. In this experiment there were ten plats, one fertilized with blood alone, one with nitrate of soda alone, four with complete fertilizers of different formulas, one with nitrogen derived from vetch, one with nitrogen derived from a summer crop of cow peas, one with superphosphate alone and one with superphosphate and potassium sulphate. There were no plats to which nothing was added. Taking the two plats to which no nitrogen was added as a basis, and comparing the figures of the four years' yield, it appears that the average production on the two plats to which nitrogen had been added by means of cover crops was increased by eight per cent, while the average of the six plats to which commercial nitrogen in some form had been added showed an increase of sixteen per cent. Records were not kept of the grade of fruit on the various plats, but no differences were observed in any case.

The Value of Potash.

A third experiment conducted in a grove near Pomona on a soil quite different from either of these considered above, was designed simply to show the value of potash. This orchard is at present about twenty

years of age. For a number of years it received no fertilizer except barnyard manure. For the past five years the whole grove has received nitrogen from blood or tankage, and phosphoric acid from bone meal. Seven rows, containing one hundred and twenty trees, in the center of the orchard have received in addition to this from two to four pounds of potassium sulphate per tree. There has been no appreciable difference between the part fertilized with potash and that not so treated. The past season's crop, which was the fifth since the experiment was started, was picked and graded separately and no difference that could in any way be laid to the fertilizer was evident.

There are other experiments which I might cite, emphasizing these same points. On the other hand there are doubtless those who feel very confident that their experience demonstrates other points. I have as yet been unable to find evidence which satisfies me that other points have been established. As Dr. Lipman said in his paper this morning, there seems to be very little scientific evidence regarding the exact value of either potash or phosphoric acid in the forming or maturing of citrus fruit. As Dr. Webber has explained to you, the experiments at Riverside have so far shown that nitrogen is by far the most important factor, and, as Mr. Leffingwell has just said, many of the orchardists are coming to wonder if much of their money spent for potash and phosphoric acid is not wasted. I can only urge that you as individual growers test out these various questions, keeping accurate records where possible. It does seem, however, that a word of warning is also necessary. We must not draw conclusions from one year's results. A man told me this morning that he knew potash had given him results because the year he used it he matured the largest crop which his orchard had ever borne, but on inquiring I found that he had applied this fertilizer fairly late in the spring, so that probably very little of it had actually affected the particular crop in question.

WINTER WORK ON THE LAWN AND FLOWER GARDEN OF THE FARM.

By W. Vortriede, Sacramento, California.

By the end of November the lawn starts to take a rest and stays mostly dormant until the end of February, in Central and Northern California. This is the time to do the winter work. Dandelions and chicken or sheepsorrel should be destroyed by cutting the taproot two inches or more underground, and then pulling the plant out. An old chisel or table knife is a good tool for such work. If the lawn is full of chickweed and red Oxalis, a lawn weeder is the best tool to use for destroying

these weeds; but if the lawn is small, a thorough raking with a narrow steel garden rake will destroy them, and a heavy raking will do the lawn good.

Bone meal, from 1,000 to 1,500 pounds to the acre, is a splendid fertilizer for lawn grasses, but should be applied early in winter. Special lawn fertilizers should be used in the beginning of the growing season. If the lawn is treated every third or fourth year with a dressing of old, well rotted manure, it will do very much better. If the manure is full of weed seeds, rake heavily as soon as the weeds show. Most of the weeds will be killed in this way and the rest will be killed by mowing.

The pruning of ornamental trees and shrubs should be mostly done in the winter months. All dead and diseased branches should be cut away and all wounds covered with lead paint, coal tar or tree wax. Deciduous trees and shrubs, which bloom early in the spring, before or with the leafing out, should be pruned after their flowering time is over, in the spring. To this class belong the Lilacs, Weigelas, Mock Oranges, Bridal Wreaths, Snowballs, Dogwoods, Japanese Quinces, Magnolias, Flowering Almonds, Peaches, Plums, and Cherries. Roses should be pruned now, all diseased and dead wood cut out, and also weak branches. The Tea Roses, Hybrid Teas, Noisette, and Polyanthos roses should be pruned so as to give fine, large flowers; the weaker the plants the heavier the cutting back. The Hybrid Perpetual or Monthly Roses should not be cut back too much at this time.

Flower beds should be well manured and spaded. Beds of bulbs or for bulbs should have only well rotted manure. Roses, shrubs and other flowers stand fresh manure, well spaded under, very well.

Gladioli and Dahlias should be taken up and put away in a dry, cool cellar over winter. Annual and perennial plants do better if beds for them are changed every two or three years.

Plants raised from seed sown in September—as Pansies, Daisies, Candytuft, Pot Marigolds, Sweet Alyssums, Snap Dragons—can be planted in beds in any month in winter in our mild climate, and if no plants are on hand the seed can be sown. Hardwood cuttings of roses and shrubs can be easily rooted in the first three winter months. Hardy annuals and perennials are better sown in seed boxes from the beginning of December to the middle of January; after that they can be sown in the open ground. Sweet Peas can be sown from September to February. If Violets are to be transplanted the best time is right after flowering is over. Tender annuals can be sown in boxes any time after January, but should not be planted in the garden before April or May. Lawn grass is best sown in September and October, or February and March, but can be sown any time during the winter months, especially if protected by a light mulch of well rotted manure.

THE NATURAL MODES OF DISTRIBUTION OF PEAR BLIGHT IN CALIFORNIA.

By B. J. Jones,* Maxwell, California.

When the campaign against pear blight was carried on by the experiment station, under a state appropriation made for that purpose, the wide distribution and virulence of the disease necessitated immediate

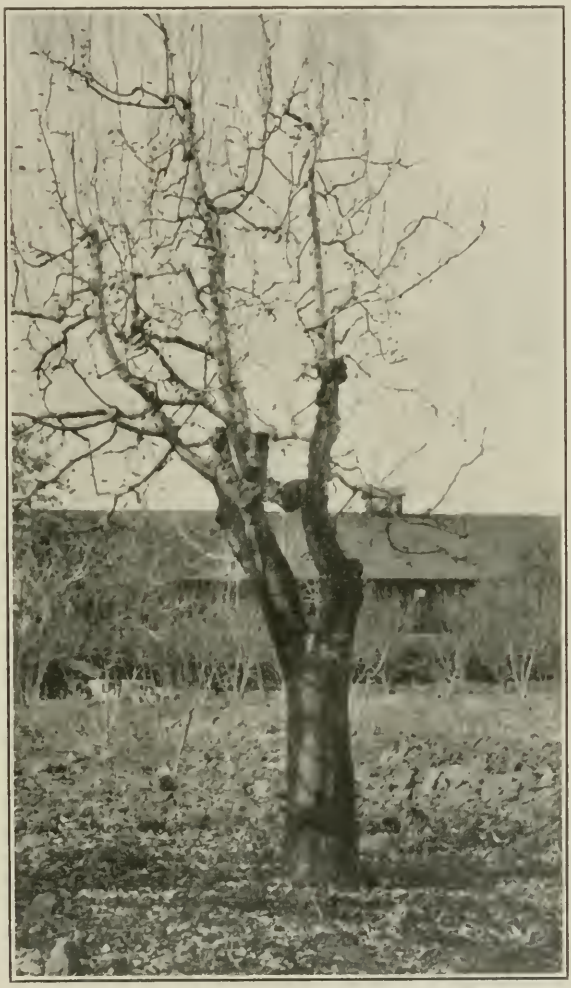

Fig. 116.—Pear tree treated for pear blight. Showing removal of bark as well as many of the larger limbs. (After Gammon, Monthly Bul. Cal. Hort. Com.)

demonstration work. This was done after the method introduced by Prof. Waite of the Department of Agriculture, which was then and still is the only practical way of handling this disease.

*Address before the State Fruit Growers' Convention, June 1-6, 1914.

There were, however, differences in points of infection, the length of the season and in the virulence of the disease, and the rapidity of its spread that made it necessary to include the entire tree in examination for blight, and to modify somewhat the methods of control. In order to determine the agencies responsible for this sort of infection, which was not common in the East, where the original experience was had, in order to justify and emphasize the method of treatment and at the same time account for every type and point of infection and make it a matter of general knowledge among the growers, it was thought wise to spend some time in a study of the agencies responsible for blight distribution.

The great mass of evidence gathered during a year's work was directly incriminating to the insects found in the pear orchards. To eliminate them would mean to at once halt the spread of the disease between communities, between orchards, and between individual trees. This is beyond the wildest dreams of the wildest—or wisest—entomologists. But it may be of value to know what evil the chief offenders are prone to, and to keep temptation out of their way, as far as is possible in a commercial way.

It would require some years of study to give a complete catalogue of the insects responsible for blight distribution, and the value of such a thing would not justify it.

I will take up the principal types and discuss them as classes, rather than specifically.

It is true, of course, that the winter stages—the cases of so-called holdover blight—are in a community sense the key to the situation, not because they are themselves a source of much infection, but because they are the foci of infection, the contaminated sources from which the first germs are taken. The complete eradication of winter blight has been attempted, has been accomplished in individual cases, but never universally. So, then, with blight present in or near our orchard, we are at the beginning of the growing season face to face with that most destructive phase of the disease called summer infection, which begins with the rise of the sap and continues as long as there is vegetative growth in the trees. This is the season that insects are most active and to them belongs the responsibility for this enormous damage.

This summer blight enters through the late bloom, the lateral and terminal buds of growing shoots, and the fruit. The greatest loss has been that which occurred through blighted sprouts at the base of the trees, or well down on the trunks. This growth is desirable as a protection to the boles of the trees, but in this case it must be eliminated, for when blighted at the base it is usually necessary to condemn the trees outright, though various methods of removing the blight from the trunks, and even the roots, have been resorted to, and often with excellent results.

The Honey Bee as a Carrier of Pear Blight.

The honey bee has been called a great rascal in the distribution of pear blight germs. He is a rascal during the season in which he can do injury. He and his many wild cousins carry much of the disease among blossoms. It is argued that bees do not find blight exudate palatable. This is only

partially true. When first blighted the blossom cup fills with a milky liquid which is not unlike sap and is, therefore, not distasteful to flower-visiting insects.

This gum retains its edible qualities much longer than lateral exudate, probably because of its association with the nectar of the flowers, and is largely sought for several days after the first symptoms of blight. The flower seldom begins to wilt until after the disease has reached the pedicel below the bulbous seed pod, and as it passes through this the entire exudate appears in the cup, which is the most natural outlet on account of its lack of cuticle. There are many other insects that may be classed with the bees, such as the Bombyliids, or bee-flies and syrphid flies, that feed from the nectar of the flowers.

Where there has been much holdover blight and early spring infection is abundant, these insects do enormous injury in curtailing the crop, as well as in actual damage to the trees themselves, where blight descends into the larger limbs.

Flies as Pear Blight Carriers.

In the case of pear blight the common flies, as we know them about the farm lot, are quite as much of an abomination out of doors as they are indoors. Few insects are more responsible than they for the transmission of winter blight to the blossoms. But their depredations do not end with this, for while they are present in the early spring they remain throughout the summer. The great injury due to them is largely by reason of their omniverous feeding habits, their diet ranging throughout the animal and vegetable kingdoms, and including almost every type of food that is available to their peculiar mouth structure. They are attracted to gummy exudate as readily as to table syrup, and it is never too badly fermented to be distasteful to them. They are fond of the nectar of the flowers. If a blighted pear be cut open it will be found to contain a quantity of milky liquid which has a very marked odor. If the pieces of this be placed on the ground a group of flies will soon collect about them, and a fly is a detective of rare ability. He will find the smallest blighted twig, whether in the tree or cut off and cast upon the ground, and after feeding upon it is ready to go on his destructive way. The moral is: Do not leave the twig in the tree or on the ground; cut it off and burn it up.

Pear Blight Carried by Ants.

Formicids or ants are similar to flies in their fondness for blight exudate, and also for the persistent visits to the flowers. Their destructiveness as promulgators of blight is greatly enhanced by their social habits. A solitary ant, finding a case of gumming blight, often notifies others of the colony, and soon there is a perpetual train of them going to and coming from the dangerous gum. Because of their association with the aphids and also because of their habits of feeding from the flower cups, they are always in and about the trees in great numbers. Many growers have expressed the belief that their twig infection was due to ants, but, with the exception of an occasional gnawing upon the stamens or pistils of the flower in their search for nectar, I have never seen them feeding upon pear foliage except in the situations mentioned above.

Ants will also carry much blight back to the trees from cuttings left on the ground. This is made possible by a sweating process which takes place from the under side of these cuttings, as a result of dew or artificial moisture that settles upon them. Under the influence of this moisture the hard film that has formed over the outside of the gum readily dissolves and exposes the soft materials underneath, that is full of live germs. This is the chief danger in all cuttings that are not destroyed. The glassy surface of the gum protects the germs beneath for many days, and even weeks, making them a constant menace. The affinity between ants and aphids is well known. Add to this the fact that ants have actually carried blighted sap into their underground nests to help feed their precious milk cows during the winter, and you have a situation not easy to reckon with. Both ants and aphids will emerge in the spring thoroughly contaminated and ready to start infection. Carbon bisulfid is cheap at any price where ants are living in or near a pear orchard.

The Pear Thrips as a Disease Disseminator.

Pear thrips are very fond of the pear bloom and upon their appearance in the spring are chiefly confined to the flowers which are then very general. Going from the bloom their first attacks are largely upon the leaf buds in the tops of the trees. Later, as these begin to harden, they are found in greater abundance in the lower growth, which comes on later and remains soft and succulent much longer. They may be found in all parts of the trees, however, where there is any material available to them as food. Within the developing leaf buds, and enclosed within the rolls of the growing leaves of these buds, are their favorite haunts. They also infest freely the lateral buds, and much blight which enters at the sides of twigs and suckers is due to their attacks at these points. Even buds on second year wood are freely invaded and contaminated by these pests. Leaves, petals of the flowers, stamens, pistils and even the tender first year wood itself are all included in their diet. Dangerous as these insects are in orchards containing blight, they must, like most of those which follow, be distinguished from the preceding by the fact that they do not deliberately spread the disease through a fondness for the gum of blight exudate. Like the aphids and many other forms, they extract their food from the tissues of the host plants and are not fond of these when blighted, though they may occasionally be found upon tissues quite blackened with the disease. Blight germs which they receive from any feeding grounds except the flowers, must be inoculated into the tissues by other insects or by thrips which have already received the virus from other sources, and are extracted by them from the plant cells into which the blight is spreading. They have frequently been found in flower cups containing milky exudate and, as has been stated, are probably not able to distinguish this from the nectar of the flowers. When the virus is once secured from either flowers or shoots they are perpetually supplied with it and prepared to leave infection in their wake.

Mr. Moulton, in his bulletin on this insect, points out that the beak is used in making an incision for the deposition of the egg beneath the epidermis of the stems of the blossoms, the petioles, midribs and veins and even the tissues of the leaves, and this, of course, is a prolific source of infection from the contaminated mouths of the females.

Their most serious injury in the spread of blight may be largely avoided by removing all sprouts from the crowns and from the main boles of the trees as fast as they appear. A few hours of this sort of work before this infection begins to appear in the spring will save hundreds of trees where this insect is abundant.

FIG. 117.—Pear tree treated for pear blight. Showing how the infection started from a single limb, which was removed. The gouge marks are plainly visible on the healthy limbs. (After Gammon, Monthly Bulletin, Cal. Hort. Com.)

The Work of Aphids in Spreading Pear Blight.

Aphis pomi, the apple Aphis: As a rule aphids are capable only of spreading very local infection. These insects are numerous everywhere and more or less infection has been traceable directly to them. Toward the close of the infection period they were especially prominent and caused much damage on the growth in the crowns of the trees. They

receive the germs chiefly from blight which enters their feeding grounds through inoculation by other insects. As the twigs upon which they are feeding begin to wither they naturally seek other quarters, carrying the germs with them and readily inoculating them into fresh tissues. One case became especially noticeable in our studies, where a colony of these insects had vacated a blighted shoot, each individual descending to the base and going upon fresh material. The colony thus became scattered and seven surrounding fresh shoots were found to blight as a direct result of their attacks. As these withered from blight the growing colony from each again sought new quarters and thus became scattered among the fresh growth. Summer cutting prevented me from carrying out these observations, but the progression indicated and a knowledge of the rapidity with which these insects multiply will readily indicate the damage they are capable of doing.

Blight Near Base of Tree Due to Insect Attacks.

Many mysterious cases of blight at or beneath the ground are due to the attacks of insects living in the ground, and among these are one or two species of Elaterids or click beetles, and several others that were not classified when these studies were made. In some cases the soil about the trees is quite honeycombed with their burrows. They are very fond of blight exudate. Like the root weevil, they feed upon the roots as well as upon growth above the ground. They are often seen about wounds caused by the tools or where sprouts have been removed from the base of the trees. They have been found to cause infection both here and upon the roots themselves.

Add to this list the cucumber beetle, an ubiquitous thing feeding over a wide area and in a variety of places, deliberately taking exuding gum and nectar from the flowers and attacking growing twigs and leaves; include the canker worm, the codling moth larvæ, numerous green fruit worms, tussock moth larvæ and a number of Pentatomids, and other true bugs, both large and small, and you have the chief insects carrying this disease. It is a formidable list and sufficient to account for the enormous virulence of pear blight and its appearance in every part of the trees.

There is one other agency worthy of mention, and this is contact blight, a thing most common during a rainy spring. We found during our studies that infection increased at a high rate following rains. This was thought to be due to the dripping of blight virus from the upper to the lower portions of the tree. Carrying this out with an atomizer, we found that we could produce infection in as high as seventy-five per cent of the cases tried, by spraying blight germs over tender growth, flowers and even fruit. The abrasions through which the bacilli enter may be caused by insects or by the rubbing. Blighted pears were cut open and rubbed over the surface of healthy fruit, the pressure being only sufficient to cause the gum to adhere. Infection following reached nearly 100 per cent, and the disease did not enter at one point but over the entire surface touched by the virus.

Résumé.

It becomes evident that the amount of injury insects are capable of inflicting in the spread of pear blight, depends directly upon the amount of blighted material that is available to them in their search for food. This is true from the very first transmission of winter blight into the spring growth to the end of the infection period, and throughout the range of insect life from those which search out and feed upon blight to those which come upon it unwittingly and thus become factors in its distribution. Through the agency of the former class, however, the amount of infection increases so rapidly that this does not always seem to be true. An orchard from which a few evident cases are removed on a certain day may in the course of another week contain many times more than were at first removed from it. This is due to the fact that it requires from four to six days after inoculation, even when the sap is most active, for the disease to become evident. Several days before they are evident, however, these cases are in a condition to distribute infection; indeed, by the time they have blackened sufficiently to be easily found they have passed their prime as factors in the spread of the disease. This is especially true of flowers, which may contain much blight exudate while still appearing fresh and healthy. Twigs are often found to bear beads of lateral exudate before they have wilted sufficiently to attract attention. These cases especially attract insects which intentionally make blight exudate a part of their diet. Adding to this the number of these insects that have received the germs from blight already removed, it will be seen that there is a perpetual source of infection and that the progression is an enormous one. It is not as great, however, when these cases are removed as fast as they appear as when they are left to continue down the limbs, gumming as they extend and thus eventually necessitating the removal of more and larger wood, meanwhile serving as perpetual sources of infection to swell the percentage.

Within the second class of insects it is especially true that profuse infection greatly increases their capacity for inflicting injury. A tree in which 50 per cent of the growth is blighted contains one chance out of every two for further contamination from it by every insect that feeds upon it; so while summer cutting may be discouraging on account of the perpetual reappearance of blight, and while it is never successful as eradication, it is certainly a most important aid, when properly done, in minimizing the ravages of this disease. Its danger lies in improper or incomplete methods, namely: short cutting, lack of disinfection and negligence in burning infected parts when removed. The growers who cut too short or fail to disinfect are doing exactly what the insects are doing, and are capable of far more damage than they.

CITRUS CANKER IN FLORIDA AND THE GULF STATES.

By H. S. Fawcett, Whittier, California.

The seriousness of this new fungous disease was referred to by Dr. Cook in The Monthly Bulletin for September. The hard and expensive fight which the Florida growers are now waging against this disease suggests that the citrus growers of this state should be thoroughly informed in regard to the nature of the disease, so that it would be detected at once should it by any hook or crook get started in any locality. This is the motive for this article. The writer does not believe that the drier climate of California would be at all congenial for its spread, nor does he believe that with our present quarantine against all citrus trees from the Gulf States there is any serious danger of its introduction, yet we should be on the guard against any possible outbreak and thus be able to deal with it at once. This new fungous disease, "citrus canker," thought to have been introduced from Japan, is attracting serious attention in Florida and in some of the Gulf States. The information in this article is obtained from the following publications, which have all appeared during the present year: Citrus Canker in the Gulf Coast Country, etc., in Proceedings of the Florida State Horticultural Society for 1914, by E. W. Berger; Citrus Canker in Bulletin 122, Florida Agricultural Experiment Station, by H. E. Stevens: Circular 27, Alabama Agricultural Experiment Station, by F. A. Wolf and A. B. Massey; Bulletin 150, Louisiana Agricultural Experiment Station, by C. W. Edgerton, and various articles in recent numbers of the Florida Grower, published at Tampa, Florida.

Attention was first called to this new disease by Dr. E. W. Berger. Florida State Inspector of Nursery Stock, who found it on 40,000 young trees in two nurseries in Florida in 1912, at which time its seriousness was not fully known. Its damage is most severe on grapefruit trees, the twigs and leaves and fruit of which are affected. According to E. W. Berger, the different citrus varieties are affected about in the following order: Pomelo, *Citrus trifoliata,* wild lime, navel, sweet seedlings, Satsuma, tangerine, King orange and lemon. It seems from this list that the lemon is least affected and the grapefruit is most seriously damaged.

Outside of Florida it has been reported in seven localities in Alabama, one in Mississippi, five in Louisiana and three in Texas, and it has been received in Florida on specimens of citrus from Japan. As far as known, it originally came to this country from Japan. In one locality in Florida it has been found on nursery stock which had been shipped directly from Japan, and in another case on nursery stock from a Texas nursery which is thought to have also gotten it directly from Japan.

The seriousness of the disease is apparent from the following statements, to be found in some of the publications mentioned above:

In the Florida Bulletin 122, Professor Stevens says, "If it is once well established in the state it may become a serious menace to the grapefruit industry."

In Alabama Circular 27, Wolf and Massey say, "This disease was very severe in certain grapefruit groves during the previous season and threatens to become the most serious difficulty with which the grower will have to contend."

In Louisiana Bulletin 150, Professor Edgerton says, "It may be that we will find some method of control which will be satisfactory, but from our present knowledge of the trouble it appears that this disease is going to be the most serious of all of the citrus pests."

As the climate of Florida and the Gulf States is so much more moist than that of California, it is not likely that it would ever prove such a menace to California, but the state should certainly use every possible means of keeping it from getting in. The disease known as "scab" so common on sour orange and grapefruit in Florida never became established in California, although it is known that in the earlier days thousands of sour orange stock was brought into the state with scabs on the leaves. But citrus canker is due to an entirely different fungus and it is not known what it might do if it once got established in California.

Stevens describes the appearance of the citrus canker as small, circular spots, from less than one sixteenth to one quarter of an inch across. The spots are raised above the surrounding tissue, are light brown, and composed of a spongy mass of dead cells covered by a thin membrane that finally ruptures and turns outward, forming a ragged margin around the spot. The general appearance of the spots is much the same whether they are found on the leaves, fruit or twigs.

The disease somewhat resembles the citrus scab and may be mistaken for it by those not acquainted with both diseases. The roundness of the typical canker spots, however, which are white to a grayish color, and the fact that they do not distort the leaf or cause wart-like projections. distinguish them from the scab.

The Florida growers at the present time are making a serious fight to eradicate this disease in the two localities where it has been found. The disease was first found in about 40,000 young trees in two citrus nurseries. Later it was found to have spread to many trees in orchard form. These were first cut back to the stump and sprayed with Bordeaux mixture, with the idea that this would eradicate the disease. When these trees came out again, however, it was found that some of them were again affected. The method now used is to destroy the trees completely by spraying them with distillate, setting them on fire and burning them down to the roots.

Quoting from a recent number of the Florida Grower, "For this purpose they have invented a large blow torch that is fed with distillate and a tree is consumed in a very short time, branches, leaves, stem and fruit, down to the very roots." In all there had been destroyed up to September 10th, over 1,500 trees in orchard form and 100,000 nursery trees in one of the affected localities. The Growers and Shippers League of Florida appropriated $2,000 for inspection work, and it is stated that the work carried on by the growers themselves is costing from $40 to $500 per week. At a recent meeting of the Florida citrus growers held at the Florida Experiment Station, a resolution was passed that each grower in the state be asked to donate one dollar for each acre of citrus fruit owned by him for use in this fight.

An inexpensive prevention is better than an expensive cure. We are fortunate at this time in California to have had a strict quarantine against citrus stock from the Gulf States.

As stated above, it is not likely that we are in great danger of getting in this disease, with our present quarantine protection in California, but the citrus growers should be informed in regard to it so that if anything suspicious should come up, it would be known at once and dealt with accordingly.

CROP REPORTS AND STATISTICS.

NOVEMBER REPORT.

Compiled from reports sent in by the county horticultural commissioners, by GEO. P. WELDON.

Counties	Grapefruit	Lemons	Olives	Oranges
Alameda	#	#	#	#
Butte	#	#	100	70
Colusa	#	#	#	#
Contra Costa	#	#	#	#
El Dorado	#	#	#	#
Fresno	#	100	100	90
Glenn	100	100	100	100
Humboldt	#	#	#	#
Imperial	#	#	#	#
Kern	#	#	100	70
Kings	#	#	#	#
Lake	#	#	#	#
Los Angeles	90	90	100	90
Madera	#	#	120	#
Mendocino	#	#	#	#
Merced	#	#	100	#
Modoc	#	#	#	#
Monterey	#	#	#	#
Napa	#	#	#	#
Nevada	#	#	100	100
Orange	110	125	80	100
Placer	#	#	100	90
Riverside	90	90	20	65
Sacramento	100	100	100	100
San Benito	#	#	#	#
San Bernardino	90	90	55	85
San Diego		35	90	85
San Joaquin	#	#	#	#
Santa Barbara	#	100	100	100
Santa Clara	#	#	#	#
Santa Cruz	#	#	#	#
Shasta	#	#	90	#
Siskiyou	#	#	#	#
Solano	#	#	#	#
Sutter	#	75	75	80
Sonoma	#	#		100
Stanislaus	#	100	100	90
Tehama	#	#	100	100
Tulare	90	95	100	90
Ventura	90	104	75	80
Yolo	#	#	75	#
Yuba	#	#	100	100

Figures in table indicate condition of crop in per cent on the basis of 100 per cent as normal.

#Crop is not grown sufficiently in a county for a report.

All blank spaces indicate a failure on the part of a county horticultural commissioner to report in time or in the required form.

THE ACREAGE OF FRUITS BEARING AND NON-BEARING BY COUNTIES.

By Geo P. Weldon.

The following table has been compiled from the 1914 annual reports of the county horticultural commissioners, to the State Commission, and shows the bearing and non-bearing acreage of fruits grown in the various counties where commissioners are at work.

Counties	Almonds	Apples	Apricots	Cherries	Figs	Lemons	Olives	Oranges	Peaches	Pears	Plums	Prunes	Walnuts
Alameda.													
Bearing	500	136	5,000	2,000					200	565	75	116	12
Non-bearing	400	100											
Butte													
Bearing	1,800	500	80	75	155	22	1,900	2,000	3,000	400	100	2,000	
Non-bearing	1,000	400	15	40	80	32	1,100	240	730	350	125	1,500	
Colusa													
Bearing	300		30		20			40	303	30		1,000	40
Non-bearing	1,800					800		200	100		20	2,000	
Contra Costa.													
Bearing	1,737	160	500	200	20	5	143	13	600	800	100	1,100	20
Non-bearing	850	80	220	80	5	1	5	5	250	600	50	250	1,200
El Dorado.													
Bearing		350		6					300	500	300		
Non-bearing		200		10					500	900	500		
Fresno.													
Bearing		2,750			2,919	48	502	1,788	43,151	136	343	981	159
Non-bearing													
Glenn.													
Bearing	150	78	200			58	42	75	93	17		210	
Non-bearing	1,665	140	255		370	280	103	2,830	2,720	420		614	150
Humboldt.													
Bearing		1,100											30
Non-bearing													350
Imperial.													
Bearing			110		52	8	51	73	32	36	18		
Non-bearing			320		96	13	135	126	125	90	25		
Kern.													
Bearing		100	200		14		40	100	600	190	50	200	
Non-bearing	90	1,857	185				475	1,572	450	892	100	342	
Kings.													
Bearing			1,700						7,950			560	
Non-bearing			260						1,040				
Lake.													
Bearing	53	135	27	16	15				65	360		347	34
Non-bearing	250	62	9	14	2				82	1,208		100	142
Los Angeles.													
Bearing	600	1,400	2,039		500	5,000	2,400	25,585	1,600	350	600	250	10,074
Non-bearing	100	300			500	5,000	2,000	10,000	300	200	100	200	2,063
Madera.													
Bearing	40	200	100		100	5	155	10	650	5		60	
Non-bearing	35	70	35		65	1	585	5	1,050	5	60	5	5
Mendocino.													
Bearing	25	948	12	16	5				55	650	10	320	15
Non-bearing		160								110	250	75	25
Merced.													
Bearing	400	60	200	5	400	12	65	40	4,000	75	36	40	30
Non-bearing	150	40	125	10	390	8	50	45	2,000	80	30	75	35
Modoc.													
Bearing		265											
Non-bearing		335											
Monterey.													
Bearing	20	4,500	395						50	40		20	
Non-bearing	10	600	285							45			
Nevada.													
Bearing	10	1,500	15	75	20	2	5	20	350	600	110	110	20
Non-bearing		200	5	10	5				300	1,000	200		50

ACREAGE OF FRUITS BY COUNTIES—Continued.

Counties	Almonds	Apples	Apricots	Cherries	Figs	Lemons	Olives	Oranges	Peaches	Pears	Plums	Prunes	Walnuts
Orange.													
Bearing	------	133	1621	------	------	2249	------	9980	------	------	------	------	11,965
Non-bearing	------	200	163	------	------	2101	------	6838	------	------	------	------	1,789
Placer.													
Bearing	250	450	420	350	45	------	320	350	7,600	1,500	5,500	------	------
Non-bearing	------	------	------	50	------	------	------	------	750	250	1,000	------	------
Riverside.													
Bearing	818	498	1,995	25	27	2,478	1,203	17,492	987	235	6	318	349
Non-bearing	1,328	2,419	2,577	230	42	1,965	572	2,810	1,627	470	26	210	870
Sacramento.													
Bearing	921	344	470	330	100	15	600	875	1,650	2,900	1,250	650	150
Non-bearing	700	200	100	200	------	20	560	825	1,000	2,000	600	500	50
San Benito.													
Bearing	125	325	1,500	70	------	------	------	------	525	250	------	2,400	25
Non-bearing	50	150	1,000	5	------	------	------	------	225	175	------	650	50
San Bernardino.													
Bearing	------	1,024	1,618	41	------	2,309	566	32,888	5,666	36	8	54	470
Non-bearing	------	10,131	499	25	------	2,152	764	7,574	1,847	498	12	72	324
San Diego.													
Bearing	45	1,110	113	18	10	3,016	820	1,262	621	------	17	48	106
Non-bearing	------	271	23	------	------	784	50	67	250	------	------	44	166
San Joaquin.													
Bearing	1,500	------	1,000	1,500	67	------	600	15	4,000	700	300	500	200
Non-bearing	500	------	50	500	22	17	150	20	4,000	1,000	500	1,000	1,800
Santa Barbara.													
Bearing	------	400	110	110	------	800	440	5	75	20	------	------	4,800
Non-bearing	------	150	220	150	------	400	150	2	709	2	------	------	800
Santa Clara.													
Bearing	321	430	5,701	2,457	72	25	181	21	6,120	1,321	2,750	52,950	447
Non-bearing	96	624	255	3,143	33	15	68	13	425	163	187	4,113	151
Santa Cruz.													
Bearing	------	15,900	1,200	100	------	3	------	------	50	------	------	300	------
Non-bearing	------	1,500	800	200	------	50	------	------	100	------	------	------	------
Shasta.													
Bearing	50	300	6	8	16	------	200	7	300	110	20	750	33
Non-bearing	------	140	4	7	5	------	236	3	175	10	15	100	7
Siskiyou.													
Bearing	------	800	45	40	------	------	------	------	950	------	36	------	1
Non-bearing	------	1,250	38	60	------	------	------	------	11	------	530	------	45
Solano.													
Bearing	1,000	------	1,300	700	------	------	20	10	4,200	1,000	2,521	4,345	------
Non-bearing	415	------	150	300	------	30	------	20	600	230	1,520	1,800	------
Sonoma.													
Bearing	152	6,968	408	935	170	------	1,007	151	803	1,077	99	7,629	288
Non-bearing	242	5,167	25	679	------	------	------	7	421	501	118	2,503	297
Stanislaus.													
Bearing	625	113	525	25	200	15	150	225	2,520	233	210	45	50
Non-bearing	400	20	50	------	20	5	20	20	650	40	30	25	70
Sutter.													
Bearing	1,200	200	100	150	300	------	35	------	3,100	250	250	500	------
Non-bearing	500	50	50	70	150	------	50	------	1,700	50	125	350	50
Tehama.													
Bearing	500	500	600	------	50	25	1,000	225	3,877	350	100	1,300	------
Non-bearing	------	------	------	------	------	------	------	------	700	350	------	300	------
Tulare.													
Bearing	20	300	250	------	210	450	100	11,550	6,920	40	400	2,200	5
Non-bearing	15	100	100	15	100	750	200	30,450	1,500	20	150	700	5
Ventura.													
Bearing	200	------	2,830	------	------	2,390	------	2,131	------	------	------	------	7,785
Non-bearing	------	------	2,377	------	------	3,000	------	924	------	------	------	------	2,623
Yolo.													
Bearing	2,250	25	1,850	------	250	------	320	50	1,900	975	600	1,350	30
Non-bearing	2,750	------	75	------	25	------	90	30	150	50	70	175	15
Yuba.													
Bearing	135	430	80	25	120	25	330	300	765	495	260	280	------
Non-bearing	25	75	25	25	200	------	200	25	235	100	100	75	------

RECAPITULATION—ACREAGE OF FRUIT BY COUNTIES.

Counties	Acres bearing	Acres non-bearing	Total acreage
Alameda	8,604	500	9,104
Butte	12,032	5,612	17,644
Colusa	1,763	4,920	6,683
Contra Costa	5,398	3,596	8,994
El Dorado	1,456	2,110	3,566
Fresno	52,777		52,777
Glenn	923	9,617	10,540
Humboldt	1,130	350	1,480
Imperial	380	930	1,310
Kern	1,494	5,963	7,457
Kings	10,210	1,300	11,510
Lake	1,052	1,869	2,921
Los Angeles	50,398	20,763	71,161
Madera	1,325	1,921	3,246
Mendocino	2,056	620	2,676
Merced	5,363	3,538	8,901
Modoc	265	335	600
Monterey	5,025	940	5,965
Nevada	2,837	1,770	4,607
Orange	25,948	11,091	37,039
Placer	16,185	2,050	18,235
Riverside	26,431	15,146	41,577
Sacramento	10,255	6,755	17,010
San Benito	5,220	2,305	7,525
San Bernardino	44,680	23,898	68,578
San Diego	7,195	1,655	8,850
San Joaquin	10,382	9,559	19,941
Santa Barbara	6,760	2,583	9,343
Santa Clara	72,796	9,286	82,082
Santa Cruz	16,653	2,650	19,303
Shasta	1,800	702	2,502
Siskiyou	1,872	1,934	3,806
Solano	15,096	5,055	20,151
Sonoma	19,687	9,959	29,646
Stanislaus	4,931	1,350	6,281
Sutter	6,085	3,145	9,230
Tehama	8,527	1,350	9,877
Tulare	22,445	34,105	56,550
Ventura	15,336	8,924	24,260
Yolo	9,600	3,430	13,030
Yuba	3,145	1,085	4,230
Totals	515,517	224,671	740,188

COST OF PRODUCTION OF BLACK TARTARIAN CHERRIES IN SACRAMENTO COUNTY.

By F. C. Brosius.

The following statistics not only show that the grower who furnished the figures given below knows how to get results from his trees, but also that he knows how to dispose of his crop profitably, one of the most important items in cherry culture. Without the aid of the reefers, Tartarian cherries seldom arrive in the eastern market in a condition other than that which results in a red ink sale.

Yield of 360 boxes, averaging 10 pounds and 940 pounds bulk, from 95 trees, average 20 years old:

CULTURAL COSTS.

Two plowings, 4 harrowings, irrigation, etc., labor and team, pumping	$25 00
Picking and packing, labor	223 00
Boxes and cartons	55 70
Reefers, icing and return express	13 05
Total cost	$316 75

RECEIPTS.

360 boxes, 10 pounds each, net	$571 00
940 pounds, bulk, at 10 cents per pound	94 00
Total receipts	$665 00
Deduct cost of production	316 75
Balance	$348 25

FRUIT SHIPMENTS.

We are indebted to Mr. Chas. E. Virden, of the California Fruit Distributors, for the following comparative statement of the carload shipments of fruits in 1913 and 1914. Shipping for this season is not quite finished:

Sacramento, Cal., November 23, 1914.

COMPARATIVE STATEMENT.

	1913	1914
Cherries	230¾	166¼
Apricots	158¼	382
Peaches	2,359	2,144¼
Plums	1,706¼	1,906½
Pears	2,495¾	2,725¼
Grapes	6,275¼	8,688¼
Miscellaneous	18½	48¾
Totals	13,243¾	16,061¼

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. Cook, State Commissioner of Horticulture----------Censor
E. J. Vosler, Secretary State Commission of Horticulture----------Editor

ASSOCIATE EDITORS.

Geo. P. Weldon----------Chief Deputy Commissioner
Harry S. Smith----------Superintendent State Insectary
Frederick Maskew----------Chief Deputy Quarantine Officer

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Apple Book.—It is our desire to complete our list of monographs on the several fruits grown in California. Almost every mail we are receiving requests for such treatises. To the ten already issued in the last three years we now add one on the apple by Chief Deputy State Commissioner of Horticulture, George P. Weldon. Mr. Weldon's scientific attainments and his wide experience in Colorado where apple culture is so successfully carried on fit him admirably for this work. We are sure this volume will be heartily appreciated. It will be sent out only on individual application.—A. J. C.

Time for Pruning Vines.—The viticultural department of the University of California has secured interesting results on the effects of time on the pruning of vines as it relates to frost injury in spring and the consequent size of crops. It has been found that pruning at different times affects the time of starting growth in the spring, the late starting growth naturally being most likely to avoid frost injury.

The earliest vines starting in spring were those that were pruned when most dormant. Pruning before the leaves fall in autumn delayed the starting of buds only slightly. Late pruning, after the terminal buds had started in spring delayed the starting of the buds near the base of the canes. Pruning as late as March 13 saved the crop from a frost occurring on April 21. Whitewashing the vines after pruning delayed the starting slightly.

Pruning as related to blossoming showed two things. Late pruning, after starting of buds, delayed blossoming. When early pruning resulted in frost injury, the late pruned vines blossomed first.

As affecting the crop, frost injury in spring diminished the crop of early pruned vines. The average crop of early pruned vines at Davis

was 13.44 pounds, of late pruned vines, 18.64 pounds. Pruning after the terminal buds had started seemed to increase the crop irrespective of frost injury, the crop on vines pruned March 14, averaging 17.72 pounds per vine, and of vines pruned April 14, 22.55 pounds, but pruning after the shoots had grown several inches made a big decrease in yield. Late pruning also delayed the time of ripening, late pruned vines giving grapes with much less sugar at time of harvesting, though the grapes with less sugar would have ripened up more if left on the vines. Late pruned vines also gave grapes of inferior quality; by late pruning in this case being meant pruning delayed too long. Apparently as late pruning as can be done without reducing the yield, that is, when terminal buds are just about to start, is good for the yield and good as a method of running less risk of frost injury.—Orchard and Farm.

The Los Angeles Convention.—The attendance and interest at the recent State Fruit Growers Convention left little to be desired. I believe such meetings are of lasting benefit. The attendance must of necessity be largely local, but the scattering attendance from all portions of the state is so much leaven to spread the valuable truths and suggestions which are so generously offered.

I have two criticisms to make regarding the program of this convention. It was too crowded. I think, after many years of experience, that three papers at a session are quite enough. Also, I believe that one half of the papers or addresses should be from the growers themselves. It was impossible to meet either of these conditions at Los Angeles, yet we need not lament very greatly for there was time for discussion of each subject, and all the papers were of great value.

Too much praise can not be accorded to the local committee nor to Dr. Webber and the admirable corps of workers from the Riverside Station for their part in the success of the convention. I wish also to extend very grateful acknowledgements to all who took part in carrying out the program and in the discussion.—A. J. C.

Citrus Canker.—The Gulf States from Florida to Texas are much concerned because of the appearance of citrus canker in their groves. Mr. E. W. Berger, Inspector of Nursery Stock, University of Florida, Gainesville, in an official tour of inspection in 1912, found the disease in Alabama and Mississippi. It was already known to exist in Florida and Texas, and Mr. Berger thinks it may also be in Louisiana, though a limited inspection failed to discover it. It has since been found in Louisiana.

The supposed nativity of citrus canker is Japan. It is a fungous disease and attacks twigs, leaves and fruit of most, if not all, species of citrus. It blights the twigs, causing numerous slender twigs to push out, reminding us somewhat of peach yellows. It spots the leaves, causing them to turn yellow and to fall prematurely from the trees. Its attack of the fruit resembles scab, for which it has been mistaken. The scarring of the fruit ruins it for market, although not really for eating as the scarring is only skin deep.

The following is taken from Bulletin 122, "Citrus Canker," Florida Agricultural Experiment Station:

DISTINCTION FROM OTHER DISEASES.

"The other citrus diseases with which this one is likely to be confused are Scab, Scaly Bark, and, possibly, Anthracnose. It can be distinguished from any of these by the following points of difference:

"(1) It differs from Scab in the roundness of the typical spots, in the larger size of the spots, and in their white or grayish color. It does not distort the leaves, nor cause the wart-like projections that are common in infections of Scab. Canker is found on the older wood, while infections of Scab never occur on older twigs or branches.

"(2) It differs from Scaly Bark in producing much smaller spots, which are more circular in outline. Scaly Bark spots usually show a hard glazed surface, while Canker is more spongy. Canker is common on the grapefruit, and forms spots on the leaves; while Scaly Bark rarely attacks grapefruit or causes spots on the leaves.

"(3) Canker differs materially from Anthracnose spotting. Anthracnose spots are sunken, usually many times larger, and much firmer and more compact. Anthracnose occurs only on fruit, and does not attack young shoots or twigs."

Florida, Louisiana and Alabama have issued quarantines against citrus nursery stock because of this disease. It is most severe on pomeloes but attacks Satsumas and all kinds of oranges. As yet we feel certain that the disease does not occur in California. Our strict inspection of all importations from Japan and our quarantines against citrus nursery stock from the Gulf States because of the white fly and against Florida and the island of Porto Rico on account of Melanose will do much to safeguard our citrus groves. Our small plantings of pomeloes, Satsuma oranges and citrus on trifoliate stock will also aid us in keeping free from this citrus canker.

We quote the following from a letter received from Mr. Ernest Walker, State Horticulturist, Auburn, Alabama:

"On account of the presence of 'citrus canker' at various points along the gulf coast, and the anxiety of citrus growers in preventing any further spread of the disease, this state has decided to debar all *Citrus trifoliata* seedlings and grapefruit trees, but to allow the shipment of Satsuma orange trees only under 'special permit.' In order to obtain these permits your nurserymen, in filing their nursery inspection certificates, should have thereon and accompanying the same a specific statement that the trees are free from all infection by 'citrus canker' and have not been exposed to infection by this disease from growing in the nurseries, orchards or other places near trees infected by 'citrus canker.'"

We urge all our county horticultural commissioners and growers in citrus districts to keep a close watch out for any possible appearance of this disease, for if once established here it would prove a calamity to the state and certainly to our citrus interests. Identification will not be difficult. In case an unusual disease is discovered look for the characteristics referred to above.—A. J. C.

General Citrus Quarantine.—Quarantine Order No. 8, adopted November 11, 1914, by the Arizona Commission of Agriculture and Horticulture, reads as follows:

In order to prevent the introduction of citrus insect and red spider pests and destructive citrus diseases into the State of Arizona it is hereby ordered and declared:

(a) That hereafter the introduction of citrus nursery stock, either budded or seedling, into the State of Arizona from any other state or territory is prohibited.

(b) That all citrus buds, scions or seeds hereafter shipped or brought into the State of Arizona from other states or territories or from foreign countries shall come immediately under quarantine and must be held by the common carrier or person or persons in possession of the same until the state entomologist has been notified and a written order issued as to the disposition of such quarantined matter.

(c) That the introduction into the State of Arizona of cape jessamine (*Gardenia jasminoides*), privets (*Ligustrum* spp.) and rubber plants (*Ficus indica*) which are favorite food plant of destructive white flies (*Aleyrodes* spp.) which infest citrus from North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Yuba County of California, Cuba, Japan, China, India, and Chili, is prohibited and all such brought into this state in violation of this order shall be under quarantine subject to being shipped from the state or destroyed at the option of the owner or owners.

(d) That all persons, firms or corporations in the State of Arizona are prohibited from having possession of, transporting, selling or giving away any of the quarantined plants or materials except as provided for in this order.

(e) That Quarantine Orders Nos. 2 and 6 of the Arizona Commission of Agriculture and Horticulture are hereby rescinded.

A State Horticultural Society.—For some time there has been considerable discussion looking to the formation of a state horticultural or pomological society. This eventuated in the appointment of a committee at the Los Angeles Convention, a report from the same and a resolution requiring that a committee be appointed to report a plan in detail. The committee at Los Angeles, of which Mr. C. B. Messenger was chairman, reported tentatively in favor of a state horticultural society to meet once or twice a year in conventions much like the one now held by the State Commission of Horticulture, the proceedings of these conventions to be published from funds received from the annual dues. A more elaborate and pretentious plan was suggested in a state agricultural society like the above, only it would include all phases of agriculture, like dairying, grain growing, truck crop production, etc. At the meetings in this case there would be sections, each considering its own special problems. This would be a new kind of organization, and if successful, ought to be of paramount value.

During the heated discussions the past summer called forth by the proposed eight-hour amendment, a Farmers' Protective League was formed, which did phenomenal service. Over fifty thousand members were secured and thousands of dollars were voluntarily subscribed, a considerable portion of which is still in the treasury. This organization has only one paid officer, the secretary, who manages the business under the direction of an able executive committee. It also publishes a paper which is sent, as we understand, to all the members of the league. It is thought by some that this league might be merged with the present convention system, and all needed advantages secured.

Without doubt cooperation is the key to progress in agriculture. Organization is the big booster for cooperation, so every true friend of cooperation must be a stout advocate of organization. Our present horticultural convention reaches back to 1881 when Professor Dwinell and Mr. Mathew Cooke inaugurated so ably the present plan. They surely performed a worthy work. This organization, if it can properly be so called, is weak in executive lines and so possibly lacks efficiency in the direction of marketing and legislation. A more formal and compact organization might work with more success in these lines. That our present system is successful in an educatory sense when pushed with wisdom and energy the recent conventions certainly proved. The society plan has in its favor the general practice in nearly all the states. To succeed it must enlist general interest and must be engineered by some two or more persons who are so full of self-sacrifice

and devotion to the work that they will push its interests even though it presses hard upon their own time and business. Our great state, an empire in itself, makes this difficulty even more aggravated. Can the interest of the many and the devotion of the leaders be counted on? The agricultural society would be greater and correspondingly harder to establish and develop to the desired point of usefulness and excellence.

Another plan is to join the Farmers' Protective League with the State Commission of Horticulture in carrying forward this work. The conventions would go on as at present; the work looking to marketing, legislation, etc., could be carried forward by the league. The great work performed by the Citrus Protective League in the south and the services wrought by the new organization in the north in its short life would argue in favor of utilizing the league.

The convention passed a resolution that a committee be appointed by the State Commissioner of Horticulture, of which he should be a member, to take the matter under advisement and to report a plan in detail at the Forty-sixth State Fruit Growers' Convention at Stanford University next July. The committee appointed is as follows: Messrs. H. J. Webber, C. B. Messenger, H. E. Van Norman, Geo. H. Hecke, F. B. McKevitt and A. J. Cook.—A. J. C.

The Potato Session of the Convention at Los Angeles.—The large attendance, rapt attention and animated discussions at the potato session of the convention at the hotel parlors Tuesday afternoon proved that no mistake was made in devoting one half day to the potato industry

Mr. E. H. Phreaner, who might be called the "Potato King" of El Dorado County, spoke wise and timely words on the cultural phase of the subject. What gives added weight to Mr. Phreaner's talk is the fact that he does all and more than he says as to cultivation. By deep and frequent cultivation he insures moisture, aerates the soil and prevents weeds from robbing his tubers. He never permits his potatoes to suffer from want of water. Very few in California use fertilizer as lavishly as does Mr. Phreaner. The thrifty, vigorous, luxuriant vines, no less than fourteen or fifteen large, fine tubers to each hill, prove that the potatoes appreciate such treatment. Mr. Phreaner will practice a long rotation, thus hoping to keep his land free from germs and other pests that would reduce the production of first-class tubers. He believes that two hundred and fifty or three hundred sacks of potatoes per acre will only come when every detail of first-class cultivation is observed. Even sprouting must always be practiced, as this will increase production and hasten development, thus paying richly for added labor and pains.

Mr. W. V. Shear of the United States Department of Agriculture urged that only disease-free seed should be planted, treating the same with corrosive sublimate, 1-1000, to destroy the germs of scab and Rhizoctonia which might possibly escape the notice of even the most vigilant inspection. Stem wilt, Fusarium, is even more destructive than scab and as serious as Rhizoctonia, and can only be eliminated by planting clean, sound seed in a clean soil. If all the vines keep fresh and sound to the very close of the season we may be pretty sure that the wilt fungus is not present.

Mr. William Garden, county horticultural commissioner of San Joaquin County, urged that clean seed planted in a clean soil in a moth-free section would secure against celworm and tuber moth. He regarded celworm as much more harmful than the tuber moth. He had known of the presence of the moth in the delta region for years, and it is no more prevalent or destructive today than it was years ago. We have shipped our potatoes to Oregon, Washington, Idaho, Colorado and Texas all these years. Surely the danger is not great, if, as they say, the growers of these states are not injured by the tuber moth at the present time. Vigilance will eliminate these pests. Deep hilling, sacking the tubers as soon as dry after being dug and leaving no potatoes, either large or small, exposed in the fields is the sure prevention of moth attack. Celworm tubers are easily distinguished and should never be used for seed.

Mr. Eugene Grubb of Colorado, author of a valuable treatise on potatoes, who has just returned from abroad, spoke entertainingly on potato culture in Europe. There the potato is much more important than here. It may almost be said to stand between the people and famine. The growers in Europe insist on a long rotation as absolutely necessary to keep the tubers free from disease. They invariably precede potatoes with grass, often ten years separating potato crops, grass, grains and other vegetables filling out the rotation. The great crops of potatoes in Europe are due to clean soil and selected seed, which is sound and of choice varieties. Only immature seed is used there and only whole potatoes are planted, as a cut surface invites infection. Care is requisite to never bruise the tubers or sprouts. Sprouting in especially prepared boxes, kept in special buildings, serves a double purpose by hastening development and giving less time for attacks of fungous or bacterial pests. In Europe potatoes for seed are usually grown by a specialist. We should follow this example in America. Mr. Grubb stated that by adopting in full the methods now practiced in Europe it would be possible not only to double, even triple, our yield of potatoes but also would lessen the time of growth and development by at least fifty days, clearly to our advantage.

The session closed with a most interesting talk by Mrs. Hilda B. Nielson, of Sebastopol, whose husband is a very successful potato grower in Sonoma County. Mrs. Nielson is as good an authority on potato growing as on making jellies, in which work she has gained a wide reputation. She and her husband have evidently made a very thorough study of the whole potato question, and as a result are said to have produced potatoes of exceptional excellence.

The discussion at this meeting proves that there is great interest in the subject in many parts of the state. Reports of yields in Orange County would seem to show that in that region at least, potatoes are not suffering seriously from any handicap.—A. J. C.

Winter Pruning of the Grape.—The subject of vine pruning is an important one to every grape producer. Bulletins 241 and 246, by Prof. Frederic T. Bioletti, lately published by the California Experiment Station, treat of vine pruning in California, and are important additions to our none too large supply of horticultural knowledge.

FIRST WINTER PRUNING.

The winter pruning of the vine is of special interest to the vineyardist at this time. The author states that the time for pruning young vines at the end of the first growing season is after the leaves have fallen, in December or early in January. An average vine will have produced, at the end of the first growing season, from three to five canes, the longest being from two to three feet. All of these should be entirely removed, except one. This one should be well matured, at least at the base, and should have well formed eyes. This cane is then shortened to two eyes. It is also well—so the author states—to cut off all shallow roots within three or four inches of the surface. This is necessary in the case of grafted vines, if any have escaped the summer root cutting. In the case of vines which have made an exceptional growth, the cane is often large enough to start the trunk, in the same way that the average vine is pruned the second winter. If the vines have not been staked before, they should be staked soon after pruning and before the buds have started. The stakes should be driven at the same side of the vine, at a uniform distance, which should be about two inches. If driven closer the stakes may injure large roots, or even the main underground stem, particularly if the vines have not been carefully planted vertically, or if they slant toward the side on which the stake is to be placed. The stake should be placed so that the prevailing winds during the growing season will press the vine toward the stake, instead of away from it. This will help in keeping the vines upright.

The vines will require very careful attention from the pruner during the spring and summer the second season. The main object during this second growing season is to develop a single strong, vigorous and well ripened cane, from which the permanent trunk of the vine is to be formed. This is done by concentrating all of the energies of the vine into the growth of a single shoot.

SECOND WINTER PRUNING.

The second winter pruning of the vine consists merely in cutting back the single cane which has been allowed to grow during the second season, to the height at which it is desired to head the vine. The vine may be pruned at this time for a high, low, or medium head. Usually the vine is so pruned that it will develop with a trunk of from twelve to fifteen inches, though this length can be modified somewhat.

The cane will consist of about seven or eight joints or internodes in a low medium head, with an equal number of well formed eyes and an indefinite number of dormant buds, these being principally near the base of the cane, or the junction of the one-year and the two-year-old wood. Only the buds on the upper half of this cane should be allowed to grow. These buds—about four in number—should give six to eight bunches of grapes, and four, six or eight shoots, from which to form the spurs during the following winter pruning. In order to form a high head the cane will be about twenty-four inches long, and can be used to form a trunk, eighteen inches high. As with the shorter cane, buds should be allowed to grow only on the upper half. These buds—about six in number—will give rise

to the shoots necessary for the formation of spurs. In all cases a full internode should be left above the top bud. This is done by cutting through the first bud above the highest one which the pruner desires to have grow. This cut is made in such a manner that the bud is destroyed, while the diaphragm is left intact with part of the swelling of the node. This upper internode is left to facilitate tying, and also to protect the upper bud. By making a half hitch around this internode the vine is firmly held. In tying the vines, the author states, no turns or hitches must be made around any part, except this upper internode. Vines will be crooked-necked where hitches were made below the top buds, as the tops will bend over in the summer under the weight of the foliage. Hitches made lower down will tend to girdle and strangle the vine. A second tying about half way from the upper to the ground will be necessary in order to straighten the cane. For high headed vines three ties are usually necessary. For the top tie, wire is very good. It seems to hold better than twine, and does not wear. The lower ties should be made of softer material, as the wire has a tendency to cut into the wood. These should be placed so that the canes will be able to expand as they grow. If the vines have not made sufficient growth of cane during the second growing season to be tied up in the way indicated, they should be again pruned back to two buds, as during the previous winter pruning, and special care should be taken to try to develop a good cane. These vines, during the summer season, will usually make vigorous growth, and must be topped. The result at the following winter pruning will be a vigorous cane with laterals. If this disbudding and thinning of the shoots have been neglected, there will be several canes on the vine, in which case only the best should be left and treated as if only one cane had been produced. During the third summer, the buds and shoots below the middle of the cane should be removed. This will leave four or five fruit buds, and will give the vine an opportunity to produce eight to ten bunches of grapes.

THIRD WINTER PRUNING.

At the end of the third season's growth, the vine should be straight, and have a well developed trunk, with a number of vigorous canes near the top, from which the arms are formed. The pruner should leave only enough spurs to supply all the fruit buds that the vine can support. The number of buds that are left will depend to some extent on the variety. Varieties which produce two bunches to the shoot, the bunches averaging a pound, will, if twelve fruit buds are produced, give about seven tons per acre, if the vines are planted six by twelve feet. The number of these spurs will depend on their length. Six spurs having two buds each will give the required number, but since some canes are more vigorous than others they should be left a little longer, in which case a smaller number of spurs will suffice. After the number and length of the spurs are decided upon, those canes should be chosen which will leave the spurs in the most suitable position for forming arms. This position will depend upon whether a vase-formed or a fan-shaped vine is wanted. In case of the vase-formed vine, the canes are chosen which will develop the spurs most evenly and symmetrically on all sides, those being avoided which cross each

other or point downwards. In the fan-shaped vine the canes are chosen which run in the direction of the trellises, the canes which stick out between the rows being cut out. Less spurs should be left if the vines are not very vigorous. The author states further, that it is easier to properly shape vines which make only a moderate growth during the first three seasons.

AFTER THE THIRD WINTER PRUNING.

Pruning after the third winter will be simple, but involving one new idea: the distinction between fruit and sterile wood. At each winter pruning a number of spurs of fruit wood must be left to produce the crop to be expected from the size and vigor of the vine. Besides these fruit spurs it may be necessary to leave spurs of sterile wood to permit the increasing of the number of fruit spurs the following year. If a vine, at the end of the third winter pruning, is left with two fruit spurs of two buds each, and one fruit spur with one bud, and these five fruit buds produce vigorous shoots during the following summer, there will be five canes of fruit wood which can be used to form five fruit spurs at the following winter pruning. This is about the normal increase necessary. However, if some of these fruit buds produce weak or badly placed shoots, the shape of the head will be spoiled, if they are used for spurs. Other shoots will be produced from base, secondary or adventitious buds, which may be used to form spurs for the starting of new arms. Each year the process is continued, that is, enough fruit spurs well placed and spaced are left to produce the crop, and on most vines supplementary spurs of sterile wood must be left to supply more arms where they are needed, and finally, when the full complement of arms is developed to supply new arms to replace those which have become too long or are otherwise defective. Sometimes, the writer goes on to say, it is difficult to find water sprouts in suitable positions for replacing spurs. This difficulty can be overcome by shorter pruning. If an arm is too long and at the same time weak, it should be pruned to extra short spurs. This tends to force water sprouts to start from the older wood near the base of the arm.

FAN-SHAPED VINES.

If the vine is to be fan-shaped in the third winter pruning, the vine should be pruned to two spurs. More vigorous vines should not be given more spurs, but the spurs should be given more buds, four, five or even six, in some cases. This is done in order to obtain some fruit. With very vigorous vines one fruit cane may be left at this pruning.

The wire of the trellis should be put up at the end of this season, if this has not been done.

As the form of the vine is determined by the renewal spurs (spurs left to supply fruit spurs or fruit canes), special attention should be paid to their position, so that they will be about the same height above the ground. The next year each of these spurs will furnish a fruit cane and one or two renewal spurs. The arms will thus, in two or three years, be increased to four or, with the very large vines, to six. These spurs should be chosen so that they will not project out sideways. The

fruit canes, also, should be as nearly as possible in the direction of the trellis. It is worse than useless to use water sprouts or suckers for fruit canes, and care in the selection of renewal spurs will prevent awkward, ungainly vines.

DOUBLE-HEADED VINES.

Some growers attempt to arrange the arms of their vines one above the other, forming what is known as double-headed vines. One criticism of this method is that it can not be maintained permanently, the lower head or ring, of arms, finally becoming weak and failing to produce wood. This system is easier to maintain in trellis vineyards, as some advantage is gained, which is that it makes it easier to keep the vine in the same plane, and prevents the arms getting into interrows.

VERTICAL AND BOWED CANES.

Vines long pruned, in which the fruit canes are tied vertically to a tall stake, is one method used commonly in many vineyards. The unit of pruning consists of a fruit cane and a renewal spur. It is used with fair success with seedless Sultanas, and with some vine grapes, such as Colombar, Semillon, Cabernet, Reisling, in the hands of skillful pruners. The results with Sultanina are unsatisfactory. With this method, on many of the vines the fruit canes start from high up, near the top or the middle of the stake, and are, therefore, too short for the best results. The canes which start from low down are, in most cases, suckers, and are, therefore, of little value for bearing fruit.

The method of pruning with bowed canes is the same as for the vertical system of pruning. Bowing of the canes, however, overcomes some defects of the other method. This is used regularly by many wine grape vineyardists of the cooler regions, but it is unsuited for very vigorous vines planted in rich soil.

VERTICAL CORDON PRUNING.

In the system known as vertical cordon pruning, the vine is cut back to two buds, near the level of the ground, until a cane sufficiently long to serve for the formation of the trunk is obtained. In this system of pruning the trunk is from three to four feet long, instead of from one to two, as in head pruning. It may require a year longer to obtain this trunk—that is, at the end of the second season's growth many vines will not have a single cane sufficiently developed to give three and a half feet of well-ripened wood and properly developed buds. It will often be necessary, therefore, at the second winter pruning, to cut the vine back to two buds, as was done at the first winter pruning. When the cane of the required length is obtained it is then tied to the stake. At the end of the third season's growth the vine is pruned so that spurs are left at intervals along the trunk. Each of these spurs will be a fruit spur, and will also be the commencement of an arm. The future treatment of these arms will be the same as that of the arms in head pruning.

THE HORIZONTAL CORDONS.

In the system known as horizontal cordons, the vines are treated the first two or three years exactly as for the vertical cordon, that is, each winter they are pruned back to two buds, and growth is forced, by disbudding into a single cane during the summer. As soon as a well-ripened cane of the length required is obtained, the author states, it is tied to a wire stretched horizontally along the row at from fifteen to twenty-four inches from the ground. If the vines are pruned in this manner the rows should be twelve to fourteen feet apart, and the vines six to eight feet apart in the rows. As the trunk or cordon of each vine should reach the next vine, its length will be from six to eight feet. The best shape for this system of pruning is obtained when the trunk is formed in one year from a single cane. Sometimes, however, it will be necessary to take two years for the formation of this trunk. In every case, however, the cane first tied down should reach at least half way to the next vine. The following year the new cane from the end of this should be used to complete the full length of the trunk. Care must be taken in attaching the cane to the wire to bend it over in a gentle curve. Sharp bends should be avoided. The cane should be placed on the top of the wire, but should not be twisted around it, and the end tied firmly, the rest of the cane being supported by strings tied loosely, in order to avoid girdling. The following spring most of the buds on a good cane will start. Some of the shoots should be removed, if the cane is short-jointed, and only those shoots left which are conveniently situated for the permanent arms. For short pruning, arms should be developed from every eight to twelve inches from a few inches beyond the bend to the extreme end. For long pruning the arms should be from twelve to twenty inches apart. Shoots starting from the top of the canes and growing vertically are to be preferred. The strongest shoots should be pinched back continually during the growing season, because the weaker shoots will be forced. At the end of the season there should be from five to ten canes on each cordon of full length. These canes are then pruned back to two or three buds, or a little longer for half-long pruned varieties.

VARIETY PRUNING.

The author further states that in choosing any of the systems for pruning the characteristics of the particular variety which the orchardist is growing must be considered carefully. A variety which bears only on the upper buds must be pruned long. In general, grafted vines require shorter pruning than ungrafted. A list of varieties which require long pruning under all conditions, varieties which usually require long pruning, varieties which usually require short pruning, varieties which require short pruning under all conditions, and varieties of table grapes which usually require half-long or cordon pruning, is given in this bulletin.—E. J. V.

REPORT OF RESOLUTIONS COMMITTEE.

State Fruit Growers' Convention, Los Angeles, Cal., November 10-14, 1914.

Expression of Thanks.

WHEREAS, There have been gathered together for this meeting a large number of valuable addresses and discussions from which the people of the State of California will derive much lasting benefit;

Be it resolved, By the Forty-fifth State Fruit Growers' Convention, in convention assembled, that we hereby express our sincere thanks to the State Commissioner of Horticulture for his strong efforts in procuring this program and in carrying it through to a successful meeting. We would further express our appreciation of the part taken in the arrangements and program by the Citrus Experiment Station of the College of Agriculture. We desire, further, to thank all the speakers who have taken part in the various meetings.

WHEREAS, This convention has been very comfortably housed; and

WHEREAS, Everything possible has been done for its comfort, education and success, we do hereby express our deep gratitude to the committee of arrangements, and especially to Messrs. Messenger, Wood and Jones of Los Angeles, for their untiring efforts on our behalf. We would further express our thanks to the Los Angeles Chamber of Commerce, the city of Los Angeles and the management of the Hotel Clark for the many courtesies afforded us, for the music rendered at the convention, and to the nurserymen for their generous donations of potted plants.

Commission of Horticulture.

QUARANTINE SERVICE.

WHEREAS, The state quarantine service has been increased from six to eleven officers during the present administration; and

WHEREAS, The present force is beyond doubt far more efficient than ever before; therefore,

We do hereby commend the action of the State Commissioner of Horticulture in increasing this force and do express our utmost confidence in the present quarantine service.

THE RAKER BILL.

WHEREAS, The State Commission of Horticulture has recognized the grave danger of the introduction of injurious insect pests and plant diseases into California, through the medium of the mails and especially since the introduction of the parcel post; and

WHEREAS, A bill providing for the inspection of all horticultural products at certain points of entry into any state, which meets the approval of the state quarantine service, has been introduced into congress and is known as the Raker bill; therefore,

Be it resolved, That we do most heartily endorse said bill and urge its prompt passage; further,

Be it resolved, That a copy of this resolution be forwarded to each member from California in congress.

THE STATE INSECTARY.

WHEREAS, Mr. H. S. Smith, superintendent of the State Insectary, and his assistants have been working with great energy and care toward the establishment of new beneficial insect parasites; and

WHEREAS, Certain of these new parasites now appear in a very encouraging way; be it

Resolved, That we express our complete sympathy with this work and our confidence in Mr. Smith's ability, and do hereby urge the continuance of these efforts.

MONTHLY BULLETIN.

WHEREAS, The State Commission of Horticulture has adopted a policy of publishing a Monthly Bulletin which is filled with timely articles and information in a most readable form; and

WHEREAS, The appropriation by the state legislature for printing is insufficient to cover both this monthly publication and the complete proceedings of the conventions; therefore,

Be it resolved, That we do heartily approve the financing of the publication of proceedings through some outside medium, as is being undertaken for this meeting, and the continuance of the publication of The Monthly Bulletin.

STATISTICS.

WHEREAS, The State of California is at present expending a considerable sum of money for the collection of agricultural statistics through the office of the state statistician; and

WHEREAS, The sum of money now spent is inadequate when used in the present way for the gathering of reliable and complete data; and

WHEREAS, The State Commission of Horticulture is in position, through cooperation with the county horticultural commissioners, to gather this data more accurately and cheaply than any other organization;

Be it resolved, That we recommend to the California state legislature that the work of the state statistician be placed under the State Commission of Horticulture, and that the appropriation now granted for the compilation of data as mentioned above be attached to the commission's office for this purpose.

RURAL CREDITS.

WHEREAS, President Benjamin Ide Wheeler of the University of California has appointed a commission with Dr. David Barrows as chairman to prepare a measure to be submitted to the next California legislature providing for a system of state rural credits; and

WHEREAS, The farmers and fruit growers of the state feel deeply concerned in such measures, believing that if wisely enacted and properly administered they must materially add to the welfare of the commonwealth of its people; therefore,

Be it resolved, That the thanks of this fruit growers' convention be hereby extended to President Benjamin Ide Wheeler and to the commission appointed by him to prepare the desired legislative measures, and that hope is expressed by this convention that such measures will meet with the hearty and earnest support and consideration of the members of the coming legislature.

(Signed)

R. C. ALLEN, *Chairman*.
H. J. WEBBER,
E. H. PHREANER,
C. W. BEERS,
R. S. VAILE.

COUNTY COMMISSIONERS' DEPARTMENT.

WINTER WORK IN A PRUNE ORCHARD.

By G. H. Hecke.

The harvesting of the prune crop in Yolanda orchard is generally finished by the beginning of October. The orchard, a generous producer for a long number of years, is then ready to receive its compensation in the shape of stable manure, as far as such can be obtained from the corrals of the surrounding grain farms, or by hauling it from the nearby city of Woodland. Generally ten to fifteen out of sixty acres can thus be served every year. The balance would have to go hungry if we had not our experience to guide us in the planting of the leguminous cover crop. For this purpose we give the orchard a light irrigation to induce a quick starting of the seed of the vetch. The mixture that is used consists of two thirds hairy vetch and one third barley. Starting it by an early irrigation means that by November the ground between the trees is entirely covered by the growth of the cover crop, which will give an abundance of good humus in nitrogenous material to plow under in March.

The pruning is confined to an annual thinning out of the tops of the trees. We endeavor, in a general way, to reduce old substitute and encourage new growth. Particular care is exercised in the proper making of the cuts, and if a limb is amputated a careful covering of the wound with asphaltum "D" is necessary. Contract labor is never allowed in pruning, and we find that the native Spaniard, under the guidance of an American foreman, is making the most intelligent pruner available.

There is no scale in the orchard at the present time. The sixty acres of the twenty-three year old prune orchard, part of the Yolanda farm, was first infested with the European fruit scale in 1907. No control measures were adopted at that time, except the liberal introduction of its parasite, *Comys fusca*. Much valuable time was lost while experimenting with this parasite, which, for numerous reasons, failed to increase at the same rapid ratio that was characteristic of the fruit scale. Conditions in 1908-09 were closely watched and proved the total failure of *Comys fusca*. A partial control and check for the scale were begun in 1910, with a distillate spray. The years of 1911-12 again brought a rapid increase of the pest, and a thorough campaign of control was decided upon in the fall of 1913. With Mr. Geo. P. Weldon's assistance and advice the spraying operations were commenced in December, but, due to the heavy rains of the season, were not finished until March 1st, just before the blossoms of the trees were showing color. Several kinds of sprays were used, but the best all around satisfaction was given by the crude oil emulsion, used at the rate of thirty-two gallons of oil emulsion for the 200-gallon tank. The cost of spraying was from $1 to $10 per acre for material. The average amount per tree used was eleven gallons. This large quantity per tree was needed to give the perfect result of this spraying campaign.

This fall it is practically impossible to find any survivors of this scale on the trees, after thorough inspection. We consider that a splendid job was done.

THE COLORADO POTATO BEETLE IN GERMANY.

Translated from the German by G. H. Hecke.

Some disquieting things have spread these days from Northern Hanover throughout the land. The Colorado potato beetle has been found again. Since the year 1878 this dangerous leaf beetle has not been seen. Ten years before that period it had been first introduced from America.

In consideration of the danger of this insect to our local potato industry, in former years the broadest safety measures were taken, and our authorities succeeded in absolutely eradicating it by 1878. The authorities are now endeavoring with all energy to again exterminate this evil in its beginning.

The beetle was found first in three fields, located very closely to one another. In the mean time a new field, separate from the other fields, has been attacked, so that we may consider that this dangerous beetle has spread over further territories.

The authorities proceeded in this manner: The passing over attacked fields was strictly forbidden, even to the nearest land, and a watch was placed upon the fields. The following day the president requested military aid of the general commanding in that district, whereupon 300 soldiers, under the leadership of a sergeant, were immediately dispatched to hunt on these fields for the beetle, by order of the government commission, that had been summoned. Immediately the whole territory upon which the beetle had been found was surrounded with deep ditches the outer sides of which were saturated with coal oil. The potato greens were mowed, thrown in deep holes and covered with benzol. After the fields had been cleared in this way the soil was plowed about six inches deep and saturated with benzol. The owners of the potato fields received as compensation for the loss of the crop a sum that will pay them well.

The cost of having this beetle eradicated was particularly high, because it would multiply rapidly and cover large territories. So far the ground covered amounts to merely a few acres.

The authorities think that a banana importer was responsible for the importation of this beetle, as his merchandise was packed in material that was afterward spread out in the field.

ENTOMOLOGICAL.

THE PROGRESS OF SCYMNUS BIPUNCTATUS.

By Harry S. Smith.

The addition of any foreign insect to our local fauna is always of great interest. It is of especial interest when that insect happens to be a beneficial one. In June, 1914, a colony of several thousand adults of the Philippine ladybird was sent by the insectary for liberation at Alhambra by Mr. A. S. Hoyt. This insect, it will be remembered, is predaceous upon the citrus mealy bug and was obtained in the Philippines by the writer in the fall of 1913. As nearly as can be ascertained from descriptions, this is the same ladybird as the one brought in by George Compere in 1910, although the species was determined as *Cryptogonus orbiculus*, a very different insect, but superficially similar in appearance. Undoubtedly Mr. Compere should have the credit for discovering this promising species. For reasons unknown to the writer, the insect introduced as *C. orbiculus* did not become established, at least so far as any direct evidence is concerned. It is particularly encouraging then to be able to record that upon a recent visit to the site of the June colony referred to above, the little ladybirds were found breeding by the thousands upon the lemon trees where they were liberated. The trunk of one tree was on one side literally plastered with the white waxy larvæ of Scymnus.

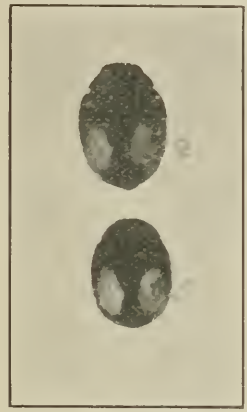

Fig. 118.—Adults of *Scymnus bipunctatus* Kugel. Enlarged (Original).

In the case of *Scymnus bipunctatus* Kugel., being a tropical insect, it would seem that the crucial test of its ability to establish itself in our fauna will come during the winter months. However, as the species is said to be widely distributed in the eastern palaearctic region, especially China and Japan, it ought to be able to adapt itself to our climate. Its progress will be watched with great interest and it would not be surprising if it became of considerable value in the control of *Pseudococcus citri*.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS FRUIT INSECTS.

The San Jose Scale.

The San Jose scale occurs throughout the entire state. It attacks the almond, plum, prune, peach, pear, and apple. The female scales are light gray in color, circular in form, and less than one eighth inch in diameter. Trunks and branches covered with the scale have a gray and rough appearance. The scales, however, are most easily detected on the fruit, which becomes spotted with small red circles which form around the scales. Scale infested fruit is unfit for the market. The millions of the tiny scales suck out the juices of the host and poison the tissues.

To control, use commercial lime-sulphur solution, 1 part in 9 to 11 parts of water, during the dormant season. Spray thoroughly, using a driving spray at a pressure of from 150 to 200 pounds.

The Italian Pear Scale.

The Italian pear scale occurs in Alameda and Napa counties and also in the Santa Clara Valley. The host plants are the pear, plum, apple, peach, and currant. The female scale is dark gray in appearance, circular or oval in form, and less than one eighth inch in diameter. It closely resembles the San Jose scale and is often mistaken for it. It works to a large extent, however, under the moss on the trunks and larger limbs, and therefore is not easily noticed.

Spray with distillate oil emulsion at 6 per cent strength, crude oil emulsion at 12 per cent strength, commercial lime-sulphur solution, 1 part to 9 parts of water, during the dormant period.

The European Fruit Scale.

The brown apricot scale, or European fruit scale, as it is often called, is common throughout the deciduous fruit growing sections of California. Its favorite hosts are the prune, plum, apricot, almond and pear.

The adults of this scale are from $\frac{1}{8}$ inch to $\frac{3}{16}$ inch in length, about $\frac{1}{8}$ inch high, yellowish brown in color, sometimes marked with black. The older scales are shiny, convex and oval.

In the early spring one will find the under sides of limbs and twigs thickly encrusted with this scale. It is at this time that they begin to develop into the adult form, after which they soon begin to deposit large numbers of eggs. The young scales emerge, settle on the leaves and begin to suck out the sap. They excrete a sticky substance known as honeydew. This honeydew, on infested trees, covers the foliage, fruit

and twigs, and furnishes a medium in which the black smut fungus works. This honeydew also collects large quantities of dust, resulting in the impairing of the leaf functions, and therefore the entire tree suffers. Honeydew covered fruit is unfit for use. Bulletin No. 80, part VIII, of the Bureau of Entomology, U. S. Department of Agriculture, by P. R. Jones, contains the following summary:

"Distillate oil emulsion at 5 per cent and 6 per cent strengths, with and without caustic soda; crude oil emulsion at 12 per cent strength, and resin soda wash are effective in controlling the European fruit Lecanium and in cleaning up the trees from lichens, and do not injure the trees when applied as a winter treatment.

"Caustic soda and creosote oil emulsion sprays control this scale and destroy the lichens, but are injurious to the tree.

"Lime-sulphur and borax sprays are not so efficient in controlling this scale, especially the European fruit Lecanium, as are the distillate oil and crude oil emulsions, and borax acts on the trees in the same way as does caustic soda.

"Distillate oil and crude oil emulsions appear to have distinct fungicidal properties aside from their insecticidal value.

"Distillate oil emulsions at 6 per cent strength and crude oil emulsion at 12 per cent strength, measured by their efficiency against scales and lichens, convenience of preparation and application, and cost, are the sprays best adapted for the European fruit Lecanium.

"The 6 per cent distillate oil emulsion will cost about 2½ cents for each prune tree and 3½ cents for each apricot tree.

"The 12 per cent crude oil emulsion will cost about 2 cents for each prune tree and 2½ cents for each apricot tree.

"All sprays, to insure the best results, should be applied with a power outfit at a high pressure (180 to 200 pounds). A coarse, drenching spray applied with crook nozzles is preferable, and February is the best month in which to spray."

The formulæ* for the crude oil and the distillate emulsions are as follows:

CRUDE OIL EMULSION.

Water	175 gallons
Liquid soap	3 gallons
Crude oil	25 gallons

Fill the spray tank with the water, add the liquid soap, agitate thoroughly, after which add the crude oil. If the liquid soap can not be obtained use whale oil soap, 20 pounds dissolved in 10 gallons of hot water, to which 3 pounds of caustic soda is added.

DISTILLATE EMULSION.

Distillate, 28° Baumé	20 gallons
Whale oil soap	30 pounds
Water	12 gallons

Dissolve the whale oil soap in hot water, add the distillate, agitate thoroughly while the solution is warm. For use add 12 gallons of water to each gallon of the above mixture.

*Injurious and Beneficial Insects of California, by E. O. Essig.

To destroy mites or lichens on fruit trees add 2 pounds of lye to the formula of the stock solution.

The prepared crude oil and distillate emulsions can be obtained from several insecticide dealers throughout the state.

PLANT DISEASES.

Shot Hole Fungus of Almond Trees.

The shot hole fungus of almond trees, as suggested by its name, gives a shot hole effect to the almond leaves. The young twigs are also sometimes spotted. If the infestation is serious, trees may be defoliated early in the season, the crop being badly damaged as a result. In order to control this disease spray with Bordeaux mixture, consisting of copper sulphate (bluestone), 5 pounds; quick lime, 5 pounds; water, 50 gallons; just prior to the opening of the buds in the spring.

INSECT NOTES.

Eulecanium robiniarium Dougl. is quite common on madrone at St. Helena, Napa County.—E. J. BRANIGAN.

Specimens of the **common bulb mite**, *Rhizoglyphus hyacinthi*, on onions, kindly determined by Mr. Nathan Banks of the Federal Bureau of Entomology, through the courtesy of Dr. L. O. Howard, were recently received from Mr. D. S. Boyer, of Thermal, California.—E. J. VOSLER.

Adults of *Hippodamia convergens* Guer., were collected in their hibernating quarters in the Feather River Canyon, in large numbers, November 15th. Two weeks previous to this date these ladybirds were seen flying in swarms through these canyons in the daytime, from about 10.30 a. m. to 3 p. m. It is unusually warm in this section of the Sierra Nevada Mountains for this time of the year.—E. J. BRANIGAN.

The steel-blue ladybird, *Orcus chalybeus*, introduced by Koebele from Australia, was observed to be very abundant in Santa Barbara County in November, feeding upon the black scale, *Saissetia oleæ*.—HARRY S. SMITH.

Chionaspis quercus Comst. was collected from the valley oak, *Quercus lobata*, at St. Helena, Napa County.—E. J. BRANIGAN.

The codling moth, *Cydia pomonella*, L., has been infesting English walnuts to a rather unusual extent in the vicinity of Carpinteria during the season just passed. Prof. H. J. Quayle is carrying on an investigation.—HARRY S. SMITH.

The English holly leaf-miner *Phytomyza aquifolii*, Gour., has been intercepted in the first shipment of holly received from Holland this year. The larvæ were very minute and had evidently hatched while in transit. As found by the writer the infestation was greatest near the base of the tree on the new leaves with a scattering infestation throughout the top.

Whether this insect has any economic bearing on shrubs or trees other than holly is not known to the author, but in the case of ornamental holly it seems to be of great importance as all infested leaves slowly decline and finally drop, which condition leaves the tree in an unsalable state.—L. A. WHITNEY.

The golden mealy bug, *Pseudococcus aurilanatus* Mask. has been seriously damaging the Araucarias at Pasadena this fall.—HARRY S. SMITH.

Pseudococcus citri is breeding in considerable abundance on one of the Carob trees in the vicinity of Santa Barbara.—HARRY S. SMITH.

One of the frog hoppers (Cercopidae) is abundant on madrone at St. Helena, Napa County.—E. J. BRANIGAN.

A small snout beetle, identified as *Apion cubicolle* by Dr. E. C. Van Dyke, was recently sent to this office by R. L. Gibbons, at Orangevale, who reported that it was found feeding on olives.—GEO. P. WELDON.

The adults of *Scudderia furcifera*, and *Schistocerca* sp., were common November 10th in the Feather River Canyon.—E. J. BRANIGAN.

Among the more or less serious insect pests intercepted by the members of the Quarantine Division in the performance of their varied duties this past summer, were two species of diptera, an anthomyiid *Atherigona* sp. and a syrphid fly, *Volucella obesa*, Fabr. These insects were found infesting squash and melons in ships' stores from Tahiti.

According to Dr. Aldrich, the first mentioned is a tropical genus and probably a bad fruit insect, having been reared from various fruits from Havana, Cuba, Cook's, Fiji and Hawaiian Islands. In addition to this record the first occurrence of the genus in the United States was recorded when the fly was reared from bell peppers intercepted at San Francisco by this division from Iona, Florida.

General Description.—Adult robust, somewhat smaller than our spinach or sugar beet leaf-miner *Pegomyia vicina*, with three well defined brown stripes on dorsum of thorax. Abdomen light brown with several dark brown to black stripes.

The last mentioned *Volucella obesa* is a large dark metallic green syrphid, which, unless closely examined, would easily be mistaken for one of the large Muscids. The genus as a whole are scavengers and in this case were probably a result rather than a cause. This insect is recorded from the southern United States, Colombia, Ecuador, Guiana, Asia, East Indies, etc.—L. A. WHITNEY.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF OCTOBER, 1914.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	60
Passengers arriving from fruit fly ports	3,159

Horticultural imports—

	Parcels
Passed as free from pests	63,755
Fumigated	788
Destroyed or returned	65
Contraband destroyed	11
Total parcels horticultural imports for the month	64,619

Horticultural exports—

Inspected and certified	2,984

PESTS INTERCEPTED.

From Belgium—

Aleyrodes sp., and *Thrips* sp., on Azaleas.

From Ecuador—

Chrysomphalus dictyospermi on rose plants.

From England—

Diaspis boisduvalii on orchids.

From Honolulu—

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Larvæ of weevils in sweet potatoes.
Hemichionaspis minor and *Chrysomphalus aonidum* on green cocoanuts.
Asterolecanium sp., *Saissetia nigra* and *Saissetia hemisphærica* on Hibiscus cuttings.

From Japan—

Larvæ of weevils in chestnuts.

From Mexico—

Lepidosaphes gloverii on limes.
Lepidopterous larvæ and *Calandra oryzæ* in corn.

LOS ANGELES STATION.

Ships inspected	34

Horticultural imports—

	Parcels
Passed as free from pests	90,293½
Fumigated	600
Destroyed or returned	14
Contraband destroyed	4½
Total parcels horticultural imports for the month	90,912

PESTS INTERCEPTED.

From Belgium—

Cerataphis latania on Kentia palms.
Eriococcus araucariæ on Araucarias.

From Central America—

Chrysomphalus scutiformis, Aspidiotus cyanophylli, Saissetia hemispharica, and *Pseudococcus* sp., on bananas.

From Colorado—

Cydia pomonella on apples.

From Honolulu—

Aspidiotus sp., *Chrysomphalus ficus* and *Pseudococcus* sp., on bananas.
Diaspis bromeliæ and *Pseudococcus* sp., on pineapples.

From Massachusetts—

Eriosoma lanigera on apple.

From New York—

Lepidosaphes beckii on citrus trees.

From Ohio—

Lecanium sp., on honeysuckle.

From Oregon—

Aspidiotus perniciosus on pear.

From Pennsylvania—

Chrysomphalus aurantii and *Eucalymanatus perforatus* on palms.
Pseudococcus longispinus on *Ficus* sp.

From Texas—

Parlatoria sp., and fungus on grapefruit.
Aleyrodes citri on jasmine.

From Washington—

Cydia pomonella, Lepidosaphes ulmi and fungus on apples.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	26
Passengers arriving from fruit fly ports	152

Horticultural imports—

	Parcels
Passed as free from pests	6,631½
Fumigated	¼
Destroyed or returned	------
Contraband destroyed	1¼
Total parcels horticultural imports for the month	6,633

PESTS INTERCEPTED.

From New Jersey—

Aspidiotus sp., on orchids.

From Central America—

Aspidiotus cydoniæ, Aspidiotus sp., and *Chrysomphalus scutiformis* on bananas.

EUREKA STATION.

Ships inspected 6
No horticultural imports.

ERRATA.

VOL. III.

No. 2.

Page 56, Medicago lupulina for lupuntina.

No. 3.

Page 119, Cineraria sp. for Ceneraria sp.

Page 171, Lepidopterous for tepidopterous.
Aphids for asphids.

No. 5.

Page 208, Under illustration, Greatly for Gretaly.

Page 220, Irbisia for Irbesia.

No. 6.

Page 241, Gray scale (*Coccus citricola*) instead of Longulus scale.

No. 7.

Page 293 and 294, Flour paste 4 gal. instead of flour paste 4 lbs.

Page 297, Napa County instead of Merced County.

No. 8.

Page 319, Guigne for Guine.
Page 340, Ortalidæ for Ortalididæ.
Page 341, Drosophilidæ for Drosophidadæ.

No. 9.

Page 360, W. V. Shear for N. V. Shear.
Page 370, Hyalopterus arundinis for Hyalopteris arundinus.
Page 380, in table, 225 trees instead of 25.

No. 11.

Page 476, October report instead of September.
Page 477, Aphis pomi for Aplus pomi.
Page 477, Precipitated sulphur for Lime-sulphur, in table.
Page 479, Oxycanthæ for orycanthæ.
Page 480, Eriosoma for Erisoma.
Page 487, Forest Tent Caterpillar for Western apple-tree tent-caterpillar.

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