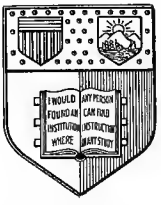

SPECIAL CONSULAR REPORTS.

OLIVE CULTURE

IN THE

ALPES MARITIMES.

REPORT FROM CONSUL BRADLEY, OF NICE, IN ANSWER TO A CIRCULAR FROM THE DEPARTMENT OF STATE.

ISSUED FROM THE BUREAU OF STATISTICS, DEPARTMENT OF STATE.

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OLIVE CULTURE IN THE ALPES MARITIMES.

REPORT BY CONSUL BRADLEY, OF NICE.

INTRODUCTORY REMARKS.*

I have the honor to send herewith my report on olives. The Alpes Maritimes produces more of them than any department of France with one exception, and probably now gives more scientific attention to their culture than any. It is decidedly the most important agricultural industry of my district. Since receiving the questions from the Department of State I have received letters from California, Texas, and Florida in regard to them.

For these reasons, and as I am somewhat familiar with the language, I felt it necessary to look into the subject with some care personally, and give something of the researches made by scientists of late years, particularly of M. Peragallo on the insects more or less harmful to the tree and fruit; of M. Gos on manures and pruning; and Mr. Brullé on adulteration. There is a great deal of adulteration of the olive oil, and Mr. Brullé finds it hard to gain recognition for his discoveries.

*This valuable report was received too late for insertion in "Fruit Culture in Foreign Countries."

IMPORTANCE OF THE OLIVE TREE.

Importance of the tree.—Mr. Gos, in his interesting little brochure on the regeneration of olive culture, says regarding the importance of the tree to the agricultural community:

> It is possible in this mild climate and near the sea to obtain in good soil from other plants that can be raised to perfection net products worth more than can be realized from the same extent of land planted in olives; but given identical conditions of soil nothing gives equal results. The soil it occupies would be without the olive left barren. It encroaches upon the territory of no other plant, and to dig it up is generally a bad speculation. The olive prospers and yields its oil, so highly esteemed, in calcareous, gravelly, dry, or arid soils in the narrow valleys of the "Alpes Maritimes," on slopes precipitous and water washed, which could not be used for the culture of annuals. It is, besides, a forest tree of the highest order, and its disappearance from our region would be a veritable calamity.

The olive covers about 70,000 acres in the department of "Alpes Maritimes," it yields a revenue of $2,000,000, and is the only income of many families.

VARIETIES.

There seems to be but two species of olive trees in the south of France: First. The Oleaster (wild olive), having a kind of thorn, very short leaves, and producing only a few small berries, which neither the Dacus nor the boring caterpillar will attack.

Second. The Sativa (cultivated olive), leaves lanceolate, fruit large, often attacked by the dacus. Seedlings of the sativa sometimes deteriorate so as not to be distinguished from the oleaster.

Varieties are as numerous as those of peaches or other fruits in the United States. From fifty to a hundred have been described and named in much the same arbitrary manner, with this perplexing difference, that the names are given in five or six different languages or dialects.

Mr. Barbe, sr., in his "Etudes sur les Oliviers," describes four varieties, as follows: The Blanquetier, which grows large, branchy, with light green foliage; the fruit is small, the pulp has at first a bitter taste, then a mellow after taste; the oil is abundant; it blossoms freely, but too often disappoints the hopes of the farmer for fruit.

The Blavier, which has a very rustic appearance, is very hardy; its fruit is oblong and comparatively large; the pulp is coarse, the oil deeply colored; the fruit is sensitive to cold.

The Arabanier or Araban is less rustic and less lofty than the last; its foliage is poor, the fruit round; the oil is of ordinary quality, better when made from fruit not quite ripe. This tree is hardier than either the Blavier or the Blanquetier, and resists better the effects of wind and frost.

The Cailletier, well known and popular for years past, grows tall; its branches hang low, the leaves are glossy dark green on the upper surface, nearly white underneath; the bark is rough and of a gray hue; the tree appears less green than the other varieties because of the disposition of the branches; the fruit, in clusters at the ends of the branches, is of good size, convex on one side, concave on the other; yields oil which is of superior quality in all points. This tree, also known by the characteristic name of Pendoline, thrives best in dry lands; at its best, its fruit sells for a third more than others for mixing with poorer qualities. It is a robust tree and can be severely pruned. Its greatest enemy is the Dacus oleæ or Keïron. Cattle, too, if pastured in the grove, must be kept from its low-hanging branches. Other good varieties for oil are the Nirvana, also called Noustrales and Brocienne; the Auriola, also called Pignola; the Nicoise, the Blanche, the Roberon, the Negrette, the Sager, the caillan, etc.

For preserving the Verdale, a large oval fruit, the Amenlean, the Lucques, a small variety with sharp pointed stone. The Poncinere, grown everywhere in the "Alpes Maritimes," the Calliache, too, and the Picholine are well liked.

WORKING AN OLIVE ORCHARD.

With the olive, however, as with our fruit trees, the best named do little if left to themselves; care and cultivation seem of even more importance than the name of the variety, although it is certainly advantageous to get young trees from groves which have made some varieties celebrated.

I would suggest for the commencement of a grove the Cailletier and Nirvana, or Noustrales for oil, and the Verdale and Lucques for preserving.

Propagation.—The olive is propagated readily by any of the methods in use among our fruit orchards. A Nicois farmer who wishes a new grove generally transplants wild young trees, planted by the birds in the woods, and when they are well started grafts upon them the desired variety. The wild stocks give hardier trees. For a long time it was thought almost impossible to cause an olive stone to sprout; but the fact that seeds, having passed the digestive organs of birds, sprouted readily enough, taught that only a thorough washing, to remove the oily substance which protects the stone from moisture, was necessary to produce the desired result; some, however, plant only the kernel. Cuttings from root or branch, well soaked for a day be-

fore being planted at a depth of 5 or 6 inches and afterwards watered, do well.

Planting.—Trees in an orchard should be at least 45 or 50 feet apart.

Cultivation.—It pays to work the ground lightly around the olive trees several times a year, not deep enough to break the rootlets, which are wide-spreading, but enough to let the moisture penetrate readily and destroy the weeds.

Manuring.—The question of manure is one of utmost importance, and for the double reason that elements taken from the soil by successive crops must be restored to prevent utter exhaustion of the soil and consequent deterioration of the crop and fruit, and that we may give strong appropriate food to the tree to increase the amount and value of the fruit. To accomplish all these ends analyses of soil, wood of the tree, leaves, and fruit at different seasons of the year must be made to find out what elements are needed. Here the authorities only differ as to amounts and frequency of application, some trying to produce a crop every year, others a crop every 2 or 3 years. Mr. Peragallo says, every 2 years in winter, before the rains, give each tree either 450 pounds of barnyard manure or 6½ pounds of guano; in odd years give them either fresh earth, soot, or plaster taken from old buildings.

Mr. Barbe says: Nothing comes amiss, from weeds, plowed under, to woolen rags, the latter preferred to almost anythiug, sometimes mixed with horn and old leather; this only needs renewing once in 6 years. To avoid generation of too great heat the rags, horn, or leather should not be buried deep nor close to the tree trunk.

Mr. Brullé, of the Nice Agronomic Station, has carried out a very complete series of experiments which space forbids translating in full. He says:

> Our final decision was that sulphate of ammonia and woolen rags were the best manures. The first increased the crop and fruit, the second produced a strong, healthy growth of wood and leaves necessary to the welfare of the trees. Forcing young trees with sulphate of ammonia must be done with care, for they can not produce wood enough to keep up the proper balance between the crop and growth of the tree.

He gives, finally, as a formula for young trees:

	Kilos.
Woolen rags	4
Chlorate of potash	0.350
Sulphate of iron	0.350

This amount to each tree.

For older trees in full bearing, the quantity for each tree as follows:

	Kilos.
Woolen rags	3
Sulphate of ammonia	0.500
Chlorate of potash	0.350
Sulphate of iron	0.350

In the two formulæ the sulphate of iron and ammonia should be put on in the spring, the rest in autumn.

The lectures that Mr. Gos, professor of agriculture at Nice, delivers to the farmers throughout this department on this subject are so full of interest that I give large extracts as follows:

"Hardy as it is, the olive tree is not an exception in the vegetable kingdom. It demands for the best results an abundant and appropriate nourishment, and its harvest is given in proportion to the amount of manure used; if the soil, as is often the case, is not provided with the elements which are indispensable to its welfare, the olive tree decays and its fruitfulness is checked. It is not to be denied that many groves live on exhausted lands, and it is often the case of those which formerly produced largely. Nothing is more logical and natural; it is not possible to obtain crops from a soil for an indefinite length of time without ever restoring some of its elements taken each year with the crop. The farmer who does not give back these elements, or, in other words, does not manure, robs his land, the consequence being unproductiveness and a gradual reduction in quantity and quality of the crop.

However, restitution to be equitable can not be left to chance. There are sundry kinds of manures, and the nature and quality of elements taken from the soil by an olive crop must be known. The chemical analysis without giving strictly accurate results affords useful indications. Mr. de Grasparin appears to be the first who was interested in this question, but his analyses are not complete. After him Mr. Audoynard, the erudite master of the agricultural school of Montpelier, published on the olive tree an excellent pamphlet giving very definite information as to the needs of the tree. He writes as follows:

"Plants, not excepting the olive tree, contain mineral principles which are found again more or less modified in their ashes after their combustion. The composition of these ashes does not show, it is true, the nature of the mineral compounds which are useful to the plant; but for some of them, such as potash and phosphoric acid, it can give useful indications. This induced me a few years ago to study the ashes of the wood, leaves, and fruit of the olive tree.

My analyses were directed at first to young stalks from 2 to 5 years old, with their leaves. They came from several varieties of olive trees in the environs of Nice. Collected in May, 1870, they were not burned to ashes until December. They had been left 7 months in my laboratory, the temperature of which varying from 15° to 25° and from 25° to 10° C., and had become very dry, the leaves breaking in the fingers. It is in that state that they were burned. The description of the results obtained is as follows:

Ashes of young stalks and leaves.

Varieties of olive trees.	Weight of the stalks.	Weight of the ashes.	Ashes per 100 of stalks.	Weight of the leaves.	Weight of the ashes.	Ashes per 100 of leaves.
Wild	217	6	2.70	58	4	6.89
Colomban (*a*)	135	4.4	3.26	114	5.2	4.56
Poncineri	91	2.5	2.74	81	4	4.94
Ordinary (*b*)	125	3.3	2.64	104	5	4.80
Sala	150	3.1	2	82	4.5	5.48
Total	718	19.3	.....	439	22.7	.....

	Ashes.
Average for 100 of stalks	3.66
Average for 100 of leaves	5.17

I afterwards analyzed the two varieties, *a* and *c*, and found the chemical substances as indicated in the following description:

Description.	Mineral substances found in 1 gramme of ashes of—			
	Stalks.		Leaves.	
	a	*b*	*a*	*b*
Carbonic acid (CO^2)	0.195	0.148	0.280	0.222
Phosphoric acid (PhO^5)	0.049	0.033	0.080	0.037
Potash (KO)	0.135	0.147	0.154	0.145
Lime (C_aO)	0.225	0.180	0.324	0.258

Those olive trees came from a calcareous soil and still their ashes do not show a large proportion of lime; the quantities of potash and phosphoric acid are below those generally found in the vine branches.

In taking the averages of the preceding numbers it is found that 100 parts of—

Dry stalks—
- Contain in phosphoric acid 0.10
- Contain in potash 0.35
- Contain in lime 0.50

Dry leaves—
- Contain in phosphoric acid 0.29
- Contain in potash 0.74
- Contain in lime 1.45

MINERAL COMPOSITION OF THE FRUIT OF THE OLIVE TREE.

It also seemed to me useful to find the principal mineral substances contained in the olive. I at first proceeded to the burning to ashes, which presents some difficulties. At the first exposure to fire the olives flame and are speedily covered with a white crust which stops the combustion; as this crust is soluble in water, a washing dissolves it. After two or three washings a perfect incineration is obtained, and this last product, with the residue of washing, composes the ashes. In following this method I got the following results for four samples of olives, three coming from a calcareous and one from a siliceous soil. I designate the

three first samples by the three letters, *a*, *b*, *c*, and the fourth one by *d*; the sample *c* came from wild olives.

The weight of the ashes of 1 kilogramme of olives is as follows: For *a* 20.77 grammes olives coming from Grasse; for *b*, 17.28 grammes olives coming from Biot; for *c*, 11.82 grammes olives coming from Biot; for *d*, 13.73 grammes olives coming from Biot.

I looked for the phosphoric acid, potash, lime, and magnesia contained in the ashes; the proportions found were:

Mineral substances contained in 1 gramme of olive ashes.

Description.	*a.*	*b.*	*c.*	*d.*
	Gramme.	*Gramme.*	*Gramme.*	*Gramme.*
Carbonic acid (CO^2)	0.140	0.158	0.100	0.128
Phosphoric acid ($Ph.O^5$)	0.072	0.064	.....	0.070
Potash (KO)	0.242	0.240	0.188	0.159
Lime (C_aO	Traces.	Traces.	Traces.	Traces.
Magnesia (m. G. o)	Very little.	Very little.	Very little.	0.004

There is then very little magnesia and lime; this, even for the olives grown in calcareous soil, appears to have stopped in the leaves, and not to have gone as far as the fruit. On the other hand, the olives coming from a calcarous soil contain more potash than those grown in siliceous soil; therefore it would be supposable that there is a kind of relation between the acids united to the lime in the leaves and the potash of the fruit; besides the potash appears to have a strong influence on the abundance and quality of the fruit.

I asked myself whether that potash belonged more to the stone than to the fruit. Thirty-seven olives (*a*) kept uninjured for 4 years gave 20 grammes of pulp and as much of stone; the pulp gave 0.596 gramme of ashes containing 0.185 gramme of potash, and the stones 0.482 gramme of ashes containing 0.138 gramme of potash.

The pulp thus contains a very large proportion of potash, and this fact appears to me to have a certain importance; in any case it is rather singular to find at the same time with an oily substance the alkali which apart could saponify it. If we take in 1 gramme of ashes an average of 0.070 gramme of phosphoric acid and 0.200 gramme of potash, we find that in 1 kilogramme of olives there is an average of 18 grammes of ashes containing 1.3 grammes of phosphoric acid and 3.6 grammes of potash.

CONSUMPTION OF THE OLIVE TREE IN NITROGEN, PHOSPHORIC ACID, AND POTASH.

A hectare of sloping or rolling land may contain 200 middle-sized olive trees, but only 125 on level ground. To calculate the yield an average of 150 of good-sized growth may be taken. The hectare giving on an average per year, 4,500 liters of olives, an olive tree will give 30. It is on an olive tree of this annual produce that we are going to estab-

lish our calculations. The weight of a liter of olives being 600 grammes the above olive tree produces 18 kilogrammes of olives.

Mr. de Gasparin admits that an olive tree loses yearly in leaves half the weight of the crop, say 9 kilogrammes.

Then the wood lost by accident or pruning may be estimated at a minimum of 5 kilogrammes.

The mineral composition of the wood must come near that given by the analyses hereabove indicated. As to the leaves analyzed, as they were still attached to the branches, they contain certainly more phosphoric acid and potash than the fallen leaves. In estimating the loss due to the leaves according to these analyses, a little overstatement will be found; but in the final result it will not amount to enough to note.

The olive tree producing yearly 30 litres of olives will therefore lose—

	Kilos.	Kilos.
In ashes—		
By its stalks	0.025.5	= 0.125
By its leaves	0.059.9	= 0.450
By its fruits	0.018.18	= 0.324
Total		0.899
In phosphoric acid—		
By its stalks	0.001.05	= 0.005
By its leaves	0.002.99	= 0.026
By its fruits	0.001.318	= 0.023
Total		0.054
And in potash—		
By its stalks	0.003.55	= 0.018
By its leaves	0.007.49	= 0.067
By its fruits	0.003.618	= 0.065
Total		0.150

As to nitrogen, according to Mr. de Gasparin, 100 kilogrammes of olives would contain 0.274, leaves 5 per 1,000; granting that the wood of the olive tree contains at least 1 per 100 of nitrogen, as the greatest part of other woods do, it will be found for the loss in nitrogen:

	Kilos.	Kilos.
By the stalks	0.000.5	= 0.050
By the leaves	0.005.9	= 0.046
By the fruits	0.002.7418	= 0.049
Total		0.145

Therefore the same calculation for 150 olive trees of same production contained in 1 hectare will give:

	Kilos.
In nitrogen	21.6
In potash	22.5
In phosphoric acid	8.1

It is seen by this discussion that the olive tree presents about the same consumption of necessary fertilizing principles as the vine. A part of its roots are spread out near the surface, the other penetrates

deeply when the subsoil is permeable. The olive tree then spreads out upon a cube of ground which may be sometimes very large. This explains how it finds, in the substances surrounding it and when left to itself, the conditions of existence for so long a time, how groves of olive trees may exist for thousands of years, and also how by culture, by a rational manuring, it is possible to assure the duration of that valuable tree and the abundance of its crops during a long period of centuries.

Knowing now the nature and the quantity of the elements drawn from the soil by the olive tree, it is well to look after their restitution by a good manure, the cost of which can be estimated from 100 to 120 francs per hectare.

In restoring all waste to the soil, the crop of the olive tree would not be exhausting it. The elements of oil are especially drawn from the atmosphere and water. What exhausts the soil is the enormous proportion of pulp, stones, wood, and leaves gathered with every crop without restoring the elements taken with them.

When the oil is extracted all residuum goes into industry without any thoughts for the soil which has supplied it. The olive husks, after complete pressing, feed the furnaces of the mills; the pulp is entirely lost, boughs from pruning are burned on the farms, nothing in short of what has composed the crop of the tree returns to the soil.

Agriculturists have for a long time had the custom of manuring almost exclusively with nitrogenous manure. In analyzing the composition and fertilizing value of the residuum of the olive tree, it would seem well to add some manures containing potash and phosphoric acid.

The following is the composition of the ashes of dead twigs coming from the pruning: Ashes of twigs of olive tree, per kilogramme, 270 grammes of coarse fragments (coal, earth, etc.). Per kilogramme of fine ashes: Potash, 55.780 grammes; phosphoric acid, 33.867 grammes. As shown above, Mr. Audoynaud having got per kilogramme of ashes potash 147 grammes, phosphoric acid 33 grammes, it can be concluded from the comparison of the two analyses that the potash disappears progressively in the vegetable organs in proportion as they come near their death.

This is now the composition of the residuum after the extraction of oil: Per kilogramme, water 763 grammes; dry substance, 237 grammes. Per kilogramme of dry substance, ashes 29.1 grammes; nitrogen, 22.2 grammes; potash, 0.3 grammes; phosphoric acid, 1.5 grammes.

According to these analyses the loss represented by not utilizing the ashes of the twigs is rather considerable in potash and phosphoric acid, and the residuum is worth nothing except for the nitrogen and for the organic matter capable of modifying advantageously the physical qualities of the soil. It must not be forgotten that this residuum contains always water and may conduce to maintain moisture at the foot of the trees. But the ashes of the twigs and the residuum are not the only losses

of the olive tree; the olive husks and the fallen leaves must be reckoned. Besides the soil must have its reserve of principle which can be supplied only by special manures as oil cakes, wool rags; they are manures containing nitrogen used periodically in careful culture. It would be well to add wood ashes not leached, sulphate of potash, and chloride of potassium. Fiually to complete the restitution it is well to use either excrements or urine diluted in water, bone powder, or phosphate of lime, being manures with a phosphoric-acid base. In appropriating to the application of such manure a sum of 100 francs per hectare, say 75 centimes per tree of good growth, the rules of good culture are followed, and after a few years the soil is supplied again with all the principles extracted by a long series of crops.

Amongst the manures of domestic animals, one of the most active for the culture of olive trees is that from sheep. It is first class manure when phosphate is added. Also to be recommended as cheap and economical manures are: Wool rags, old leather, horsehair, hoofs, bones, and horn scraps.

FORMULÆ OF CHEMICAL MANURES.

The following are some practical formulæ for the composition of chemical manures, to be used for the manure of 1 hectare or of 150 olive trees of good growth:

(1) Applicable to a soil poor in nitrogen: Sulphate of ammonia, 150 kilos; superphosphate of lime at from 30° to 32°, 200 kilos; triturated sesame oil cakes, 6 to 7 per cent. of nitrogen, 400 kilos; unleached ashes, 200 kilos; total, 950 kilos, or, say, from 6 to 7 kilos per tree.

(2) Applicable to a soil poor in potash: Nitrate of potash at 95°, 150 kilos; mineral phosphate in bone powder, 200 kilos; triturated sesame oil cakes, 300 kilos; crude pulverized sulphate of lime, 200 kilos; total, 850 kilos, or, say, 5 to 6 kilos per tree.

(3) Applicable to a soil poor in phosphoric acid: Phosphate of lime at from 30° to 32°, 400 kilos; chloride of potassium, 100 kilos; triturated sesame cakes, 300 kilos; soot, 200 kilos; total, 1,000 kilos, or, say, 6.5 to 7 kilos per tree.

These formulæ can be altered according to the composition of the soil; that composition can be known either by analyses in the laboratory or by analyzing the soil by the trees themselves; that is to say, in dividing the plantation in five nearly equal parts—1, 2, 3, 4, 5—and in manuring No. 1 with a manure without nitrogen, No. 2 with one without potash, No. 3 with one without phosphoric acid, No. 4 with a complete manure, and No. 5 being left to stand as witness of the results. These experiments require, to be useful, to be continued for 5 or 6 years at least, as the atmospheric circumstances have a notable influence on the fruitfulness of the olive tree; serious errors might follow if the experiments were made during 1 or 2 years only. For this reason the

direct analysis in the laboratory is to be preferred; it prevents the loss of time.

Circumstances which have influence on the nature of manures.—When plantations are in the vicinity of towns, near railways, or highways there is often an advantage to use town manures as excrements, industrial products, or dung coming from stables or cow houses in manuring frequently and in small quantities.

When they are far from populous centers and from railways or highways, the preference must be given to wool rags, old leather, horn scraps, horsehair, hoofs, bones, and sheep's manure in manuring abundantly every 4 or 5 years. Commercial chemical manures, as well as olive cakes, which with little weight contain a considerable quantity of useful substances, are also to be recommended when the carriage of the manure is expensive.

Manure with undried plants.—In the plantations far from highways, and of difficult access, the culture around the trees of plants of prompt growth, as broad beans, white lupinus, vetches, Madia sativa, etc., is useful; they are buried undried. They are not very nutritive, but as they take from the atmosphere the greatest part of their nourishment, they do not exhaust the soil of its mineral principles, and, therefore, return more than they take. Their physical influence is considerable; they disintegrate the ground and give to it more permeability; buried during the spring, they maintain, at the foot of the tree during the strong heats, a moisture much more advantageous than the waterings.

Composts.—It is not to be forgotten that the spontaneous vegetation of many untilled lands may abundantly supply plants which, after having been previously crushed by the feet of horses, can be put in water-tight pits, mixed with mold, straw fragments, leaves, lime, ashes, any part of dung or excrements produced on the farm, and give, after fermentation, a compost of a real value, worth much more than its cost price.

Time of manuring.—Manure of a slow decomposition, as wool rags, old leather, horn scraps, horsehair, hoofs, old rubbish, cow-house dung, and composts are advantageously spread in autumn. They receive then the rains of the winter, which facilitate their disintegration, check their fermentation, and render easier assimilation by the roots. The more these manures are disintegrated more is their action beneficial.

As to the very soluble manures, as excrements, dried night soil, poultry excrement, guano, and all commercial manures generally which contain much organic nitrogen, it is better to apply them in winter time.

Finally, the sulphate of ammonia, chloride of potassium, and especially nitrates, manures very soluble in water, are to be spread in preference during the first days of spring.

Mode of spreading manures.—Whatever their nature, manures must be buried over the whole extent of ground occupied by the roots. It

is known that the roots spread all the further from the foot of the tree as the soil is poorer and less deep. Theory as well as practice require, then, the spreading of the manures on a circle, the diameter of which equals the length of the longest horizontal branch of the tree.

The depth to be covered depends upon the nature of the manure. Commercial nitrogenized substances and chemical manures must be much divided, mixed previously with earth, and not deeply covered.

As to composts, wool rags, not decomposed manures, a circular ditch is dug about the tree, 30 or 40 centimeters deep, at a distance from its foot varying with the horizontal length of its branches; in this the manure is placed in layers 5 centimeters thick and covered with the earth taken from the ditch.

It is indispensable not to spread the wool rags in too thick layer, for if the spring was too dry a fermentation might supervene which would raise the temperature of the soil and injure the roots.

Time for manuring.—In considering a biennial crop, which is recommended for the advantage of the agriculturists, the manuring must take place in the course of the winter which precedes the year of production and directly after the pruning; the tree, cleared from its suckers and dead wood, receiving fully air and light, copiously manured, is put in a good condition for producing new wood which will be loaded with fruits the following year.

HARVESTING THE CROP.

The olive tree flowers every year, and there are those who advocate an attempt to gain a yearly crop; but the majority are content to try to get a good crop every two years. The trees bud in May and flower in June.

Olives to be preserved green are picked in September, those destined for oil from November until the following May; but the best results, to crop and tree, seem to follow harvesting near midwinter when the olive is black, though oil made from olives gathered as late as February and March is preferred for its keeping properties. The main reasons for early harvest seem to be that the insects have less chance to propagate, and that new shoots, which are to bear the fruit of the following year, have not started, and are thus safe from injury during harvest.

The farmers in this neighborhood, many of them, spread sheets under the trees and knock the fruit down with poles, injuring fruit and tree in so doing. It is a bad plan, made necessary by neglect of proper pruning.

The harvest is gathered largely by Italian women who come into France for that purpose; they are paid by the quantity gathered, boarding themselves.

OIL MANUFACTURE.

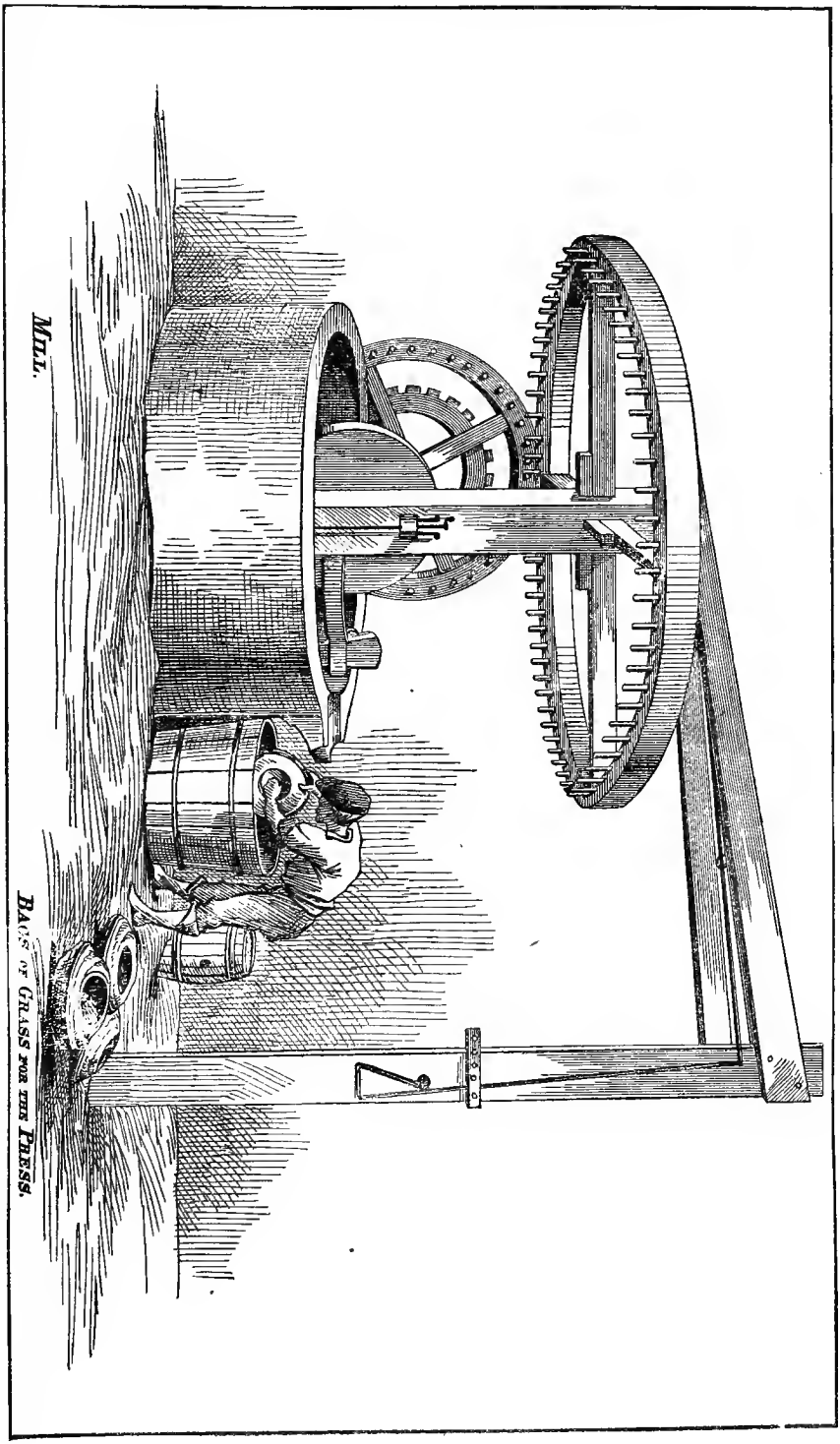
Oil mills.—The olives being gathered, the farmer here either takes them to the mill at once if he sells to the miller by weight, or spreads them in the sun or granary to dry out some of the moisture if they are simply to be ground by weight for his own benefit. The olive seems to lose no oil until the humidity is taken out; but water hot or cold, or still better, oil, must be added to olives too dry, to cause their oil to flow.

The mill in use to-day to crush the olives differs little from those used for centuries. I visited one near Nice early in November, when the crop was just beginning to arrive (see sketches of the mill); the olives were poured into an enormous stone bowl from the center of which rose a large wooden shaft crowned with a large wheel; in the rim of the wheel, pointed downwards and regularly spaced, were strong oak pegs for cogs; these met similar pegs or cogs in the power wheel, which was turned slowly by an overshot waterwheel; attached to the up right shaft, forming an acute angle with its lower end, was a large millstone exactly the shape of a large grindstone, the edge bevelled to match the slightly concave bottom of the great bowl; from the side of the upright shaft, opposite to the great millstone on the end of a short horizontal shaft, was a scraper which fitted the inner side of the bowl. When the mill starts the olives in the bottom of the bowl are crushed by the stone, those forced up the inner sides of the bowl as the great stone revolves, are scraped off and drop back under the stone until the mass is reduced to an oily paste; this paste shoveled out was packed into flattish-round woven-grass bags, which were taken to the presses; these are simply rough heavy frames fitted with large screw presses worked by hand; the bags are piled up in single piles, like so many cheeses, on the wide oak slab forming the bottom of the frame, the presses are screwed down upon them with a hand bar, exactly as our house-raising tacks are screwed up; the oil drains into tubs placed to receive it, when boiling water is poured over the bags to help the flow, and joins the oil in the tub; the oil rising to the surface of the water is skimmed off with very large tin skimmers.

Mr. Brullé, director of the agronomic station of Nice, has invented a mill which, as it crushes the pulp, extracts the stone and throws it out; this allows, according to Mr. Brullé and other authorities, the oil of the pulp, the true virgin oil, to be obtained from the press without any mixture of that from the stone or kernel.

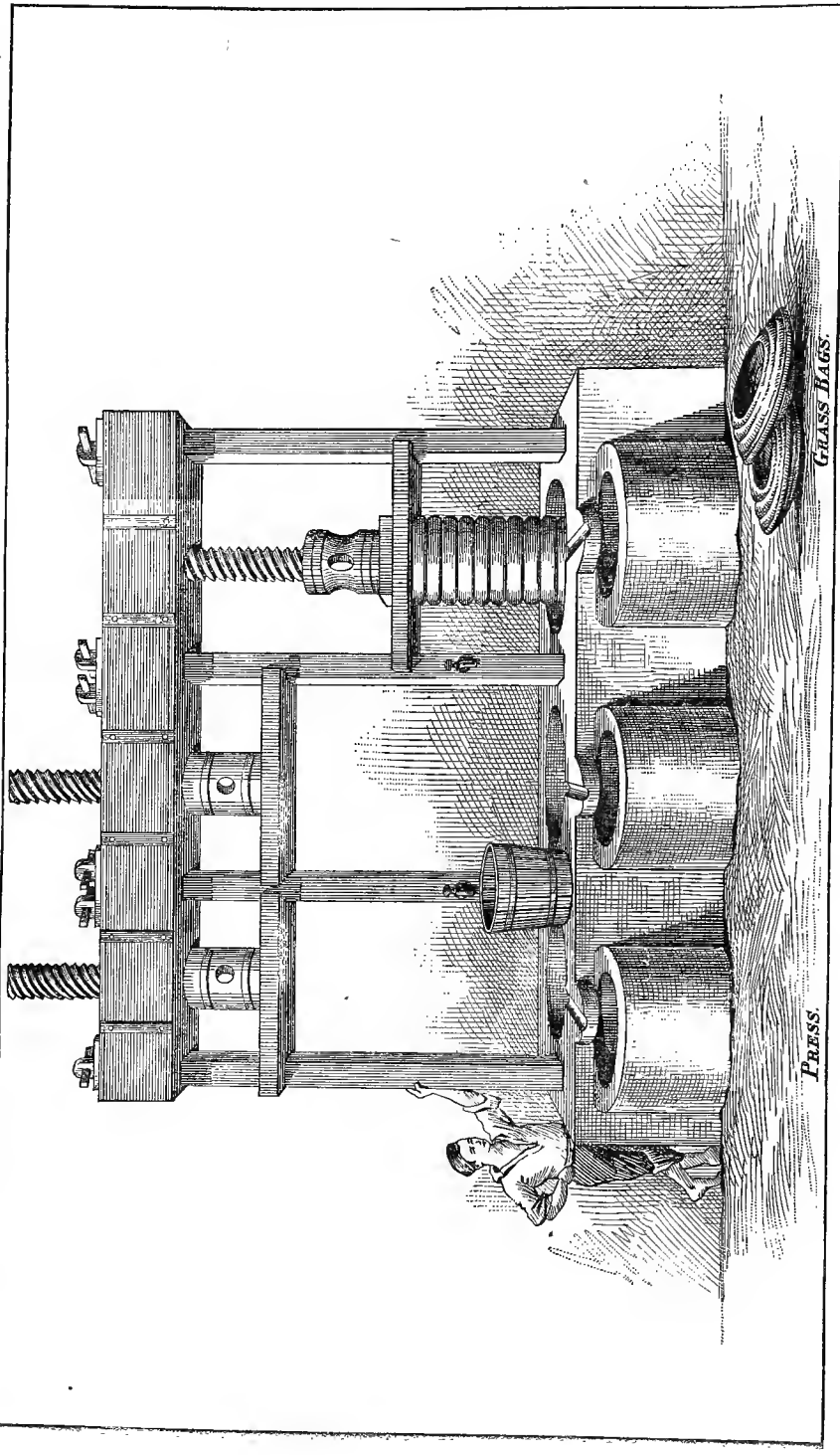
The people of these warm, olive-raising countries are slow to adopt new ideas, so Mr. Brullé will have to wait some time before seeing his new labor-saving (to say the least) invention supersede the clumsy, old-fashioned methods which are used now, because the ancestors of the people used them.

Virgin oil.—Many people talk about virgin oil, but such a thing can not be found by the ordinary consumer. It requires so much care and



Mill.

Bags of Grass for the Press.


GRASS BAGS.
PRESS.

attention to prepare this oil that it is only to be found in the house of a farmer who has a mill and prepares this oil for his own use. Olives are taken when only three-quarters ripe; these are all selected free from any blemish; they are taken immediately after they are gathered to the mill where they are but slightly crushed, so that the pulp alone comes in contact with the millstone; the seed must not be touched, for though the kernel contains a certain quantity of oil, it is, as connoisseurs know, rather acid and has not as fine a taste as the oil from the pulp. This pulp having been crushed without the addition of water, either hot or cold, is gathered in a heap, the center of which is made hollow in the shape of a funnel. The oil flows by itself from the inner sides into the center of the reservoir, from which it is taken with a large ladle. The oil so prepared is greenish in color, its perfume is exquisite and it can be kept for many years.

First-quality oil.—For oil of the first quality, called "cannon oil," the olives are placed in the mill without addition of water if the fruit is freshly gathered. The oily paste is placed in bags made of clean esparto, and submitted to the press. In mills with more modern improvements hydraulic presses are used.

Second-quality oil.—To obtain oil of the second quality, and in order to extract from the pulp all the oil which it contains, they throw the contents of the bags into a vat which is full of cold or warm water; the whole is well stirred up, the broken fragments of the seeds fall to the bottom, while the pulp floats, this is gathered and replaced under the press. Some pour boiling water over the bags the first time they are put under the press; this simplifies the labor, greatly increases the yield, but reduces the quality.

After all the usual means of extracting oil from the pulp have been employed, 10 per cent. of oil can still be obtained by using bisulphide of carbon.

Oil yield.—The best oil is undoubtedly obtained from olives not fully ripe, for too ripe fruit gives oil which is heavy and without perfume. Risso says that 100 kilogrammes of sufficiently ripe and sound olives ought, in a good year, to yield 20 kilogrammes of good oil and 4 kilogrammes of inferior quality, and in bad years only 10 of good oil and 2 of inferior.

Olive refuse.—After the oil is extracted the skins and refuse are employed in heating boilers, the muddy substance found at the bottom of the most inferior quality of oil is used as manure, and last of all the broken stones or "grignons" make a very excellent fuel, which has the advantage of not giving off any carbonic-acid gas as charcoal does. Fraud is found in the oil mills, as everywhere else. Should the olives be moldy, which often happens when they have been gathered or kept in bad condition, the bad taste is hidden by adding leaves of wild olive trees to the pulp. Others even go so far as to throw seed oils over the pulp while it is being ground, so as to get a perfect blending with the new oil

Keeping oil.—To keep oil in good condition needs great care and attention; the clear oil ought to be separated from the turbid at once, for the longer the oil remains on the lees the more apt it is to contract a rancid or a bad odor. When the oil has been decanted several times, as the needs may be, filtered through dry moss, carded cotton, sand, plaster, charcoal, etc., it must be stored in a place which is sheltered both in summer from the heat, and in winter from the cold.

Restoration.—Oil must be kept in vessels, which close tightly, and are made of a substance on which oil has no action; these precautions are indispensable, for the effect of the air on oils is too well known not to be guarded against; they absorb oxygen very rapidly and soon reach a condition which renders them unfit for food. They can be restored nearly to their original state by warming them with the addition of alcohol and washing them afterward, but they become much paler in color, without any strong taste or odor. Limewater in equal proportions can also be used, or 25 centigrammes of caustic potash per kilogramme of oil.

The best way to obtain a lighter color in very dark oils is to mix them with oils which are nearly white.

Oils when exposed to the cold become congealed; a gentle heat will restore them to their original state. On the surface of congealed oils is found an essential oil, which is employed on the pivots of watches by watchmakers.

Proving the oil.—Mr. Brûllé, the director of the agricultural station at Nice, has, during the past 2 years, perfected two methods of proving the purity of olive oil as well as the quantity and kind of oil used in adulteration. The first process is a quantitative analysis of which the following is a translation:

PROCESS BY ILLUMINATED NITRIC ACID.

The process consists in submitting the suspected oil to the action of nitrous vapors produced by the action of nitric acid upon dry albumen.

(The cubic centimeter equals a gramme of distilled water.)

Operation.—Take a test tube, put in it 0.1 gramme of albumen powdered, 2 cubic centimeters of nitric acid and 10 cubic centimeters of the oil to be tested; heat gently over the alcohol lamp so that acid and oil keep the same temperature. When the acid boils, incline the tube over the flame in such a way that by the ebullition albumen and oil may be thoroughly mixed; this will be accomplished when a movement of particles is apparent facilitating the dissolving of the particles of albumen which give off shining vapors as they dissolve.

If the oil analyzed is pure olive oil, the color of the mixture is pale yellow with a greenish tinge, while olive oils adulterated with seed oils, (even 5 per cent.), take a clear yellow color which varies from pale golden yellow to orange, and even to red, according to the oil used in adulterating.

To get the best results, after having examined the mixture in its heated state, plunge the test tube into ice water, and in about 2 minutes examine again. When the contents are congealed the traces of the oxidization of the mixture by the nitrous vapors upon the inner side of the tube are more apparent.

The reaction of Mr. Brullé is very sensitive; it permits to detect as little as 5 per cent. of cottou-seed oil in the olive oil; with 5 per cent. of cotton-seed oil the color of the mixture will correspond exactly to 100 parts water, 5 units of Naples yellow, and 5 units of dark chrome.

Given prepared samples of oil with exact amount of adulteration known, it is easy to decide the amount of adulteration in any sample offered with the help of this reaction.

As the proportion of adulterating oil increases, the colors become more intense. Fifty per cent. of cotton-seed oil would give a precipitate of a color to correspond with 100 parts water, 5 units Naples yellow, 5 units chrome yellow, and 5 units of vermilion.

It is to be noted that when other oils, such as sesamum, are joined with the cotton-seed oil in an adulteration, the fraud is as easily detected, but not the amount of cotton-seed oil, as the sesamum oil tends to change the vermilion red to deep orange.

The following mixtures of pure olive oil and 10 per cent. of adulterating oils gave the following results: Olive oil, pale yellow greenish tinge; olive oil, 10 per cent. cotton, vermilion red; olive oil, 10 per cent. groundnut, golden yellow; olive oil, 10 per cent. sesamum, golden yellow, pale; olive oil, 10 per cent. beechnut, dark red; olive oil, 10 per cent. poppy seed, golden yellow pale; olive oil, 10 per cent. nut, yellow orange; olive oil, 10 per cent. cotton and sesamum, dark orange; olive oil, 10 per cent. cotton and groundnut, golden yellow, bright. The observer, by comparison, will readily detect 5 per cent. of adulteration by any of these oils.

SECOND PROCESS.

QUALITATIVE ANALYSIS.

Process based upon the curious effects produced by nitrate of silver upon oil.

Operation.—Treat 10 cubic centimeters of oil with 5 cubic centimeters of nitric acid in a porcelain capsule, heating and shaking thoroughly at the same time until it foams. Different colors are obtained according to the oil used. We pay no attention to this, but letting the capsule cool, we add 5 cubic centimeters of a solution of nitrate of silver (25 per cent.) with alcohol of 90°.

If we continue the heat, then comes a moment, at about 115° C., where the nitrate of silver is suddenly decomposed and deposits the metallic silver upon the inner sides of the capsule. The heat is continued far enough to cause the first luster to disappear, and on tapping

the capsule lightly, we observe on the one hand on the inner sides the color of the thin oily coating, on the other the metallic luster playing on the surface of the liquid. To tell then whether the oil is pure or adulterated we turn to the following table:

Oils.	Colors (natural state).	
	Oily coating.	Metallic luster.
Olive	Olive green	Green.
Cotton	Green	Ash green.
Sesamum	Chrome green	Sevres blue.
Groundnut	Greenish yellow	Emerald green.
Poppyseed	Olive green	Green, light blue.
Camelina	Persian lake	Light blue.
Flaxseed	Dragon's blood	Emerald green.
Rape seed	Persian lake	Cyprus green.

Second operation.—Examination by saponification of the oils. It sometimes happens that by the first operation the kind of oil used in adulterating is not clear; in that case proceed to saponify the mixture.

For this purpose 20 grammes of an alcoholic preparation of caustic potash is dissolved in a larger quantity of 90 per cent. alcohol, not, however, exceeding 100 cubic centimeters. Add 20 cubic centimeters of this solution in a test tube to 10 cubic centimeters of the oil to be tested, shake thoroughly, and heat in a water bath to 92° C., leaving it in the water 20 minutes. Empty the contents of the tube into a porcelain capsule holding say half liter; fill it with boiling water, adding 50 cubic centimeters of a 20 per cent. solution of sulphuric acid.

After shaking decant the acidified water, again add boiling water until, after several decantations, the last traces of sulphuric acid have gone.

Treat the oil thus obtained by the first operation to get a different set of colors as per the following table:

Oils.	Colors (saponified).	
	Oily coating.	Metallic luster.
Olive	Orange of Mars	Cyprus green.
Cotton	Sienna	Cobalt violet.
Sesamum	Golden yellow	Do.
Groundnut	Persian Lake	Light violet.
Poppy seed	Golden ochre	Blue.
Camelina	Dark chrome	Do.
Flaxseed	Black	Green.
Rape seed	Burnt carmine	Ultramarine blue.

In these tables the names of colors are those of water colors, which are the same everywhere.

PRESERVING.

According to location the olives for preserving are generally gathered by hand when they are still green, in September or October, depending on the locality; they are thrown into tubs which are full of water

and in which a certain quantity of soda of salicornia has been dissolved. The salicornia and "salsola" of the Chenopodiaceæ family grow naturally on the Mediterranean coast. When burnt their ashes contain a great quantity of excellent soda, which is used in glass and soap manufactories. These plants can be sown on lands that have been overrun by the sea so as to absorb all the soda the sea has left on the soil. The olives are left in this bath 3 or 4 days, when they soften and at the same time are pickled; then they are placed in small casks with water, salt, and aromatic herbs. The olive is ready for eating when the stone is easily separated from the fruit. Another way to preserve them is to pour over the olives water with ordinary ashes rendered caustic by the addition of a little quicklime; after staying some days in this mixture they are placed in other tubs of clean water, which is changed frequently; to this water is added muriate of soda and aromatic herbs.

When the olives to be preserved are quite ripe the blackest and finest are chosen and exposed to the sun for several days, salt is sprinkled over them, and they are then put in oil.

There are some varieties of olives which when perfectly ripe can be eaten as they are in their natural state.

The olive tree, evergreen, bears its fruit on the wood of the preceding year, and never twice at the same place; sprouts readily from the trunk and becomes a vigorous tree. With rational pruning it gives a regular, abundant, and early crop.

PRUNING.

In regard to pruning, I can not do better than draw largely on Mr. Gos, who seems to agree with the majority of authorities. He says:

"Pruning is most important and requisite; it regulates the production of fruit and improves its quality, making it larger sized and the crop more abundant. The opinions of the agriculturists as to pruning do not agree; some maintain that the olive tree must be sparingly pruned, as it is the small boughs which bear fruit; some say that it wants a vigorous pruning, as it bears its fruit only on the new wood, and that to have new wood it is necessary to prune vigorously; others think that every variety wants a distinct system of pruning. All these opinions have no serious basis, and generally come from special cases. What occasions those differences of opinion is that in practice three distinct cases are present, viz:

(A) Trees never having been pruned.

(B) Trees not having been pruned for a long time.

(C) Trees having always been regularly pruned.

The system of pruning being unchanged, the method of application only is different, and it is well to examine closely the operations necessitated by the above three cases, two of them being, as regard culture, pathological cases, the last one only being a normal case, on which it is possible to study methodically the pruning that the olive tree requires.

(A) Trees never having been pruned: Those trees are of course full of wood; they have many confused branches, few boughs lower down, and very picturesque form, not at all favorable for the production of fruit. In these conditions some abundant crops may be obtained, but they are very irregular; further, the tree is a complicated mass of exhausted branchlets, which are the shelter of numerous parasites. To bring these trees to a regular production some agriculturists would, prune radically, leaving only the stem and the principal branches, but it would be better to pull up the trees or not to prune them at all than to have them submitted to such amputation.

When one wishes to submit an olive tree which has never been pruned to a rational pruning it is well to proceed gradually, and to avoid revolutionary prunings, because in years of dryness or of severe cold the greater part of the trees might be destroyed.

The best method of pruning is as follows:

Cut off the top at a distance from the ground equal to the greatest diameter of the tree; although the sacrifice of the tops is often distressing it must be done, and the branches cut off will soon be succeeded by new ones more productive and in better form.

Clear the inside of the tree, suppress the vertical branches which follow the direction of the stem, take off the dead wood and all that hinders the climbing of the pickers into the tree; let every leafy part receive air and light, which are indispensable to good fructification; suppress the branches too close as well as the unhealthy ones, or those which have not sufficient room to grow; clear the shoots about the tree, spare the branches which hang towards the ground as the branches of the weeping willow do.

This pruning will not bring fruit in the same year; more often it is not until the fourth year that the tree bears fruit; during that time and every spring it will be well to nip off the shoots which would have a tendency to rise above the new top, and during the summer prevent the growth of any suckers, which pruning encourages.

Five or six years after the application of the above pruning the olive tree gets again a regular production, and its fruit is larger sized, earlier, more abundant, and less accessible to parasites; in fact the tree has passed from a wild to a domestic state, and will have to be pruned as the trees having always been regularly pruned.

(B) Trees not having been pruned for a long time. The first needful operation in such plantations is the clearing up of the trees; they generally are too close to each other, and therefore want air and light; their roots steal nourishment from each other, and a multitude of parasites live on their drooping branches; one out of three, sometimes two out of three, must be dug up; the trees left will be in better condition and can be easily brought into good order. After the clearing up, all dead or unhealthy branches are to be cut off, so the tree will live easily, its nutrition not be hindered, and it can have room to spread. After these

two operations the trees will have to be pruned as those having always been regularly pruned.

(C) Trees having always been regularly pruned. The aim of the pruning is:

First, to give to the tree an agreeable shape in accordance with the laws of production of the fruit.

Second, to draw to the extremity of each twig and leaflet the sap which circulates in the plant.

Third, to get large-sized, savory, and early fruits.

Fourth, to save the tree from the dry winds and the rays of the sun.

These aims can not be reached by an irrational pruning; the physiology of the tree must first be studied. Amongst the fruit-bearing trees, some, as the vine, bear their fruit on the wood of the year, some, as the pear and apple tree, bear their fruit only on the old wood; finally there is found, in olive and peach trees in particular, a form of intermediate vegetation. Mr. Riondet says on this head:

A branchlet appears this year and is covered with fruit next year; the part which has given flowers and fruit will not again do so, but it can grow for some years until it is fully exhausted and be succeeded by a new branchlet, which grows at its base. The pruning of the peach tree, based on the principle of the annual substitution of a new branchlet on the old one, was brought to remarkable perfection in the environs of Paris and especially at Montreuil; any form you may desire can be given to the peach tree, and, in the hands of a skilled gardener, all branches stand every year completely filled with flowers and fruit. The branchlets of the preceding year blossom and bear fruit; but a careful nipping prevents their becoming wood boughs, and brings forward the formation of a new branchlet for the following year; in this way the peach tree is always provided with new boughs and may, during many years, give regular and abundant crops.

The olive tree has just the same form of vegetation as the peach tree, with the sole difference that it easily puts forth new branchlets on its old wood, and this is sufficient to explain the short life of the uncultivated peach tree, while the olive tree is almost imperishable. It is well always to bear in mind that the olive tree blossoms only on the wood of the preceding year, but that it can, always and from all sides, put forth new branchlets.

After having applied the common principles of pruning, sharp pruning on the side of the strongest growth, light pruning and vertical cutting on the weaker side to preserve proper proportion among the branches, after having hindered the spreading of the suckers, and after having suppressed them when some have sprouted; after having cleansed the interior of the tree by clearing it of the too abundant shoots, and thus secured the free circulation of air and the action of the sun in all parts of the tree, it is not good to apply the radical pruning spoken of above.

Mr. Riondet says:

The pruning of the olive tree is only the clearing of the tree of the branchlets which, after having grown during several years, and after having successively borne fruit on all parts, begin to be exhausted and to dry up.

The trees are to be pruned after the crop; they put forth then new branchlets which, the following year, will give flowers and fruit; in the course of spring and summer the shoots are to be cut off and the vertical branches of the top nipped off if possible. Is the olive tree to be pruned often? A yearly pruning will give a yearly crop; after the crop (the fruit being as much as possible picked by hand and not knocked down with a pole) all boughs which have borne fruit are to be nipped; new branchlets will grow, but this will not hinder the tree ripening its fruit; a well-cultivated and well-manured tree may have at the same time the power of giving nourishment to the fruit grown on the branchlets of the preceding year and of producing new branchlets, or of letting the old ones grow longer to prepare the crop of the following year. However, a biennial pruning is to be preferred; it is true that it only brings a biennial crop; but it has for effect the suppressing, one year out of two (as we shall see further), of the means of existence of the most destroying parasite of the tree, the Dacus oleæ. Furthermore, even if that parasite did not exist, it would be rational and especially economical to have one year destined to the production of wood and the following year to the production of fruit.

What is the shape to be given to the olive trees? The goblet shape is the most simple and the easiest to be formed and kept up; it is applicable to all varieties of trees; it allows air, light, and heat to circulate among the branches, reduces the work of pruning and facilitates the gathering; where the trees have a tendency to grow too large, it is well when they are young to commence the goblet form in order to maintain proper proportions.

Lower and drooping branches must not be cut off, as they give fruit abundantly when they receive air and sunlight; to cut them off would be a loss, for the lowest parts of the tree are the most fruitful, more easily reached at harvest time.

Proper means to regulate the production of the olive trees.—The trees being well tilled, no other plants cultivated between the rows, a careful pruning of the older twigs after the harvest every two years should be sufficient to keep them in vigorous bearing.

Recapitulation in the order of questions supplied by the State Department:

1. The verdale and lucques are suggested among many for preserving.

2. The cailletier and nirvana are probably as good as any for oil.

3. Names and descriptions are given on sheets 2 and 3 of manuscript.

4. The trees above mentioned are grown within a hundred miles of the sea, and from the shore to at least 2,000 feet above the sea level, on hilly and rolling ground, exposed to the southern sun where possible.

5. The questions of climatic influence were quite fully treated in the portion of the report devoted to oranges and lemons.

6. There is no regular system of irrigation.

7. Cultivation by hoe or plow several times a year. Sheet 3 of manuscript.

8. Vigorous pruning beneficial; keep the tree low and of goblet shape. Sheets 25–28 of manuscript.

9. Harvest for oil is gathered from November to May. The earlier the better. For pickling green, in September or October. Sheets 16–25 of manuscript.

10. Trees begin to fruit at from 4 to 5 years.

11. Average yield per tree may be placed at 30 quarts. Sheet 9 of manuscript.

12. Trees should be planted 40 to 50 feet apart. Sheet 3 of manuscript.

13. The tree is propagated as any common fruit tree. Sheet 3 of manuscript.

15. See Bibliography.

16. For account of all the latest researches on insects see the portion of report on the Enemies and Friends of the Tree. The chief malady, the "Morpée," was minutely described in the portion of report referring to oranges. (See Fruit Culture in Foreign Countries.)

ENEMIES OF THE OLIVE TREE.

There is no tree known to have more enemies than the olive; they attack the wood, the blossom, the leaves, and the fruit.

These foes do not include the cold and the fogs, both of which are very injurious to this sensitive plant; great drought and warm winds are also detrimental to its welfare. The olive tree has to bear the attacks of certain mammifers, certain small birds, and insects of nearly every description.

(1) Mammifers.

In certain localities young trees must be guarded against the teeth of rabbits and against cattle. The field mice (*Mus sylvaticus*), are great consumers of olives; but as they only attack fallen fruit, which ought to be considered as unfit for oil, I consider them as very trifling culprits.

(2) Birds.

Among birds of medium size there are some which feed on the olive itself; these are the thrush (*Turdus musicus*), the black bird (*Turdus merula*), the starling (*Sturnus vulgaris*), the magpie (*Pica melanoleuca*); others feed on the almond or kernel; the *Coccothraustes vulgaris*, and the *Loxia curvirostra*. One can say that birds in general are fond of olives; but as the appetite of the smaller kinds, such as the warbler, the robin red breast, figeaters, the wren, etc., is very quickly satisfied, and as they devour a much greater quantity of insects than fruit, one should class them among the friends of the olive tree.

The thrush and the black bird consume a very large quantity of olives; there are certain parts of the country in autumn where these birds literally swarm; they seek among the olive trees their resting-place for the night, and before roosting they partake of their evening meal; this operation they do not perform in silence, far from it, for from far away one can hear their noisy chatter; it is to these birds that we are indebted for the wild olive tree which grows in the forests; they are therefore of some utility; but can this be compared to the enormous damage they do? I do not think so; therefore the farmer who comes with his gun to disturb the feast of these devastators can not be blamed.

The *Coccothraustes vulgaris* and the *Loxia curvirostra*, which must not be confounded one with the other, both belong to the families of

sparrows and conirostres. Both are birds of passage, which rest wherever they find abundant food; they emigrate towards the Mediterranean about the month of November; they are heavy stubby birds of the size of a large sparrow; they have great strength in their claws and in their beaks; they use them for opening pine cones and the stones of other fruits so as to get at the kernel; both these birds are prejudicial to the olive harvest in this sense, that they attack the fruit in order to get at the stone, out of which they extract the kernel; the *Coccothraustes vulgaris* specially is very wasteful, for every olive which he may eat he plucks fifty; therefore one can not declare too severe war against them; they are easily distinguished from other birds by their size and by their call, which is not very shrill.

The starling ravages the olive trees that are in the neighborhood of marshes. Lastly, the magpie, which is almost unknown in the Alpes Maritimes, eats olives wherever found.

(3) Insects.

I have said before that the olive tree has to fear nearly all insects; among the Hymenoptera, the ants (*Cremastogaster scutellaris* and *Camponotus pubescens*). Among the Coleoptera, *Phlœotribus oleæ*, or Neïron; *Hylasinus fraxini; Cionus fraxini; Peritelus Schœnherri*, and *Cremissi; Othiorhynchur meridionalis; Ghilianii* and *oleæ; Apion galactitis*, and others of the same species, etc. Among the Neuroptera: The *Termite Calotermas flavicollis*. Among the Hemiptera: *Phlœothrips oleæ* of Targioni (or black worm or Barban); *Euphyllura oleæ* or *Psylla oleæ*, and several cochineals (*Lecanium oleæ, Aspidiotus villosus, Mytilaspis flava, Pollinia costæ, Philippia follicularis*), etc.

Among the Lepidoptera: *Pray's oleellus* or miner caterpillar is really dangerous; *Margarodes unionalis*, the caterpillar of which is dangerous for shoots and for the graftings; *Zelleria, oleastrella Boarmia umbrasia, Metrocampa honoraria*. These three last species attack more particularly the wild olive trees.

Among the Diptera: *Dacus oleæ*, or Keïron. The list is a long one; I shall start with the

Hymenoptera Ants.

(1) *Cremastogaster scutellaris*.—I had at first, after reading Laure, placed that ant essentially southern among the friends of the olive-trees, but since arguing the point very seriously with two of my colleagues of the entomological society, I have been forced to alter my opinion, and obliged to bring down this insect from the pedestal on which I was disposed to let it remain.

One of these colleagues was kind enough to give me a description of the *Cremastogaster scutellaris* taken from nature; I will now render his account, which I am, to my great regret, obliged to curtail;

The head of the male insect is round and short; the mandibles are large; the maxillary palpi are of 5 articulations; labial palpi of 3; antennæ of 12; the thorax is rather compressed; it is armed with two thorns, which diverge a little; the first articulation of the petiole is flat; the second is nodiform and hollow above a longitudinal groove, rather deep, which divides it in two parts; the abdomen is united to the petiole, not by its fore side as in most of the other ants, but by its antero, superior part, which is nearly heart-shaped; generally this insect is black and the head bright red, the leg brownish red; sometimes the thorax and the petioles are also red; length 3 to 5 milimetres.

These cremastogasters advance in a file along the olive trees, carob trees, and other trees. Laure says that they are in search of the scars that the Dacus has made in the olives in order to deposit its eggs; the former is hunting for these eggs. It is certain that this ant has an object in wandering over the trunk and leaves of the olive tree; but it is not at all proved that these insects are any help against the invasions of the Dacus, for the female of this dipteran, when depositing her eggs in the olive, makes an insignificant wound in the fruit, and the larva is too deeply sunken in the latter for it to be possible to be got at by the ant. The cremastogaster could, if it were in any way carnivorous, attack the fly when, still weak, it leaves the olive.

It is far more likely that they are hunting for cochineals peculiar to the olive trees, not to destroy them, but to utilize them for their own benefit. This is what this insect does, according to the opinion of Mr. Ernest André, who has made a special study of the ant: The *Cremastogaster scutellaris*, says he, is far from frequenting specially the olive tree; it is found on other trees of entirely different natures; its object is to look for the plant-louse and the cochineals, of which it delights to suck the liquid dejections. The case described by Laure is void of any foundation, and quite contrary to what is known about the habits of the ant.

The visits which the cremastogaster pays to the wounded olives are simply to suck the juice which may by chance run out, for it is proved that the ant cannot mastigate its food.

One of my colleagues goes further and says that the ants not only furrow galleries under the bark of trees which are detrimental to them, but carry their love for the plant-louse and the cochineal so far as to pick them up from the soil where they may have fallen accidentally, and carry them back to the tree where they find their food.

It is therefore useful to look after the nests of the cremastogaster under the trees or under their bark, and to destroy them when found.

(2) *Camponotus pubescens.*—It is a large black ant which abounds on the trees attacked by the Morfée; this insect evidently comes to lick the Lecanium oleas. The camponotus seems to live in good understanding with the cremastogaster.

COLEOPTERA.

(1) *Chlosotribus oleæ.*—This insect is a Coleopter, of the ravaging family of the Xylophagans, and is known in these regions by the local names of Neïroun, Neïron, Courcoussoun, Babarotte, Charençon; in Italy it goes by the name of *Tunteruolo dell'olivo.* This is its scientific description: Length, 2 millimetres; of blackish tint, covered with a greyish down; the head is indented; the mandibles are projecting; the face is flattened and finely dotted; the antennæ are in proportionate length with the size of the insect; the last articulation is divided in three leaves of unequal size, having the shape of a rake, of reddish tint, and bristled with hairs of a special type, showing their connection with the great family of Lamellicorus; the body is convex, narrower in the fore part than the hind, round on the sides; elytra convex, very dotted, ornamented with 10 very prominent striæ, bristling with red hairs; the body is thick set; the legs are brown. The Phlœotribus has under its elytra membranous wings which it uses readily. This insect is considered after the Dacus or Keïron, of which I will speak later, the most injurious insect to the olive harvest. It attacks the tree itself while the Keïron attacks only the fruit. It not only does harm to the tree by injuring and weakening its fruit-producing branches, but by the shelter which its abandoned holes give to the Phlœothrips or black worm, in which the latter deposits its eggs and where it goes through its various transformations; therefore every one ought to do all that is possible to destroy them entirely.

In 1826 Professor Risso mentions, without giving any detail, an insect which he denominates "*Cionus destructor;*" it seems to me to be the same *Phlœotribus oleæ.* In 1843 the engineer Bertrand mentions three insects which must have some analogy with the Phlœotribus; the Scarabee of the olive-tree which attacks only dead wood, which seems to be the "Apate sex-dentata," of which I will not say anything now; the "Bostriche," which is the Hylesinus; and lastly the "Vrillette" of the olive tree, which seems to me to be no other than the Phlœotribus for the very reason of the characteristic division of the enlargement of its antennæ in three branches. The author adds that the larva nourishes itself on the alburnum of the tree and lives on the small branches which it kills. In 1848 Bompar of Draguignan gives more ample details than his predecessors; he exposes the errors made by Amouroux and Bernard, and makes mistakes himself by stating that the Phlœotribus is born and lives on the olive tree, that it rarely flies, and that it feeds rather on the dry wood of the olive tree than on its young and tender shoots. He even goes so far as to say that it might very well originate from the sap when in fermentation in the wood separated from the tree, and ends by putting this singular question: "Is the germ ambient?"

Dr. Martineng, of Grasse, published in 1863 and 1864 two reports on

the Neïron, in which he gives a summary of the very judicious remarks of Mr. Bernard, proprietor at Chateauneuf. I have read with a great deal of care Mr. Martineng's notes and have compared his with mine and have arrived at the conclusion that Mr. Bertrand was correct, and what great service his observations might have been to the agriculturists had they only been followed! The following is an analysis of the reports of Dr. Martineng showing wherein our observations differ:

There is not a single olive farmer who does not know, or who has not observed that small insect, the size of a millet seed, which measures but 1 millimetre from its head to its abdomen, burrowing to deposit its eggs under the bark of the branches which have been cut off in pruning at the end of the winter or early spring. These branches are in a very short time pierced all over with small holes, rendered noticeable by a yellowish dust, which is thrown out by the insect while establishing its interior galleries.

Mr. Martineng continues: The branches preferred by the Neïron are those of medium size, where the bark is soft and thick and preserves for a longer time than the smaller ones moisture sufficient for the development of the eggs. It is easy to observe that the eggs deposited in too small branches do not mature.

It has been noticed that the insect only attacks the branches which have been pruned between January and July, for branches cut off after this period and placed in the same conditions as those pruned in the spring are not covered with Neïron.

That observation, which in my opinion is open to discussion, has certainly one use, viz, to show the advantage or disadvantage of keeping the branches which have been cut off anywhere near the olive-tree plantations, also what is the proper period for pruning the trees.

Messrs. Bernard and Martineng divide the existence of the Neiron in two very distinct phases, the laying of the eggs in the newly-cut branches and the damages caused to the tree itself. It gnaws the soft bark that surrounds the young shoots which bear the next year's harvest, and very often perforates through and through the young branches; it seems to select the angle formed by two shoots, choosing generally the part opposed to the direction of the rain and avoiding the north exposure; its galleries are not deep and it abandons them willingly to go and form others in the vicinity.

The Neïron lives all the year round on the olive tree, except at the time of laying its eggs, in the boughs cut off in pruning. This operation begins at the end of the winter and lasts 45 to 50 days, sometimes till the month of June. It is very likely that the parents die as soon as they have secured a shelter for their progeny.

Mr. Bertrand was of opinion that the female insect produced the larva directly itself, but Mr. Martineng has corrected this error.

It is useless to explain at length that the female Phlœotribus, being fecundated, deposits its eggs in small recesses, often very numerous, which both insects, male and female, have excavated in the galleries they have tunneled, and that these eggs are covered over with the dust of the wood, which they resemble in color and size. It is for this reason that they have escaped Mr. Bernard's observation.

One can see, adds Mr. Martineng, the young larva start, on leaving its birth place, to perforate the branch in its length, piercing galleries in a line more or less perpendicular to those made by its parents. By the middle of July all larvæ have changed into Neïrons, and one only finds in the branches either dead or imperfect larvæ.

As soon as the insect is perfect it perforates the bark from within, escapes to the trees, and commences its ravages.

Are these ravages real? Can they be attributed to the Neïron? Messrs. Bertrand and Martineng say so, and I, for my part, certify that I have observed them many times and have shown their work to many agriculturists, who only notice the loss of their olives year by year due to the Keïron or Dacus, but take no measures to protect their trees from this real danger threatening them.

It is the Neïron, continues Mr. Martineng, which undermines the young shoots and causes them to dry up and fall. Does this insect lay its eggs on the live tree? That point has not yet been solved, adds the doctor.

Nearly all authors seem to agree that there is only one generation of Phlœotribus oleæ per annum, and that that generation takes birth exclusively on the wood that has been cut down; hundreds of these insects have died in my glass cases after having lived in them for weeks, and after having caused very visible damage to the young olive branches placed with them. As I said, these insects died without sexual connection, and therefore without having prepared a second generation. In my observations I have not noticed on the branches of young trees the trace of secondary galleries indicating the work of the larva; we can not perhaps conclude from this that the insect hatched in June or July and which has gone through its different metamorphoses in 50 or 60 days, only remains until the following spring before satisfying the laws of procreation. Bernard, Campanio, Bompar, and others admit of several annual generations, and the following I translate from the "Anuales d'Agriculture" of Florence, published in 1879. It is the most thoughtful and recent document which I have found on this subject:

The honorable Baron G. Ricasoli sent in 1877 from Valdarno and from the province of Sienna, to the entomological society of Florence, and this society also received in 1878 (April 20) of the agricultural meeting of Perouse, young olive branches in which were confined a few female insects of the first generation of the *Phlœotribus oleæ* (*Puntevuolo dell olivo*), engaged in perforating their galleries and in depositing the eggs of their summer generation, so fatal to the branches that bear blossom, and so preparing for a third and fourth generation to create havoc in the harvest of the following year.

There can, therefore, be in the course of a year several generations of Phlœotribus oleæ, either in the wood that has been cut off or on the branches which have been attacked on the tree. This would show the necessity of fighting against the most important of these generations, the best proven in my opinion, the one found on the wood cut off in pruning which we have at hand, and which offers us a way, if not of destroying the enemy completely, at least of reducing its numbers materially.

Mr. Companio, of Perpignan, is the only one to my knowledge who has spoken of a parasite of Phlœotribus oleæ, which he describes under the name of Locusta arachnoïda (arachnoid grasshopper), and of which he gives a rather singular illustration; it is possible that in the "Pyrenées Orientales" the Phlœotribus has a parasite, or rather an enemy; but though I have made numerous researches I have failed to find anything similar in these regions.

From what I have said it is certain that when the pruning season comes, viz, the end of the winter or in the spring, one must separate in two lots the cut wood of medium size and the small branches, which must contain more or less Phlœotrips, Cochineals, Psylles, of which I will speak later; these ought to be burnt at once, and the larger branches and limbs, which must be thoroughly investigated so as to find out whether the Neïron has attacked them. Twenty days after, when one can have sure proof that the larva is living and working, the best thing is to burn all this wood that has served as a trap, or if one wishes to keep the wood, one ought to singe it well and take off the bark, or to leave it for several days under water, then dry it and place same in a dry place, hermetically closed, and as far as possible from any olive plantation. If the limbs cut off be burned, it is advisable to do so at night, as in so doing one has a chance of destroying many moths and Tineidæ which are detrimental to the olive tree.

As for the wood which is cut from July to the winter, the small branches particularly are full of living Phlœotribus and Hylesinus, many Phlœotrips and caterpillars also, and must be burned immediately; but one can use the larger wood which does not, at this time of the year, serve as nests; it is nevertheless advisable to look it over from time to time should it be in vicinity of any olive plantation. Personally I should like this wood treated in the way above mentioned.

Mr. Martineng, who arrived at conclusions very similar to my own, ends his report by a remark made by Mr. Funel de Clausonne, chairman of the Society of Agriculture of Nice:

> Many persons, says Mr. Funel de Clausonne, appear surprised to see the Neïron leave the living tree to attack the branch which has been separated from it. The Neïron lays its eggs in the spring when the trees are turgid with sap. It could not work and lay its microscopic eggs in the living bark where the current of sap was in constant motion ascending and descending.

The damage caused by the Neïron to the olive trees was known imperfectly by the mayor of Pelissanne, for in 1857 this magistrate, acting in accordance with the laws of 1831 and 1837, made decree in order to fight the ravages caused by the insect named by him "Barbarotte." He ordered the immediate removal of all cut wood into a far-away shed, or the same to be burnt. This measure, though incomplete, showed, it is said, very good results.

In 1878 the Society of Agriculture of Nice gave, in its pamphlet entitled "The wood of the olive tree," excellent advice to the oil farmers.

I have one objection to make; that is, they recommend the immediate removal of the wood which has been cut off; by leaving for 20 days or so the heavier wood where it fell, the purpose in my opinion would be better attained.

The *Phlœotribus oleœ* or Neïron is therefore a coleopteran, a relation of the weevils, it is true, but belonging to the family of the Xylophagans, while the Thrips, or Phlœothrips, called in these regions black worm, or "Barban," is a Hemipter Thysanopter; they are insects of size, shape, nature, and habits essentially different; their only similitude is their propensity to injure the olive trees.

Hylesinus fraxini.—The *Hylesinus fraxini* seems not to be very well known by agriculturists in general, who mistakes it for the Phlœotribus, or Neïron. It has been little studied by authors who have wrongly described its mode of living and the damages it causes to the olive tree.

It is said that this coleopteran causes its ravages while still in the state of larva, that the female whilst pregnant chooses a branch upon which it deposits its progeny, which can be detected by reddish or greenish-gray spots which appear where the attack has taken place. My observations, on the contrary, show that the Hylesinus behaves in a manner very similar in every way to the Phlœotribus. It is at the end of the winter or early spring that the Hylesinus follows the Phlœotribus onto the cut wood; like the latter, it operates in couples; but while the Phlœotribus attacks the medium-sized branches, the Hylesinus chooses the heavy wood as being more fit to protect its larva, and makes its hole generally in the rough parts, more often near the spot where the previous year a branch has been cut off, where the wood is dead. The couple or pair work in a manner identical to that of the Phlœotribus and deposit, like it, their eggs in cells arranged along galleries; the larva works lengthways of the wood; when matured into a perfect insect it regains the living tree, where it forms galleries, which have not a very great depth, and chooses the spot where the young branches are attached to the tree, thus causing their decay.

The Hylesinus fraxini is less thick-set than the Phlœotribus, less dark and more varied in color; its elytra are longer than their width and have 6 striæ. Its principal distinction from the Phlœotribus is that its size is double that of the other, and that its antennæ, instead of being terminated in three unequal branches like a rake, are ended by a mace in the shape of a heart. The larva is in proportion for size with the insect; it is curled in half circle, larger in the fore than after part, apodal, whity and regularly wrinkled, while that of the Phlocotribus is much smaller in size, deformed, irregular, and with a large head.

The ways of destroying this insect are the same as those recommended for the Phlœotribus, and as this insect chooses from preference the rough and dead parts it is advisable to cut off as far as possible these refuges from the living tree; therefore, in keeping not only the trunk but the

branches in a very clean state one will be able to destroy a great quantity, not only of Phlœotribus and Hylesinus, but also of Phlœothrips; of this latter I will speak later on.

The result of my observations is that the Hylesinus is to the Phlœotribus in number and proportion as 1 is to 10; but as it is twice the size of the latter, and as its wounds to the living tree are in proportion to its size, it may be considered as very injurious.

Cionus fraxini.—The olive tree has still in the family of Coleoptera another enemy all the more dangerous as it only attacks the shoots which would bear fruit, the young trees, and the grafts, which it rapidly strips of their leaves.

I was able to study all the transformations of a curculionida which in the state of a perfect insect, as well as when a larva, caused in 1865 and 1866 in Nice and its neighborhood real injury to the young olive trees. This insect, which was the Cionus fraxini, appears in April after having most likely spent the winter under the bark, and deposits its eggs on the leaves of the shoots, or of the young trees.

The larva is yellowish, sticky, attacks the white of the leaf, the under part, which it eats in irregular spots without touching the bright green surface.

After 10 or 12 days this larva has attained its full maturity; it selects a leaf and, uniting under itself the two extremities of its body, forms itself into a ball, loses its yellowish tint, its stickiness, turns to a gray color, then white, dries up and becomes transparent. After 24 hours one can only notice a perfectly oval-shaped shell, in which the larva, deprived of its coat, spins freely; one can see it (with the assistance of its mandibles) thickening, rounding, and polishing its abode, which takes an amber tint; it has accomplished these transformations by coating its body with a slimy substance which is excreted by a retractable nipple situated on the upper part of the terminal segment of its abdomen; this substance allows the insect to attach itself to the leaves or to protect itself from the rain or sun. When in the state of a nymph it takes a rest, and prepares itself for its last transformation, which takes 8 or 10 days; then the insect perforates its shell with the aid of its rostrum, cutting an exactly spherical segment.

Then the Cionus spreads on the leaves, which it devours in the same way as the larva, or on the edges; they pair, then fly to the summit of young trees, which they prefer. Here is the scientific description of the *Cionus fraxini:* Centennæ, tawny; proboscis, or trunk, cylindrical and curved, brown at its basis, black at extremity; head, grayish-brown, with the upper part blackish; corselet narrower than the elytra, of a brownish-gray, with upper part blackish; elytra of a whity gray, with small striæ not very distinct, dotted with brown and gray; sometimes there is a large black spot alike on both elytra, which extends from the base to the center; under part of the body covered with dark-gray scales; feet tawny; thighs dentated on the under side.

The male is smaller than the female, its rostrum is shorter; the markings on the elytra vary much in both sexes; as soon as hatched they seek one another and commence mating, which is not the habit of the Phlœotribus nor the *Hylesinus fraxini*.

It is in its perfect insect state that this one of the curculionidæ causes the most damage; its appetite not only leads it to devour the leaves upon which it walks from end to end, making a mark a millimetre wide, but it digs its rostrum into the soft and tender shoots, which are full of sap, making wounds which infallibly cause the loss of both flower and fruit which their shoots were to bear. I have noticed that from April till the end of July there might be two seasons of laying, and that the first was always deposited on the young shoots or grafts; the best way I can suggest to fight against this enemy is to shake the young shoots over an open umbrella, reversed so that by the shaking the insect would fall in the receptacle thus prepared; the leaves could also be examined, when it is easy to detect the larva in the act of preparing its abode for the purpose of its various transformations. The larvæ of the Cionus fraxini are attacked by several species of Hymenoptera; the larva, stung by the Hymenopter, depositary of its enemy's egg, continues its existence and becomes food for the parasites, which transform themselves into a small chrysalis, of a metallic black color, admirable in shape. Of 10 cocoons, 5 have given birth to Hymenoptera.

Peritelus Schœnherri.—This coleopteran belongs essentially to the south ,and is of the family of the Curculionidæ; it attacks the young shoots, in the center of which it settles itself; its transformations take place in the ground, and it is most likely also in the earth that its larva finds its food, either on the roots of the olive tree or of some other plants. The fact is that I never found this larva on the tree, but in May the perfect insect is often found on the young shoots which wither under its attacks. The *Peritelus schœnherri* is a pretty insect, silvery gray, of slender form, and is in size a little larger than the Cionus. The following is its scientific description:

The case of the prothorax and elytra cut square (this is the distinctive sign of the species); shield-shaped spot dark; size regular, about 5 to 6 millimeters long; color, silvery gray, with sometimes a yellow or bronze hue, which forms a darker longitudinal band upon the elytra; rostrum short, as long as the head; antennæ gray, pubescent, oval, terminated in a point; prothorax cylindrical, slightly depressed on the upper side; elytra slender, oval, cut square at the case, terminating in a point, nearly flat on the back, convex toward the end, which turns down; striæ fine distinctly dotted; legs small; forelegs ending in hooks rounded on outer edge; female slightly convex underneath.

The relative large size of this insect, its silvery color striking against the tender green of the shoots make its capture easy; it can be caught by hand or by shaking young shoots and grafts over an open umbrella.

Peritelus cremieri, more numerous than the preceding, like it, but smaller, plumper, less silvery; rostrum thick and a little longer than the

head. *Othiorhynchus ghilianii* (Fairmaire) and *Othiorhynchus Oleæ* are mentioned as hurtful to the olive in Italy; but they have not been seen in the south of France.

Othiorhynchus meridionalis.—Bompart mentions the *Othiorhynchus meridionalis* as injurious to the olive tree. The head is long in shape, antennæ elbowed, body black and hard; at Toulon it bears the name of "chaplum." This insect is nocturnal, performs its different transformations at the foot of the tree, and feeds on the leaves and young wood; it must be looked for in the daytime at the foot of the tree; it abounds at Flyères, but is less commonly found in the Alpes Maritimes.

Oryctes grypus.—Another Coleopteran of strong build, the *Oryctes grypus*, of the family of the Lamellicorns, called by Bompart Rhinoceros or Engraitto galinos, is harmless when it has become perfect; the only time it may be (for it has been proven) injurious to the olive tree is when it is in the state of larva; for being deposited amongst the roots it may gnaw them. The way to fight against this insect is to spread soot at the foot of the trees, which at the same time acts as manure, or in burying oil lees, which are a deadly poison to insects.

Vesperus strepens.—This insect is sometimes accused of injuring the roots of the olive trees when in a state of larva, but the fact needs proof, although the perfect insect is often found on the olive trees.

CANTHARIS VESICATORIA (Linnéu).

Bompart classes the Cantharis amongst the insects which are injurious to the olive tree. He says that it attacks the leaves in April and May. It is not to be wondered at that the Cantharis seeks the olive tree when it can not find any ash or lilac trees, which are its natural food and of the same botanical family. This insect, in my opinion, is not a very serious enemy of the olive tree.

Companyo, of Perpignon, speaks of a *Vesperus sex-pustulatus* of the family of Longicorns, which lives in olive wood; as it appears that this insect is very rare, it can not be very dangerous.

The same would be the fact concerning the *Agrpnus carbonarius* of the family of the Elateridæ, which is black, velvety, speckled with silvery white spots. This insect is also mentioned by Compayno.

NEUROPTERA.

Colotermes flavicolis—One of my colleagues of Amelie les Bains informed me that he had discovered a termite (is it the *Colotermes flavicolis?*) reducing to dust the trunks of olive trees which though old still showed signs of life. As the olive tree still gives a crop even when it appears only to have its bark left, it is of the highest importance to destroy this insect, which though it attacks the dead parts of the tree is certainly not without injury to the living wood.

The means to be employed for its destruction are boiling water and fire, only both remedies must be applied with great care.

HEMIPTERA.

Phlœothrips oleæ (Targioni) *Thrips oleæ* (Costa.)

My chapter on the thrips was ready when I first learned of a series of reports by Haliday, who, struck by the marked characteristics of these insects, has considered them as forming a particular order, and has denominated them Thysanoptera, which he has divided into two families; the Tubulifers and the Terebrantes. Our black Hemiptera homoptera will therefore be a *Thysanopter tubulifer*, as it has a borer in the shape of a tube, and we ourselves will call it *Phlœothrips oleæ*, name which Targioni has given it.

This being established, we will continue our original undertaking.

In 1826 Risso spoke of a black Staphylinus (*Staphylinus lugubris*), which might very well be our Phlœothrips of the olive tree.

In 1834 Passerini published in Florence a memoir, in which he states that he had found thrips in their different transformations on the olive-tree leaves in the neighborhood of Pietrasanta; he also noticed that many buds contained from 4 to 5 eggs, that the larvae were fixed to the under part of the leaves, in order to take their nourishment from their parenchyma. Then from the spring to the autumn many generations saw life. To this Hemiptera the learned Italian had given the name of *Thrip phaœsaphus* (Linneus).

In 1846 Mazzarosa, in a book which he published on agriculture in general in the providence of Lucques, says that at the beginning of the century many olive trees of the locality were infested from May to August by thrips which caused great havoc amongst the young fruit and leaves. Over 6,000 trees were affected by this scourge; the damage done was so enormous that the terror stricken agriculturists abandoned the trees which were affected; some nevertheless tried remedies, principally pruning, from which process they derived some benefit.

In 1848 Bompar, of Draguignan, who is the first French naturalist who has spoken at any length of a thrips without however designating its species, considers it as an enemy of the olive tree.

He is of opinion that this insect lays eggs twice a year, in April and in September, at the summit of the shoots at the top of the tree in the small holes which have been made by the Phlœotripus or Neïron, or in those it perforates for itself. This Hemiptera caused great ravages in 1603, 1820, 1836, in the neighborhood of Draguignan. The thrips, adds Bompar, finds its nourishment in the sugar or sap of tender leaves or buds, which it literally perforates with thousands of small holes. The trees that are thus attacked only give fruit on the lower branches. The largest part of the harm is in June, July, and August. In 1863 and 1864 Dr. Martineng, of Grasse, gives far more precise indications on this insect. The thrips, which is called black worm in the district of Grasse, and Barban on the left bank of the Var, lives during the winter months under the bark and the dead leaves, but chooses in preference the gal-

leries abandoned by the Neïron, and selects those that are the most sheltered.

During the fine season this insect circulates on the trunk and on the leaves; the female makes use of the galleries made by the Nüroun and deposits its eggs in them; it is proved that this insect attacks the young fruit, and the farmers believe that it poisons all with which it has had any contact. I have gathered a few of these insects from Falicon and the Mantega localities which unfortunately are attacked; this has placed me in a position to study, describe, and sketch them. My description which follows agrees with that of the Italian Naturalist Targioni Tozzetti: Length, 2 to 3 millimeters. The body is all a brilliant pitch black, has six legs; the head is as wide as deep, rounded in the forepart, eyes large, with facets; antennæ have 9 articulations and are as long as half the length of the body, inserted on the front of the head, the first and last articulations black, the others pitch color, on the last articulation a few black hairs; the prothorax is nearly hexagonal; 4 membraneous wings are attached very high on the shoulders and are fixed two by two folding themselves on the body so as to reach beyond the abdomen; these wings are very transparent, reddish, narrow, rounded at their extremities, garnished with long, black hairs; each wing resembles a feather; the legs are black and short; it has two tarses, one terminated by an air hole thickly garnished with fine hairs; both are armed with hooks; the abdomen is black, has 9 segments dark pitch color on the junction of the rings; it is terminated in both sexes by a tube or borer garnished with hairs at its extremity. I do not know what distinction there is between the male and female. This insect, before reaching the perfect state described above, undergoes two transformations which are characterized by a lighter color and the absence of wings.

Among the remedies used against these insects are whitewashing the trunk and larger branches, fumigation of tobacco and sulphur, washes of boiling water, and plenty of manure to strengthen the growth; but as the evil is generally on some one tree, or even parts of a tree, the most effective means of combating it is vigorous pruning, with the precaution of burning all the leaves and branches pruned, not forgetting to keep the tree in good condition.

FALSE PUCERONS.

Psylla—Euphyllura oleæ (Foerster, 1848), called Araneum by Pliny, Bumbacella Ragnatella in Italy, Pulgilla in Spain.

I give here the description given by B. de Fonscolombe of this insect, which he calls false puceron or cotton of the flowers:

Its larva, says this learned naturalist, produces the cotton which surrounds the olive bloom, and hides itself under this cotton which it has secreted; the perfect insect appears in July, and then frequents the olive tree, either for its food or for the purpose of laying its eggs, while the larva and its nest appear when the buds begin to

develop; the false Puceron in its full maturity is only the length of one line; its color is a greenish yellow; its forehead, prominent and flat, has the shape of a shield; the antennæ are longer than the head, filiform at extremities; the corselet is transversal and very narrow; the elytra are nearly square, widening at the outside of the base, and are rounded at their extremities, white and of a clouded transparency, spotted here and there with reddish stains, with two black points in centre of inner side; the wings are white and transparent; the abdomen is conical; the anus of the female appears to he armed with two long united triangular blades, which must assist her in laying or placing its eggs; the trunk lies along the breast; the legs are rather thick; the thighs are enlarged to club shape, to enable the insect to jump.

The larvæ and nymphæ resemble, with the exception of the wings, the perfect insect, but they are of a paler green.

The description of the insect in its perfect state is correct, but that of the larvæ and nymphæ is not so satisfactory; besides, nothing is said of the habits of the Euphyllura. Mr. Bernard, the engineer, as early as 1848, says it is a false Puceron, resembling very much a small grasshopper, which attacks in great numbers the twigs and stems of the leaves, producing a loss of sap injurious to the tree. Its length is one line, with four transparent wings; antennæ are filiform; the proboscis is visible, the abdomen greenish, terminating in a point; yellowish legs; very seldom flies; if disturbed it walks sideways, and jumps with grea ease. They gather in company at the axilla of the leaves and round the petiole, under a cottony covering which Pliny calls a cobweb. It secretes from the anus a honey-like substance, sweet-tasting, which gathers in drops, and which might very well be the Elsomeli of the ancients.

Bompar, in his account of the false Pucerons, says that they are very small insects, with large heads, stumpy bodies, protruding eyes. The larva, he says, has six legs. They lay twice a year—once in April, then in September. This insect attacks the young shoots, which it very soon destroys. It is called "Sauteret" (Tumper) at Grasse, because of its facility in jumping, and Blanquet (Whitey) in Toulon, because of the color of its wrapper. Since 1848 many people have studied this interesting family of insects. It has been shown that the larva has two phases in its existence, and that the nympha had all the activity of the perfect insect, with the exception of jumping and flying.

These are my own observations: The larvæ and nymphæ move about under a cottony covering which is milky white and a little shiny at its basis; the perfect insect keeps away from this substance, which it secretes no more. If the inhabitants of this white abode are in any way disturbed, one sees bristly white balls exit with precipitation and crawl along the branches; freeing these living balls of some of their outer covering matter, one easily distinguishes thick-set larvæ of a yellow-red tint, with thick, black antennæ; the body is flat shield shape and carried by six slender legs with black extremities. No apparent sign of elytra; the body is covered with long white threads of great tenuity; at the extremity of the body there is an apparatus of a darker

tint from which escape lumps of cotton; in the midst of the larvæ is found drops of a slimy liquid which has been produced by them.

So much for the larvæ; as for the nympha, it resembles already the perfect insect in shape, and specially in its greenish color; it has less cotton about it than the larva; but still has the apparatus which terminates the abdomen; on each side of the thorax can be noticed rudiments of elytra of a brownish red, very short, and standing out from the body; the nympha, like the larva, lifts its abdomen in moving forward. Independently of the abundant sweating which the Psylla causes with its proboscis, says Bompar, it must, to a certain extent, injure the clusters of fruit; besides, as the flowers are surrounded by a slimy substance, they grow with difficulty, and dampness and dew gather about and cling to them.

The agriculturists are glad to have a moderate wind blowing during the blooming season, so that it may carry away the cotton left by the psylla and free the flowers.

The olive trees should be examined and the flowers and young fruit which show signs of the invasion be burned. This operation offers no difficulty, as the branches attacked are generally those nearest the ground. When the flower has fallen and the fruit grown the psylla spins its cotton lower on the tree at the axilla of young leaves, especially on young shoots or grafts. They can be detected under their white covering, perforating holes which must be detrimental to the growth of the tree. There is a small green spider, marked with black lines, which kills quantities of the false pucerons.

COCHINEALS.

Lecanium oleæ; Aspidiotus villosus; Mytilaspis flava; Pollinia costæ; Philippia follicularis.

One can safely say that if the cochineals have been utilized by industry they are generally detrimental to agriculture; that is to say, that nearly every species of trees harbors several species, which by their number, their frightful fecundity, and their incessant voracity exhaust the plants on which they live.

In the south of France, where the cochineals abound, says Mr. Signoret, many kinds of trees, amongst them olive, orange, and fig, are covered with black, which, on examination, proves to be a fungoid growth called "Fumagine," growing on coatings of the dejection of Coccus and Lecanium, seriously injuring the tree. Of all trees the olive tree is preferred by the cochineals of different species, amongst which can be mentioned: The *Lecanium oleæ* (Bernard-Signoret); the *Aspidiotus villosus* (Targioni); the *Mytilaspis flava* (Targioni); the *Pollinia costæ* (Targioni); the *Philippia oleæ* (Costa). The characteristic and general distinction of the cochineals is the nonexistence of a beak or rostrum in the male and the absence of wings or elytra in the female.

Lecanium oleæ (Bernard).—This cochineal is detrimental to the olive tree, not only by absorbing the saccharine substances of the young shoots and leaves, but also by the result of the spread of these saccharine matters, or by its excretions, which give rise to the birth of a cryptogamous plant, which is no other than the "Morphee" or "Fumagine," of which I shall speak later.

This insect is particular to the olive tree, and is even sometimes in such abundance that it invades the surrounding trees. The *Lecanium oleæ*, says Mr. Signoret, is rough, of a blackish brown, sometimes of a yellowish gray, has the shape of a rounded oval, rather pointed towards its extremity; its antennæ are large and have eight articulations.

The embryonic larva has only six articulations to the antennæ. The male of the *Lecanium oleæ* has never been discovered. At the period of laying, the female, then the size of a lentil, of a brownish red, places itself on a branch, contracts itself into a convex shape, and gives birth to more than 1,000 eggs; there are two layings a year. This cochineal was the object of a notice by Mr. Pablo Colvei; he called it the *Aspidiotus oleæ*. His notice was published in Madrid in 1880, in an edition with engravings.

Colonel Goureau, in his work published in 1859 on injurious insects, already at that date spoke of a cochineal, called by him *Coccus oleæ*. It is said in this work that this gall insect, real plague in the Var, was not known at Aix, and does not alarm Provence to any degree. All agree as to the part played by the said cochineal, which infects certain olive trees and exhausts them by constant stings, which cause an injurious loss of sap; this sap, with the very abundant dejections of the insect itself, facilitates the growth of "Morfee" or "Fumagine." The following species of cochineals are also found on the olive trees, but are not as injurious as the one above:

Aspidiotus villosus (Targioni).—This species was discovered by Targioni on the olive trees of Florence. He has only described the female, which is gray, covered with hairs, and of a cottony substance. The male, according to Mr. Signoret, is a yellowish red.

Mytilaspis flava (Targioni).—This cochineal is found mixed up with the *Pollinia costæ*, with which it must not be confounded; the female is covered with a gray dust, which renders its detection difficult, as it is the same color as the bark of the tree. The last segment presents five thread plates. The male is smaller and nearly yellow.

Pollinia costæ (Targioni).—Color, yellowish brown; shape, a rounded oval covered by a thick film formed by a whity secretion, more or less regular, which adheres quite firmly to the tree; but in which the insect is perfectly free.

These small masses, says Mr. Signoret, are sometimes aglomerated in a considerable heap resembling a white exudation of the sap of the tree; this cochineal was plentiful in Cannes on the olive shoots in 1870; it has no legs and rudimentary antennæ; the male is long, the abdomen large, the head wider than long; antennæ have nine articulations.

Philippia follicularis (Targioni), *Oleæ* (Costa).—This species forms a white bag, very voluminous, which is secreted by the female and deposited on the under part of the leaves; the antennæ have six articulations in all its transformations; the body is covered by a multitude of small hairs, the dorsal part particularly. Male unknown.

No other way is known for their destruction than to give plenty of vigor to the tree, keep it from constant moisture, kill the cochineals and destroy their nests with injections or lotions of water and vinegar or petroleum.

LEPIDOPTERA.

Certain Lepidoptera or butterflies can also be classed amongst the enemies of the olive tree.

Here are two reports sent in 1837 by Mr. B. de Fonscolombe to the French Entomological Society. The author says that there are two Tineidæ particularly injurious to the olive tree; one attacks the leaves and the other the fruit.

Tinea oleella (B. de Fonscolombe). *Chenille mineuse* (Dray's oleellus).—A small caterpillar with sixteen legs of a greenish brown, with black jaw, black scaly plate on back of neck, and another on the last rings of the body; has no hairs, yellow head, causes heavy damage in the Var and the County of Nice. It is seen in winter working between the two thicknesses of the leaves, or in March, towards the end of its existence, wrapping itself up in a few silk threads between the shoots and young branches along the tenderest twigs. This caterpillar, two lines long, transforms itself towards April into a chrysalis of oblong shape, the color of which is a yellowish green; it is found amongst the silky threads I have just mentioned, or in the cracks of the branches; the butterfly comes to light about the end of April; its wings are wrapped round its body; its antennæ are filiform, nearly as long as the insect itself; its trunk is small, its head scaly, its body of an ashy gray; its wings are long, marbled with black tints; the abdomen is yellow, with grey hairs, which forms a tuft towards the arms; its antennæ and legs are gray, the latter are armed with a spear which facilitates the jumping.

Tinea olivella (B. de F.).—This caterpillar lodges itself in the kernel of the olive in the same way as others do in the apples, cherries, etc. The egg which produces it must be deposited by the female on the blossom when the fruit is forming itself. It penetrates in the stone, which is still tender, and lives there until the time for its transformation has arrived, in September, when it perforates the stone at its only vulnerable spot; that is, where the fruit is attached to the stalk; then issuing from the fruit, it lets itself drop on the ground, where it undergoes its transformations. The fruit thus pierced falls at the least wind. This caterpillar is larger than the Tinea oleella; the chrysalis is yellow, the wings coverings a little brownish. The insect which comes out of it resembles very much the first described. This one, however, is larger. Bernard, of Marseilles, in his memoirs of 1872, thought there was only one species, which lived in the stone in the first generation, and on the leaves in the second.

B. de Fonscolombe combats this opinion on account of the characteristic difference of the two caterpillars, and on the impossibility of admitting that the same insect should feed itself on the mealy and at the same time oily substance of the kernel and on the cellular tissue of the leaf. Anyhow, many learned men, amongst whom are Duponchel,

Millière, and Stainton, who all have carefully studied the question of microlepidoptera, have come to the conclusion, notwithstanding the many reasons to believe the contrary, that there only exists one sole and same insect which they call the *Pray's oleellus.* Stainton, an English lepidopterist, has given satisfactory evidence that the two species were one and the same. B. de Fonscolombe, too, 14 years after his statement as above, admits of his error in his circular to the Entomological Society of France of 1851.

I can certify that the result of the breeding of the caterpillars that I obtained either from fallen fruit, from leaves or young sprouts in March and April, was that I obtained the same Tineidæ color iron grey, wings rolled up. I can also certify that amongst the numerous caterpillars which come out of stones, the largest, the deepest in color (wine lees tint), transformed themselves immediately; but that the smallest and youngest ones did not in any way hesitate to feed upon the olive tree leaves that I gave them.

There is, therefore, only one same and identical species of these caterpillars having annually two generations in different circumstances and conditions, observation which is very interesting to study. The caterpillar is greenish, spotted here and there on the back, with stains, color of wine lees; the chrysalis is either green or brownish yellow; the butterfly, which sees light in September, is iron grey with fringed wings, the upper ones being spotted with black, the under ones plain.

Coming to the means of destroying this insect, B. de Fonscolombe shows with reason that in Provence, where the trees are small, it is easy to detect and burn the leaves which are attacked by their yellowish brown irregular spots, which harbor the caterpillar; but this process of detection becomes far more difficult in the Var., and especially in the Alpes Maritimes, where the olive tree attains such large dimensions. Good advice to the oil cultivators is to light up at night large fires in the olive gardens in March, August, September, and October; any amount of Tineidæ, will come and burn themselves in the flame; another way is to stretch out at night time ropes coated with honey; the best way, however, is to frequently turn over the soil at the foot of the olive trees and not to let the fallen olives lie in September, for nearly all these olives have been detached from the tree by the work of the boring caterpillar, which has eaten away the base of the stalk so as to escape from the fruit and reach the ground, where it undergoes its transformations; these olives should be picked up before they dry, and as they do not yet contain sufficient oil to be used advantageously, the best thing to do with them is to burn or destroy them immediately. One can easily see what would result from leaving them by placing a few handfuls of the olives, showing the work of the insects in a bag; after one night quiet, large numbers of the caterpillars will have come out and can be seen making, on the inner sides of the sack, light cocoons in which to shelter their chrysalis.

Margarodes unionalis.—This pyralis deposits its whitish eggs at the axilla of the smaller branches; they are hatched 15 or 20 days after. The young caterpillar attacks the inferior part of the leaves at night-time; in the daytime they shelter themselves between two leaves that they have united by means of threads. The Margarodes take 5 or 6 weeks to develop itself, then it retires into the crevices of the bark where it undergoes its transformations.

The butterfly, which measures $0^{m}.0025$ to 0.0027^{m}, has white antennæ, large silky white transparent wings, without lines, of a pure white, iridescent in the newly born, the upper ones have the sides of a reddish brown; the thorax and abdomen are white; the female is larger than the male.

This is the only specimen which we possess in Europe of this remarkable and numerous species. The unionalis is plentiful in Provence, specially at Cannes, where it attacks particularly the olive and jasmine trees.

Lelleria oleastrella (Millière).—Caterpillar of a spindle shape, of a green, more or less dark, with longitudinal lines; the head, testaceous, is yellow. It lives on the *olea europosa*, but principally on the non-grafted tree; it attacks the new leaves, on which it settles and eats their under-parts; after its third molting it retires into a spun tunnel in the crevices of the bark which it only leaves at night to feed; its liveliness is remarkable. The chrysalis is of a brownish red; the hatching takes place a fortnight after the metamorphosis. Dimensions $0^{m}.0021$ to 0.0022^{m}; the upper wings of the butterfly are long, narrow, rectangular, and of an earthly appearance like the thorax and abdomen; the under wings are darkish gray, shining and garnished with long silky gray fringes; antennæ are filiform, brown, as long as the body; the head is white, the eyes are large and black; it can be caught at night, but not easily.

Boarmia umbraria (Millière).—The shape of the caterpillar of this species is cylindrical, of a brownish gray; it may be mistaken for the Rhomboidaria. It falls plentifully in the sheets that are spread under the trees when they are shaken for the harvest in February and March. The perfect insect is very noticeable. The male and female differ only by their size; in the female the antennæ are comb-shape. It has two hatchings a year, one in June and another in September. The caterpillar is quite common, the butterfly rare; the latter is sometimes taken at night with a light. This insect is not very dangerous to the olive tree, for it attacks only the old leaves of the large trees.

Metrocampa honoraria.—The caterpillar of this species shows on each of its middle segments a sort of projecting ring of a whitey-gray tint, varying from a violet to a reddish hue; it has twelve legs, eleven segments; frequents the olive tree, on which it takes its winter quarters stretched along its branches; it falls in the sheets at the time of harvesting when the trees are shaken. The chrysalis is a reddish brown. It is hatched in May and October, and is very prolific. The female is

larger than the male. The butterfly, flesh-colored, comes readily to the light; it is one of the largest of European Phalæna. It is also found on oak trees.

Acherontia atropos.—The caterpillar, which has two hatchings, one in April, the other in September, lives on the *Lycium barbarum* and *Europæum*, the *Datura stramonium*, the *Ligustrum vulgare*, and the *Tasminium fructicans;* it has also been found on the *Quercus robur.*

Sphynx ligustri.—The caterpillar lives from July to September on the privet, the lilac, and the pink laurel; it can therefore also live on the olive tree, which is of the same botanical family. Anyhow both the caterpillars of these two butterflies are too large not to be detected, their habits being, too, to settle on the lower branches in reach of eye and hand.

DIPTERANS.

Dacus oleæ (Latr.).—Of all the enemies of the olive tree the one that principally occupies the minds of cultivators at present is a fly called scientifically the *Dacus oleæ*, and for immemorial times bears the names of Gueïron, Keïroun, or Keïron, given it by the cultivators of the olive tree.

The *Dacus oleæ* is an insect of the Dipterans family, which is characterized by the existence of two wings, having behind them two other wings, movable, rudimentary, and useless for flight; they are called balancers.

The Dipterans have for a mouth a sucker composed of many scaly pieces, which are inclosed in a sort of trunk.

Blanchard has divided the Dipterans into two classes—the "Meniocerces," comprising the Culex or gnats and the Tipulæ; the Brachoceres, comprising the "Musciens," of the family of the "Athericeres," amongst which he places "Tephrites," which he again subdivides into the Dacus and the Tephritis.

The general characteristics of the Dacus of Meigen and Macquart, the Oscinis of Fabricius, the Tephritis of Latreille, are as follows:

Palps enlarged; the anteunæ reaching the epistoma, with the third articulation three times as long as the preceding one; the style bare, the abdomen oval.

Dacus oleæ, of which I give description below, is the type of the genus: Length 2 lines (0.005 milimeters); body yellowish gray, tint of head paler, having a black spot on each side of face; eyes grayish blue; front of face tawny; antennæ tawny, with large brown pallets, furnished with a simple hair or bristle; thorax gray, spotted, and a little pubescent, with black longitudinal lines; anterior sides tawny, posterior sides black; escutcheon large and whitey; abdomen oval and blackish, spotted, pubescent, with a yellow longitudinal band which widens towards the anus and forms a transversal band which occupies nearly all the penultimate segment; it is terminated in a point in the females with a pro-

jecting oviduct; its extremity in the male is blunt; wings transparent, always in motion, with yellow veins towards the exterior side, their summit marked by an obscure stain; legs and feet yellow, with the extremity of the posterior ones slightly brown.

Larva apodal, length 5 to 6 millimeters, and resembling a worm; head not very distinct, pointed, retractible, with black mandibles; a third longer than the chrysalis; of a yellowish white; body wings a little projecting.

The chrysalis is in shape like a small barrel of 0.004 milimeter of length and is only the skin of the larva hardened, shortened, and regularized in its shape; it is a perfect oval, yellowish, with the line of the rings of a darker color.

In the year 1826 Professor Risso, of Nice, in the second volume of his Natural History, says, speaking of the *Tephritis oleæ* or Keïron, that he considers this insect as very dangerous to the olive tree. In his opinion the Tephritis comes in swarms towards the end of the summer and deposits two or three eggs in each olive; the larvæ, when hatched, suck all the oily substance out of the fruit.

The olive [says Boyer de Fonscolombe] is very apt, at the time of its maturity, to be attacked by the larva of a dipteran of the muscides family, which is perhaps the bitterest enemy the olive tree has; it lodges itself in the very pulp of the fruit, and one very often finds two, three, and even more larva in one olive; these often forsake the fruit they have attacked before its complete maturity; they then appear in the form of flies, and reproduce themselves the same season by a new deposit of eggs. It is principally at the time of the gathering of the olives that they leave the fruit, especially when it is stored for a time before being ground: they transform themselves into chrysalides in the dust and dirt; the heat changes them in a few days into flies, these linger for some time round those heaps in a state of torpor and await in this state the return of fine weather.

He continues:

This plagne seems to me sufficiently bad to encourage in every possible way the prevention of the birth of these insects, and it is important to burn all dust and dirt in storerooms as soon as the olives are taken away; even before. By these means the chrysalides will be destroyed, as well as the flies before the latter have had time to fly away in order to deposit new eggs on the trees.

A few fine days during the winter months suffice to encourage these insects to seek the open air.

Fonscolombe adds:

While looking over the gathered olives some days after the harvest I invariably found larvæ, nymphæ, or insects at the same time in their perfect state. I collected a few nymphæ, and taking them away from the heat placed them in glass vases in a cool place. These nymphæ only became flies late in the spring. This insect does not reduce the quantity of olives; but it spoils the quality, for the olive and the oil it contains are tainted by the flesh of the larva, as the mill crushes all—the olive, the larva, and its excrements; nevertheless, the oil made in 1817 was of excellent quality, though the number of olives attacked that year by this insect was considerable. On the other hand, in 1834 the crop was nearly entirely destroyed, and the small quantity of oil made was nothing but mud These variations can be attributed to the difference in temperature, which may favor or hasten more or less the birth of these flies before harvest time.

I know very well [continues the author] that the precautions above indicated, though they be founded on the habits of these insects, will appear difficult or inadequate in countries where the making of oil lasts all the winter, as in Nice and its surroundings, but then the heaps of olives will have to be carefully watched, especially during midwinter, whenever the temperature, becoming more genial, would tempt the flies to the open air.

The method I would advocate to destroy the worms and flies would be to close up all the openings into the storerooms where the olives are kept, and to put in the room a few robin redbreasts, wagtails, tomtits; these birds willingly seek shelter during the winter months, are tame by nature, and as their food consists principally of insects they would give chase to the *Dacus oleæ*.

This system is practiced in other countries to destroy the weevil in the corn sheds; in my opinion it would answer the same purpose in this case. It will, of course, be necessary to keep water within reach of the birds.

Many different plans have been suggested, but after what has been said previously the best and perhaps the surest way of all is good culture, great care of the trees, and not to sow any crops around them, so as not to weaken them. It has been noticed that insects always select trees that are stunted and have suffered from the effects of frost; it seems as if the strong sap of the healthy specimen did not suit them, and were even detrimental to them.

This advice given by such a careful observer is undoubtedly excellent; many may criticise it, some may find the application if not impossible at least difficult; it is anyhow very sad to think that the question of the *Dacus oleæ*, which was so well treated at the end of the last century by both Bernard and Amouroux, which was again carefully studied in 1840, more than 40 years ago, has not given the results that one would expect in 1890; our olive crops are more than ever threatened by the simple negligence of those most interested in the harvest of the olive trees.

In 1840 Cauvin, doctor in charge of the hospital at Nice, published on the *Dacus oleæ* or Keïrou, to which insect he still gives the name of "Tephrite," a very interesting and conscientious work, which he completed in 1842.

The fly, says this author, begins its devastating work at the end of July, seeking out then the olives, to the care of which it will intrust its eggs, leaving unnoticed the *Oliva conditiva* or "Doucinére," the skin of this olive offering too strong a resistance to its auger.

The apode larva with eleven rings, without eyes, and armed with two hooks (mandibles) auxiliaries to the mouth, penetrates into the fruit as far as the stone, burrowing round it to its place of entrance; it remains thus for a fortnight, forms itself into a chrysalis, and then into a perfect insect.

Should the fruit in which the larva has taken its abode fall to the ground or be gathered, it abandons it, for the fruit is no longer sustained by the sap of the tree, and then completes its transformations somewhere else.

In his second book Cauvin gives the result of eleven experiments as follows: In his opinion the fly ceases laying eggs in November, and the insects hatched in March are the result of eggs laid in the autumn, it needs

a frost of 8° Reaumur to kill the larva, and 12° to kill the germs of the eggs; the flies can be kept for 9 and 10 months under glass by feeding them with a sirupy liquid, or still better with grapes or squashed raisins; the larva can only be kept alive with olive pulp; the adult larva taken from one fruit to another will die unless it be on the eve of its transformation; the larva or even its chrysalis will die if put in water or left in the open; the female lays as many as ten eggs in a day and can perform this duty for several days; the best way to ascertain the exact moment for gathering the olives is to fill a small bag of the fruit in April, to visit them a week after and to continue watching them; when it is noticeable that the larva abandons the fruit for its transformation, then is the time to gather the crop. In acting in this way for several consecutive years there will, says the author, be a chance of destroying the insect.

This conclusion may appear a little too affirmative; but Cauvin's two memoirs are drawn up with such great care, and supported by so many proofs that one may place confidence in them and utilize his recommendations at least in part.

Cauvin in the end of his second volume confutes and exposes the opinions of his predecessors.

Sieuve, of Marseilles, and after him Amouroux, of the same city, were wrong in stating that the fly deposited its eggs under the bark of the trees.

It appears impossible that these authors could have been familiar with the larva, for had they examined it minutely they would have been aware that the larva being apodal and very flabby could not possibly leave its cradle to go and attack the olive trees. What may have led them into error is that in the olives which are freed from the larva two holes are found which may have been considered as the inlet and outlet of the insect when they only indicate that the fruit had been inhabited by two insects.

Sieuve has made many mistakes; he does not speak of a miner caterpillar but he mentions a worm with a proboscis which is unshapely, thin, elongated, whitish in color; this worm uses two claws to form a breach in the olive; the ant is very fond of this insect; it tears open the olive, forces the worm out of the fruit, and devours it.

The worm remains 3 months in the bark, the chrysalis for a month remains in a state of torpor, the fly is hatched at about the 15th of December, its food is the gum of the olive tree (on this point alone I agree with Sieuve), the female lays her eggs in the cracks of the bark, the apodal larva hatched in May waits under the leaves the favorable moment to attack the olive tree; we ask in vain where Sieuve could have found these indications. Bernard, the laureate of 1782, finds no other remedy for this plague than to trust to Providence.

Penchienati advised the gathering of the crop in November or December; this precaution seems rather exaggerated, but is anyhow justified up to a certain point.

Risso alone gave the real remedy: Early gathering of the crops, great care and attention to be bestowed on sheds where the gathered fruit is kept, with burning of all sweepings.

In 1843 Mr. Bernard, the engineer, gives very exact information concerning the natural history of the Dacus, of which he does not know the scientific name, but describes the insect perfectly. He says: This fly which appears in August becomes plentiful by the end of September and in October. He admits that there are several generations.

At the same period as Bernard, Louis Roulandi, of Nice, describes the Keïron or *Musca oleæ;* in his opinion this insect has three or four generations annually from August to December; he gives the chrysalis a fortnight to develop itself into a fly; under 10° Reaumur of temperature the insect remains in a state of torpor awaiting the spring to revive; the Keïron attacks at first the early trees which generally have but little fruit; the Pignole of Villefranche, Monaco, La Turlie are spared by it. During the coupling, which lasts an hour, the female seeks the fertilization of her eggs in the body of the male by means of her borer; the great time for multiplication is September. A few olives left on the tree late in the spring will bring on an invasion. If at the end of March there is not a single olive on the trees, there will not be any appearance of Keïron.

It has been shown that certain naturalists, who studied the Dacus at the end of the last century, were mistaken in the most important question of all, the laying of the eggs.

In a very interesting book published in 1845 on the insects which attack the olive tree, Guérin-Menneville discusses the opinion given in 1834 by Laure, and since adopted by other authors, that is, that the Dacus attacks the olive in the autumn, and that it has a first hatching on other plants; this false idea arose from this fact, that Laure had sent to Boyer de Fonscolombe a fly which had originated from a larva found on some cereal, without mentioning where he had gathered it. Boyer de Fonscolombe knowing that his colleague was occupying himself with the study of insects detrimental to the olive tree returned the fly stating, that, in his opinion, it was one belonging to the olive tree. It is easily understood that simple agriculturists as Laure and Bland were received this as gospel truth, and turned into a certainty this simple supposition of one of the masters of science who had been called upon to give his opinion at a distance without having before him the necessary data.

This error could also be explained by the fact that the Dacus had previously been a Tephritis, and that Fabricius had made it an Oscinis; now the *Oscinis lineata* of Fabricius lives in the state of larva to the great detriment of rye; and Linneus places the fly (Frit) amongst the Oscines and taxes it with having destroyed in Sweden the tenth part of the barley crop.

Guérin-Menneville advises the early gathering of olives, and to crush

them as soon as gathered in the years that the fruit has been infested by the Dacus. In operating in this way you still can obtain half the usual yield of oil, while if you waited for the usual time of harvesting the larva has time to eat up the flesh of the olive, and with it the oil which would have been saved had the fruit been gathered earlier.

Lastly, in 1878, Dr. Maurice Girard, in his catalogue of animals useful and harmful, shares Guérin-Menneville's opinion with respect to early gathering; he believes in three generations of flies per annum, and says that the fruit attacked ripens sooner than that untouched.

I have thus given a faithful analysis of the different works that have been published during the last century on the different enemies of the olive; I have shown that the insects which destroy our olive crops have been carefully studied, and that for many years past perfectly sound advice has been given, advice which unfortunately has not been followed by the agriculturists. I take the liberty of giving now my opinion.

I give it only after having gathered the most numerous and precise information from the olive farmers in different districts, even departments, after having made, myself, conscientious experiments and having bred and studied larvæ. It is my opinion that by taking as a basis what takes place in other insects, taking for example the hornet (*vespa cabro*), the first invasion of the Dacus may be composed of flies of both sexes, and specially by females impregnated at the end of the season, which have sheltered themselves during the winter under the bark or in cracks of trees; this fact makes me sincerely regret that the farmers have abandoned the wholesome habit that the Greeks had of scraping with care the bark of their olive trees before the winter had set in. Operating in this way they destroyed any possible refuge for the enemies of their trees.

My opinion is confirmed by the fact that Mr. R. of Grasse, having cut down an olive tree in the middle of the winter, found in its trunk, perforated in many places by time and rain, Dacus developed into perfect insects and in large quantity.

I can not admit that there be only one generation, when all leads to show that there are at least three. I refuse to admit that the egg of the fly is deposited under the bark of trees, and that the larva, soft and apodal as it is, can possibly crawl as far as the fruit and work its way into it; this hypothesis is all the more inadmissible, as everybody knows that the olive hangs at the end of a long peduncle. I think that the Dacus becomes really dangerous only at the beginning of August; it is therefore then that it ought to be hunted and attacked in an intelligent and general manner. The more people will take advantage of the numerous counsels given, the greater will the following crop be the ensuing year. It is evident that Bernard of Marseilles was right when he said that all may be expected from time and study, but this is not sufficient; nature must be helped repeatedly.

The olive tree starts budding in May; from the 20th to the 30th of June the bloom appears. If it takes 2 months for the fruit to form itself and its oil, and to be of sufficient size to allow the larva to develop itself, it would only be in July that the female Dacus would prick the new fruit with its borer and deposit its eggs in the wound.

But what is to be done to fight against the Dacus during the months of August, September, October, and even November? Try and destroy the insect while on the tree is only a secondary means; to gather the olives at an early period would not be a much better mode, for you would only obtain little oil and its quality would be inferior. But a useful thing to do anyhow, would be to use Bernard's liquids, or any others as long as they are sugary, sticky, and aromatic; strings dipped in honey and stretched between the branches are good things, but great care must be taken to gather all the fallen olives, as these may contain larvæ, and their leaving the fruit and grinding themselves for their transformation must be prevented.

In years of great invasion of Dacus, as soon as it is seen that the olives change their tint, that the oily matter has sufficiently swollen the fruit, then all the berries must be gathered without exception, especially if the winter is slow in making its appearance; for it has been noticed that very warm autumns are detrimental to the crops; therefore, if at the end of November the cold does not appear, then gather in all haste and take your stock to the mill.

On the other hand if there are early signs of cold weather, then wait. The cold, even a slight frost, does not destroy the larva, not even the chrysalis, for experiments have proven that they can bear a lower temperature than that which we generally get in this climate, but it stays the development of the plague and consequently diminishes the intensity of the damage.

When the warm weather sets in, if you have not gathered in November do so in March. It is of the greatest importance that not a single olive should remain on the tree by the end of March, nor one on the ground, for the latter would be sufficient to guaranty the destruction of the crop for the ensuing season.

People generally have the bad habit of storing the olives in rooms or attics, in order, it is said, to improve both the quality and quantity of the oil; it is my opinion that this is done simply for economy's sake; either to have all the olives pressed together in one lot, or to have to pay a less amount of manual labor in carrying the crop to the mill. Up to a certain point I admit the system, for it is not every farmer who possesses a mill, and by going to a miller one has to wait one's turn; but in any case keep your stock for as short a time as you can, and watch it with great care; turn over the fruit very frequently, keep the heaps low so as to prevent fermentation and mouldiness, in order also to assist the larvæ to quit the olives; sweep constantly, twice a day is not too frequently, the storeroom, and on no account throw the

sweepings, in which there are larvæ and chrysalides, to the fowls, as it is generally done, for they let a certain quantity get away, neither throw them in the manure heap for the mild heat of the latter will facilitate their development.

Burn all your sweepings or throw them in a pond, for it is proven that the immersion of a few hours will destroy both larvae and chrysalises; also burn some juniper branches in the storeroom where the olives are kept. You can also, if you like, follow B. de Fonscolombe's advice, though it is 40 years old. Keep closed your storerooms, and place in them insect-eating birds, having the precaution to give them water to drink.

A fact which can not be contradicted is that the larva of the Keïron leaves the fruit as soon as it ceases being fed by the tree; the want of moisture or drying of the fruit are also reasons why the larva forsakes the plucked fruit.

The whole mystery is solved in these three things: Early gathering, cares to be bestowed on the fallen fruit, as well as on that gathered.

Count Blancardi, of Sospel, who is always trying to find improvements, said to his farmer neighbors:

> You perceive that your crop is attacked by the Keïron; your olives fall to the ground, and as you know them to be tampered you leave them there. Do you not fear that in so doing you encourage the plague? On the contrary, gather all the fallen fruit in order to force the larvæ to leave it, and then have it pressed; you will get a secondary produce, it is true, but you will have saved your next crop, and your work will not have been useless.

This advice is good to this extent, that it is always dangerous to leave olives attacked by the larvæ of the Keïron upon the ground, because, coming out of the fruit, they find shelter in the inequalities of the soil to accomplish their transformation; but to crush olives containing the remains and excrements of the Keïron is to obtain an oil neither clear nor having good odor, and which ought not to be mixed with oil obtained under good conditions. This is also the opinion of Dr. Maurice Girard, who says:

> The oil made with olives containing the excrements of any larva is detestable.

Rosier, in 1804, and Roubaudi. in 1843, agree in saying that all oil made with fallen and sick fruit has a disagreeable taste.

I have said that the fly, during the winter months, shelters itself in the cracks of trees. I have had proofs of this from the Grasse districts; but on the Riviera, where the winter is so short, if the Dacus rests during the cold season it rouses itself pretty early in the year.

During this period of rest on what does it feed? An interesting question which has not as yet been cleared up. It has been seen to suck sweetened water prepared for it, but what its constant diet may be is not known.

FRIENDS OF THE OLIVE.

Mr. Peragallo gives the place of honor in this class to the insectivorous birds of all kinds, recommending that they be invited to stay by all possible means. Spiders, too, he has found helpful about the trees, and the genus of Coccinella, to which our lady-bird, with its bright spotted wing covers, belongs. This latter family and their larvæ devour large quantities of the insectivorous enemies of the olive. Of Hymenoptera he describes four which are parasites of the Dacus, and two of the Cionus fraxini; also a Dipteran, *Phorocera picipes* (Rondani), parasite of a Lepidopter, the *Margarodes unionalis.*

(1) *The Eupelmus urozonus*, (Dalman).—One of Hymenoptera, said to follow the Dacus to the olive, lays its eggs in the fruit so that its larvæ may feed upon the larvæ of the Dacus. It is described as from 2 to 4 millimeters in length, green, head triangular, abdomen depressed.

(2) *Eulophus pectinicornis* (Latreille).—Another of the Hymenoptera which, more surely than the first described, preys upon the Dacus, as Mr. Peragallo observed them in his glass cases. The female is a bronzed green; the legs are white, excepting the feet and middle of the hips, which are the same color as the body. The male smaller, plumper, has some white on its abdomen and less green on its legs. It differs principally, however, in that its antennæ have long fan-shaped appendices which themselves are articulated. This insect always selected an olive attacked by the Dacus and laid its eggs in the hole made by that insect; the larva when hatched fastens itself to the larva of the Dacus and soon kills it; in this condition it was pointed at both extremities and of a transparent white color, showing a black cove, its chrysalis slightly flat, shining black in color. The chrysalis of another parasite of the same order, an Eurytoma, was of a lusterless black. The perfect insect was dead black shagreened. It differs further from the former by its slow movements, in which it seems hindered by its long and heavy antennæ.

The last parasite of the Dacus described was the *Ephialtes divinator* (Grav.) one of the Ichnenmonides.

While studying the Cionus fraxini Mr. Peragallo found a number of Hymenoptera of the family of Chalcidites and genus Pteromaliens. These were of two distinct species, of which he was unable to find farther distinguishing names.

The first male, blackish metallic green, lighter, however than the female; abdomen rounded and as long as the wings; coupling with

the female it flaps its wings and seems to be in a frenzy. The female, a dark metallic green, knees and legs white, feet black, abdomen terminating in a pointed heart-shape beyond the end of the wings.

The second male short, head large, thorax a light green, wings longer than the abdomen, which is whitish, pointed, heart-shaped, with greenish extremity; legs rose color. It couples frequently and dies sooner than its female.

Female, short, heavily formed, wings longer than abdomen, which is chestnut color, with metallic luster; head aced, thorax dark metallic chestnut, legs rust-color, head as large as abdomen, antennæ yellowish at base, elsewhere brown, enlarged toward the end.

In studying the habits of the *Lepidopterous Margarodes unionalis*, Mr. Peragallo found that it had a parasite among the *Diptera genus Phorocera:* The Picipes of Rondani described as follows:

Length, 4 to 5 millimetres; forehead as wide as the eyes; 3 or 4 hairs fall on the cheeks below the point where the antennæ are inserted; others smaller grow outside of these; ear bristles; very slender antennæ; third articulation four times as long as the second; palpi black; shield black with grey luster; abdomen grayish black; edges of posterior segment hairy; legs brownish, lighter on thighs and tibias.

Female, like the male, third articulation not so long, forehead a little wider than the eyes.

RECAPITULATION.

First. Prune at the end of the winter or beginning of spring at latest; cut off all unhealthy branches and the smallest boughs of the summit of the tree, which are preferred by the insects. Take off at once from the large cut branches the branchlets and burn them the same night; in doing so large quantities of Phlœothrips, caterpillars, false-pucerons and butterflies will be destroyed. Make small piles with the largest branches, leave them as a trap for about 20 days, and then store them after having stripped from them the bark, which is to be singed or soaked in water for a week; large quantities of Phlœotribus or Keïron and Hylesinus, which would have eaten up the young stalks and produced new generations of insects, will be thus destroyed.

Second. Moths, Pyralis, and Moth-worms can also be destroyed by stretching through the trees strings covered with honey, upon which these butterflies during the night will be caught and the Keïron during the day.

Third. Watch over the shoots from March until the winter; shake them lightly from time to time in the early morning over an umbrella turned upside down, into which larvæ of coleoptera and caterpillars will fall; but do not destroy the spiders and the coccinellæ.

Fourth. Use against the Dacus or Keïron Mr. Bertrand's method, which is to hang between the branches when the fly appears, and as

early as the middle of September, flat dishes containing some sweetened and sticky liquid.

Fifth. As far as concern the cochineals, the false-pucerons and the Morphée, cut down the trees or prune them thoroughly, where they are located in very damp places, and as soon as the cochineal appears hunt it out. Kill it and treat the tree as described above.

Sixth. To fight the Phlœothrips keep the trunk and branches as smooth as possible in order to destroy the nests, and leave no perforated wood up the tree, particularly in the higher parts.

Seventh. Give air to the groves, plant the trees wide apart, drain the soil, let weeds be burned slowly in order to dry the atmosphere, and make smoke. Do this generally at night.

Eighth. Do not let the fallen olives lie; pick them up at once and burn or crush them.

Ninth. At harvest time pick up and burn the caterpillars and larvæ of the Dacus and the butterflies fallen upon the sheets.

Tenth. Leave the olive but a short time in the storerooms.

Eleventh. In these storerooms keep the windows closed; turn over the olives twice a day, and sweep up the larvæ and pupæ of the Dacus.

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Nice, December 6, 1890.

INDEX.