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FUNGOID PESTS

OF

CULTIVATED PLANTS

BY

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3.—*Septoria Unedonis*, Rob.—*a*, section of perithecium; *b*, conidia × 400.
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28.—*Microsphæra Euonymi*, DC.—*a*, tip of appendage, enlarged; *b*, ascus and sporidia × 400.
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37.—*Podosphæra Oxyacanthæ*, DC.—*a*, tip of appendage enlarged,
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3.—*Septoglœum Hartigianum*, Sacc.—*a*. twig with pustules; *b*, section of pustule; *c*, conidia × 400.
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12.—*Phleospora Ulmi*, Fries.—*a*, section of perithecium; *b*, sporules × 400.
13.—*Piggotia astroidea*, Berk.—*a*, conidia × 400.
14.—*Phyllachora Ulmi*, Fckl.—*a*, section of stroma; *b*, ascus and ascospores × 400.
15.—*Septoria Fraxini*, Desm.—*a*, section of perithecium; *b*, sporules × 400.
16.—*Glœosporium umbrinellum*, B. & Br.—Hyphæ with conidia × 400.
17.—*Microstoma album*, Desm.—Basidia and conidia × 400.
18.—*Uredo Quercus*, Brond.—*a*, uredospores × 400.
19.—*Stereum hirsutum*, Fries.—*a*, basidium with spores × 400.
20.—*Stereum frustulosum*, Fries.—*a*, basidia with spores × 400.
21.—*Diaporthe taleola*, Sacc.—*a*, pustules enlarged; *b*, section of stroma; *c*, conidia; *d*, ascus and ascospores × 400.
22.—*Phytophthora omnivora*, DBy.
23.—*Glœosporium Carpini*, Desm.—*a*, pustule enlarged; *b*, conidia × 400.
24.—*Gnomoniella fimbriata*, A. & S.—*a*, section of perithecia enlarged; *b*, ascospores × 400.
25.—*Phyllosticta betulina*, Sacc.—*a*, conidia × 400.
26.—*Melampsora betulina*, Pers.—*a*, uredospores; *b*, teleutospores; *c*, teleutospores germinating × 400.
27.—*Dothidella betulina*, Fries.—*a*, section of stroma enlarged; *b*, ascospores × 400.
28.—*Septoria Tiliæ*, West.—*a*, section of perithecium enlarged; *b*, conidia × 400.
29.—*Septoria alnicola*, Cooke.—*a*, section of perithecium; *b*, conidia × 400.
30.—*Passalora bacilligera*, Fres.—*a*, hyphæ with conidium; *b*, conidia × 400.
31.—*Septoria Populi*, Desm.—*a*, section of perithecium; *b*, conidia × 400.
32.—*Marsonia Populi*, Lib.—*a*, section of pustule; *b*, conidia × 400.
33.—*Glœosporium Tremulæ*, Lib.—*a*, section of pustule; *b*, conidia × 400.
34.—*Melampsora Tremulæ*, Tul.—*a*, uredospores; *b*, teleutospores × 400.
35.—*Melampsora æcidioides*, DC.—*a*, uredospores; *b*, teleutospores × 400.
36.—*Melampsora populina*, Jacq.—*a*, uredospores; *b*, teleutospores × 400.
37.—*Taphrina aurea*, Fries.—*a*, section of blister; *b*, ascus and spores; *c*, ascospores × 400.

Fig. 38.—*Septoria salicicola*, Fries.—*a*, section of perithecium enlarged; *b*, conidia × 400.
39.—*Melampsora vitellina*, DC.—Uredospores × 400.
40.—*Melampsora mixta*, Thüm.—Uredospores × 400.
41.—*Melampsora epitea*, Kunze.—*a*, uredospores; *b*, teleutospores × 400.
42.—*Melampsora farinosa*, Pers.—*a*, uredospores; *b*, teleutospores × 400.
43.—*Rhytisma salicinum*, Pers.—*a*, section of stroma; *b*, ascus and ascospores; *c*, ascospores × 400.
44.—*Uncinula adunca*, Wallr.—*a*, perithecium with appendages, enlarged; *b*, ascus with ascospores × 400.
45.—*Pestalozzia Hartigii*, Tub.—Conidia in various stages × 400.
46.—*Peridermium Pini*, Wallr.—*a*, cluster-cup, enlarged; *b*, æcidiospores × 400.
47.—*Peridermium elatinum*, A. & S.—Æcidiospores × 400.
48.—*Æcidium pseudo-columnare*, Kuhn.—*a*, cluster-cup, enlarged; *b*, æcidiospore × 400.
50.—*Cæoma pinitorquum*, Br.—*a*, æcidiospores × 400.
51.—*Nectria cucurbitula*, Fries.—*a*, cluster of perithecia, enlarged; *b*, ascospores × 400.
52.—*Lophodermium Pinastri*, Chev.—*a*, perithecium enlarged; *b*, ascospore × 400.
53.—*Cæoma Laricis*, West.—*a*, æcidiospores × 400.
54.—*Dasyscypha calycina*, Fckl.—*b*, cup; *c*, section; *d*, ascospores × 400.

PLATES XXII., XXIII., XXIV.

Pests—Field Crops.

Fig. 1.—*Ustilago Tritici*, Jens.—*a*, spores; *b*, spores germinating with conidia ×
2.—*Tilletia Tritici*, Wint.—*a*, spores; *b*, spores germinating with secondary spores and conidia ×
3.—*Puccinia Graminis*, Pers.—*a*, uredospores; *b*, teleutospores ×
4.—*Puccinia Rubigo-vera*, DC.—*a*, uredospores; *b*, teleutospores; *c*, teleutospore germinating with conidia ×
5.—*Puccinia coronata*, Cord.—*a*, teleutospores ×
6.—*Fusarium culmorum*, W.G.S.—Mycelium with conidia ×
7.—*Septoria Tritici*, Desm.—*a*, section of perithecium enlarged; *b*, conidia ×
8.—*Septoria Graminum*, Desm.—*a*, section of perithecium enlarged; *b*, conidia ×
9.—*Ustilago Hordei*, Kell.—*a*, spore; *b*, spores germinating ×
10.—*Ustilago nuda*, Jens.—*a*, spores; *b*, spores germinating ×
11.—*Fusarium Hordei*, W.G.S.—*a*, grain with its parasite; *b*, hyphæ with conidia ×
12.—*Ustilago Avenæ*, Jens.—*a*, spores; *b*, spores germinating ×
13.—*Urocystis occulta*, Wallr.—*a*, cluster of spores.
14.—*Claviceps purpurea*, Tul.—*a*, ergot of rye *in situ*; *b*, ergot × 2; *c*, ergot with claviceps × 3; *d*, ascus with sporidia ×
15.—*Ustilago Maydis*, DC.—*a*, swollen receptacles; *b*, spores; *c*, spore germinating with conidia × 800
16.—*Ustilago Reiliana*, Kuhn.—*a*, spores; *b*, spore germinating × 1000
17.—*Fusarium heterosporum*, Nees.—*a*, conidia ×
18.—*Erysiphe Graminis*, DC.—*a*, receptacle × 40; *b*, ascus and sporidia ×
19.—*Oidium monilioides*, Link.—*a*, chain of conidia; *b*, conidia ×
20.—*Phyllachora Graminis*, Pers.—*a*, pustule enlarged; *b*, ascus and sporidia ×
21.—*Claviceps Wilsoni*, Cooke.—*a*, clubs, nat. size; *b*, club × 5; *c*, perithecia × 20; *d*, sporidium ×
22.—*Ustilago hypodytis*, DC.—*a*, spores ×
23.—*Tilletia striiformis*, West.—*a*, spores.
24.—*Isaria fuciformis*, Berk.—*a*, stroma enlarged; *b*, conidia ×
25.—*Fusarium insidiosum*, Berk.—*a*, tufts enlarged; *b*, conidia ×
26.—*Scolecotrichum sticticum*, B. & Br.—*a*, hyphæ; *b*, conidia.
27.—*Epichloë typhina*, Pers.—*a*, section of stroma enlarged; *b*, sporidium ×
28.—*Ustilago grandis*, Fries.—*a*, spores.
29.—*Puccinia Phragmitis*, Schum.—*a*, uredospores; *b*, teleutospores ×
30.—*Uromyces Poæ*, Rabh.—*a*, uredospores; *b*, teleutospores ×
31.—*Phyllosticta Cannabis*, Kirch.—*a*, section of perithecium; *b*, conidia ×
32.—*Melampsora Lini*, DC.—*a*, uredospores; *b*, teleutospores; *c*, teleutospore germinating ×
33.—*Fusarium Lini*, Boll.—*a*, conidia ×
34.—*Uromyces Betæ*, Kuhn.—*a*, uredospores; *b*, teleutospores ×

FIG. 35.—*Œdomyces leproides*, Trab.—*a*, spores ×

36.—*Phoma tabifica*, P. & D.—*a*, perithecium bursting the cuticle; *b*, section of perithecium enlarged; *c*, conidia; *d*, perithecium of ascospores; *e*, ascus with sporidia; *f*, sporidia free ×

37.—*Pseudopeziza Trifolii*, Sib.—*a*, parasite *in situ*; *b*, cup breaking cuticle; *c*, section of cup enlarged; *d*, ascus and sporidia; *e*, free sporidia ×

38.—*Sclerotonia Trifoliorum*, Erik.—*a*, cups or stroma; *b*, ascus and sporidia ×

39.—*Polythrincium Trifolii*, Kunze.—*a*, section of tufts; *b*, conidia ×

40.—*Phyllachora Trifolii*, Pers.—*a*, section of stroma ×

41.—*Peronospora Trifoliorum*, DBy.—Hyphæ with conidia ×

42.—*Uromyces Trifolii*, Hedw.—*a*, uredospores; *b*, sori enlarged; *c*, teleutospores ×

43.—*Peronospora Viciæ*, Berk.—*a*, hyphæ with conidia; *b*, resting spore ×

44.—*Sphærotheca Castagnei*, Lev.—*a*, receptacle with appendages; *b*, ascus with sporidia ×

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FUNGOID PESTS

OF

CULTIVATED PLANTS.

INTRODUCTION.

SOME introductory remarks are necessary as an explanation of the main facts in the life-history of some of the principal parasites to be recorded, and thus prevent their subsequent repetition when each species is under consideration. Thus iteration will be avoided and space economised where there is so little to spare.

One of the most rudimentary lessons to be inculcated is the known fact that parasitic fungi may be arranged under two types, each with a different mode of development, and each requiring a different mode of treatment. It is, at the least, essential to know to which of these types any given pest belongs before effectual steps can be taken against it. We have called these two groups the *epiphytal* and the *endophytal*. The former includes those fungi which establish themselves on the surface of the leaves, stems, or other green parts of living plants, and ultimately cause destruction by a kind of suffocation, and not by affecting, distorting, or absorbing the internal tissues. It is natural to suppose that it is this type of fungus pest which is most amenable to the application of fungicides, the object being to destroy the parasite without injury to the host-plant. We may give as examples the hop mildew and the *oidium* of the vine, both of which are to be kept in check by the application of sulphur. In these cases a white mould is developed in irregular blotches, or broad effused patches, over either or both surfaces of the leaves, the inferior stratum consisting of delicate interwoven threads, forming a mycelium, which attaches itself by means of *haustoria*, or suckers. From this mycelium arise the short fertile threads, which are mostly clavate. The upper portion is soon separated from the lower by a septum, at which it is constricted, and this upper cell, of an elliptical shape, becomes a conidium. Whilst this process is going on another septum is developed at an equal distance below the first, and another conidium is differentiated. This process goes on until a chain of conidia is produced from the original branch, the apical conidium being the oldest, and hence the first to separate itself from its companions, and so the rest fall away in succession until they form a thin stratum of conidia on the surface of the mycelium, in readiness to be transferred by wind or rain to other and healthy leaves (Pl. III. fig. 54*a*). Upon reaching its new location the conidium germinates by the production of a tube near its extremity, and this germ-tube is the initial stage of a new mycelium. This is the asexual reproduction, by conidia, of the *oidium* condition of the Erysiphei, of which the ordinary European vine mildew and the Australian *Erysiphe viticola* are examples. Later in the season the threads of the mycelium produce a more complex form of fruit. A globose receptacle, of a yellowish colour at first, is to be seen here and there upon the white mycelium. It seldom exceeds a small pin's head in size, and ultimately becomes brown or black. The outer membrane, or perithecium, remains attached, and is soon surrounded with more or less distinct radiating flexuous threads or appendages, which vary according to the genera (Pl. III. fig. 54*b*). Internally the perithecium encloses one, two, or more hyaline pear-shaped sacs, or asci, which contain the sporidia. When mature the perithecia split irregularly, and the asci, with their sporidia, are ejected. Each sporidium is elliptical, hyaline, and capable of germination, the germ threads becoming a new mycelium. This is the ascigerous and probably *sexual* reproduction.

The whole career of these *epiphytal* parasites is therefore external and superficial, and, if they can be destroyed by powdering or spraying, the leaves may recover their vigour; but if not, by the destruction of the conidia or sporidia, or by their germination being prevented, the disease is held in check, and its extension to other leaves or other plants rendered impossible. The cultivator who possesses sufficient elementary knowledge of the fungi to determine whether the pests he has to deal with are of this nature is already in possession of the power to treat them effectually. Even the very crude method of picking off the diseased leaves and burning them will limit the area of infection.

More important, and more destructive, are the *endophytal* parasites, which originate within the tissues of the host-plants, and only manifest themselves externally, when it is too late to save the plants. The "rot moulds" are of this kind, such as the Potato mildew, American Vine disease, Tobacco mildew, and many other devastating pests. They are called "rot moulds" because of the rotting of the leaves and stems subsequent to their attacks. Their scientific designation is *Peronosporaceæ*, and they have the habit and appearance of white moulds, but are parasitic on living plants. Here, again, it is of the utmost importance to know something of their life-history, and methods of reproduction, before they can be combated with success. The mature mould, when it appears on the surface of a diseased plant, produces a profusion of spores, or conidia. Each conidium is an elliptical colourless body, having a thin outer coating of membrane with fluid contents. These contents soon become granular, and at length collect at three or four centres, which condense and then become distinctly separated from each other by the growth of a special envelope. Ultimately the membrane of the mother cell is ruptured, and the three or four smaller bodies, which have been differentiated in its interior, escape, each one furnished at one extremity with a pair of delicate movable hairs, by means of which these little bodies, now termed *zoospores*, can swim actively in any thin film of moisture upon which they may fall. Possibly this film may be upon the leaf of a foster plant. In a short time all motion ceases and the zoospores come to rest, the pair of delicate cilia are absorbed, and a germinating thread is produced, the point of which seeks out and enters at one of the stomata of the sustaining plant. Having once obtained an entrance, the thread grows vigorously, and a little mass of threads, called a *mycelium*, is soon developed within the tissues, capable of spreading itself through the plant which it has infected. In the next stage we discover that this mycelium has developed erect branched threads, which pass out through the stomata again into the external air, sometimes singly, sometimes in tufts. These are the fertile threads of the mould, which soon produce a single conidium at the tip of each of the branchlets, just like the original conidium whence the zoospores were developed (Pl. VI. figs. 30, 78). When fully matured each fertile thread produces a score or more of these conidia, which fall away when ripe, and then undergo transformation into zoospores, ready and active, prepared to pass through the same stages again, and indefinitely multiply the pest. This history represents the ordinary conidial fructification of the mould, by means of which it is passed from leaf to leaf, and from plant to plant, until the whole area is affected. How many of the minute conidia may be transported to a considerable distance by a breath of wind it is impossible to say, but it is known that they may be carried to any spot where there is sufficient moisture for the conidia to be differentiated into zoospores, and afterwards come to rest and germinate. This process takes place in summer and autumn, but there is yet another means by which the pest is disseminated in spring.

The mycelium, which flourishes within the substance of the plant infested, is capable of producing larger globose bodies, chiefly within the stems, concealed from external view. These globose bodies secrete a thick envelope, mostly of a brownish colour, and after development they remain in a state of rest within the stems during the winter (Pl. IV. fig. 70*). So that old stems of plants, which are infested with the mould during the autumn, conceal within themselves during the winter a large number of these "resting spores." As the old stems rot and decay, the resting spores are set free in the spring, and then a period of activity commences. The contents of these globose bodies become differentiated into a large number of zoospores, which ultimately escape by a rupture of the thick envelope, armed with vibratile cilia, and in all respects like the zoospores which are developed from the conidia. These active zoospores swarm over the damp soil, and are carried by the spring rains into proximity with the young seedling leaves of the new crop of host-plants; then the cilia are absorbed, germination commences, the delicate threads of mycelium enter the nearest stomata, and infection results. In this way, in addition to the spread of the infection from conidia in summer and autumn, provision is made for an attack upon seedlings in the spring. It will be inferred that, in order to check the spread of these diseases, the conidia must be destroyed in the autumn to prevent their extension to healthy plants; and the destruction of all rotting *débris* must be carried out during the winter, so as to extirpate all the concealed resting spores, and thus prevent the infection of seedlings in the spring.

From these details it will be evident that plants once attacked by *endophytal* parasites are in themselves hopeless. No external application can destroy organisms which it cannot reach, or, if they could be destroyed, no manipulation can replace the disorganised tissues. Hence, then, all efforts should be directed towards the destruction of the conidia and resting spores, in order to stamp out the disease at its source and prevent the future infection of healthy plants. The application of spraying to plants apparently without disease would be done as a preventive, in order to destroy at once any germs which might be brought into contact with the foliage; and the destruction of all infected material would limit the local sources of infection. With an intelligent appreciation of the objects which have to be attained, the cultivator may accomplish a great deal in the way of prevention, even though he may be helpless to effect a cure. It will be seen how much of this depends upon an accurate diagnosis of the disease.

There are many other forms of endophytal parasites, and the life-history of some of these is still obscure. In the majority of them only a conidial fructification is yet known, and the internal tissues do not appear to be so absorbed and destroyed as in the case of the "rot moulds"; but in such black moulds as the "Apple and Pear scab" the mycelium appears to be perennial, and produces a fresh crop of conidia each successive year. There is some evidence that this disease is deep-seated and hereditary, and if so it is doubtful whether any amount of external application will result in a perfect cure. The genus *Glœosporium* includes many species which are very destructive, but often they seem to be localised, and the mycelium may not pass internally to other parts. This can only be ascertained by closer investigation. The little pustules on the leaves, and the fruits, are seated beneath the cuticle, where a cushion or stroma of compacted mycelium produces conidia, but without any enclosing membrane or perithecium. When the conidia are matured the cuticle is ruptured, and the spores escape to the surface, in many cases adhering in a somewhat gelatinous mass, which oozes out in the form of tendrils. In such cases it is evident that the application of some fungicide capable of destroying the vitality of the conidia will be of service in preventing the spread of the disease (Pl. 1, fig. 9).

A large and important group of endophytes is that known as the Uredines, of which the common and disastrous "Wheat rust" or "Wheat mildew" is a familiar example. In the first instance, the host-plant produces upon its leaves, in the spring, clusters of little cups, partly embedded in the substance of the leaf, which is usually thickened and discoloured. These little cups constitute the "cluster cups," or æcidium form; the margin is usually white and fringed, and the interior filled with orange subglobose spores, termed æcidiospores, produced in chains, but soon falling apart (Pl. I. fig. 21). The æcidiospores will germinate when mature and produce a thread of mycelium, which is capable also of producing secondary spores (fig. 1). Smaller bodies are also to be found in company, or in proximity, sometimes on the opposite side of the leaf. These have the form of minute embedded cells, containing very small hyaline spore-like bodies called *spermatia*, whilst the cells which contain them are *spermogonia*. What their function may be is as yet only conjectural, but they are nearly always present, and, presumably, not without a purpose. Later on in the summer the same leaves, or others, develop on either or both surfaces small brownish pustules, at first covered by the cuticle, but at length splitting irregularly and exposing a powdery brownish dust-like mass of nearly globose spores, each spore borne at first at the apex of a short hyaline thread, these threads arising from a cushion-like base of mycelium. These powdery spores constitute the "rust," or *uredospores* (Pl. II. fig. 22*b*), and with them ends the second stage of the fungus; but how they are evolved from the first stage, or how they produce the third stage, is a mystery still.

The third is held to be the complete or perfect stage, and the spores produced are *teleutospores*, or final spores. These teleutospores are more

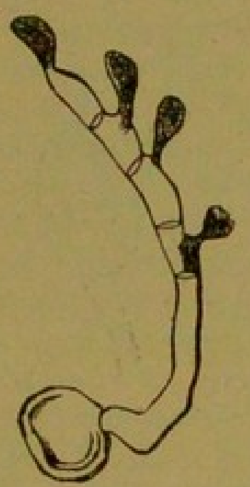

Fig. 1.—Æcidiospore germinating.

or less elongated, divided by a septum across the middle into two cells, and supported upon hyaline sporophores or spore-bearing threads (Pl. II. fig. 22*c*). They are produced in pustules similar to those of the uredospores, but often more compact, and are sometimes mixed with them. A few of the teleutospores will sometimes be found growing within the pustules of the uredospores. When the teleutospores are mature they do not always germinate at once, but a period of rest supervenes, and perhaps they may not germinate until the following spring, becoming, in fact, veritable resting spores. This is an important fact to be borne in mind by the cultivator.

Each cell of the teleutospore is capable of sending out a germ tube through a special pore, and as this germ tube grows, the contents of the cell of the teleutospore passes into the germ tube, known also as the promycelium, and to the extreme end. Ultimately a septum, or division, crosses the tube and prevents retreat. One, two, or more additional divisions of the apical cell take place, and from the side of each of these newly constituted cells buds or processes appear, which gradually enlarge, and in time are converted into secondary spores, or promycelial spores, into which some of the contents of the old spore pass, and these smaller bodies are eligible for the production of mycelium, which is prepared to find an entrance into the leaf of some young and new host plant, and producing infection commence the cycle over again (fig. 2). Thus, then, we have in order of succession spermogonia, æcidiospores, uredospores, and teleutospores, each of the three latter capable of producing secondary spores, but the last of all producing the promycelial spores which are the medium of reinfection, from the complete and perfect condition of the Puccinia.

It may be mentioned, in passing, that the life-history in the genus *Uromyces*, where the teleutospores are only one-celled, is precisely similar.

But all these stages are not always to be found associated together. The chain is not always perfect. In some cases the *Æcidium* only is

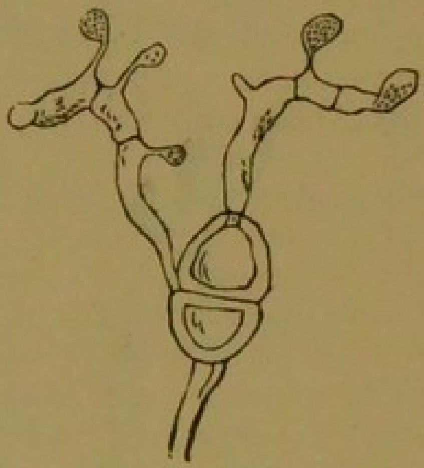

FIG. 2.—TELEUTOSPORE GERMINATING.

known, with or without spermogonia; or in other cases only the uredospores are known; or in certain cases only the teleutospores. In each of these instances the fungi are regarded as imperfect, or, at least, as imperfectly known Uredines.

Besides these cases, in which æcidiospores, uredospores, and teleutospores are produced on the same species of host-plant, there is another group which those who have implicit faith in heterœcism contend produce the æcidiospores with spermogonia on one species of plant, and the uredospores and teleutospores on another and quite different species of host-plant. Let each be persuaded in his own mind, as it will serve no good purpose to enter upon discussion here.

There is another group in which only the spermogonia, uredospores, and teleutospores are known, and these all occur on the same host-plant. Here the æcidiospores are absent.

In a fourth group only the æcidiospores and teleutospores are known, and these occur upon the same species of host-plant. The uredospores are wanting or do not produce pustules of their own.

In the fifth group teleutospores only are known, so that both æcidiospores and uredospores are absent, and the teleutospores only germinate after a period of rest. In another subsection only teleutospores are found, but they germinate at once on arriving at maturity, without an intervening period of rest. Thus much it seemed necessary to explain, as it has some connection with the dispersion of the Uredines, and the steps to be taken in contending with them. It will be evident at once that the destruction of these clusters of teleutospores will minimise the spring infections, and hence that they should be well looked after and destroyed, either by effective fungicides, or by burning up all the dead leaves and stems of the foster plants known to have been affected. In this case, again, we must suggest the importance of acquiring some practical knowledge of the history and mystery of such plant parasites, if they are to be encountered and vanquished in their career of destruction.

In this connection we cannot omit alluding to the evidence, which is gradually accumulating, of the connection between those minute organisms the microbes, or *Schizomycetes*, and plant diseases. There are certain diseases which attack cultivated plants, and produce disastrous results which have long been a mystery, since, although the host-plants appeared to be suffering from the attacks of some insidious fungus disease, none of the usual external appearances could be detected. In several cases of this kind it has been affirmed, although not yet completely confirmed, that the disease is caused by the presence of a minute *bacterium* or *bacillus* in immense numbers. There is no reason analogically why this should not be the case, and all the evidence seems to strengthen the probability; but the suggestion is so recent and the investigation so difficult that it would be imprudent to hazard any very decided opinion. Researches into a Vine disease in California, a Melon disease in some parts of the United States, and the very prevalent "Peach yellows" almost establish the fact that microbes are present in large numbers, and are hypothetically the cause of the disease. In reference to the disease of Cucumbers and Melons it has been claimed that the disease is accompanied profusely by bacteria; that the juice of diseased plants swarming with these organisms, when transferred to healthy plants, will inoculate them with the disease, which will make its appearance in three or four days; that seed watered with the juice of diseased fruits did not germinate, or only 25 per cent. germinated at all, and these soon decayed; that the diseased juice when introduced into healthy stems and fruits of Tomato rapidly produced decay; that young Tomato plants in proximity with diseased Cucumbers were all destroyed. Hence it is concluded that the disease in question is caused by bacteria, and may be transmitted to other plants by inoculation. If all this should be confirmed, then we shall have to deal with another class of plant diseases, of fungoid origin, which will require a different mode of treatment, and doubtless offer a stubborn resistance.

From the foregoing observations it will be manifest that there are such broad distinctions between different groups of pestiferous fungi that they should not all be subjected to the same mode of treatment, and that the remedies which might be successful in cases of one kind would be powerless in another. Hence, then, modes of treatment must have a relation to the known character of the parasite. It follows from this that a certain amount of knowledge of the life-history and affinities of the parasite must precede any definite effort to counteract or destroy it, as in animal diseases an accurate diagnosis must precede treatment. Such being the case, it is important to consider what means can be employed to diffuse the necessary information amongst cultivators, so as to enable them to determine the general character of the disease. This does not imply the specific identification of the fungus, which would be the work of an expert, but the general characteristics only, and especially whether the disease is caused by an endophyte or an epiphyte; after this, presuming it to be an endophyte, whether it is related to the rot-moulds, the forms of anthracnose, as represented by species of *Glœosporium*, or to the "rusts" or Uredines. The cultivator in possession of the power to determine thus much for himself might easily learn what remedies have been most successful in similar cases, and apply them systematically with some hopes of success.

Another important question cannot summarily be dismissed without consideration, and that is whether, and to what extent, heredity has to do with the dissemination of plant diseases. It is admitted that in the animal world certain diseases are hereditary. Can it be possible also that amongst plants there is any evidence to be found of the transmission of disease through the seeds to a succeeding generation? On this point we have a few authenticated facts to submit, and then we have done.

The first instance is a record of 1885 by W. G. Smith, where he states, as the result of his examination of Oat grains, that not only the mycelium but the resting spores of Corn mildew sometimes do exist within the grains of Corn when the Corn is planted; that the fungus spores germinate at the same time as the grain; and that the disease can be and potentially is hereditary.*

There can be no doubt that some of these diseases are hereditary and can be transmitted through the seeds. A writer † says: "We had about 1,000 very fine plants (Sweet Williams) for blossoming next year, all raised from seed last summer, and in the autumn we noticed a few patches of the fungus (*Puccinia Dianthi*) and used Gishurst's compound and sulphur mixed with it as a solution, applying it with a syringe. We thought we had destroyed it, but find that all the plants that are not dead are dying piecemeal, and there is not one that has escaped. We cannot grow one of these seeds from Japan; immediately they are up in the seed-pans, under glass, they are attacked and destroyed." This view is also confirmed by a subsequent writer.‡

Upwards of thirty years ago a friend sent us specimens of infected Celery leaves, asking for the name of the pest, which was *Puccinia Apii*; at the same time he stated that he had two separate stocks of Celery plants, and although both were in the same garden, only one stock was attacked by the parasite. The seed which produced the infected plants was given to him by a person who had informed him since that all his plants were similarly affected. The seed from which the other plants were raised had been derived from another source, and not a pustule of the brand could be detected on the leaves; and yet they had been transplanted and were growing in rows side by side. The conclusion is that the germs of the parasite were present in the seed

* *Gard. Chron.*, Aug. 22, 1885.

† *Gard. Chron.*, Jan. 12, 1884, p. 57. ‡ *Gard. Chron.*, Jan. 26, 1884, p. 120.

PESTS—FLOWER GARDEN.

which produced infected plants; and if not, why did not all the plants suffer alike?*

The Rev. M. J. Berkeley records an instance in which plants of *Pyracantha* raised from seeds imported from Russia were all killed by a species of *Fusicladium*, whilst old plants of *Pyracantha* growing at the same place remained perfectly free from disease.†

At the time when the Hollyhock disease was at its height a quantity of seedlings were found showing the disease in their seed-leaves: some of the seeds, or carpels, which had not been used were examined, and pustules of the disease were found developed on the outside, whilst similar traces of disease were found in seeds of Wild Mallows.‡

Cases need not be multiplied, since we contend that the above are sufficient to establish the fact that inheritance of fungoid disease must be taken into account in connection with the dissemination and perpetuation of these diseases.

It only remains for us to intimate that in the following pages our first object has been to interest and instruct the cultivator in the simplest and most practical manner, which we believe would be best attained by grouping the pests together according to the nature of their hosts, rather than by following any purely scientific and systematic classification, which would assume considerable previous knowledge, and would be better left in charge of the expert.

The grouping which has suggested itself is as follows:—

Pests of the flower-garden;
" " vegetable-garden;
" " fruit garden and orchard;
" " vinery and conservatory;
" " ornamental shubbery;
" " forest trees;
" " field crops.

PESTS OF RANUNCULACEOUS PLANTS.

Although we have included descriptions of all the ordinary diseases of Ranunculaceous plants which are under cultivation, it must be remembered that there are also a large number of fungoid pests which infest wild and uncultivated plants of this order, some of which may at any time invade the flower garden and commence their ravages upon their cultivated kindred. Some limit being indispensable, we have been compelled to exclude the parasites of wild plants, except in those cases where they have been known to invade the garden.

Black Hellebore Leaf-spot.

Phyllosticta helleborella (Sacc.), Pl. I. fig. 1.

The leaves of Hellebores are apt to become very much disfigured by parasitic fungi, of which many species are recorded, and amongst them the above-named, which made its first appearance in Italy.

* *Country Life*, Sept. 19, 1867, p. 88.
† *Gard. Chron.*, Oct. 28, 1848, p. 716. ‡ *Gard. Chron.*, July 1, 1882, p. 23.

In the form which is found in Britain the foliage is disfigured by large blotches, or spots, on the upper surface, which are sometimes very irregular and angular in shape, without any distinct border or marginal line. At first they are blackish, but soon become paler and bleached in the centre, leaving the blackness around the edge. The spots are sprinkled with little black dots, like pin-points, which are the conceptacles, or perithecia, of the fungus, and contain the spores.

Under the microscope these perithecia are blackish, minute, rounded, flattened bodies, with a pore or orifice at the apex, through which the spores escape, and are more or less immersed in the substance of the leaf. The sporules are oblong and colourless, minute (7×3 μ), with two nuclei, and are produced on short stalks within the receptacles.

In Italy this species is found growing in company with another fungus of a higher development, but resembling it in external appearance. In that case the spores are produced within delicate cylindrical cells, or asci, to the number of eight in each ascus, and the species is called *Sphærella Hermione*, of which the above-named *Phyllosticta* is an imperfect condition. Hitherto there is no record of the perfect condition, or *Sphærella*, having been found in this country.

At present, so far as we are aware, this parasite is confined to Italy and to isolated spots in Great Britain.

If taken in the early stage of its appearance, and all the diseased leaves are removed, so long as the plants are otherwise in a healthy condition, they may recover. Failing this, the application of one of the copper solutions should be made.

It may occur either on the leaves of *Helleborus niger*, *viridis*, or *fœtidus*.

Sacc. Syll. iii. 201 ; *Grevillea*, xiv. p. 73, No. 403.

Another and allied species, *Phyllosticta atrozonata* (Voss., f.), occurs on the leaves of *H. viridis* in Carniola. The leaf-spots are characterised by concentric zones, and the sporules are smaller.

In France another species, *Phyllosticta Helleboriana* (Brun.), occurs on the leaves of *H. fœtidus*, in which the spots are smaller, rounded, and margined by a brown line, whilst the sporules are smaller still.

In Italy the leaves of *H. viridis* are attacked by the angular, dry, pallid spots of *Phyllosticta Helleboricola* (Mass.), with very minute sporules. So that altogether four species of the same genus of parasite have occurred on the leaves of Hellebore in Europe.

Hellebore Leaf-spot.

Septoria Hellebori (Thüm.), Pl. I. fig. 2.

This little-known parasite has on one or two occasions been found on the foliage of *Helleborus niger* in Britain, although first discovered in Austria.

The spots on the leaves are rather large and irregular, without any determinate margin, and of a brown colour. The spots are sprinkled with the minute black dots, as in *Phyllosticta*.

The principal difference, as revealed by the microscope, lies in the form and dimensions of the sporules, which, in the present instance, are long and thread-like (40–50 μ long).

It has been found on *H. niger* and *H. fœtidus* in Austria, and in France, as well as in Britain.

Fortunately it is so rare that experiments have not been made with remedies, but probably spraying would be useful.

Sacc. Syll. iii. 2840 ; *Grevillea*, xiv. p. 102, No. 507.

A similar parasite occurs in Italy on the leaves of *H. viridis*, in which the spots are whitish and angular, circumscribed by a blackish line, and is called *Ascochyta Hellebori* (Sacc.).

The species in this genus resemble externally those of *Phyllosticta* and *Septoria*, but the sporules are different, since they are divided by a cross-partition into two cells. In this instance they are about 8 × 2 μ.

Hellebore Blotch.

Coniothyrium Hellebori (Cooke and Mass.), Pl. I. fig. 3.

The leaves of the black Hellebore have been attacked in this country by a new parasite, which at present seems to be unknown abroad, and, fortunately, very little at home.

The leaves are occupied by two or three dingy-brown spots, somewhat circular in form, but without any determinate margin. The minute dots of the perithecia are chiefly central, and more or less in concentric rings.

Microscopically it differs principally in the sporules, which are oval (4–5 × 2–3 μ) and of a pale brown colour, whereas in the other leaf-spots enumerated here the sporules are colourless.

It is unnecessary to suggest remedies.

Grevillea, xv. p. 108 ; *Sacc. Syll.* x. 5748.

Hellebore Smut.

Urocystis pompholygodes (Schl.).
Urocystis Anemones (Pers.).

This smut, which attacks Hellebore leaves, is also common on those of *Anemone Hepatica, Ranunculus, Pulsatilla, Eranthis*, &c., and is hereafter described as " Anemone smut." (See Pl. I. fig. 7.)

Hellebore Leaf-mould.

Ramularia Hellebori (Fckl.), Pl. I. fig. 4.

This delicate mould occurs in whitish patches on living, or fading, leaves of Hellebore in this country, and on the Continent, occupying either surface of the leaf.

The spots are rather small and of a circular form, becoming white, with a blackened or purplish margin. The mould appears to the naked eye only as a delicate frosting on the spots.

Under the microscope small tufts of slender short threads arise from the mycelium, which pervades the spots (scarcely 20 μ long), and the conidia are produced singly on the tips of these threads. They are somewhat fusiform or spindle-shaped, divided by a septum in the centre into two cells, and are a little longer than the threads which support them ($24–30 \times 4–5\ \mu$), wholly colourless, but rather granular within, soon falling away when mature.

Spraying is generally effective in this class of parasites.

The present species has been recognised in Italy, Switzerland, and Germany, as well as in Great Britain.

Sacc. Fung. Ital. pl. 1013; *Sacc. Syll.* iv. 970; *Grevillea,* xiii. p. 51.

Hellebore Rot-mould.

Peronospora Ficariæ (Tul.), Pl. VI. fig. 5.

Many Ranunculaceous plants are liable to attack from a destructive mould of a similar kind to that of the Potato disease, and amongst them are the Hellebores. The foliage is attacked by the parasite, which soon takes possession of the entire plant.

The external patches of the mould are effused, and of a dirty-white colour, looking like mealy blotches to the naked eye.

When magnified the tufts of mould are seen to consist of erect fertile threads, which are from five to six times forked in the upper portion, the final branches, and those immediately preceding them, being curved and bent downwards, leaving obtuse angles. The conidia are borne singly on the tips of the threads, and are broadly elliptical, with a slight tinge of violet.

Resting spores are produced, for the winter, upon the internal mycelium, the thick external coating being of a pale yellowish-brown. These resting spores are set free in the spring, by the rotting of the foster plant, and active zoospores, which are formed in the interior, then escape from their temporary prison and infect the young host-plants and perpetuate the disease.

This disease is widely spread in Europe, being known in Britain, France, Germany, Belgium, Finland, and Italy, as well as in Bosnia and Lapland, and in the United States of America.

Being such a complete endophyte, it is almost hopeless to attempt to save plants when once they are attacked; external applications are of little avail.

Sacc. Syll. vii. 835; *Cooke M. F.*, p. 235; *Gard. Chron.* July 7, 1888, fig. 2; *Mass. B. F.*, p. 119.

German Hellebore Rot-mould.

Peronospora pulveracea (Fckl.).

This disease, which attacks the foliage of Hellebores in Germany, has not yet been discovered in Britain. Externally it much resembles the British species, but the microscopical characters are somewhat different.

The size of the conidia is represented as $25–30 \times 18–22\ \mu$.

Sacc. Syll. vii. 875; *Berlese Icones*, t. 52.

Globe Flower Leaf-spot.

Phyllosticta Trollii (Trail).

This parasite has only recently been found on the leaves of *Trollius europæus* in Scotland.

It forms irregular brown spots on the leaves, which are usually limited by the veins, and the receptacles, or perithecia, are scattered over the spots, on the under surface.

The sporules, which are produced within the perithecia, are very minute (4×1 μ), obtuse at each end and colourless.

Should it ever become aggressive, it would be well to try spraying with a copper solution.

Trail, Trans. Crypt. Soc. Scot. 1889, p. 43 ; *Sacc. Syll.* x. 5003.

The Globe Flower Brand (*Puccinia Trollii*, K.) has only been recorded in Italy, Switzerland, and Lapland.

Two other leaf-spots are known to occur on the leaves of *Trollius*, namely, *Ascochyta Trollii*, with two-celled sporules, only known in Siberia, and *Septoria Trollii*, with long thread-like sporules, near Lake Lucerne in Switzerland.

Aconite Diseases.

Hitherto none of the special diseases which attack the Aconites have been recorded for this country. *Septoria Napelli* (Speg.) has occurred in Italy, and also *Septoria Lycoctoni* (Speg.).

Æcidium Aconiti-Napelli (DC.) and *Uromyces Aconiti-Lycoctoni* (DC.), the former in France, Germany, and Switzerland, the latter in Italy, Switzerland, France, Germany, Hungary, and Siberia, are not British, whilst *Æcidium circinans* is confined to Scandinavia.

An Aconite white mould *Ramularia monticola* (Speg.) is also recorded for Italy.

Larkspur Diseases.

At present we have been spared the infliction of these diseases, of which *Septoria Delphinella* (Sacc.) is found in France. The mould called *Cercospora Delphinii* (Thüm.) is still Siberian, whilst *Puccinia Delphinii* (Diel) is Californian.

Anemone Rot-mould.

Plasmopara pygmæa (Unger), Pl. VI. fig. 6.

This "rot-mould" is similar in character to that already described as occurring on Hellebore, and is found on the leaves of Anemone as well as sometimes on Aconite.

The threads are often in bundles of two to six together, and are either simple or branched above, the branches are either simple or once or twice forked, the tips surmounted by from two to four short conical branchlets supporting the conidia. The latter are elliptical, of variable size (18–25 $\times$ 15–20 μ), with the apex broadly and obtusely teat-like.

In the interior of the plant the resting spores are produced from the mycelium. These are globose (45–55 μ diam.) with a yellow-brown coating, or epispore, which is either smooth or minutely rugulose.

The history and development of these rot-moulds are rather complicated, and may be found more in detail in the Introduction, p. 3.

The distribution of this pest includes not only Great Britain, but France, Germany, Italy, Belgium, and North America.

The remark on remedies under "Hellebore Rot-mould" applies with equal force to this species.

Sacc. Syll. vii. 807; *Cooke, M. F.* 234, t. xv., f. 267; *Berlese Icones*, t. 10; *Cooke Hdbk.* No. 1776; *Mass. B. F.* p. 112.

Anemone-smut.

Urocystis Anemones (Pers.), Pl. I. fig. 7.

This smut attacks the leaves and petioles of various allied plants, such as Anemone, Hepatica, Aconite, Hellebore, Ranunculus, Pulsatilla, and Eranthis, swelling and deforming them.

To the naked eye its presence is very evident, as the leaves are blistered, and the petioles swollen, becoming paler in colour, until the distended cuticle bursts, and shows the mass of sooty spores, which are produced in profusion, and scattered over the plant as soon as they are mature, producing a most unsightly appearance.

Under the microscope these spores are seen to be of a compound character, forming glomerules, or clusters, more or less globose. The central spores are dark brown, spherical, and compressed (18–16 μ); the peripherical or outer cells, to the number of about ten or more, are colourless and compressed at the sides (each glomerule about 26 μ long). The tissues of the host-plant are traversed by mycelium.

This pest is to be found in most European countries, in Asiatic Siberia, and in North America.

It is always desirable to pick off and burn all infected leaves as soon as the parasite makes its appearance, and thus it will probably be kept in check. Generally only one or two leaves are at first attacked; but although the pest may appear year after year, it is possible to keep it under control if taken in time.

Sacc. Syll. vii. 1901; *Cooke M. F.* 91, 232, t. ix., f. 183, 184; *Gard. Chron.* Sept. 30, 1876, fig.; *Plowr. Brit. Ured.* 288; *Cooke Hdbk.* No. 1541; *Mass. B. F.* p. 188.

Anemone Cluster-cups.

Æcidium punctatum (Pers.), Pl. I. fig. 8.

The leaves of the garden Anemone are liable to attack from this species of cluster-cup which is generally believed to be a distinct species from the *Æcidium Anemones* (Pers.), which attacks the foliage of the Wood Anemone, and has colourless æcidiospores.

The cups are scattered over the leaves, somewhat uniformly, whilst the leaves are much thickened by the mycelium. The cups are flattened, and semi-immersed, with a torn, rather yellowish margin. The lobes are larger than in the common wild species, and are often not more than four to each cup. The æcidiospores are almost globose (16–23 μ) and of a brownish-yellow colour. The foliage is very much distorted when attacked by this parasite, which has a facility for spreading rapidly.

Hitherto it has not been demonstrated that there are associated with this species, as with many others, a Uredo form and a Puccinia form, but it appears to be complete in itself.

It has been found, besides Great Britain, also in France, Italy, Germany, and Belgium.

Pick off affected leaves and spray with copper solution to destroy scattered spores.

Sacc. Syll. vii. 2705; *Cooke M. F.* ii. 194; *Cooke Hdbk.* No. 1604; *Plowr. Brit. Ured.* p. 268.

Another cluster-cup (*Æcid. leucospermum*) with whitish æcidiospores and the accompanying rust (*Puccinia fusca*) is found on Wild Anemone.

Anemone Peziza.

Sclerotinia tuberosa (Hedw.).

It has long been known that certain long-shaped bodies, resembling Anemone roots, are to be found amongst the roots of the Wood Anemone, and are called sclerotia, which represent a kind of compact fungus

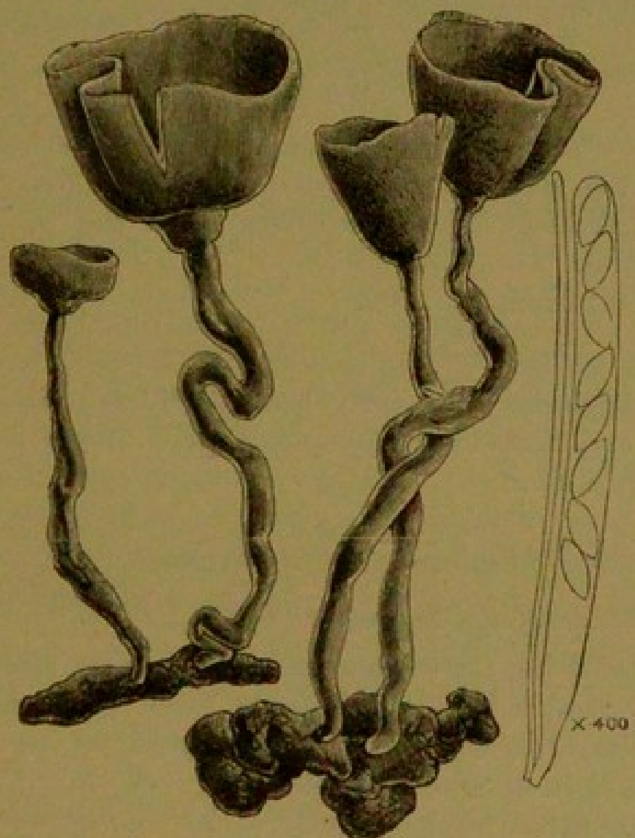

Fig. 3.—Sclerotinia tuberosa, natural size; Ascus and Sporidia × 400.

mycelium. It is more than probable that they were originally true Anemone roots converted into sclerotia, as the grain of Rye is changed into ergot. In 1893 evidence was given (*Gard. Chron.* p. 75) that these sclerotia have appeared also amongst garden Anemones.

In form and size they resemble the rhizomes of Anemone, but are harder and more compact, and of a different internal structure and composition.

Ultimately, and in autumn, these sclerotia send up one or more fleshy stems to the surface of the soil, where the apex at length expands into a cup-shaped form, half an inch or more in diameter, and of a brownish colour, with a fleshy substance, easily broken up with the fingers. These cups are such as were formerly called *Peziza*, but now *Sclerotinia*, because developed from a sclerotium (fig. 3).

The interior of these cups is fertile, and a thin section shows, under the microscope, that it is composed of long cylindrical cells called asci, placed side by side. Each of these asci contains eight spores, or sporidia, uncoloured, and elliptical in form ($15-17 \times 6-7\ \mu$): when mature these spores are ejected like a cloud of fine dust.

Collect the Peziza form in the spring to prevent diffusion.

Sacc. Syll. viii. 797; *Gard. Chron.* May 28, 1887, p. 712, fig. 137; *ib.* July 15, 1893, p. 75; *Mass. Pl. Dis.* p. 157.

Anemone Leaf-spot.

Septoria Anemones (Desm.).

We have no record of this leaf-spot hitherto on any but uncultivated Wood Anemone, and upon this it is common.

Hepatica Diseases.

At least two diseases of Hepatica are known on the Continent, but at present have not made their appearance in Britain. These are the cluster-cups, *Æcidium Hepaticæ* (Beck), and the leaf-spot, *Septoria Hepaticæ* (Desm.).

Sacc. Syll. iii. 2830, vii. 2706.

The May Apple leaf-spot (*Phyllosticta Podophylli*) has occurred in gardens on the leaves of *Podophyllum peltatum*, although of little importance (*Grev.* xiv. 74).

Columbine Anthracnose.

Glœosporium Aquilegiæ (Thüm.), Pl. I. fig. 9.

The leaves of living Columbines are subject to the attacks of a minute fungus of a destructive kind, but hitherto little known in this country. In this case the little dots make their appearance on both surfaces, clustered together on discoloured spots.

The spots are rather large, irregular, and of an ochraceous colour, with a broad brown margin, caused by the internal mycelium which destroys the vitality of the leaf. The dots represent cavities in the substance of the plant, which contain the numerous conidia, or spores: these are at first borne on short stalks, but soon liberate themselves, and are expelled in a kind of tendril from the orifice in the cuticle.

In this species the conidia are elliptical, without any division ($12-15 \times 5\ \mu$) and colourless.

The species was first discovered in Siberia, but has recently been found in gardens in this country, although hitherto there has been no record of its appearance in Continental Europe.

There is no accounting for the manner in which some of these parasites diffuse themselves, so as to suddenly appear, and perhaps as suddenly disappear, in localities far remote from each other.

Another species, *Glœosporium Martianoffianum*, with the conidia twice as large, has also been found in Siberia on the same host-plant.

Diluted Bordeaux mixture checks the disease.

Sacc. Syll. iii. 3660; *Grevillea*, xiv. 123.

Columbine Leaf-spot.

Ascochyta Aquilegiæ (Roum.), Pl. I. fig. 10.

One kind of leaf-spot has been found in this country on Columbine leaves, and has probably migrated from France, where it was first discovered.

The spots on the leaves are somewhat rounded and nearly white ($\frac{1}{2}$–1 m. diam.), with a dusky margin, dotted towards the centre of the spots with the minute perithecia.

The conidia are narrowly elliptical, with a brownish tint, and are divided by a septum across the centre into two cells.

If troublesome, try spraying with one of the fungicides.

Sacc. Syll. iii. 2191.

Another leaf-spot has been found in France on Columbines, *Phyllosticta aquilegicola* (Br.), with brownish spots and small continuous conidia ($8 \times 2\ \mu$).

Another occurs in Italy, in which the spots are whitish, with a broad brown margin, but the conidia are long and threadlike. This is called *Septoria Penzigii*. The purple spot parasite has also been found in Italy. *Septoria Aquilegiæ* has rather longer threadlike conidia. The North American leaf-spot is perhaps different.

A tufted mould, seated on purple-brown spots, is known in the United States as *Cercospora Aquilegiæ*, of which the conidia are very long (140–300×5–$6\ \mu$).

Columbine Cluster-cups.

Æcidium Aquilegiæ (Pers.).

These cluster-cups have often been regarded as a variety of the Ranunculus cluster-cups, but there are other writers who contend that they constitute a distinct species, without any indication of either uredospores or teleutospores being affiliated thereto. They occur collected in clusters upon round or irregular yellow spots, with a violet-brown margin, on leaves of Columbine.

The cups are shortly cylindrical, on the under surface, seated upon a thickened cushionlike base. The æcidiospores are compressed and angular (16–30×14–$20\ \mu$), orange in colour, and distinctly warted.

They have been known for many years as occasional occurrences in

Britain, and their geographical distribution includes France, Switzerland, Germany, Finland, and Siberia.

Never likely to cause sufficient trouble to call in the aid of fungicides, better to pick off the diseased leaves if the cups appear.

Sacc. Syll. vii. 2710; *Pers. Ic. Pict.* iv. t. 23, f. 4; *Cooke Hdbk.* No. 1615*a*; *Plowr. Brit. Ured.* 263.

Pæony Leaf-spot.

Phyllosticta Pæoniæ (S. & Sp.), Pl. I. fig. 11.

Pæony leaves are subject to several kinds of leaf spot in different countries, but only the above has at present been recorded for Britain. This scarcely deserves to be called a "leaf-spot," since the spots are obsolete, and the rather large perithecia are scattered, like little black dots, over the leaves.

The conidia are elliptical, with two nuclei ($10 \times 5\,\mu$), and have a slight tinge of olive.

The greatest harm that the majority of these leaf-spots do to the plants is to disfigure the foliage. In general they may be kept in check by spraying and picking off the infested leaves.

Sacc. Syll. iii. 200.

Three other species of *Phyllosticta* are recorded as producing leaf-spots on Pæony. These are *Phyllosticta Moutan* and *Phyllosticta baldensis* in Italy, and *Phyllosticta Commonsii* in North America.

Other leaf-spots are produced by species of *Septoria*, with long thread-like conidia, such as *Septoria Pæoniæ* in N.-W. Europe, and *Septoria macrospora* in Italy. *Septoria Martianoffiana* is only known in Asiatic Siberia.

Pæony Rust.

Cronartium Pæoniæ (Cast.), Pl. I. fig. 12.

A peculiar kind of rust, not very common but occasionally appearing in gardens, on Pæony leaves, chiefly on the under surface, is the above, which has been known for very many years.

The pustules are small, and collected together on paler spots, but with none of the bright yellow or rusty colour peculiar to most of the plant rusts.

The uredospores are enclosed in a kind of peridium, or volva, and are either ovate, or elliptical, and spiny ($20-30 \times 15-30\,\mu$). From the centre of the spore mass arises a compact column composed of the brown teleutospores, or final spores, many of which commence to germinate while still attached to the foster plant. The long flexuous columns (2 m. long) give a peculiar appearance to this parasite, making it look rather like a colony of worms or larvæ upon the leaf, commonly extending over a considerable surface. It has very little of the general appearance of a Uredine, and would rather puzzle the inexperienced.

It is found throughout the greater part of Europe and in Asiatic Siberia.

No successful experiments recorded, and the presumable æcidiospores are unknown.

Sacc. Syll. vii. 2139; *Mass. Pl. Dis.* p. 235; *Cooke M. F.*, 215; *Plowr. Brit. Ured.* 254.

PÆONY BROWN MOULD.

Cladosporium Pæoniæ (Pass.), Pl. I. fig. 13.

This mould was first found in Italy by Professor Passerini in 1876, and has since made its appearance in this country.

It forms broad chestnut-brown spots on the foliage, which ultimately turn black.

The threads are short and unbranched, nearly straight, and erect, divided transversely into joints, and springing from an abundant creeping mycelium. The threads bear at their tips the very variable conidia or spores, which are commonly one- or two-septate, and sometimes two or more are attached in a short chain ($15–22 \times 6 \mu$).

Although found upon still living, but faded, leaves, it is rather uncertain whether it should be regarded as a destructive pest. Many species of *Cladosporium* are very common on decaying plants, and for the most part are simply saprophytes. The Tomato mould (*Cladosporium*) is nevertheless a destructive parasite, and possibly others may become so.

Spray with dilute potassium sulphide solution.

Sacc. Syll. iv. 1729.

Another brown mould, of a different character, *Cercospora variicolor*, with long slender conidia ($35–50 \times 3\frac{1}{2} \mu$), has been found on Pæony leaves in the United States. This is a true parasite.

DROOPING PÆONY DISEASE.

Botrytis Pæoniæ (Oud.), Pl. VI. fig. 14.

This white mould appear rather suddenly upon what appears to be healthy-looking plants, causing them before the time of flowering to become limp, the stem droops, and at length the plant dies.

The mould may be detected on the stem of a diseased plant like a delicate white mould on the blackened and shrivelled surface.

The threads terminate in somewhat globose heads, which bear a profusion of colourless elliptical conidia, or spores ($16–18 \times 7 \mu$).

Later on small black *sclerotia*, which are compact masses of hibernating mycelium, will be found in the tissues, both above and below the ground.

It is presumed that these sclerotia remain in the soil until the succeeding spring, when they may start into new life, as some of these sclerotia do, under the form of a minute Peziza.

This threatens to be a troublesome disease, and should be encountered at once should it appear. All infected parts should be destroyed, so as to prevent hibernation of the sclerotia.

Mass. Pl. Dis. 157; *Gard. Chron.* Aug. 13, 1898, fig. 32.

CLEMATIS DISEASES.

The cultivated species of Clematis have hitherto been remarkably free from fungoid pests, whilst our common hedgerow species has two or three enemies. One or more of these may at any time make their appearance in the garden, especially those in which *Clematis Vitalba* may have secured a place. Hence we enumerate, incidentally, the diseases to which the Clematis is liable.

The common Clematis cluster-cup (*Æcidium Clematidis*) occurs over the greater part of Europe, on the leaves of *C. Vitalba*, *C. recta*, and *C. Flammula*.

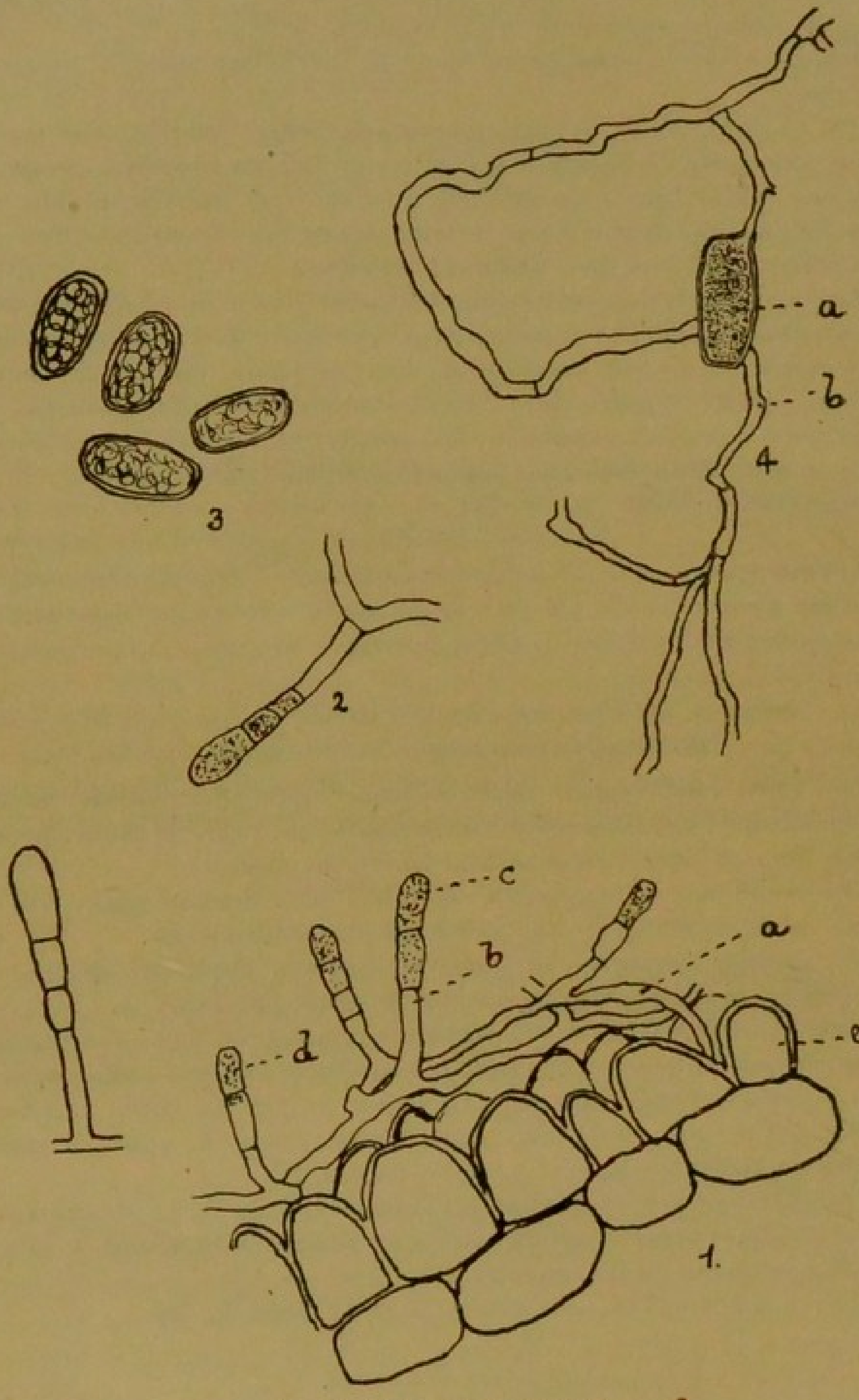

FIG. 4.—OVULARIA CLEMATIDIS.

1. Section of petal with mycelium (*a*) and conidiophores (*b*, *c*, *d*); 2. Conidiophore with conidium; 3. Conidia × 400; 4. Conidium (*a*) germinating (*b*).

Another cluster-cup (*Æcidium Englerianum*) has been found on Clematis leaves in Abyssinia.

In India another species (*Æcidium orbiculare*) has been found on

C. grata, *C. orientalis*, and *C. puberula*, whilst *Æcidium otagense* is confined to New Zealand.

Leaf-spot is also common, with *Phyllosticta Vitalba* (Cooke), formerly included by error under *Septoria Clematidis*, on our indigenous species. *Phyllosticta Clematidis* in Canada; *Phyllosticta corrodens* upon *Clematis Vitalba* in Italy, in company with *Phyllosticta bacteriosperma*.

One form of leaf-spot, with bicellular conidia, is *Ascochyta Vitalbæ*, found in France.

Of leaf-spots having long threadlike conidia *Septoria Clematidis* is British, as well as proper to some other parts of Europe. *Septoria Clematidis-Flammulæ* on *C. Flammula* in France; *Septoria Clematidis-rectæ* on *C. recta* in Italy, as well as *Septoria Flammulæ* on *C. Flammula*, and *Septoria Viticellæ* on *C. Viticella*. To these may be added *Septoria Jenissensis* on *C. glauca* in Siberia, and *Septoria Jackmanni* on *C. Jackmanni* in New York.

Clematis White-mould.

Ovularia Clematidis (Chitt.).

From Chelmsford the flowers of *Clematis Jackmanni*? were sent, infested with a white mould, which has been named *Ovularia Clematidis* (Chittenden), forming whitish patches on the upper surface of the petals, and may thus be described: Spots epiphyllous, white, conspicuous, circular or sub-circular, from 2 to 4 centimetres in diameter. Mycelium colourless, branched, creeping. Fertile hyphæ erect, simple (40–$60\,\mu \times 7\,\mu$), two or three times septate. Conidia hyaline, solitary, or mostly so, cylindrical, with rounded ends (28–42×14–$16\,\mu$), smooth. (See fig. 4.)

This species occurred in September, 1903, and differs from all described British species in the large conidia, which sometimes give indications of being shortly catenulate.

Gard. Chron. Oct. 31, 1903, p. 299; *Journ. R.H.S.* xxviii. (1904), p. clxxvii, fig. 176.

Crucifer Rot-mould.

Peronospora parasitica (Pers.), Pl. VI. fig. 30.

There are but few parasites on garden Crucifers, but this is sufficiently destructive to the foliage of Wallflowers, Stock, and some other garden flowers to make up for the deficiency.

It occurs in whitish mouldy patches on the leaves and inflorescence.

The mycelium is profuse, thick, and very much branched, from which arise the erect threads, which are also rather thick, soft, and flexile, from five to eight times branched, in a forked or trifurcate manner, the ultimate branches awl-shaped and curved, bearing the broadly ellipsoid conidia (20–22×16–$20\,\mu$).

The resting spores, which are seated upon the mycelium in the stems and branches of the host, are globose (26–$40\,\mu$ diam.), either smooth or rugged, and of a yellowish or tawny colour.

For details of life history and development of the rot-moulds see Introduction, p. 2.

Diseased parts should be burnt to destroy resting spores.

Sacc. Syll. vii. 830; *Cooke M. F.* t. 14, f. 265; *Hdbk.* No. 1778; *Mass. Pl. Dis.* 79, 355; *Mass. B. F.* 119, f. 45, 46, 129.

Poppy Rot-mould.

Peronospora arborescens (Berk.), Pl. VI. fig. 15.

This is the principal pest of the Poppy family, and occurs on the leaves of the Opium Poppy, as well as on those of some uncultivated species. It was first described by Berkeley in the Journal R.H.S. forty years ago.

It appears as a white mould, in patches, on the under surface of the leaves.

The fertile threads are erect, slender, and divided from seven to ten times, in the upper portion, in a furcate manner. The branches are more or less flexuous and spreading, gradually attenuated, so that the final branches are very thin, somewhat curved, and pointed. The conidia are almost globose ($15-22 \times 13-18\ \mu$), with a tinge of violet. In the autumn resting spores are produced upon the mycelium, within the tissues of the host-plant, and these are globose, with a striate brown envelope or coating.

The production of active zoospores, and their aid in the perpetuation of the species, follow the type of the other species of rot-moulds. See Introduction, p. 2.

This species has been found in France, Belgium, Germany, and Italy.

Spraying as a remedy can be of little use in so deep-seated an endophyte, but all parts of diseased plants should be burnt so as to destroy the resting spores.

Cooke Hdbk. No. 1785; *Journ. Roy. Hort. Soc.* i. p. 31, t. 4, f. 24; *Sacc. Syll.* vii. 836; *Cooke M. F.* p. 217; *Berlese Icones,* t. xliii.; *Mass. B. F.* 120.

A black mould, *Heterosporium Eschscholtziæ*, is found on Eschscholtzia leaves in California.

Mignonette Disease.

Cercospora Resedæ (Fckl.), Pl. I. fig. 16.

This fungus is rather common on the wild species of *Reseda*, and sometimes proves destructive to the cultivated Mignonette, causing dusky-brownish patches upon the foliage.

To the naked eye the blotches on the leaves seem to be minutely velvety from the threads of the mould, and without definite margin, but it spreads rapidly from plant to plant.

The threads are short ($50\ \mu$ long) and densely crowded together, septate, and brownish in colour. The conidia are produced at the apex of the threads singly, and are very long and flexuous ($100-140 \times 3\ \mu$), attenuated gradually upwards, and divided by numerous (four to five or more) transverse partitions, or septa; they are also slightly coloured.

It has been observed in Britain, Germany, Italy, the United States, and Australia.

Spraying with dilute Bordeaux mixture has been recommended.

Sacc. Syll. iv. 2092; *Mass. Pl. Dis.* p. 319; *U.S.A. Depart. Agric. Rep.* 1889, with plate; *Grevillea,* iii. 182; *Journ. R.H.S.*, xxix., p. 766.

A rot-mould, *Peronospora crispula*, has been found on leaves of *Reseda luteola* in the Rhine Provinces, and may at any time attack the Mignonette, should it appear on our uncultivated species of *Reseda*.

PESTS OF VIOLET AND PANSY.

Considerable anxiety is manifested by those who grow these plants extensively as to the prospects of the future, with the increasing number of Violet diseases which we are about to enumerate. Nevertheless it must still be remembered that quite a number of fungoid pests are known as affecting this family which have not yet made their appearance in the garden, but are common on uncultivated representatives. To be forewarned is to be forearmed, and all prospect of contagion from infested wild plants should always be held in consideration. For this purpose we have thought it prudent to give incidental notices of the diseases to which uncultivated plants are liable, as well as some affecting cultivated species, which have not as yet invaded our shores.

VIOLET LEAF-SPOT.

Phyllosticta Violæ (Desm.), Plate I. fig. 17.

This spot has occurred on the leaves of *Viola odorata* and *Viola tricolor* in various parts of Europe. It disfigures the foliage, but seems to have but little influence on the flowering.

White rounded spots are formed on both surfaces of the leaves, several spots occurring on the same leaf, and then occasionally coalescing and forming irregular blotches, but with a definite margin. The receptacles, or perithecia, are very minute, resembling little black dots just visible to the naked eye, scattered over and immersed in the bleached spots.

The sporules, or conidia, are produced within these receptacles, escaping when mature by a pore at the apex. In this instance they are cylindrical and straight (10 μ long), rounded at the ends and colourless, oozing from the mouth of the receptacle in the form of a whitish tendril.

The variety on the Pansy has rather smaller sporules ($7 \times 3\,\mu$).

This pest is known in France, Belgium, Italy, and Great Britain, as well as in Australia.

If troublesome in gardens fungicides should be resorted to in order to prevent spreading.

Sacc. Syll. iii. 203; *Cooke Hdbk.* No. 1352; *Grevillea,* xiv. 73, No. 404.

Another species, *Phyllosticta Libertæ* (Sacc.), with blackish leaf-spots and very minute sporules, occurs on Sweet Violet leaves in France and Belgium.

Ascochyta Violæ (Sacc.) has badly attacked Violets in this country. See *Gard. Chron.* Nov. 5, 1904, p. 328.

DOG VIOLET LEAF-SPOT.

Septoria Violæ (West.), Pl. I. fig. 18.

This minute endophyte has occurred upon the leaves of several species of *Viola,* and especially on the Dog Violet, *V. canina* and *V. sylvestris,* probably also on the Sweet Violet.

Pale bleached spots are formed on the leaves, circumscribed by a reddish-brown line. Upon the upper surface of these rounded bleached spots, but immersed in their substance, are numerous minute dotlike brown receptacles, or perithecia, so small as to appear like pin-points to the naked eye.

The sporules, contained within these receptacles, are long and threadlike, sometimes straight and sometimes flexuous, and colourless, escaping when mature by a pore at the apex.

It may be remarked here that the ordinary leaf-spots are produced by fungi of three genera, all very much alike in external appearance, but differing in the form of the sporules. In *Phyllosticta* they are very small, about twice as long as broad, more or less, and undivided. In *Ascochyta* the sporules may be similar, or larger, divided across the centre into two cells. In *Septoria* the sporules are generally very long, and threadlike, sometimes with a row of nuclei, or several transverse divisions.

The above-named species is found in Britain, Belgium, and Italy.

If troublesome, spraying may be useful to check it.

Sacc. Syll. iii. 2811 ; *Grevillea*, x. 48.

Septoria violicola is found on leaves of *V. biflora* in Switzerland and Germany, and *Septoria hyalina* on two or three species of *Viola* in North America.

Violet Anthracnose.

Glœosporium Violæ (B. and Br.).

Some years ago the Rev. M. J. Berkeley received some leaves of *Viola odorata* from Scotland, with a parasite which he briefly described under the above name.

The leaves were disfigured by one or two pallid spots, which concealed minute cavities scattered over the surface. In these cavities were produced minute sporules, or conidia, which were expelled through ruptures of the cuticle when moist, oozing out in little orange gelatinous masses, and spreading themselves over the surface of the leaf.

Thus far goes the description, and we have since seen the only specimens which passed through Berkeley's hands, but fail to find any trace of conidia or sporules on the discoloured spots ; and as the parasite has never been found since, it must remain uncertain or doubtful.

Grevillea, vi. 126 ; *Sacc. Syll.* iii. 3668.

Another species of Anthracnose, which might possibly be the same, has been found on Violet leaves in Italy, and called *Marsonia Violæ* (Pass.), the difference being that the spots are of a chestnut colour, and the sporules, which are narrowly elliptical (15–18 $\times$ 5 μ), are divided across the centre into two cells, the only distinction between *Glœosporium* and *Marsonia* being that in the latter the sporules are bicellular.

Sacc. Syll. iii. 4036.

Violet Smut.

Urocystis Violæ (Fischer), Pl. I. fig. 19.

In some gardens, for the past century, the Violet smut has been more or less of a nuisance, disfiguring the foliage and weakening the plants.

PESTS—FLOWER GARDEN.

The leaves are blistered and distorted, chiefly along the midrib, and the petioles become swollen and gouty, usually twisted and pallid. Later on these pustules split irregularly down the centre, and expose a mass of blackish spores, like soot, which are scattered over the leaves.

These spores are complex, like those of the smut on Hellebore and Anemone, and consist of irregular rounded balls (32–50 × 20–45 μ) compounded of a number of smaller cells, the central ones being dark brown (10 × 17 μ diam.) and from one or two to six, angular by compression, while the outer ones, or those of the circumference, are colourless and somewhat hemispherical, but they do not germinate (6–10 μ diam.).

When the coloured spores germinate they give origin to a short thick thread (promycelium) into which the coloured contents of the spore pass. From the end of this thread five or six fusiform secondary spores are produced. Sometimes the secondary spores will germinate and produce tertiary spores.

This parasite is so deeply seated that fungicides are of little avail. All that can be done is to pick off all the diseased leaves, as soon as they appear, and burn them, so as to prevent the germination of the spores and the spreading of the disease.

It is certainly well known in France, Germany, and Italy.

Sacc. Syll. vii. 1905; *Cooke M. F.* 92, 232, t. ix., f. 185, 186; *Mass. B. F.* 189; *Plowr. Brit. Ured.* 288; *Cooke Hdbk.* No. 1538; *Tubeuf, Dis.* 317, fig. 174; *Gard. Chron.* Sept. 30, 1876.

Violet Rust.

Puccinia Violæ (Schum.), Pl. I. fig. 20.

The Violet rust is so widely diffused, and so general on wild plants, that it is fortunate it is not found oftener in the garden than it is. Like many others of its kindred it is developed under three forms or stages, the earliest being the cluster-cups, and afterwards the *Uredo* and the *Puccinia*. For practical purposes it is better to treat them as distinct diseases, without reference to their genetic connection, or, at least in so far as the cluster-cups are concerned, their entirely different appearance to the ordinary observer. The pustules of the *Uredo*, and afterwards of the *Puccinia*, are scattered over the surface of the leaves, the former of a rusty-brown colour, and the latter dark brown, nearly black, breaking through the epidermis.

The uredospores are powdery, and are produced in little pustules on either surface of the leaves. Individually they are nearly globose, and rough with short spines (21–26 × 17–23 μ).

The teleutospores, or final spores, are darker in colour, and are produced in similar pustules, often mixed with those of the *Uredo*. They have the usual *Puccinia* form, with a central partition dividing them into two cells (20–35 × 15–20 μ).

When mature these teleutospores are capable of germinating from each cell, the threads so produced developing towards their apex two or three secondary spores, which are simple and much smaller than the primary spore. The life-history and development are very similar in all the species of *Puccinia*. See Introduction, p. 5.

The present is a widely diffused species, and is known, not only in Britain, but also in France, Belgium, Germany, Switzerland, Italy, Austria, Finland, Asiatic Siberia, North America, and Patagonia.

It is doubtful whether fungicides are of much service with such deeply seated endophytes as *Puccinia*, although it was affirmed, during the greatest prevalence of the Hollyhock *Puccinia*, that spraying with Condy's fluid was decidedly advantageous.

Sacc. Syll. vii. 2163 ; *Cooke M. F.* 102, 210 ; *Plowr. Brit. Ured.* 152 ; *Cooke Hdbk.* No. 1502.

It should be mentioned here that another species of rust has been found, in Britain and Germany, on the leaves of *Viola palustris*, and named *Puccinia Fergussonii*, in which the pustules are clustered together in large rounded patches. The teleutospores are smooth and rather deformed ($20–30 \times 13–20\ \mu$) ; no uredo spores have at present been found (*Grevillea*, iii. p. 179).

Yet another species (*Puccinia hastata*) occurs on the leaves of *Viola hastata* in the United States, with much larger teleutospores ($35–40 \times 20–25\ \mu$) and smooth globose uredospores.

A third species (*Puccinia alpina*) is found on leaves of *Viola biflora* in Germany, Switzerland, Italy, and Lapland. The teleutospores are longer than in any other of the species ($30–52 \times 17–23\ \mu$), with the surface finely granulated.

Violet Cluster-cups.

Æcidium Violæ (Schum.), Pl. I. fig. 21.

In these modern days the above cluster-cups are treated as a stage in the development of *Puccinia Violæ*, but their general appearance is so distinct that for general purposes we prefer to treat them as a separate disease.

All the green parts of the Violet plants are liable to be invaded by this parasite. The cups are disposed in groups or clusters, seated on the leaves upon yellowish spots. The margin of the cup is white and torn into irregular teeth, exposing the bright orange æcidiospores ($16–24 \times 10–18\ \mu$), which, as usual, are produced in chains, being separated and dispersed when mature.

The area of distribution corresponds with that of the Violet rust.

It is not sufficiently common to have originated any experiments with fungicides.

Scattered Cluster-cups.

Puccinia ægra (Grove), Pl. II. fig. 22.

Another species of cluster cups was discovered in 1876, principally on the stems, but also on the foliage of *Viola cornuta*. The cups are few and scattered (*Æcidium depauperans*) and the æcidiospores are also orange. In 1883 the corresponding *Uredo* and *Puccinia* were found, which were described under the name of *Puccinia ægra*. They have hitherto only been found in Britain (*Grevillea*, v. p. 57).

A species of cluster-cups has also been found on wild Violets in the United States.

Sacc. Syll. vii. 2174; *Cooke Hdbk.* No. 1626; *Gard. Chron.* 1876, 175, 361, fig. 72; *Cooke M. F.* 198; *Grove Journ. Bot.* 1883, p. 274; *Plowr. Brit. Ured.* 158.

Violet Rot-mould.

Peronospora Violæ (D. Bary), Pl. VI. fig. 24.

Amid all the vicissitudes of the Violet crop it has hitherto suffered little serious injury from the rot-mould, which is of close kindred to the Potato disease mould. It has appeared, and is not uncommon, on wild plants, and has recently invaded the Violet and Pansy under cultivation.

The tufts of the mould are effused on the foliage, and although white are not particularly conspicuous; the threads are collected in little bundles, growing erect, and are many times divided in the upper portion into forked branches, with the final branchlets awl-shaped and bent backwards.

The conidia are elliptical, growing singly at (22–27 × 15–19 μ) the tips of the branchlets, but with a slight tinge of violet in their colour.

It is assumed that resting spores are produced, as in other rot-moulds, but they have not yet been detected. (See Introduction, p. 3.)

Plenty of air, and not too much water, retard the spread of the disease.

Another rot-mould (*Peronospora megasperma*) has been found on *Viola tricolor* in the United States.

Sacc. Syll. vii. 838; *Berlese Icones*, t. xlii.; *Mass. Pl. Dis.* 80; *Cooke M. F.* 235; *Grevillea*, iv. 109; *Mass. B. F.* p. 121.

Violet White Mould.

Ramularia lactea (Desm.), Pl. I. fig. 23.

This common little white mould on Violet and Pansy leaves does not much trouble the cultivator, since it has preference for the wild plants.

White orbicular spots appear on the leaves, circumscribed by a brown line, three or four spots being usually present on one leaf. The mould gives a mealy appearance to the spots, as if they had been powdered with flour, and principally on the under surface.

The mould itself is a very simple structure, consisting of rather twisted short threads (30–60 μ long), without branches, bearing at their tips the oblong or spindle-shaped conidia (8–10 × 2–3 μ). Occasionally two or three of the conidia will be met with attached to each other, end to end, so as to form a short chain.

It has been suspected that many of the species of this genus of moulds are only the naked conidia of some higher form of fungus, as has been proved in a few cases.

The present mould is known, not only in Britain, but also in France, Germany, Bohemia, Austria, and Italy.

It seems to be amenable to fungicides if taken in time.

Sacc. Syll. iv. 979; *Journ. Roy. Agr. Soc.* lxi. (1900), p. 735 (sub *Ovularia lactea*); *Journ. R.H.S.* xxvi. (1901), p. 198; *Grevillea*, iv. p. 109.

Another species, *Ramularia agrestis*, with larger and sometimes septate conidia, has occurred on Violet and Pansy leaves in Italy.

AMERICAN SPOT DISEASE.

Alternaria Violæ (Gall.), Pl. II. fig. 25.

There is very little doubt that this disease has made its appearance in this country, and is capable of doing considerable damage. It occurs principally on the leaves, commencing with small yellowish spots, surrounded by a narrow rim; sometimes they spread till they occupy the whole leaf. Most of the spots are free from fungus spores, with scarcely any indications of mycelium. Spores are developed in a saturated atmosphere after twenty-four hours.

The spores are borne in chains, or darkish-brown threads, which rise from the diseased surface. They separate easily, and can be transported freely to other and healthy leaves. These spores, or conidia, are club-shaped, or flask-shaped, divided by transverse as well as vertical septa, so as to be muriform ($40–60 \times 10–17\mu$), somewhat olive in colour.

Hitherto known only in the United States and in Britain, it is undoubtedly a dangerous pest.

At present no effective remedy has been discovered. Fungicides have produced little or no effect. Suggestions are made as to prevention, rather than cure, by giving careful attention to the production of vigorous, healthy plants.

Healthy plants inoculated with the fungus spores soon produced the disease.

U.S.A. Dep. Agric. Bull. 23, 1900; *Journ. R.H.S.* xxvi. (1901), p. 246, pp. 491–3; xxvi. 1902, p. ccxxii.

ITALIAN VIOLET BLACK MOULD.

Macrosporium Violæ.

A black mould, under the above name, of which we have no description up to now, is reported to be destructive to Violets in Italy.

At the time of going to press we have seen Violets with the leaves in a bad condition, but there is no evidence that such condition has been caused by a parasite. The tissue was entirely bleached and dead over a large portion of the surface, commencing at the margin, and extending inwards, and not interfoliary. Cultivators are of opinion that it is due to external circumstances, which is most probable.

All the dead spots seen by us become occupied by tufts of black mould, which are not present when the fading commences, but occur only on the dead tissue, and hence it is probably a saprophyte.

The moulds are of two kinds, growing in company, forming small dark olive tufts, and not becoming confluent. The earliest form is a *Cladosporium,* with slender unbranched septate threads of a pale olive and rather long. The conidia at first continuous, then uniseptate, at length bi- or tri-septate ($18–30 \times 7\ \mu$).

The other mould, which appears mixed with the former, is a *Macrosporium* resembling *M. sarcinula,* with delicate deciduous threads and somewhat cubical conidia ($30–35 \times 25–30\ \mu$). Truncate at the ends and but slightly constricted. The septa, longitudinal and transverse, divide the conidia into quadrangular cells, mostly in three irregular rows, and of a darker olive-brown than the *Cladosporium.*

Further investigation is advisable, but it certainly is not the Italian species.

Gard. Chron. 1902, April 12, p. 265.

Violet Black Moulds.

Cercospora Violæ (Sacc.), Pl. II. fig. 26.

This destructive genus of black moulds has no fewer than six representatives, which attack members of the Violet family. They form spots on the leaves, and develop tufts of short erect threads upon the spots. These threads are each surmounted by a long slender spore, which in most cases is septate, or divided by transverse partitions, and is gradually attenuated upwards almost to a point.

The British species (*Cercospora Violæ*) has five or six rounded white spots on each leaf, upon which the mould is developed.

The threads are very short, but the spores are very long (150–200 × $3\frac{1}{2}$ μ), attenuated upwards, divided by numerous transverse partitions, threads and spores having a smoky tinge.

It occurs also in Italy, Austria, and the United States.

It is recommended to spray with dilute Bordeaux mixture.

Sacc. Syll. iv. 2087; *Sacc. F. Ital.* t. 651; *Mass. Pl. Dis.* 319.

Another species (*C. Violæ-tricoloris*), with longer olive threads, occurs in Italy.

A species (*C. Violæ-sylvaticæ*), with shorter spores (45–70 μ), is found on *Viola sylvatica* in the Netherlands.

A British species (*Cercospora Ii*) has been found in Scotland on *Viola palustris*, with short spores (20–60 μ).

In the United States *Cercospora murina*, with spores (25–35 × 4–5 μ), has occurred on *Viola cucullata*, and *Cercospora granuliformis*, with variable spores on the same host.

In Saxony *C. lilacina* has curved or sickle-shaped conidia (50–75 μ long).

DISEASES OF CARYOPHYLLACEÆ.

A synopsis of the diseases of the Carnation family has already been published, which did not attempt to include the parasites of uncultivated plants, and yet extended to a considerable length. It will be necessary here to give more explicit details of the several diseases, so that they may be recognised by the ordinary observer.

Journ. R.H.S. xxvi. 1902, p. 649, Pl. I. II.

Dianthus Leaf-spot.

Phyllosticta Dianthi (West.), Pl. II. fig. 27.

This leaf-spot occurs on the foliage of *Dianthus barbatus* in gardens. It is not a destructive fungus, except to the foliage, which it discolours and distorts to a considerable extent.

The spots are whitish, and sometimes two or three are run together into one irregular blotch. The receptacles are quite minute, but visible to the naked eye, scattered over the upper surface, but more clustered towards the centre of the spots, with the circumference almost bare.

The sporules are elliptical and colourless, without any division, but usually with two or three small guttules (about $8 \times 3\ \mu$). At one time it was the custom to call these small sporules by the name of "spermatia," which led to the inference that they were fertilising, and not direct reproductive bodies. This name and supposed function were abandoned with the discovery that they were capable of germination under favourable circumstances.

The present species has also been found in Belgium, where it was first discovered by Westendorp.

If troublesome, spray with one of the copper solutions; otherwise picking the diseased leaves may be sufficient to prevent recurrence.

Sacc. Syll. iii. 237 ; *Journ. R.H.S.* 1902, Pl. I., f. 1.

Phyllosticta tenerrima is a Canadian species on leaves of *Saponaria.*

Carnation Leaf-spot.

Ascochyta Dianthi (Alb. and Schw.), Pl. II. fig. 28.

The leaves of Pinks, Carnations, &c. are liable to be infested with another small parasite, which causes spots on the living leaves. The pale spots are somewhat rounded or elongated, without distinct margin, and are dotted with the minute receptacles, which are accumulated in patches, at first covered by the cuticle.

The sporules are elongated, rather broader at one end than the other, but sometimes nearly equal, divided by a transverse septum in the centre into two cells; each extremity is furnished with an obtuse nipple or apiculus ($14–16 \times 3\frac{1}{2}\ \mu$).

In this and similar cases, where the sporule or spore is divided into two or more cells, it may be taken for granted that each cell is capable of germination, and for all practical purposes acting as if each cell were an individual sporule.

The little receptacles in which the sporules are produced are like little flattened round flasks, with a short neck, pierced at the apex, through which the matured sporules may escape. The base of these receptacles is attached to the delicate mycelium, upon which they are seated, and which pervades the spots.

This species is also found in Germany and the Netherlands.

Sacc. Syll. iii. 2203 ; *Journ. R.H.S.* 1902, p. 649, Pl. I., f. 2 ; *Cooke Hdbk.* No. 1357.

Lychnis Brown Spot.

Septoria Lychnidis (Desm.), Pl. II. fig. 29.

This parasite occurs on irregular red-brown, or pallid-rufous spots, on the leaves of *Lychnis dioica* and other species. The spots have no definite margin, and are sprinkled with the scattered receptacles, which are as minute as usual, and but just visible to the naked eye.

The sporules are long and threadlike, often curved or flexuous, and divided by from five to seven transverse septa ($50–70 \times 2\frac{1}{2}–3\ \mu$).

It has been recorded in France, where it was first discovered, and afterwards in Italy and Great Britain.

Sacc. Syll. iii. 2804; x. 6318.

Another species, with round pale spots, margined by a narrow bright brown ring (*Septoria noctifloræ*), occurs on *Silene noctiflora* in America.

One species without any definite spots (*Septoria dianthicola*) attacks the leaves of Sweet Williams and Pinks in Italy and Portugal.

Another affects the leaves of Saponaria (*Septoria Saponariæ*) in France, Italy, and Germany, in which the spots are pallid and rounded or irregular, the sporules being more robust than usual.

The leaf-spot most prevalent in Europe, S. Africa, and Australia (*Septoria Dianthi*) is not recorded for Britain. (See JOURNAL R.H.S. 1902, Pl. I., f. 3.)

LARGE DIANTHUS SPOT.

Septoria Sinarum (Speg.), Pl. II. fig. 31.

This leaf-spot seems hitherto to have been confined to the leaves of *Dianthus sinensis*, which are blotched with large and somewhat rounded whitish spots, often occupying the greater part of the leaf, and without any definite margin. The receptacles are scattered over the upper surface of the spots.

The sporules are of the threadlike type, but very short for fungi of this kind ($20\text{–}25 \times 2\text{–}2\frac{1}{2}\,\mu$).

The species was first found in Italy, but has since migrated to Britain.

Sacc. Syll. iii. 2802.

We may just mention *Septoria dianthophila* which affects the stems of *Dianthus Caryophyllus* in Brazil.

Two species are recorded as selecting specially the calyces of *Dianthus* for their host. One of these is named *Septoria Carthusianorum*, and occurs in Belgium; whilst the other is called *Septoria calycina*, and is given as Belgian also; but except in the names we fail to detect any difference between them, and suspect that it is the same parasite described independently by two different persons.

CARNATION ANTHRACNOSE.

Glœosporium Dianthi (Cooke).

During the spring of 1902 Carnations in several localities were attacked by this pest before it could be found in fructification and described, as it would appear to be an entirely new pest.

The leaves are at first spotted with small purple roundish spots. These gradually enlarge and become confluent and indeterminate, and at length brownish in the centre. Meanwhile the leaves become sickly, and commence to die off at the tips. The pustules are not to be distinguished by the naked eye, and scarcely by the aid of a lens. Cells beneath the cuticle supply the place of definite receptacles, and in them a large number of elliptical hyaline sporules ($10\text{–}12 \times 5\,\mu$) are produced, which escape through the fissured cuticle. At length the cuticle about the orifice turns pallid, and appears as a pale dot on the purple spots.

No remedies have been tried, but it would be advisable to apply diluted Bordeaux mixture, so as to destroy the extruded sporules, and to pick off as many of the diseased leaves as possible.

Observed since the plates were in press, and hence too late for illustration here.

Septate-carnation Anthracnose.

Marsonia Delastrei (De Lacr.), Pl. II. fig. 32.

We venture to include here references and descriptions of another of those destructive forms of disease which is called in America "Anthracnose," although there was no record of a British species until the immediately preceding species was discovered as this description was going to press. They form spots on leaves and stems, but there are no definite receptacles, only cells or cavities in the substance, which are covered by the cuticle. The sporules are formed in these cavities, and are liberated by the rupture of the cuticle.

The spots on the leaves of *Lychnis* are tawny and without definite margin. The sunken cells are scattered over these spots. The sporules are narrowly club-shaped, rounded at the apex, and attenuated towards the base. They are colourless, and at first without division, but at length are divided by a septum in the centre into two cells (20–25×6–$7\,\mu$), and are at first attached to long slender threads. Because of the divided spores it is called *Marsonia*. If the spores were undivided it would be *Glœosporium*.

Evidently this is only a mature form of another described parasite called *Glœosporium Lychnidis*, with which it agrees in every respect except in the septation of the sporules, both occurring upon the same host.

The distribution of this species is France, Belgium, the Netherlands, Germany, Austria, Italy, and Siberia.

Diseased parts should be collected and burnt.

Sacc. Syll. iii. 3700; iv. 4035; *Journ. R.H.S.* 1902, p. 650, Pl. I., f. 4.

A similar parasite (*Cylindrosporium Saponariæ*) is found on the leaves of Soapwort in France. The sporules are straight and cylindrical (10–$40 \times 3\frac{1}{2}\,\mu$), Journ. R.H.S. 1902, p. 650, Pl. II., f. 17.

Soapwort Smut.

Sorosporium Saponariæ (Rud.), Pl. II. fig. 34.

This smut occurs chiefly on the Continent upon the inflorescence of the Soapwort, on which it has been known for half a century. Only recently has it made its appearance in gardens in this country on *Dianthus deltoides*. It attacks and destroys the reproductive organs of the flowers, converting them into glomerules of spores.

The spore masses, or glomerules (40–$100\,\mu$ diam.), are rounded and composed of a great number of loosely connected cells, or teleutospores, which are yellowish-brown and angular from mutual pressure. The outer surface is rough with little tubercles and ridges (12–18 × 10–14 μ). The spores have been induced to germinate artificially, but not to proceed to the formation of secondary spores.

In the majority of species of the "smuts" the spores and glomerules are very dark brown, or almost black, and hence the name; but in a few species—and this amongst the number—the colour is pale.

Undoubtedly the smuts may be disseminated by means of the spores, but at the same time there is strong evidence in support of a perennial mycelium in perennial plants.

The present species is known in France, Germany, Austria, Italy, and Algeria, as well as Britain.

Difficult to combat, but seldom occurs in this country. Better to burn infected plants.

Sacc. Syll. vii. 1872; *Plowr. Brit. Ured.* p. 296; *Mass. B. F.* p. 202, figs. 59, 59A; *Journ. R.H.S.* 1902, p. 650, Pl. II., f. 9.

ANTHER SMUT.

Ustilago violacea (Pers.), Pl. II. fig. 33.

This smut habitually attacks the flowers of many species of *Caryophyllaceæ*, chiefly appropriating the anthers, and converting them into a mass of blackish powdery spores, which are diffused and scattered over the petals. In older books it is known as *Ustilago antherarum* from its habit of growth.

The spores are subglobose and lilac under the microscope, covered with a network of ridges (6–9 μ diam.), the meshes being about $\frac{1}{2}$ μ apart. On germination a fusiform promycelium is formed, which is commonly three-septate, each joint giving origin to a secondary spore, or sporidiole, of an ovate form.

This species is known also in France, Belgium, Germany, Switzerland, Austria, Bohemia, Transylvania, Italy, and North America.

Naturally there can be no remedy, as the presence of the parasite is unknown until it makes its appearance in the flowers, and then it is too late. All that can be done is to destroy all infected plants, so as to prevent the spread of the disease.

Sacc. Syll. vii. 1781; *Cooke M. F.*, figs. 102–104; *Plowr. Brit. Ured.* p. 280; *Mass. B. F.* p. 179; *Cooke Hdbk.* No. 1534; *Journ. R.H.S.* 1902, p. 651, Pl. II., f. 11; *Tubeuf, Dis.* p. 297.

SWEET WILLIAM BRAND.

Puccinia Dianthi (DC.), Pl. II. fig. 35.

One of the most common and best known pests of Sweet Williams and other allied plants, attacking the living foliage and rendering them most unsightly. There are usually large pale spots upon the leaves, which are somewhat rounded, or one or two other spots are joined to make them irregular, or to occupy nearly the whole of the surface of the leaf.

The pustules are rounded and cushion-like, either disposed in circles on the spots, or running together and forming an irregular crust, which is at first pale brown, then dark brown, covered with the pale cuticle, which splits irregularly, leaving the ragged margins like a frill round the pustules.

The teleutospores are fusoid or clavate, rounded at the apex, or conical, with the epispore thickened, divided at the middle into two cells, the lower one attenuated downwards into the hyaline pedicel (30–50 × 10–20 μ), pale in colour, and ochrey-brown.

No cluster-cups, or uredo, known to be associated with this species, which is reported over the greater part of Europe, Asiatic Siberia, and North America.

In some books it is called *Puccinia Arenariæ*, and in others *Puccinia Lychnidearum*. There are authors to whom names are pretty playthings, to be tossed about as they please.

Doubtless infection is transmitted of this disease through imported seeds.

Sacc. Syll. vii. 2361; *Mass. Pl. Dis.* 253; *Cooke Hdbk.* No. 1503; *Cooke, M. F.* p. 210; *Plowr. Brit. Ured.* p. 210; *Gard. Chron.* Jan. 12, 1884, p. 57; Jan. 26, 1884, p. 120; *Journ. R.H.S.* p. 652, Pl. I., f. 5.

Campion Brand.

Puccinia Silenes (Schröt.), Pl. II. fig. 36.

We are not prepared to affirm to what extent this pest has worked in gardens, but it is common on wild plants, and we fear sometimes on cultivated ones also. It occurs on the living leaves of almost any species of *Silene* and *Melandryum* throughout Europe.

The first stage, or cluster-cup (*Æcidium Behenis*), appears in the spring on the Bladder Campion, in small rounded clusters of the usual appearance, with white fringed margins and orange spores. The æcidiospores are angular and granulated (17–26 × 14–20 μ).

The pustules of the uredo form come later, and are rather small, either scattered, or at times confluent, and the uredospores are elliptical or ovoid, externally rough (19–26 × 17–22 μ), pale brown.

The teleutospores are contained in darker pustules, of a similar form and scattered, but not collected upon bleached spots. They are elliptical, or ovate, quite different in general outline from those of the Sweet William brand, rounded at both ends, and divided in the middle into two equal cells (25–40 × 16–25 μ), externally smooth, and of a chestnut-brown colour, with a short and uncoloured pedicel.

The area of distribution includes France, Belgium, Germany, Switzerland, Italy, and Siberia, as well as Britain.

Dilute Bordeaux mixture has been recommended as having proved effective.

Sacc. Syll. vii. 2154; *Journ. R.H.S.* 1902, p. 652, Pl. 2, f. 15; *Cooke M. F.* p. 211; *Plowr. Brit. Ured.* 147.

Puccinia fastidiosa on *Dianthus sinensis* has larger teleutospores, and seems to be peculiar to Siberia (*Journ. R.H.S.* 1902, Pl. II., f. 16).

Carnation Brand.

Uromyces Dianthi (Niessl.), Pl. II. fig. 37.

The teleutospores in this parasite are one-celled, in which it differs from *Puccinia*, although the habit is the same. We met with it in 1891 on Carnations imported from Switzerland, and its visits may be repeated.

At first there are pale spots on the leaves, caused by the innate mycelium; then scattered minute elevated blisters follow, which are for a long time covered by the cuticle. Finally these pustules crack at the apex and disclose the brown powdery spores.

The uredospores are spheroid or elliptical, and rather large (40×17–$28\ \mu$), externally rough, and pale brown. No cluster-cups associated with it.

The teleutospores, which are the last to arrive, are globose, rarely oblong, with the cell membrane thickened at the apex, externally smooth and brown (23–35×15–$22\ \mu$), a little narrowed below into the long deciduous pedicel.

Another name by which this brand is sometimes called is *Uromyces caryophyllinus*.

Hitherto its exploits have been chiefly confined to Germany, Italy, Moravia, and the Tyrol, in addition to Switzerland and Britain, but it has appeared at the Cape and in Australia.

No time should be lost, should the pest make its appearance amongst imported plants, to destroy the bad and spray the doubtful.

Sacc. Syll. vii. 1949; *Journ. R.H.S.* 1902, p. 652, t. II., f. 13.

Another species (*Uromyces Silenes*) is known in Italy, Germany, and Hungary on *Silene* and *Dianthus* (*Journ. R.H.S.* 1902, Pl. II., f. 14).

Carnation Black Mould.

Heterosporium echinulatum (B. & Br.), Pl. II. fig. 39.

One of the worst enemies of the Carnation. It was first observed in 1870, and has occurred very often since. The leaves become studded at first with large round whitish spots, upon which sooty-brown mouldy patches quickly spread, giving a minutely velvety appearance from the tufted threads. These tufts have a habit of arranging themselves in circles, so that the mould has acquired the cognomen of "Fairy Ring of Carnations."

The threads are very regular, pale olive, and form little tufts or ascicles, each thread being simple or slightly branched, with very short branches, sometimes only like knots or nodules, the upper knots, as well as the apex of the thread, bearing the spores, or conidia. These are cylindrical, with from two to five transverse divisions, mostly two or three, externally rough with minute warts (30–50×10–$15\ \mu$), slightly coloured. The conidia are capable of germination from each one of the separate cells.

Numerous minute sclerotia are said to be formed in the dying leaves, which remain as resting spores through the winter. These we have not yet had the opportunity of seeing.

Known in France, Switzerland, Cape of Good Hope, and Australia.

It should be vigorously attacked wherever it makes its appearance, and infected plants destroyed.

Sacc. Syll. iv. 2311; *Gard. Chron.* August 21, 1886, fig. 50, and 1870, p. 382; *Mass. Pl. Dis.* p. 320, fig. 87; *Cooke Hdbk.* 1728; *Cooke Journ. Q.M.C.* 1877; *Grevillea*, v. p. 123; *Tubeuf, Dis.* 5, 6.

The small white mould (*Ramularia lychnicola*) has only been seen on Wild Lychnis. (*Journ. R.H.S.* 1902, p. 650, Pl. II., f. 10.)

Carnation Macrospore.

Macrosporium nobile (Vize.), Pl. II. fig. 38.

At first we were doubtful whether a species of this genus of black moulds could become parasitic, since, for the most part, the numerous species are saprophytes on dead and rotting vegetable matter. This is, however, only one of three or four species which are now known to be dangerous parasites.

This pest usually forms small black spots on the leaves and stems, which are sometimes confluent in patches. The mycelium is widely diffused in the tissues before the spots appear. The clusters of threads and conidia burst through the cuticle and are ultimately scattered. The conidia are large, and pale olive-brown, subcylindrical, pear-shaped, obclavate, or irregular ($60\text{–}80 \times 40\ \mu$), divided transversely, according to the length of the spore, from four to ten times, each division again subdivided by longitudinal partitions into somewhat cubical cells, in a muriform manner. Each cell is capable of germination.

It is also affirmed of this species that later in the season numerous minute black sclerotia are embedded in the diseased parts. As these would act as resting spores, to reproduce the disease in the following spring, it is essential that every portion of diseased plants should be effectively destroyed.

Spraying with a solution of ammoniacal copper carbonate or potassium sulphate arrests the spread of disease.

Mass. Pl. Dis. 322, fig. 88, p. 440; *Journ. R.H.S.* 1902, p. 651, Pl. I., f. 8; *Grevillea*, v., p. 119.

The rot-mould (*Peronospora Dianthi*) has not yet been found in this country. (See *Journ. R.H.S.* 1902, Pl. I., f. 7.)

Bacteriosis of Carnations.

Bacterium Dianthi (Ar. & B.) Pl. II. fig. 40.

Examples of mysterious and inexplicable diseases of Carnations are occasionally being investigated, some of which may possibly be attributed to this disease, but until quite recently no other evidence beyond suspicion has been afforded.

In 1896 the results of investigations into the Bacteriosis of Carnations in North America were first published, and from those we learn that the disease is one of the leaf, rarely attacking the stem. In young leaves, when held to the light, pellucid dots are seen scattered irregularly over the leaf. After a time the dots show a distinct spot, and as the disease extends inside the leaf the surface tissues dry, the internal tissues collapse, and whitish sunken spots appear. As the spots enlarge the leaves wither. Very badly diseased plants have more yellowish-green leaves than normal. The lower leaves die prematurely, and the vitality of the plant is lowered so as to check growth and decrease flowers.

The disease is caused by parasitic bacteria entering the plant from the air. The germ associated with the disease may be separated and shown, by artificial infection of healthy plants, to be the cause of the disease. The cells are described as elliptical, single, or rarely united ($\frac{3}{4}$–$1\frac{1}{4} \times 1$–$2\,\mu$), in fluid media more united, forming short filaments, afterwards elongated and convoluted zooglæa.

Plants may be kept essentially free from the disease by keeping the foliage dry, and preventing the presence of aphides. Unfortunately we examined British-grown plants affected badly by the disease in February 1902.

Purdue University Exp. Station Bull. 59, March 1896; *Bacteriosis of Carnations*, by J. C. Arthur and H. L. Bolley; *Journ. R.H.S.* 1902, p. 653; xxviii., 1904, p. 713.

Mallow Leaf-spot.

Phyllosticta destructiva (Desm.), Pl. II. fig. 41.

This form of leaf-spot is common enough on all the uncultivated Mallows, and sometimes finds its way into gardens on nearly any kind of malvaceous plant. It makes the foliage very unsightly, since the tissue of the spots falls out, and leaves ragged holes in the leaves.

The spots are somewhat rounded, of a pale ochrey colour, surrounded by a darker line. The perithecia, like little dots, are often in concentric rings, but the whole dead tissue of the spots is brittle, and soon crumbles away.

The sporules are oblong, with two nuclei, and are expelled from the mouth of the perithecia in flesh-coloured tendrils.

It is known in France, Belgium, Italy, and Austria.

Sacc. Syll. iii. 814; *Grevillea*, xiv. p. 73.

Another leaf-spot (*Phyllosticta altheina*) is found in France and Italy on Hollyhock leaves, and one, *Phyllosticta althæicola*, on the Marsh Mallow in France. One of the species with two-celled sporules, *Ascochyta parasitica*, favours the Hollyhock in France, and one with long thread-like sporules (*Septoria parasitica*) accompanies it on the same plants.

Septoria heterochroa (Desm.) (*Cooke Hdbk.* No. 1313) is found on leaves of uncultivated Mallows.

Hollyhock Brand.

Puccinia Malvacearum (Corda), Pl. III. fig. 42.

This was at one time one of the most dreaded enemies of the Hollyhock, which suddenly made its appearance on the leaves of all malvaceous plants, and spread with extraordinary rapidity all over the country. It was first known in Chili in 1852, and in 1862 appeared at Melbourne, at which time no *Puccinia* on malvaceous plants had been known in Europe (*Gard. Chron.* Sept. 2, 1865). Afterwards it is heard of in the countries named below. It reached Spain in 1869 and France in 1873. In the latter year it was first heard of in the south and on the east coast of England; but it was not until afterwards that it was heard of in Bavaria, then in Italy, and later in Germany.

The pustules are round and firm, and are scattered over the leaves and petioles, being at the first of a greyish-flesh colour, and afterwards of a reddish-brown. They never become powdery, but the spores adhere together in a compact mass. No æcidium or uredo has ever been found associated with it, or suspected of any connection. The teleutospores are spindle-shaped, gradually attenuated towards each extremity, but sometimes with the thickened apex rounded ($35–75 \times 12–26\,\mu$). A cross-division in the centre separates them into two nearly equal cells. The whole surface is smooth and the contents yellow-brown. The pedicels, or footstalks, are long, firm, and persistent. The pustules often drop out from the leaves and stems, leaving holes and scars. It is easy enough to make these spores germinate in water.

The area of distribution is a large one, and it is probably even greater than we know. In Europe it was recorded in Britain, France, Portugal, Switzerland, Germany, Bavaria, Austria, Italy; in Eastern Africa, the Cape of Good Hope, and Algeria; in many parts of North America, and in Chili, Brazil, Argentina, Uruguay, Patagonia, and in Australia.

No efforts were spared, when the disease was at its height, either to eradicate or mitigate its evils, but with small success. One cultivator was sanguine in the application of diluted Condy's fluid, which, it is reported, caused the pustules to turn black and fall out, whilst the fluid did no injury to the plants.

It has been questioned whether the disease became hereditary, and whether the germs were contained in the seeds. One nurseryman affirmed that all their Hollyhock seeds exhibited in the seedlings when growing this fungus on their first leaves. Three other cultivators vouched for seeing young seedlings similarly affected, and the Rev. M. J. Berkeley confirmed this view.

Gard. Chron. Aug. 22, 1874, fig. 163; Nov. 11, 1882, fig. 106; Aug. 23, 1890, figs. 33–35; *Sacc. Syll.* vii. 2368; *Mass. Pl. Dis.* p. 252; *Grevillea*, i. 41, ii. 137, iii. 41; *Corda Icon.* vi. t. i. f. 12; *Cooke Fungi Uses &c.* p. 231; *Tubeuf, Dis.* 360, fig.; *Plowr. Brit. Ured.* 212.

Hollyhock Anthracnose.

Colletotrichum Althææ (South.), Pl. II. fig. 43.

It is not quite certain whether this disease has already made its appearance amongst us, although it has for some time given considerable trouble in the United States. Any part of the plant may be attacked, but it is chiefly visible on the leaves.

Large brown or smoky patches occur on the leaves, which increase in size until the whole leaf is diseased or withered. On the petiole the spots are light yellowish-brown, becoming blackish and sunken.

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There are no true perithecia, but the little dots, or openings, on the spots indicate the small cavities beneath, in which the conidia are produced. These cavities are surrounded by abundant dark brown hairs ($60–100 \times 3–5\ \mu$) which are once or twice divided by transverse septa. The conidia are irregularly oblong and colourless ($11–28 \times 5\ \mu$), but flesh-coloured in the mass.

Spraying with diluted Bordeaux mixture at intervals, as soon as the leaves appear, proved to be the best preventive. Diseased plants should be destroyed.

Sacc. Syll. x. 6848; *Mass. Pl. Dis.* p. 290; *U.S. Journ. Myc.* vi. p. 45, plate; *U.S.A. Dept. Agric.* 1890, pl. 1.

Hollyhock Black Moulds.

Cercospora (sp.).

It is rather remarkable that no instance has been recorded of the appearance of these black moulds on the foliage of Mallows or Hollyhocks in this country.

One of these (*Cercospora altheina*) not only has appeared in Italy, but also in the United States, and another, chiefly on the stems (*Cercospora nebulosa*), in Italy. A third species (*Cercospora Malvarum*) has been found on fading Mallow leaves in France. Other species affect plants of *Hibiscus*, *Sida*, &c., but none of them have as yet crossed the Channel. These moulds are characterised by the very long and narrow conidia, which are attenuated upwards, and divided by more or less numerous septa.

Malvaceous Brands.

Uromyces (sp.).

About five species of one-celled brands (*Uromyces*) and about as many of two-celled brands (*Puccinia*), in addition to the Hollyhock disease, attack the foliage of malvaceous plants, especially of *Sida*, *Abutilon*, and *Hibiscus*. Of the former, all of them are extra-European, and nearly all of the latter, so that little danger can be feared from them in our greenhouses, save by accident.

St. John's Wort Rust.

Melampsora Hypericorum (DC.), Pl. III. fig. 44.

This parasite makes its appearance on the underside of the leaves of various species of St. John's Wort, including those which are found in gardens.

The pustules are mostly scattered over the leaves, and are rather small, but conspicuous on account of their bright yellow colour.

The uredospores are those which are usually seen, and are somewhat globose or ovate, and sometimes angular, orange-yellow, and powdery, with a rough surface ($14–21 \times 11–17\ \mu$). The teleutospores are wedge-shaped, brown ($26\ \mu$ long).

The area in which this pest has been recognised includes the greater part of Europe, Asiatic Siberia, and the Indian Himalayas.

So little injury is caused by this parasite in gardens that no experiments have been made with fungicides, which would probably be of some service should the rust ever prove troublesome.

Sacc. Syll. vii. 2114; *Cooke M. F.* 215, f. 174, 175; *Plowr. Brit. Ured.* 243.

Leaf-spots, such as *Septoria Hyperici* and *Ascochyta Hyperici*, are at present confined to the small uncultivated species of *Hypericum.*

Pelargonium Stem-rot.

Fusarium Pelargonii (Cooke), Pl. III. fig. 45.

The disease attacks the stems of cultivated Pelargoniums, and at first the varieties 'Vesuvius' and 'Henry Jacoby,' and was first observed in 1896.

The plant seems to stop growing, and in a few days some of the lower leaves turn yellow, then the stem appears to turn black and decay.

The blackened stems exhibit over the decayed spots pallid, mealy-looking little patches, not more than a line in diameter, sometimes with a tinge of flesh colour. They seem to burst through the cuticle, and at first are somewhat gelatinous, soon becoming dry and powdery. This exudation consists of long spindle-shaped conidia, curved at each end and attenuated to a point ($60–70 \times 6\,\mu$), at first with three, and afterwards five, transverse divisions, or septa, and uncoloured.

As a recent disease the result of treatment by fungicides has not been ascertained, but as it seems to be an endophyte, which establishes itself in the tissues before it produces any external effects, it would be better to prevent its spreading by burning all the diseased plants and cleaning the soil, but the free application of diluted Bordeaux mixture would prevent its spreading.

Gard. Chron. July 25, 1896, p. 92.

Pelargonium Anthracnose.

Glœosporium Pelargonii (C. and M.), Pl. III. fig. 46.

This is also a recently developed disease on the leaves of Pelargoniums, which was unknown until 1889, and has scarcely been observed since.

The leaves are attacked on the under surface, but do not exhibit any distinct spots, only that the entire leaf soon droops and withers.

Minute pustules are to be seen scattered over the surface, especially in the neighbourhood of the veins, which cover the cells in which the conidia, or sporules, are generated, from which when mature they are expelled through a fissure in the epidermis. These conidia are quite colourless, oblong, rounded at the ends ($20 \times 4–5\,\mu$), and a little narrowed towards one extremity.

All known species of Anthracnose are tenacious and dangerous pests. Spraying with diluted Bordeaux mixture has been of some service.

Sacc. Syll. x. 6764; *Grevillea*, xviii. 1889, p. 20.

A supposed bacterial disease causes spots on Pelargonium leaves in America. (See Journ. R.H.S. xxvi. 1901, p. 550.)

GERANIUM LEAF-SPOT.

We have often seen Pelargonium leaves having large and confluent discoloured and decayed spots, without any evidence of the presence of fungi, but the spotting has been attributed to sour soil, from which the plants have recovered after a good cleaning of the roots and transplanting in good soil.

Spots caused on the leaves of uncultivated species of *Geranium*, such as *Septoria Geranii* and *Ramularia Geranii*, have not been recognised on cultivated species.

GERANIUM RUST.

The leaves of Pelargonium and Geranium have not been free from the attacks of cluster-cups and rusts, but hitherto these have been confined either to uncultivated British or exotic species. Probably ten species of Uredines have been recorded under the several genera, but up to now the leaves of cultivated Pelargoniums have remained free from even an ordinary rust. *Uromyces Geranii* (DC.) is so common, in all its forms of cluster-cup, uredo- and teleuto-spore, upon uncultivated Geranii that it would be prudent to be always on the alert against wild plants in the neighbourhood of gardens.

In South Africa a Geranium rust (*Puccinia granularis*) has latterly been causing trouble.

TROPÆOLUM RUST.

Uredo Tropæoli (Desm.), Pl. III. fig. 47.

This rust is by no means common on the leaves of the commonly cultivated Tropæolum, and therefore is not likely to become a pest; in fact the species of *Tropæolum* seem to enjoy a remarkable immunity from the attacks of fungi.

The pustules are small, and are confined to the under surface of the leaves, over which they are scattered. The uredospores are powdery, elliptical, or rarely almost globose, and of a bright orange colour ($16 \times 10\ \mu$).

It has been found in France and Belgium, as well as in Britain, but is nowhere common, and hence it is unnecessary to trouble about fungicides.

Sacc. Syll. vii. 3119; *Cooke Hdbk.* 1578; *Cooke M. F.* 216; *Plowr. Brit. Ured.* p. 258.

TROPÆOLUM LEAF-SPOT.

Phyllosticta Tropæoli (Sacc.).

This is the only leaf-spot with which we are acquainted upon the leaves of Tropæolum, and this has not been recorded in Britain, but in Italy, Austria, and Portugal.

The sporules are oblong ($6–10 \times 3–4\ \mu$) and uncoloured, oozing out when mature from the orifices of the scattered perithecia.

Sacc. Syll. iii. 212.

LUPIN RUST.

Uromyces Anthyllidis (Grev.), Pl. III. fig. 48.

This rust, with its brand form, occurs not only on the wild *Anthyllis*, but also on cultivated Lupins, as *Lupinus luteus* and *Lupinus albus* in Great Britain, Germany, and Italy, and appears on the foliage.

The pustules of the uredo are rounded, rather small, and of a reddish or chestnut-brown. The uredospores, which are soon set free by the rupture of the cuticle, are globose and rough (22–24 μ diam.), of a pale chestnut-brown colour.

The teleutospores, or brand spores, are produced in dark brown pustules, and are shortly elliptical, almost globose (19–22 $\times$ 17–20 μ), dark brown, clad with obtuse stoutish warts, growing at first on a slender hyaline pedicel, which soon falls away.

If applied early, fungicides will prevent the spread of this disease, but the teleutospores are capable of acting as resting spores, carrying the disease through the winter.

Sacc. Syll. vii. 1966; *Greville Eng. Flor.* v. p. 383; *Plowr. Brit. Ured.* 135.

Another species (*Uromyces Lupini*) is found on the same Lupins in Italy, Germany, and Egypt, with smooth uredospores and smaller teleutospores. The North American species is again different.

DISEASES OF ROSES.

Fortunately the diseases to which cultivated Roses are subject in this country are few, and one of the most dangerous, the rot-mould, is rare. The common rose mildew is most troublesome and unsightly, and one or two of the others are very persistent, but they do not threaten Rose culture as that of some other flowers has been threatened.

Rose Leaf-spot.

Septoria Rosarum (West), Pl. III. fig. 49.

So far as our knowledge and experience go, the leaves of cultivated Roses are liable to spotting by three different fungi, belonging to the genus *Septoria*, with threadlike spores. The one recorded as British is named above.

White rounded spots, to the number of ten or fifteen, occur on the upper surface of the leaf, surrounded by a rather broad purple border. Now and then the minute receptacles of the fungus are dotted over the spots, but these are often wanting, as they are upon similar spots on Strawberry leaves.

The perithecia, when present, contain long threadlike sporules (50–60 μ), which are furnished with a row of from three to six nuclei, ultimately divided by transverse septa into about six cells.

This spot fungus is recorded for Britain, Belgium, and Italy.

Spray with copper solution.

Sacc. Syll. iii. 2617; *Cooke Hdbk.* No. 1328.

Another species, under the name of *Septoria Rosæ-sinensis*, is recorded for Italy and Portugal, but the pale spots have a brownish margin. The sporules seem to be the same, and possibly it is identical with the above.

Septoria Rosæ is probably distinct, and occurs in Belgium, France, Italy, Portugal, and Algeria. The spots are brownish and the sporules larger ($70–90 \times 3\frac{1}{2}–4\ \mu$).

Rose-leaf Black Blotch.

Actinonema Rosæ (Lib.), Pl. III. fig. 50.

This very common blotch on Rose leaves is to be seen in almost every garden, and many cultivators treat it as of small account, except for disfiguring the foliage.

The spots are somewhat rounded, and from half an inch to an inch broad, on the upper surface of the leaves, at first purplish and then black, without any well-defined margin. On the spots becoming black, closely adherent, flexuous, weblike lines radiate from the centre of the spot. Here and there are scattered the small black conceptacles, or perithecia, which contain the sporules. The latter are composed of two obovate cells, attached together by their broader ends ($18–20 \times 5\ \mu$), each containing two small nuclei, or guttules. The perithecia certainly are very obscure and difficult to discover, but sporules are readily found. Some authors deny the presence of perithecia altogether.

This parasite has been recorded in Great Britain, France, Belgium, Germany, Sweden, Austria, Italy, Portugal, and the United States.

If all diseased leaves were to be collected and burnt, scarcely a leaf would be left on some Rose bushes. Spraying has been recommended with diluted copper sulphates. Blue water, or Eau Céleste, is a preparation much in vogue with some cultivators, and is said to be of much service.

Sacc. Syll. iii. 2257; *Cooke Hdbk.* No. 1372; *Tubeuf, Dis.* 474.

Rose Rust.

Uredo Rosæ (Pers.), Pl. III. fig. 51*a*.

The uredines, or rusts of different kinds, are rather partial to the Rose family, and this, which is the uredo stage of a more elaborate fungus, hereafter described, has been known at different times as *Uredo pinguis* and *Uredo miniata*. It occurs on the leaves, petioles, and stems of cultivated Roses, bursting through the cuticle as a yellow powder.

The under surface of the leaves is sprinkled with the small pustules, either scattered or gathered together, which soon discharge the uredospores, which are rather variable in form, spherical, ovoid, or angular ($17–32 \times 12–24\ \mu$), with a minutely roughened surface.

Early in the year this yellow uredo may be detected upon the leaves, without any indication of the teleutospores which are to follow.

It is remarkable how this pest seems to follow the cultivation of Roses all over the world, and no efforts seem to make much progress towards either its extirpation or mitigation.

It may be said to be universal throughout Europe, and to have extended to Asiatic Siberia, probably to India and to South Africa.

It is recommended that plants which have been attacked the previous season should be drenched with a solution of copper sulphate in water, in early spring before the buds expand. The soil around may also be saturated.

Sacc. Syll. vii. 2622; *Gard. Chron.* July 7, 1877, fig. 5; *Mass. Pl. Dis.* p. 260; *Cooke M. F.* 34, 107; *Plowr. Brit. Ured.* p. 225.

Rose Brand.

Phragmidium subcorticium (Schr.), Pl. III. fig. 51.

This is the advanced stage of the Rose rust, which it accompanies in the autumn, and forms little blackish tufts on the under surface of the leaves, in succession to the gradually disappearing uredo.

The uredospores having already been described, we have to concern ourselves with the teleutospores, as seen under the microscope. These are very long and cylindrical, terminated at the apex by a colourless point, and the base continued into a long and swollen, almost bulbous, translucent stem, which is longer than the teleutospore itself, and persistently adhering to it. The teleutospore ($75–100 \times 26–30\ \mu$) is of a clear but dark brown colour, divided transversely by septa into from three to seven cells, each of which is capable of germination, and the surface minutely rough or warted. These teleutospores are usually collected in little tufts.

When germination takes place any one of the cells is capable of giving off a short germ tube, or promycelium, which becomes divided in the upper portion into several cells, each of which gives off a short process, which carries a small promycelial sporule. These promycelial sporules are charged with the destinies of dissemination, and are the medium through which other leaves are infected.

The area of distribution of the brand is accepted as the same as that of the uredo, of which the teleutospores are the recognised resting spores.

Spray with potassium sulphide and burn all fallen infected leaves.

Sacc. Syll. vii. 2622; *Mass. Pl. Dis.* p. 260; *Cooke M. F.* 201; *Plowr. Brit. Ured.* p. 225; *W. G. S., Gard. Chron.* July 17, 1886, p. 76, with figs.; *Grevillea*, iii. Pl. 45, fig. 3.

Rose Rot-mould.

Peronospora sparsa (Berk.), Pl. VI. fig. 52.

This rot-mould was first discovered in 1862 on a quantity of potted Rose plants in a conservatory. Fortunately it has not become an established pest, and we doubt if it may not be almost extinct, although in such cases revival and re-establishment are always possible.

Irregular, pale brownish, discoloured spots appeared on the upper surface of the leaves: these extended rapidly, and in a short time the leaves withered and shrivelled up, and ultimately the whole plant perished.

A delicate greyish mould on the spots was scattered over the under surface of the leaves. The threads which arise from the mycelium are scattered, somewhat torulose, and divided in the upper portion as much as eight or nine times in a forked manner, the final branchlets being scarcely hooked, bearing at their tips the elliptical conidia ($20–22 \times 15–18\ \mu$).

Hitherto resting spores have not been found, although there is no doubt of the relationship of the species to the rot-mould found on Hellebore, Anemone, and other plants.

Reference to other rot-moulds, of the genus *Peronospora*, will show the kind of treatment recommended. See Introduction, p. 3.

This species has made its appearance also in Germany and the United States of America.

Sacc. Syll. vii. 884; *Cooke M. F.* 161, 237; *Berlese Icones.* pl. lviii.; *Gard. Chron.* 1862, p. 308; *Cooke Hdbk.* No. 1790; *Tubeuf, Dis.* 133, fig.

Rose Mildew.

Sphærotheca pannosa (Lev.), Pl. III. fig. 54.

Very little description is needed of this very common and well-known disease, which clothes the leaves, twigs, and flower-stalks of all kinds of Roses with a dirty-white felted mycelium of interwoven threads, distorting,

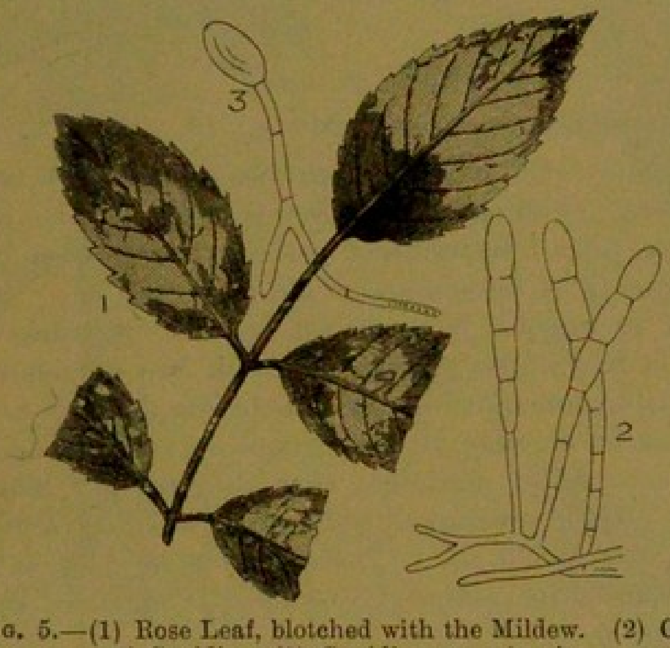


Fig. 5.—(1) Rose Leaf, blotched with the Mildew. (2) Chains of Conidia. (3) Conidium germinating.

blighting, and spoiling the Roses, to the great disgust of the gardener, and almost drives him to despair in the face of his helplessness.

This is really an epiphytal disease, and makes its appearance externally before it invades the tissues. In its first and earliest stages it is a white mould called *Oidium leucoconium*, and is of a kindred with the *Oidium Tuckeri*, which affects the Vine.

In the conidial or oidium stage the profuse mycelium sends up short branches, which produce the oval conidia attached to each other, end to end, in a chain ($20–30 \times 13–16\,\mu$) when mature: these separate at the joints, and fall away, each to germinate on its own account.

The more perfect condition of the disease is the stage in which little blackish points or globose receptacles appear scattered about upon the whitish mycelium. These receptacles are at first pale, but soon become of so dark a brown as to appear black. These receptacles adhere by little filaments to the mycelium, accompanied by free floccose appendages which do not adhere. The receptacles are composed of an outer coloured membrane, without orifice, and the gelatinous contents. When quite mature each receptacle encloses a single globose transparent sac, or ascus, which holds numerous elliptical uncoloured spores (20–27×12–15μ).

When the patches of mould upon the leaves have produced their conidia, the leaves generally curl up and fall away without producing the receptacles. On the stems and ovaries the perithecia are to be found, and within them the ascospores, or perfect spores, are produced.

The treatment suggested resembles that which has been successful in the allied Hop disease—flowers of sulphur mixed with about one-third of its volume of slaked lime dusted upon the foliage. Spraying with potassium sulphide solution has been recommended as equally efficacious. In this, as in all similar cases, it cannot be too strongly urged that all the diseased parts possible should be cut off and burnt to prevent the dissemination of the conidia and spores. Vigorous treatment would minimise disease.

Sacc. Syll. i. 6; *Cooke M. F.* 169, 238, figs. 217, 218; *Mass. Dis. Pl.* 444; *Tubeuf, Dis.* 172, fig.

Rose Tumour.

Botryosphæria diplodia (Moug.), Pl. III. fig. 53.

The living stems of Roses are often disfigured by the occurrence of blackish elliptical swellings or cancerous-looking spots marked with darker concentric lines. In former times they were called by the name of *Dothidea Rosæ* (Fr.), but names are apt to change.

The stroma, or tumour, is developed beneath the bark, and is of a tawny colour, in which the globose perithecia are immersed, becoming more or less erumpent, splitting the cuticle into flexuous fissures. The perithecia are rather crowded in this stroma, or tubercle, and are somewhat slow in arriving at maturity, when they contain numerous club-shaped hyaline asci, or specialised cells, which enclose eight sporidia in each, arranged in a double row. These sporidia are almond-shaped and colourless, or tinged with yellow (17–20×8–9μ), escaping and becoming free when mature.

We have no knowledge of any experiments in combating this disease, but presume that it is deep-seated, and has permeated the tissues before it makes any external appearance.

The distribution of this species is given as Britain, France, Belgium, Germany, and Italy.

Sacc. Syll. i. 1774; *Cooke Hdbk.* No. 2425; *Berk. Eng. Fl.* v. 255.

Evening Primrose Leaf-spot.

Septoria Œnotheræ (West.), Pl. III. fig. 55.

The living leaves of the Evening Primrose are subject to the attacks of this parasitic fungus, not only in most parts of Europe, but also in North America.

The spots are rather small, rounded, at first pale greenish, then more or less brown or bleached, margined by a vinous-red band. They occur chiefly on the upper surface, to the number of from six to ten, whilst a quantity of dot-like receptacles are to be seen collected towards the centre of the spots.

The sporules are long and thread-like, mostly curved, and contain a row of little nuclei ($35–40 \times 1\frac{1}{2} \mu$), and the spots are traversed by the mycelium.

It is generally thought that in these leaf-spot diseases spraying with Bordeaux mixture may be of service. At any rate the spread of the disease may be checked by persistently destroying diseased leaves.

Sacc. Syll. iii. 2782; *Grevillea*, xiv. 101.

A B C

Fig. 6.—*Endophyllum Sempervivi*, attacking *Sempervivum monticolum*. A, Entire plant; B, C, Leaves. (*Gardeners' Chronicle.*)

Although the above is the only parasite upon *Œnothera* which has yet appeared in this country, there are other species known, especially in North America, such as *Æcidium Peckii*, and *Æcidium Œnotheræ*, *Puccinia Œnotheræ*, and *Pucciniastrum Œnotheræ*, *Uromyces Œnotheræ* and *Uromyces plumbarius*, in addition to a rot-mould, or *Peronospora*. As these have not crossed the Atlantic, a favourite cottage flower flourishes with us comparatively unharmed.

Fuchsia Diseases.

Although the Fuchsia is largely grown in this country, its enemies are very few, and, so far as we are aware, none of a fungus origin have as yet been found, although a leaf-spot is known in France.

Houseleek Rust.

Endophyllum Sempervivi (A. & S.).

This peculiar parasite is somewhat intermediate in its character between a uredo and a cluster-cup. The envelope which encloses the spores is immersed in the substance of the succulent leaves, and bursts irregularly to discharge the spores.

The teleutospores, as they are termed, are for the greater part rounded or obovate ($25–35 \times 20–32\ \mu$), with the surface warted and of a brownish-yellow colour. They germinate after the manner of those of *Puccinia*.

The species is known over the greater part of Northern Europe.

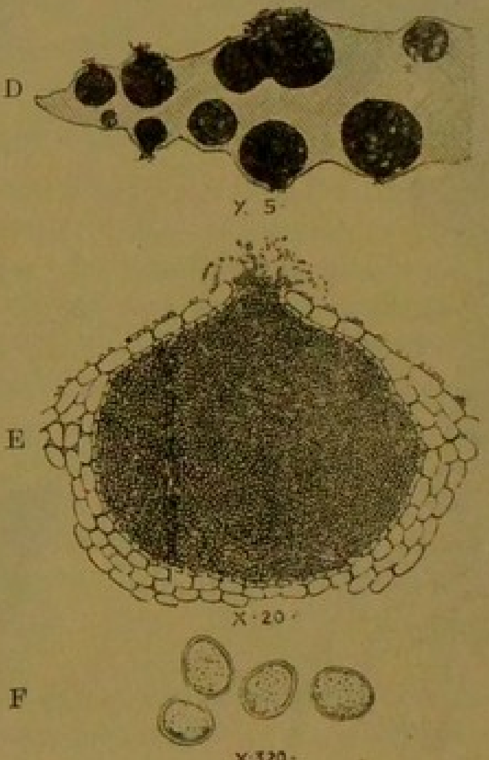


Fig. 7.—*Endophyllum Sempervivi*, D, Section through affected leaf, magn.; E, Section through pustule, magn.; F, Spores, magn.

Sacc. Syll. vii. 2675; *Gard. Chron.* May 22, 1880, p. 660, with fig.; *Cooke M.F.* 200; *Cooke Hdbk.* No. 1636; *Plowr. Brit. Ured.* 229.

Honeysuckle Leaf-spot.

Phyllosticta Loniceræ (West), Pl. III. fig. 56.

The Honeysuckle may claim to be a garden flower, and is certainly a favourite in cottage gardens. The leaf-spots are rounded and pallid, with a brown margin, and the perithecia are quite small, appearing like very minute dots upon the spots.

The sporules are rather large for the genus to which they belong, and are narrowly elliptical, with two nuclei ($10–14 \times 2\frac{1}{2}–3\frac{1}{2}\ \mu$), and colourless.

The spot is known also in France, Belgium, Germany, Austria, Italy, Portugal, and the United States of North America.

Sacc. Syll. iii. 90; *Cooke Hdbk.* No. 1353.

A similar leaf-spot with large brownish spots, and very minute sporules, *P. nitidula,* is found in Algeria, whilst another species with greyish spots, *P. Caprifolii,* occurs in Italy, France, and Siberia.

Species with two-celled sporules are known, one in France and one in Italy, as well as another in Belgium.

Two species with thread-like sporules are also known, the one in Switzerland and the other in Portugal.

Honeysuckle Cluster-cups.

Æcidium Periclymeni (Schum.).

Although the cluster-cups are usually found upon uncultivated plants, it is not an uncommon British parasite, and is one of those species to which no *Uredo* or *Puccinia* has been affiliated.

The spots on the leaves are roundish, or oblong, and yellowish, whilst the cups are clustered together on the spots. The cups are somewhat cylindrical, with a fringed white margin. The æcidiospores are roundish, sometimes angular by compression (16–28 μ diam.), delicately warted, and orange in colour.

The species is recorded also in France, Belgium, Germany, Switzerland, Italy, and Siberia.

Sacc. Syll. vii. 2809; *Cooke M.F.* 196; *Plowr. Brit. Ured.* 264.

Another species (*Æ. lonicerinum*) is reported to be found upon the living leaves of a species of Honeysuckle in Asiatic Siberia.

Honeysuckle Black Blotch.

Lasiobotrys Loniceræ (Kunze), Pl. III. fig. 57.

This is a peculiar parasite which has been known in this country for many years on living Honeysuckle leaves, although not likely to give much trouble in gardens. The leaves are spotted with several roundish black shining blotches (2–5 m. diam.).

An external stromatic cup, which ruptures irregularly, encloses a number of black receptacles or perithecia (50 μ diam.) densely clustered together. Each of these perithecia contains a number of club-shaped asci, or membranous sacs, which include the sporidia, eight of which are enclosed in each ascus. These sporidia are shortly fusiform and colourless ($8\text{–}10 \times 4\text{–}5\ \mu$), which are set free by the irregular splitting of the perithecia.

The pustules are sometimes quite round, black, shining, and convex, so that they appear to be superficial, like little spots of pitch on the leaves.

It is recorded for France, Belgium, Germany, Italy, Algeria, and Siberia.

It is so rare on Honeysuckle in gardens that the effect of fungicides has not been determined, but they are scarcely to be relied on for so deeply seated an endophyte.

Sacc. Syll. i. 121; *Cooke Hdbk.* 1909.

Although the powdery mildew (*Microsphæria Ehrenbergii*) has been found on Honeysuckle leaves on the Continent, we have no record of it in Britain.

PESTS OF COMPOSITE PLANTS.

It seems rather remarkable that so large an order of plants as the *Compositæ*, containing many garden flowers, should be so conspicuously free from the atttacks of fungoid parasites. Who shall explain wherefore *Puccinia Helianthi* (Schum.), which is so universal in North America on Sunflower and Jerusalem Artichoke, has never made its appearance in this country, although it has been reported in Europe? Why are Dahlias so impervious to attack, and a host of smaller annuals, Asters, *Coreopsis*, Marguerites, and the plebeian Marigold, go almost free? Even the cultivated *Cineraria*, which is popular enough in all conscience, has never received a check in this country, although it has been threatened abroad.

Chrysanthemum Leaf-spot.

It will be well to be guarded against the occurrence of leaf-spot on Chrysanthemums, as some three or four exotic species are already known.

The purple spot (*Phyllosticta Chrysanthemi*), with small simple sporules ($4–5 \times 2\frac{1}{2}–3\ \mu$), has up to the present been found only in Canada.

The ringed brown spot (*Septoria Chrysanthemi*), with long thread-like sporules ($55–65\ \mu$ long), has apparently been confined to Italy. This is the most essential to be watched of all, since it is European.

The black spot (*Cylindrosporium Chrysanthemi*) is very destructive in Canada, and has large, sooty, indefinite spots, with fusoid conidia ($50–100 \times 3–4\frac{1}{2}\ \mu$). When the leaves are attacked they soon turn yellow and shrivel, and the flower buds do not expand.

Mass. Pl. Dis. 292.

Chrysanthemum Oidium.

Oidium Chrysanthemi (Rabh.), Pl. III. fig. 58.

This effused white mould is found on the leaves of Chrysanthemum, but fortunately it has not hitherto been sufficiently common to cause alarm.

The thin white mealy patches are without definite form, and consist of a creeping mycelium from which the fertile threads arise. These are at first just like simple threads, with cross divisions, separating them into joints; but at length the upper joint enlarges and becomes elliptical, and when mature falls away as a conidium or sporule, capable of germination, to be followed by the next joint and the next, and so on in succession until a large number of conidia are produced and thrown off, as in other species of *Oidium*. The conidia are rather large ($40–50 \times 20–25\ \mu$) as compared with other species.

It may be assumed that such remedies as are successful with *Oidium Tuckeri* on the vine would be applicable here, and of these the application of sulphur is most to be commended.

The above-named mould appeared in this country for the first time in 1884, and is known also in France and Germany.

Sacc. Syll. iv. 199; *Gard. Chron.* Nov. 29, 1884, fig. 118; *Ib.* 1901, p. 351.

Chrysanthemum Rust.

Uredo Chrysanthemi (Arth.), Pl. III. fig. 59.

When this rust was first observed on the leaves of Chrysanthemum in 1897 it was believed that it would be discovered to be the Uredo form of *Puccinia Hieracii*, and hence was called *Uredo Hieracii*; but it has since been shown that it must be regarded as a distinct species, for which no teleutospores have yet been found.

The pustules of the *Uredo* occur on the under side of the leaves, which soon split irregularly and discharge the powdery snuff-coloured spores, and these readily disperse themselves over the surface of the leaf. The uredospores are somewhat elliptical, with a rough surface ($17\text{–}32 \times 16\text{–}36\ \mu$), and irregular in size.

This pest at one time threatened to spread over France and this country, and produce havoc amongst Chrysanthemums, but it has since been brought under control.

Spraying with potassium sulphide solution is recommended, especially upon apparently clean leaves, while rusted leaves should be carefully removed. Paraffin has also been recommended in dilution.

It should be remembered that uncultivated composite plants are, of all others, most susceptible to the attacks of rust and brand, and it is in that direction that danger lies.

Gard. Chron. Oct. 8, 1898, with figs.; *Mass. Pl. Dis.* 241; *Journ. R.H.S.* xxvi. 1902, p. 915; xxviii. 1904, p. 634; xxix. p. 769.

Great trouble in the United States in growing Asters on account of fungoid disease. (*Journ. R.H.S.* xxvi. 1901, p. 531.)

Corn Flower Rust.

Puccinia Centaureæ (DC.), Pl. III. fig. 60.

During the past year or two Corn flowers in cultivation have been seriously attacked by this rust, which has long been known on uncultivated species of *Centaurea*.

We have nothing to do with the *Æcidium* here until it is proved to be distinctly related to the rust on *Cyanea*. The *Uredo* appears on the stem and leaves in elliptical pustules, which are longer on the stems, soon fissured, and exposing the snuff-coloured uredospores which are almost globose ($22\ \mu$ diam.), and we could detect no roughness on the surface. The colour was pale brown under the microscope, and certainly not, as some have stated, chestnut-brown.

It is the custom in these latter days to lump together a number of the species of rust found on composite plants under the name of *Puccinia Hieracii*, and this among the number. For the present we prefer to call it *Puccinia Centaureæ*.

We can only suggest the spraying of healthy plants, or those but slightly affected, with the potassium sulphide solution and burning badly diseased plants out of the way.

Sacc. Syll. vii. 2210; *Plowr. Brit. Ured.* 186; *Cooke M.F.* 63, 207; *Journ. R.H.S.* xxvi. 1901, p. cxxv.

Senecio Rust.

Coleosporium Senecionis (Pers.), Pl. III. fig. 61.

A common bright orange rust is to be found every season on the under side of the leaves of the Common Groundsel and other indigenous species of *Senecio*. Occasionally the same species makes its appearance in gardens on the leaves of cultivated species of the same genus, such as *Senecio pulcher* and *S. sarracenicus*.

Theorists tell us that the æcidiospores of this pest are produced on the leaves and twigs of certain conifers, which, not being garden flowers, may here be excluded. Even the believers are a little sceptical, for Plowright says: "I have had so many failures in infecting *Senecio vulgaris* with the æcidiospores from Fir trees that I think there must be more than one species."

The pustules of the *Uredo* are reddish-yellow, soon becoming paler and powdery. Uredospores shortly catenulate, or growing in chains, then separating, elliptical, ovoid (20–40 × 14–26 μ), warted, orange. Afterwards teleutospores are said to be produced in other darker-coloured pustules. Teleutospores cylindrical (110 μ long), for the most part divided transversely into four cells of an orange-red colour.

We can suggest no remedy, except prevention, by keeping all wild species of Ragwort at a distance and destroying infected plants, as the garden forms are not apparently so susceptible to the disease.

Universally diffused through Europe.

Sacc. Syll. vii. 2638; *Mass. Pl. Dis.* 261; *Cooke M.F.* 97, 218, figs. 145, 146; *Tubeuf, Dis.* 374, fig.; *Plowr. Brit. Ured.* 240.

Recently *Æcidium Cinerariæ* has been detected in Austria on leaves of *Cineraria*.

Ptarmica Dot.

Schizothyrium Ptarmicæ (Desm.).

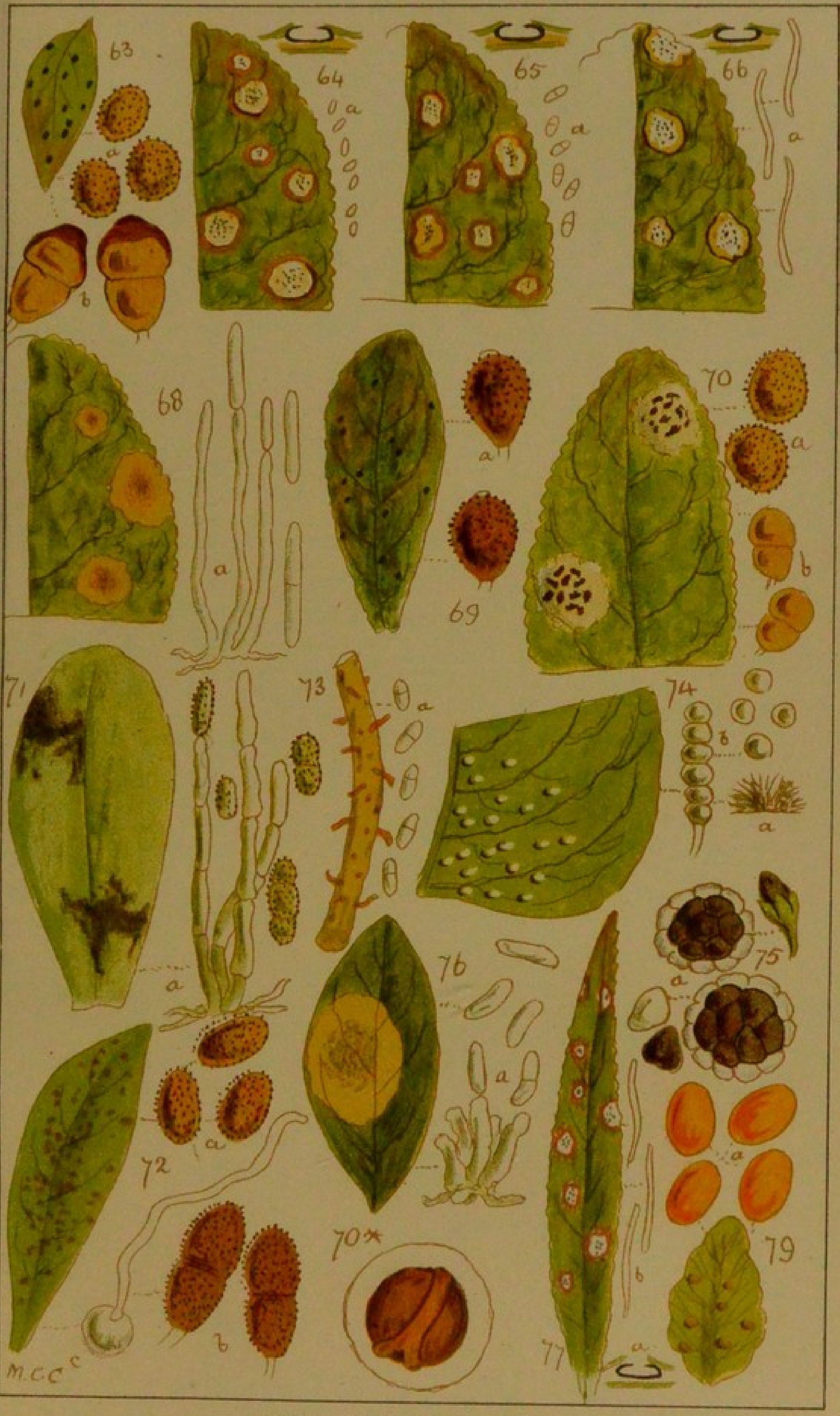
Plants of *Achillea Ptarmica* are to be met with in old-fashioned gardens, and the green leaves are liable to the attack of a special fungus.

The leaves and stems are at first dotted over with the small black points of *Leptothyrium Ptarmicæ*. These minute black receptacles contain a number of oblong sporules, with an apparent central division (10 × 6–7 μ). This is regarded as an early and imperfect condition of a more highly developed parasite, which resembles it in size and appearance, and often grows in company with it.

This latter, or *Schizothyrium*, came over from France with imported plants many years ago. To the naked eye they look like fly spots, causing no discoloration of the foliage. The receptacles are flattened and open on the upper surface, enclosing minute ovoid sporidia (10 μ long), enclosed in asci, closely packed side by side in the interior. It has evidently a perennial mycelium, since the dots or receptacles will continue to appear on the same plant year after year for many years. The plants are stunted, but not much disfigured by the parasite.

The disease is known in France, Belgium, Germany, Finland, and Siberia.

Sacc. Syll. ii. 5559, iii. 3379.



PESTS—FLOWER GARDEN.

Lobelia Dot.

Phoma devastatrix (B. and Br.), Pl. III. fig. 62.

For the first time, in 1856, the clumps of *Lobelia* in gardens were attacked by a minute parasite, which was so destructive that it secured for itself the specific name of "the destroyer." It is seldom that the fungi of the group to which this pest belongs make any attack upon living plants, being largely restricted to dead stems and dead leaves and twigs.

The dots or receptacles, which, with their mycelium, represent the entire fungus in this instance, are scarcely visible to the naked eye. They consist of a minute globose body, like a pin-point, or a small black dot, containing a number of colourless sporules, which are long and narrow (8–10 μ), rounded at the end and furnished with two or three nuclei. Fortunately in this case it took the form of an epidemic, which gradually passed away, and for many years not an example has been seen.

For a deep-seated disease like this there is no effectual remedy and no protection, except to root up bodily all the plants which are, or are likely to become, infected and burn them.

This disease appeared afterwards also in the United States.

Sacc. Syll. iii. 791 ; *Cooke Hdbk.* No. 1221.

About a dozen other parasites on *Lobelia* are recorded, most of them in North America.

PRIMROSE PARASITES.

The Primrose family seems to be rather susceptible of fungoid diseases, although perhaps their virulence is not upon an equality with their number. The most dangerous, the rot-mould, has never established itself as a pest, and the commonest are the leaf-spots. Most species of *Primula* appear, however, to be liable to attacks from the rusts and smuts.

Primula Leaf-spot.

Phyllosticta primulæcola (Desm.), Pl. IV. fig. 64.

This endophyte is not a very common disease of the leaves of *Primula vera* and *Primula elatior* in France and Belgium, whence it probably extended to Britain. Discolorations sometimes seen on leaves of cultivated Primulas, which do not perfect themselves, may belong to this species.

The spots are white, circular, and rather large on both surfaces, with a tawny margin. Sometimes the spots are naked, but at other times are dotted with the minute blackish receptacles, which are then very numerous, and, especially towards the centre, just visible to the naked eye.

The sporules developed within the receptacles are exceedingly minute, and are extruded in considerable numbers when mature (4–5 × 2–3 μ).

Sacc. Syll. iii. 308 ; *Cooke Hdbk.* No. 1349 ; *Grevillea*, xiv. 74, No. 433.

Scotch Leaf-spot.

Ascochyta Primulæ (Trail), Pl. IV. fig. 65.

This second leaf-spot has occurred in Scotland on *Primula vulgaris*, and is exactly similar in external appearance to the foregoing. The sporules, however, are larger ($5-6 \times 2\frac{1}{2}$ μ) and divided by a transverse septum into two cells.

Sacc. Syll. x. 5969; *Grevillea*, xv. 1887, p. 108.

Wild Primrose Leaf-spot.

Septoria Primulæ (Buck), Pl. IV. fig. 66.

We have included also this leaf-spot, which was found on the leaves of uncultivated Primroses near Bristol, and, apparently, has not been recognised elsewhere.

The spots are conspicuous chiefly on the upper surfaces of the leaves, and are somewhat rounded and pallid, with a brown border. The perithecia are dot-like, and are scattered over the spots, which are scarcely to be distinguished from the other two forms of leaf-spot.

The sporules are very different, for in this instance they are long and threadlike (45–50 μ long) and apparently nucleate.

It has never been shown that there is any connection between these three genera of leaf-spot fungi, and it is scarcely probable, since any genetic connection would probably be with fungi of a higher order, and, presumably, of the *Sphæriaceæ*.

Grevillea, xiv. 1885, p. 40; *Sacc. Syll.* x. 6389.

Primrose Smut.

Urocystis primulicola (Magn.), Pl. IV. fig. 75.

In some of its features this smut bears slight resemblance to the Violet smut, but it differs in that it attacks the fruit, so that all the seed capsules are filled with smut instead of seeds, and unless eradicated will continue to appear year after year. Its first appearance in this country was recorded in the autumn of 1884 upon *Primula farinosa*, although it is said to have been seen as far back as 1867.

The glomerules of spores are roundish or irregular, and are composed of from seven to ten teleutospores, which are normally globose, but become angular by compression, of a dark brown colour, and smooth (9–15 μ). The outer circle of sterile and pale-coloured spores is nearly of the same size and shape.

Germination takes place after a similar manner to that of the Violet smut. A short thick process or promycelium is thrust out, and this bears another generation of smaller and secondary spores at its extremity, and these again can produce their like. These secondary spores are engaged in the dissemination of the species.

This is a deep-seated endophyte, not to be dislodged when once it takes possession of a plant. It has been found in Silesia, Saxony, and Italy.

Sacc. Syll. vii. 1899; *Gard. Chron.* Aug. 30, 1884, fig. 52; *Plowr. Brit. Ured.* 289.

Primrose Cluster-cups.

Æcidium Primulæ, DC.

These cluster-cups, on the leaves of *Primula* of various species, might have been included with the rust, only that the habit is so different as to appear like a different disease, and the ordinary observer might well be puzzled. There is no doubt of its being a prelude or an early stage of the rust; but it may appear without the rust, and the rust may be seen quite independently of the cluster-cups.

The cups are usually clustered together on the under surface upon discoloured spots, which are also distinctly indicated on the upper surface. The cups are rather urn-shaped, partly immersed, with a white fringed margin. The æcidiospores, at first globose, are soon angular, with a roughened surface and yellow (17–23 × 12–18 μ). Of course, as usual, produced in chains within the cups.

The area of distribution is the same as that of the rust.

Hitherto cluster-cups have not generally been regarded as troublesome garden pests, so that picking off and burning diseased leaves has been considered sufficient to prevent spreading.

Sacc. Syll. vii. 2170; *Cooke M.F.* p. 199; *Cooke Hdbk.* No. 1631; *Plowr. Brit. Ured.* p. 159.

Primrose Rust.

Puccinia Primulæ (DC.), Pl. IV. fig. 70.

This is one of the species of rust which passes its three stages of cluster-cups, *Uredo*, and *Puccinia* upon the leaves of the same plant. Doubtless it is more often met with on wild than on cultivated plants, but its existence is not therefore to be ignored.

The pustules of the uredospores are aggregated together in somewhat orbicular spots, soon splitting the cuticle and setting free the powdery uredospores, which are rounded or ovoid (19–22 μ) and minutely rough on the surface, of a pale brown colour. The pustules are found on the under surface, as well as those of the teleutospores, which latter are scattered or sometimes gregarious, and darker in colour. The teleutospores are somewhat elliptical, with a central division into two cells, the upper of which is rounded at the apex and the lower a little narrowed into the very short stem (22–30 × 15–18 μ), externally smooth, brown, with the outer coat thickened at the apex.

Its distribution is recorded for France, Belgium, Switzerland, Germany, and Finland, as well as Britain.

All the rusts are difficult of treatment, and seldom can be checked to any considerable extent by the use of fungicides. Efforts should be directed rather to check dispersion and extension.

Sacc. Syll. vii. 2170; *Cooke M.F.* 204; *Hdbk.* No. 1471; *Plowr. Brit. Ured.* 159.

Primrose Simple Brand.

Uromyces Primulæ (DC.), Pl. IV. fig. 69.

Found on the leaves of *Primula integrifolia* and Auricula, and the theorists have, singularly enough, united this species, as well as *Puccinia Primulæ*, with the Primrose cluster-cups (*Æcidium Primulæ*) as the æcidiospore form. Hence the one *Æcidium* must be held to be responsible for two species of teleutospores.

In the present endophyte the teleutospores are elliptical or ovoid (20–35 × 10–20 μ) and warted, with a hyaline papilla at the apex and a short deciduous pedicel at the base. The teleutospores differ from those of *Puccinia* in being one-celled. The colour is also brown.

The uredospores are supposed to be unknown, although the pustules of the teleutospores are said to be sometimes intermixed with the cluster-cups. Never having seen them in this connection, we cannot vouch for the authenticity of the assertion.

This endophyte has been recorded, not only in Britain, but also in France, Germany, Austria, Italy, and Asiatic Siberia.

Sacc. Syll. vii. 2007 ; *Cooke M.F.* 227.

Primrose White Mould.

Ovularia interstitialis (Cooke), Pl. VI. fig. 67.

Under the name of *Peronospora interstitialis* this mould was first made known by Berkeley in 1875 from specimens obtained from Scotland, but at the time he seems to have had a suspicion that it was not a true *Peronospora*, since confirmed. It was afterwards quoted as *Ramularia interstitialis* ; but that even is scarcely tenable, and we substitute the above.

It occurs in yellowish patches on the under side of the leaves, in the spaces between the veins, rarely occupying any extended surface. The threads are short and flexuous, apparently unbranched, with a few projecting spicules in the upper portion to support the conidia, which are elliptical and either apical or lateral (which Berkeley calls "oblique"), but there is no evidence of septum ($15–17\frac{1}{2} \times 6–7\,\mu$).

We believe it to be the same species as *Ovularia primulana* (Karst) found in Finland, also on the leaves of *Primula vera* (*Sacc. Syll.* iv. 737).

This is the kind of parasite which is likely to be amenable to the influence of fungicides, and has none of the pertinacity, or the resting spores, of the rot-moulds.

Sacc. Syll. vii. 867 ; *Berk. Ann. Nat. Hist.* 1875, No. 1455 ; *Gard. Chron.* May 1, 1886, fig. 124 ; *Grevillea*, iii. 183.

Primrose White Mould.

Ramularia Primulæ (Thüm.), Pl. IV. fig. 68.

The spots in this disease are circular or somewhat angular, and of a pale ochraceous colour, without a definite margin, upon which the mould is seated in tufts on either surface. The threads are rather long ($50–60 \times 5\,\mu$), without septa or divisions, but very rarely at all branched. The conidia are cylindrically fusiform ($20–30 \times 3–6\,\mu$) and sometimes uniseptate, or with one transverse division, and uncoloured. Our own measurements are somewhat different ($25 \times 5\,\mu$).

Would be submissive to spraying with dilute Bordeaux mixture.

This mould has been recorded in Italy, Austria, and Siberia, as well as in Britain.

Sacc. Syll. iv. 1040 ; *Sacc. F. Ital.* t. 985.

A black mould (*Cercospora Primulæ*) seated on whitish-grey spots of the leaves of *Primula elatior* has occurred in France. The tufted threads are short and olive, whilst the conidia are long and narrow ($60–100 \times 4\,\mu$), attenuated upwards almost to a point, and divided transversely by eight or nine septa.

PRIMROSE ROT-MOULD.

Peronospora candida (Fckl.), Pl. IV. fig. 70*.

Although of rare occurrence in this country, the above rot-mould has made its appearance on wild plants, without visiting and inflicting damage on cultivated species, except on rare occasions.

White mouldy spots appear on the under side of living leaves which are conspicuous by their snowy whiteness, although not very dense. Slender erect threads arise from the creeping innate mycelium which are many times branched in the upper portion in a forked manner. The final branches are short and spreading, acute at the tips, and bearing singly the elliptical conidia, which are comparatively small ($22–26 \times 16–30\,\mu$) and hyaline.

Within the substance of the petioles and stem the mycelium produces the usual resting spores, which have a yellowish and afterwards a bright brown and rather thick integument ($30 \times 33\,\mu$). These bodies provide for the rejuvenescence of the parasite in the spring by remaining at rest through the winter. The production and development of these resting spores have already been described in the introduction (*ante*, p. 2).

The distribution of this parasite is narrow, only Germany and Belgium having been recorded in addition to Great Britain.

It has never been sufficiently prevalent or destructive to have been experimented on with fungicides.

Sacc. Syll. vii. 860; *Gard. Chron.* May 1, 1886, with fig.; *Cooke M.F.* 237; *Cooke Hdbk.* No. 1786.

CYCLAMEN LEAF-SPOT.

Two kinds of leaf-spot have been described on the leaves of *Cyclamen*, but neither of them has as yet been decidedly recognised in this country.

The French leaf-spot, *Phyllosticta Cyclaminis*, is manifested by somewhat circular brown spots over which the minute perithecia are scattered, and the sporules are small, narrowly elliptical ($6–8 \times 2\,\mu$), rounded at the ends, and colourless (*Bull. Soc. Myc. de France*, 1893, t. xiv., f. 4).

The other species, which we may call the "Concentric Cyclamen Spot," forms rather large and irregular smoky spots, with a rufous margin, the surface being concentrically lined (*Septoria Cyclaminis*). It was first described in the "Flora of Algeria." The sporules are long and threadlike ($25–30 \times 1\,\mu$), divided by three transverse septa. This species has occurred in Italy as well as Algeria.

So far as we are aware, these are the only fungus parasites which have been described as troubling the Cyclamen.

AURICULA BROWN MOULD.

Heterosporium Auriculæ (Cooke), Pl. IV. fig. 71.

About the year 1888 this parasite was first brought to our notice, flourishing upon living leaves of *Auricula*, and then threatening to become troublesome; however it scarcely seems to have appeared since, or during the past three or four years.

The leaves are disfigured by smoky patches on the surface, with a minutely velvety appearance, caused by the threads of this mould, which are erect, slender, and unbranched, but somewhat flexuous, and at length septate and olive. The conidia are terminal, sometimes briefly concatenate, narrowly elliptical, at first continuous, then one or two septate ($25–35 \times 10\,\mu$) the surface rough with minute scabrous points or warts, but with a rather thicker and darker epispore than in the allied species.

It has not yet been recorded elsewhere.

Two or three other species of this genus are known in Britain, and all of them have proved to be destructive pests, such as *Heterosporium echinulatum* on Carnations, and *Heterosporium gracile* on Iris.

The only remedy suggested in these cases has been spraying with ammoniacal copper carbonate solution, and clearing away all dead leaves.

Grevillea, xvi. 109.

Soldanella Rust.

Puccinia Soldanellæ (DC.).

In this instance, as the endophytes are rare, we may include all the stages which occur upon the leaves of *Soldanella alpina* under one notice.

The cluster-cups (*Æcidium*) are scattered over the lower surface of the leaves, and do not present any remarkable difference in appearance from the same kind of endophyte on other plants. The æcidiospores are subglobose or somewhat angular, with a finely granulated surface, and are of a yellow colour ($20–26 \times 17–20\,\mu$).

The pustules of the *Uredo* are developed on the upper surface, and are minute, gregarious, and brown, when ruptured encircled by the remains of the cuticle. The uredospores are rounded, ovoid, or elliptical ($20–32 \times 20–30\,\mu$), with a rough surface.

The teleutospores are produced in the same or similar pustules, and are ovate, somewhat irregular and somewhat apiculate at the apex, brown at first, with a short pedicel, the surface reticulated finely.

The entire fungus is reported from France, Germany, Switzerland, and Italy, but we are not aware that any form except the *Æcidium* has been found in Britain.

Sacc. Syll. vii. 2181; *Cooke M.F.* 195; *Cooke Hdbk.* No. 1608; *Plowr. Brit. Ured.* 159.

A Soldanella leaf-spot (*Septoria Soldanellæ*) with dark spots and thread-like sporules ($20–30 \times 1\,\mu$) has been recorded as occurring in Italy.

Gentian Rust.

Puccinia Gentianæ (Strauss.), Pl. IV. fig. 63.

Although Gentians are known to have been affected by ten separate diseases, only one of these has at present been detected in this country. In 1885 the above-named parasite first appeared in a bed of *Gentiana acaulis* in a public garden, where it was previously unknown. It commenced on some imported plants, and threatened to involve all in destruction. Various experiments were undertaken to check the disease, but proving fruitless the whole of the affected plants were uprooted and destroyed.

The lower leaves are first attacked and become of a sickly colour. The pustules soon appear upon the leaves, and these split irregularly at the vertex and expose the spores.

The earliest to make an appearance are the uredospores, which are almost globose (22 × 16 μ) and rough externally. The teleutospores soon follow, which are intermixed with the uredospores in the same pustules, and are larger, of a darker colour, divided transversely into two cells. In form they are somewhat elliptical, each cell being almost triangular, like inverted cones attached at their bases, the lower cell with a colourless stem, which finally disappears (28–38 × 20–26), the surface quite smooth.

This pest is reported to be very common in Russia, and not unknown in other parts of Europe.

As remarked above, all efforts to save infected plants by spraying with fungicides proved to be ineffectual.

Sacc. Syll. vii. 2153; *Gard. Chron.* Sept. 19, 1885, fig. 82; *Grevillea,* xiv. p. 39; *Plowr. Brit. Ured.* 147.

Periwinkle Rust.

Puccinia Vincæ (Berk.), Pl. IV. fig. 72.

This is a very tenacious species, since when it once attacks a plant it seldom leaves it, making its appearance on the under surface of the leaves.

A complicated biology is attributed to it, which recognises æcidiospores without cluster-cups, but produced in flattened pustules, of a dark brown colour containing globose spores, which are colourless and echinulate (10–12 μ diam.).

There are also two kinds of uredospores, the primary ones produced early and elongated, the secondary later on and nearly globose.

The teleutospores are developed normally in small pustules, although an Italian author attempted to establish the fact that there are two kinds of teleutospores, and therefore must be two species of *Puccinia*, one of which was to be called *Puccinia Vincæ* and the other *Puccinia Berkeleyi.*

The teleutospores are elliptical, divided in the centre, and slightly constricted, the upper cell thickened at the apex, the lower cell somewhat attenuated downwards into a long peduncle, which soon falls away. The final spores are rather large (38–56 × 17–28 μ).

Recorded for France, Germany, Portugal, and Italy.

Sacc. Syll. vii. 2241, 2495; *Gard. Chron.* July 25, 1885, p. 108, figs. 22, 23; August 20, 1887; *Cooke M.F.* 103, 205, fig. 132; *Plowr. Brit. Ured.* 161; *Cooke Hdbk.* No. 1478.

Leaf-spots and a rot-mould are known on the continent of Europe on the Periwinkle.

Convolvulus Anthracnose.

Marsonia Ipomœæ (C. & M.), Pl. IV. fig. 73.

The cultivated species of *Convolvulus* and *Ipomœa* do not appear to be susceptible to fungus parasites in this country, although some half-dozen species are recognised abroad.

The above-named was first discovered on the stems of *Ipomœa* in 1887, and occasionally on the leaves. The pustules were densely collected on the stems of living plants, elevating and splitting the cuticle in an irregular manner, then becoming dark-coloured, like the pustules of a *Uredo*.

The conidia, or sporules, ooze out in tendrils, especially when moist, and are narrowly oblong or cylindrical, blunt at the ends, and divided in the middle by a transverse septum ($10–15 \times 3\ \mu$), entirely colourless. At first the conidia are produced upon short spore-bearers, which proceed from a cushion-like base, but they soon break away, and form a gelatinous mass.

The majority of the species of *Glœosporium* and *Marsonia* are very destructive and persistent pests, against which fungicides have proved of little avail. Destruction of infected plants seems to be the only safe remedy.

Sacc. Syll. x. 6900; *Grevillea*, xvi. 48.

Rivea Chain Mould.

Oidium erumpens (C. & M.), Pl. IV. fig. 74.

It was in the autumn of 1887 that the leaves of *Rivea hypocrateriformis*, under cultivation, were found to develop, on the under surface, little tufts of a whitish mould, which soon gave a sickly complexion to the foliage. The tufts, which broke through the cuticle, were rounded and convex, of a greyish colour, becoming darker with age.

The threads composing the tufts were rather robust, and divided in the upper portion, which soon became torulose, or beadlike, and then the cells separated as globose conidia, or nearly globose ($7 \times 5\ \mu$), and became sprinkled over the leaf.

This mould is more tufted and less diffuse than in most species of *Oidium*, but the structure is the same.

No opportunity occurred for experiment, but it is possible that an application of sulphur would be the most effective.

There is no record of this species anywhere other than in Great Britain.

Sacc. Syll. x. 7091; *Grevillea*, xvi. 49.

Numerous parasites are recorded in North America as attacking the different species of *Phlox*, but hitherto none have given any trouble in this country.

Henbane Rot-mould.

Peronospora Hyoscyami (De Bary), Pl. VI. fig. 78.

This pest has assumed additional importance since it has made vigorous attacks upon Tobacco plants under cultivation, both in North America and Australia.

In this country its activities have been chiefly confined to the Henbane, but it evidently is on the alert for all Solanaceous plants.

The mycelium is abundant within the tissues of the plant before the mould makes its appearance on the surface. The fertile threads are rather robust, branching from five to eight times, in the upper portion in a forked manner, with the branches spreading apart, and attenuated upwards, the final branchlets separating at a very obtuse angle, being short and rather conical, each apex bearing a single spore, or conidium, of an elliptical shape (13–24 $\times$ 13–18 μ) with a tinge of violet.

Resting spores are probably produced on the mycelium, but at present there is no evidence.

It is uncertain whether the conidia only germinate, or whether they produce zoospores.

Hitherto the species is recorded for Britain, Germany, Australia, and North America.

The only treatment suggested is spraying with dilute Bordeaux mixture.

Mass. Pl. Dis. 81, 357; *Gard. Chron.* February 7, 1885, fig. 33; *Sacc. Syll.* vii. 877; *Grevillea*, ii. 139; *Mass. B.F.* 126.

Another species (*Peronospora dubia*) is recorded on *Hyoscyamus* in Austria.

Petunia White Mould.

Ramularia Petuniæ (Cooke), Pl. IV. fig. 76.

At present this mould must be considered as scarce, it having been found only once or twice in this country on the leaves of *Petunia*.

The spots are large, occupying nearly half the surface of the leaf, somewhat circular in form, with a pale ochraceous tint. The conidia are produced in considerable numbers at the apex of rather short undivided colourless threads, which are more or less clustered on the spots. The conidia are cylindrical, rounded at the ends, at first continuous, but at length divided by a septum across the centre (20–22 $\times$ 4 μ).

Wherever it has occurred this parasite has proved to be very destructive, the spots sometimes extending over the entire leaf. No explanation can be offered for its sudden appearance in the south of Britain, but it is known that the moulds of this genus are very erratic, and, as a rule, destructive.

In the event of picking off and burning the diseased leaves not being effective in checking the disease, it is recommended that diluted fungicides should be applied, and for this purpose weak Bordeaux mixture may be tried.

Sacc. Syll. x. 7294; *Grevillea*, vol. xx. 1891, p. 8.

Other ordinary leaf-spots have been recorded on leaves of *Petunia* abroad, such as *Phyllosticta Petuniæ* and *Ascochyta Petuniæ*.

LAVENDER LEAF-SPOT.

Septoria Lavandulæ (Desm.), Pl. IV. fig. 77.

Parasites of Labiate plants under cultivation as garden flowers are very limited. It is now many years since we found Lavender plants with a great number of the leaves attacked by this endophyte, which is not uncommon in France, but which we have not met with again.

The bleached spots are small on both surfaces of the leaves, mostly rounded, but sometimes irregular, limited externally by a raised purple line. They do not generally exceed one eighth of an inch in diameter, but several spots are often seen on the same leaf. On the upper surface of the spots a few black dots are to be discerned, which are the receptacles or perithecia of the fungus.

The sporules, or conidia, are long and thread-like, straight or curved, and very narrow ($25–35 \times 2\ \mu$) ultimately; when fully matured they are expelled through a pore at the apex of the receptacle.

This species has been found also in France, Italy, and Madeira.

Sacc. Syll. iii. 2914; *Cooke Hdbk.* No. 1340; *Grevillea*, xiv. 103, No. 523.

Lavender is also liable to a sickening disease, or "wilting," but the cause has not been ascertained, and no fungus been found.

PESTS OF THE SCROPHULARIACEÆ.

It is a singular fact that no important parasite has yet been recorded in Britain for the numerous Scrophulariaceous plants in general cultivation, although many are known abroad.

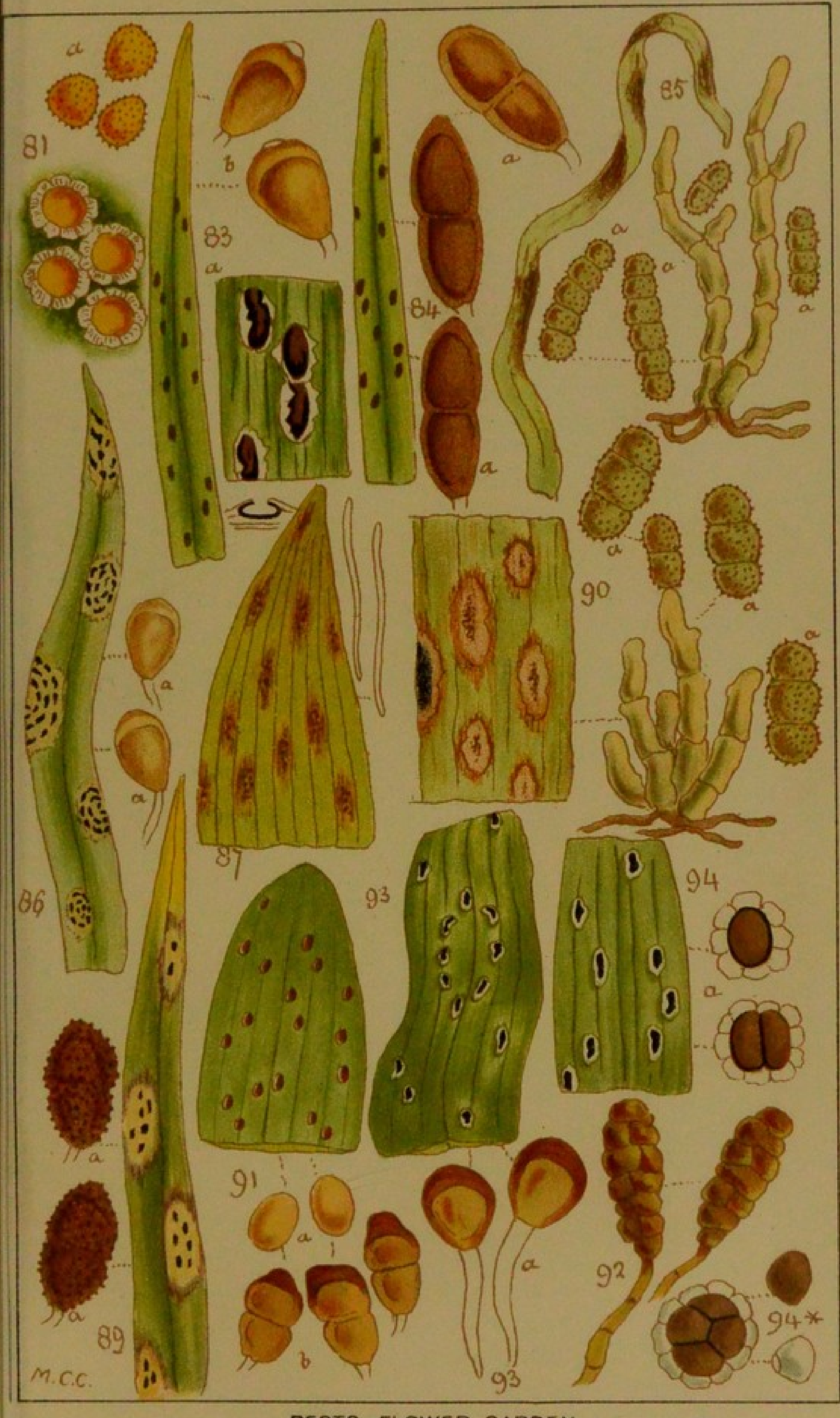
The destructive rot-moulds (*Peronospora*) are represented by at least four species, which attack *Antirrhinum*, *Digitalis*, and *Veronica*, but only *Peronospora grisea* has been met with on uncultivated *Veronicæ*, and *Peronospora sordida* on *Verbascum*, in this country.

The three diseases which produce leaf-spot on *Mimulus*, and the four on *Pentstemon*, have, with one exception, never invaded our shores, whilst *Calceolaria* is still unharmed, and therefore, on the whole, we must be regarded as peculiarly fortunate. The exception is in the case of *Phyllosticta Pentastemonis* (*Grevillea*, xiv. 90) which has produced leaf-spot on one or two occasions in this country. There is also a leaf-spot (*Septoria Pentastemonis*) with small round white spots on leaves of *Pentstemon*, known in North America.

A new fungus disease on *Antirrhinum majus* of the kind known in America as Anthracnose, produced by *Colletotrichum Antirrhini* (Stew.), is recorded recently as causing elliptical or circular sunken spots on the leaves of that plant in the United States (*Journ. R.H.S.* vol. xxvi. 1901, p. 194).

DISEASES OF ENDOGENOUS FLOWERING PLANTS.

For the sake of reference we have kept these diseases together, as they affect plants mostly of outdoor culture, reserving others, which require warm houses or stove treatment, for separate notice hereafter, with other



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hothouse plants. Hence Orchids and other exotics will find no mention here.

Lily Leaf-spots.

Fortunately Lily leaf-spot has not been detected in this country, but it is not uncommon abroad.

One species (*Phyllosticta Lilii*) has pallid spots with a broad rufous margin and small pale brownish sporules (4–5 × 3 μ) on *Lilium superbum* in Canada.

Another (*Phyllosticta liliicola*) has no definite spots, but the receptacles are scattered, and the sporules are larger (10 × 3 μ). It is found on *Lilium candidum* in Italy.

In another species on Martagon Lily (*Cylindrosporium inconspicuum*) there are irregular and indefinite brown spots, and the sporules are long and threadlike (60–100 × $3\frac{1}{2}$ μ), with from three to five transverse divisions. At present confined to Switzerland.

Lily Cluster-cups, Pl. V. fig. 81.

The cluster-cups of the Lily of the Valley (*Æcidium Convallariæ*) are credited with attacking the leaves of *Lilium canadense* in Belgium and the United States.

Another species (*Æcidium Safianoffianum*) occurs on leaves of Martagon Lily in Siberia.

These are named incidentally, as some one of them may at any time pay a visit to our shores.

Lily Brand.

Puccinia Liliacearum (Duby), Pl. V. fig. 84.

A disease which affects indiscriminately a large number of Liliaceous plants, but fortunately not common in this country, and never recognised until within the last few years, it having been found chiefly upon *Ornithogalum*. It forms unsightly pustules on the leaves, enclosing the very dark, almost black, teleutospores.

There is said to be an *Æcidium* which is the prelude to this brand; but it has not been seen in Britain.

The pustules are grouped together, and are for a long time covered by the cuticle, which is at length ruptured longitudinally. The teleutospores are oblong, divided in the middle, and a little attenuated towards each end, of a comparatively large size (40–70 × 22–35 μ), dark brown, and externally smooth, on rather long deciduous pedicels.

It is known in France, Germany, Austria, Italy, as well as in Great Britain.

Should this pest make its appearance all the affected leaves should be stripped off and burnt, so as to destroy the teleutospores and prevent the spread of the disease to other plants.

Sacc. Syll. vii. 2314; *Gard. Chron.* July 28, 1888, fig. 2; *Plowr. Brit. Ured.* 196.

Lily Simple Brands.

Uromyces sp.

These, which we call simple brands, have a similar life-history to the two-celled brands of the genus *Puccinia*, but the teleutospores have only one cell. Of those which occur on the foliage of Lilies there is one species which is found in Germany on *Lilium canadense*, and called both *Uromyces Lilii* and *Uromyces Liliacearum*, which has since been included as a variety of *Uromyces Erythronii*, a conclusion the accuracy of which we venture to doubt.

Another species on leaves of *Lilium* has been called *Uromyces Rabenhorstii*, and is also found in Germany. This has also been attributed by Saccardo as a form of *Uromyces Erythronii*. In both these species the teleutospores, which have been communicated to us, differ from each other and from the typical form of those in *Uromyces Erythronii*.

The last species is probably distinct: it occurs on *Lilium canadense* leaves in the United States (*Uromyces Lilii*, Clint.), but hitherto we have not seen it, and should scarcely venture an opinion. The teleutospores are rugulose ($36\text{–}37 \times 20\text{–}25\ \mu$).

Lily Disease.

Botrytis elliptica (Berk.), Pl. VI. fig. 80.

The history of this disease seems to have been most mysterious throughout, since it was several years after its first appearance before any light could be thrown upon its cause. It was in 1881 that specimens were sent to the Rev. M. J. Berkeley in such a condition that he was able to detect a small white mould as the probable cause of the mischief, which he called *Ovularia elliptica* (*Gard. Chron.* Sept. 10, 1881, with figure). Afterwards, by some means, it acquired the name of *Botrytis elliptica*.

Attention being called to it again, it was made the subject of reference in 1888, when it was figured again (in *Gard. Chron.* Aug. 18, 1888, fig. 21), and then for a time was permitted to rest, but not for long, since Marshall Ward, in 1889, under the name of *Botrytis*, evidently introduced the same mould into his account of the Lily disease, and figured it as a species of *Botrytis*.

This may, or may not, be the same mould as the *Botrytis parasitica* (Cav.) on Tulip stems, alluded to by Massee, but of which no description is given.

Then Saccardo intimates that the *Polyactis cana*, which he calls *Botrytis canescens*, attacks the immature fruits of Lilies.

Last of all we find the name of the mould buried altogether, and the disease attributed to *Sclerotinia*, a kind of *Peziza*, or Ascomycetous fungus, which, at the same time, it is confessed, has never been seen, and the existence of which is only suspected. A rather curious episode in "imaginative mycology," which is seeking to supplant the old-fashioned "science of fact."

Under all these circumstances we prefer to retain the name of *Botrytis elliptica*, and not travel into the region of romance.

This disease attacks most species of Lilies. Rust-coloured patches come upon the leaves and buds, as if they had been burnt, if the buds are not completely destroyed; the flowers become imperfect and distorted, and the whole plant has a blighted appearance.

The threads of the mould arise from the creeping mycelium, and are

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somewhat branched in the upper portion, the ends of the branches having pear-shaped swellings, each bearing about a dozen conidia, each conidium attached to the swollen end by a minute peg-like stalk The conidia are egg-shaped and colourless ($20 \times 14\ \mu$).

Beyond Great Britain the area of distribution is not ascertained.

No remedies have been suggested, or tried, beyond destroying infected plants and bulbs, so as to prevent the formation of sclerotia, which are the resting stage of the mycelium, and its consequent diffusion in the succeeding year.

Sacc. Syll. iv. 752 ; *Grevillea*, vol. x. 1881, p. 51 ; *Gard. Chron.* Sept. 10, 1881, fig. 66 ; Aug. 18, 1888, fig. 21 ; *Marshall Ward, Ann. Bot.* Nov.

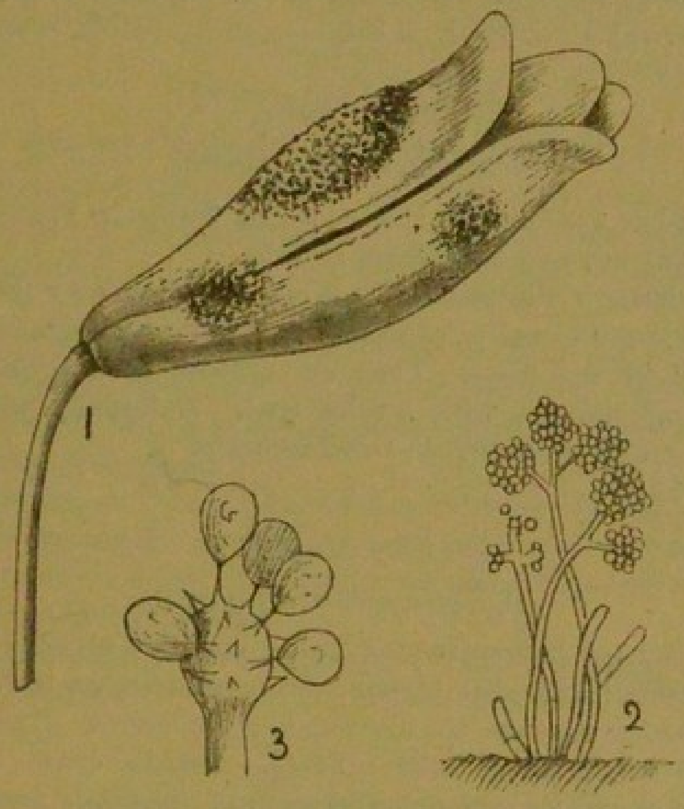


FIG. 8.—BOTRYTIS SPECIES. 1. Flower-bud of Lily attacked by the fungus. Nat. size. 2. Fruiting branch of the fungus : × 50. 3. Head of fruiting branch : × 500.

1888, p. 319 ; *Diseases of Plants*, p. 117 ; *Mass. Pl. Dis.* p. 161 ; *Journ. R.H.S.* vol. xxvi. 1901, p. 372, fig. 190 ; *ibid.* vol. xxvi. 1901, p. cxxix.

JAPAN LILY DISEASE.

Rhizopus necans (Mass.), Pl. VI. fig. 82.

This is a disease affecting the bulbs of *Lilium speciosum* and *Lilium auratum* raised in Japan for exportation to Europe, and hitherto only affects imported bulbs.

At first a slight discoloration at the base of the bulb is discovered when the bulb is cut open. This extends until the entire bulb becomes discoloured, and afterwards soft and rotten. Diseased bulbs which have become rotten show a white weft of mycelium, from which numerous clusters of the fungus, resembling miniature pins with black heads, stand erect. These are the conidial or summer fruit. The globose conidia

(5–6 μ diam.) being enclosed in the black heads, resting spores are produced within the tissues of the decayed bulb.

This fungus belongs to the Mucors, which produce resting spores, after an act of conjugation, and the species are generally saprophytes, living at the expense of decayed matter. Those who are responsible for the conclusion have probably sound evidence for regarding this as the cause and not the effect of the disease. We have not heard of any experiments to show that sowing the *Rhizopus* on healthy bulbs will produce the disease.

Naturally there is no remedy for rotted bulbs, and the only safeguard is in prevention, and the destruction of diseased bulbs.

Kew Bulletin, 1897, p. 87, plate; *Mass. Pl. Dis.* p. 57, cuts, 351; *Journ. R.H.S.* vol. xxvi. 1901, p. 376.

Tulip Smut.

Ustilago Tulipæ (Heufl.).

This smut has appeared on the leaves of Tulips in France, Germany, and Austria, but not as yet in Great Britain.

The pustules are elliptical and convex, scattered over the leaves, and soon splitting longitudinally, exposing the sooty spores, which appear to be quite black in the mass. They are globose or irregularly rounded (16–20 μ diam.), smooth, with a thick coat. Externally with much the same appearance as the smut on *Ornithogalum.*

Sacc. vii. 1640.

Tulip Mould.

Botrytis parasitica (Cav.).

We are informed that cultivated Tulips are often killed by the attacks of a mould which forms olive-brown velvety patches on the stem, leaves, and flowers, which answers to the name given above. The threads are grey, erect, with the basal joint inflated. Conidia ovate, large (16–20 $\times$ 10–13 μ), disposed on minute branches in an umbellate manner. Later on smooth lentil-shaped sclerotia appear on the outer parts of the bulb, sometimes so numerous as to form a black crust.

Cav. App. Pat. Veg. p. 10, t. 6, figs. 1–4; *Mass. Pl. Dis.* 158; *Sacc. Syll.* x. 7167; *Journ. R.H.S.* xxvi. 1901, pp. 43, 198.

Tulip Brand.

Puccinia Tulipæ (Schr.).

There are said to be two species of brand which affect Tulip leaves, of which the above is one, which is known in Germany and Austria. This is one of those species for which neither cluster-cup nor uredo is known.

The pustules are minute, rounded, or elliptical, and densely aggregated together, or confluent, dark brown. The teleutospores are broadly ellipsoid, rounded at both ends, with a thick spore-coat, or epispore, which is densely warted (30–44 $\times$ 21–32 μ). The spores appear at first to be involved in a hyaline mucous envelope. The short pedicel soon vanishes.

Sacc. Syll. vii. 2347.

Spiny Tulip Brand.

Puccinia Prostii (Moug.).

This is the second, and older species, which is known on Tulip leaves in France and Italy. This also has neither affiliated cluster-cups nor uredo.

The pustules are oblong, convex, brown on both surfaces of the leaves, either scattered or rather crowded, at length ruptured. The teleutospores are ellipsoid and, of course, uniseptate ($60–66 \times 34–36\ \mu$), considerably larger [than in the preceding, everywhere covered with long colourless acute spines. The general colour of the epispore cinnamon-brown, with a hyaline pedicel or footstalk.

Sacc. Syll. vii. 2580.

Ornithogalum Brand.

Uromyces Ornithogali (Wallr.), Pl. V. fig. 83.

The species of *Ornithogalum*, *Gagea*, and *Erythronium* seem to be specially favoured in this country by the absence of parasites, which are sufficiently common abroad, to the extent of some eighteen or twenty species.

The leaves of *Ornithogalum* and *Gagea* are alike subject to the above brand, which is only known in the teleutospore form. The pustules are elliptic and bullate, mostly scattered, soon splitting and discharging the powdery nearly black spores.

The teleutospores are ovate, or pear-shaped ($26–50 \times 17–26\ \mu$), narrowed into the pedicel at the base and rounded above, with a minute hyaline wart-like apiculus. The surface is smooth, rarely otherwise, and of a pale or chestnut-brown colour.

It occurs in France, Germany, Hungary, and Portugal.

Sacc. Syll. vii. 2015; *Plowr. Brit. Ured.* 142; *Grevillea*, vii. 138.

A corresponding species (*Uromyces Erythronii*) is found on *Erythronium* and other Liliaceous plants nearly throughout Europe and in the United States. (See fig. 9.)

Puccinia Liliacearum occurs in Britain on *Ornithogalum umbellatum*, and another species, *Puccinia Kalchbrenneriana*, at the Cape of Good Hope, and *Puccinia Lojkaiana* in Italy, the Tyrol, and Hungary, all upon *Ornithogalum*.

Ornithogalum Black Mould.

Heterosporium Ornithogali (Klot.), Pl. V. fig. 85.

In the majority of instances the black moulds are truly regarded as saprophytic, living upon and at the expense of dead vegetable matter; but there are decided exceptions to this rule in entire genera, such as *Cercospora* and the present *Heterosporium*, which seem to be entirely parasitic. The latter genus was named by Klotsch more than half a century ago, but was not clearly defined until 1877 with this as the typical species.

The leaves become spotted with sooty-looking minutely velvety spots, caused by the dark threads and mycelium of this mould, and soon decay.

The threads grow in tufts, and are long and flexuous, with thin walls, pale brown, septate, and occasionally branched, bearing at their apex the conidia of variable size and form, some being elliptical and continuous, others two-celled and longer, whilst others are cylindrical, with rounded ends and two or three divisions (30–$80 \times 10\ \mu$), externally rough with minute points and slightly coloured.

When mature these conidia will germinate freely from every joint.

Spraying with potassium sulphide is stated to check the disease. To prevent spreading, diseased leaves should be burnt.

Sacc. Syll. iv. 2306; *Cooke Journ. Q.M.C.* 1877, t. 25, f. 13; *Gard. Chron.* June 1877, fig. 163; *Grevillea*, v. 123.

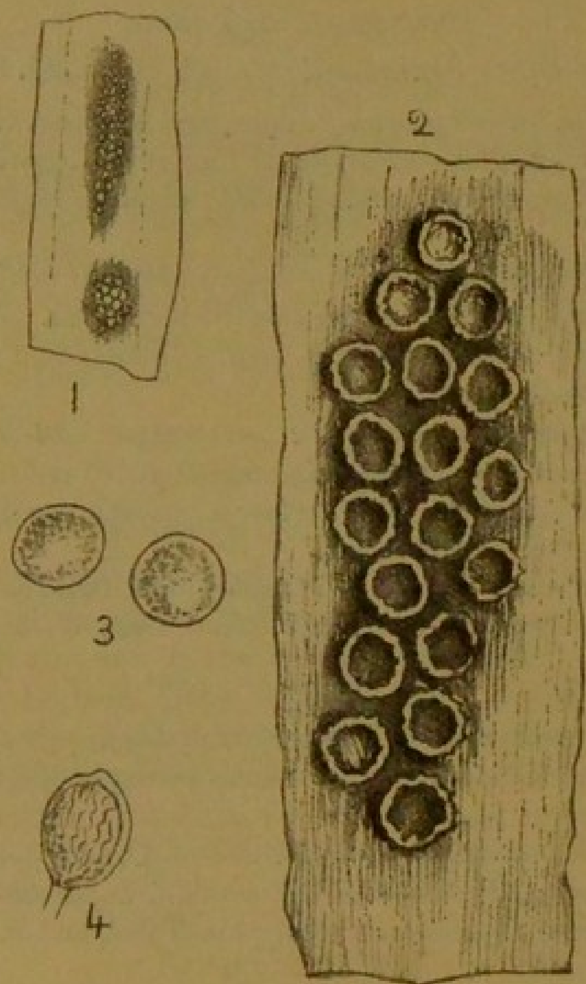


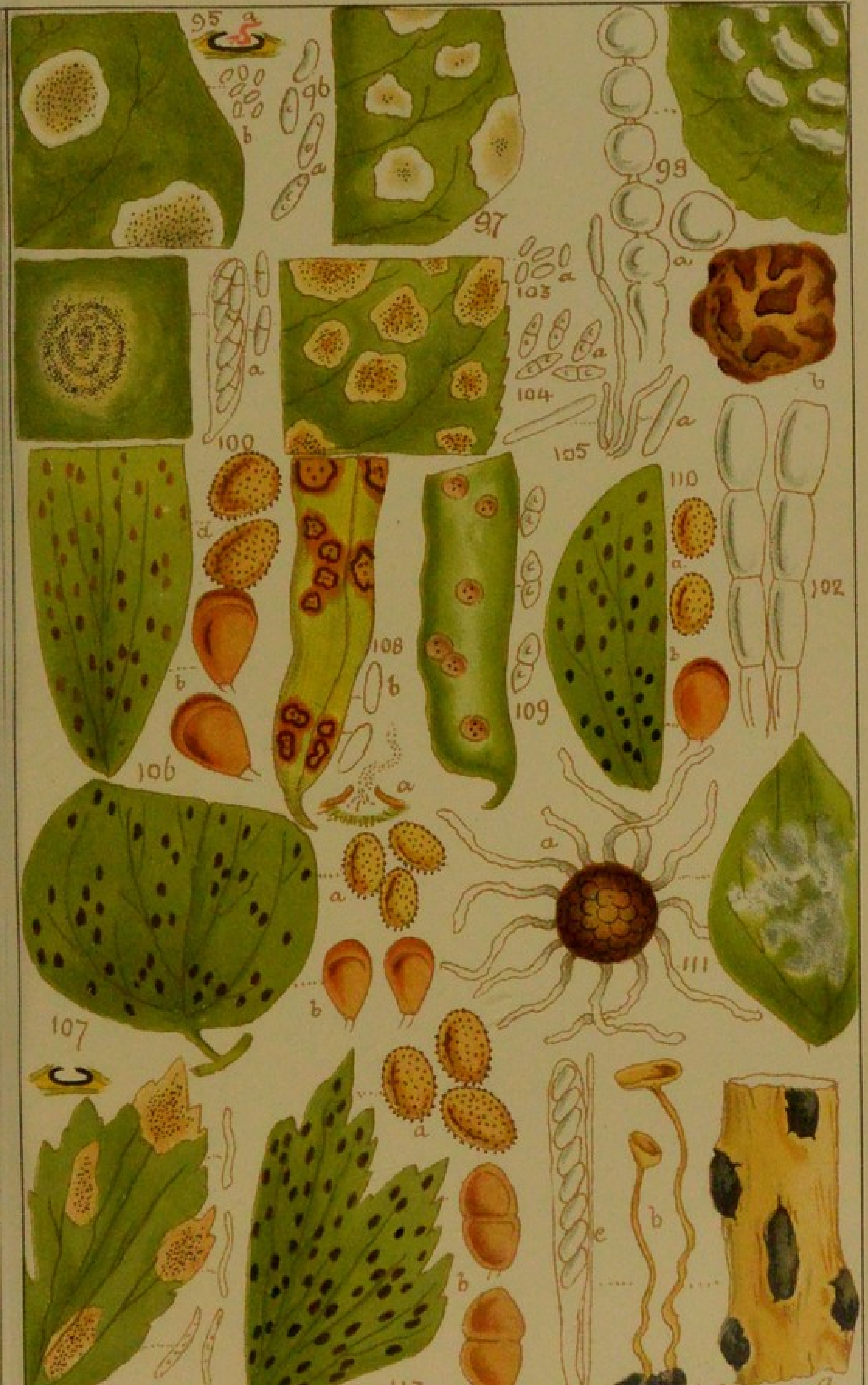
Fig. 9.—Uromyces Erythronii. 1. Portion of a leaf showing clusters of the fungus. Nat. size. 2. A single group of the fungus fruit known popularly as "cluster-cups": × 100. 3. Uredo, or summer-spores: × 400. Teleuto- or winter-spore: × 400.

Squill Brand.

Uromyces Scillarum (Grev.), Pl. V. fig. 86.

This parasite is very common on the leaves of the Wild Hyacinth, and probably has thence found its way into gardens, where it attacks the leaves of *Muscari botryoides* and other species.

The attacked leaves are blotched with paler spots, upon which the



PESTS—GARDEN VEGETABLES.

pustules soon appear, at first covered by the cuticle. The paleness is caused by the internal mycelium which pervades the tissues.

The pustules are small and numerous, generally arranged upon the spots in concentric rings, or parts of rings, with a tendency to coalesce. The spores are soon exposed by rupture of the cuticle, when they are powdery and of a chestnut-brown colour.

The uredospores are at present unknown.

The teleutospores are subglobose, or rather pear-shaped (19–30×14–$24\ \mu$), and sometimes irregular by compression, quite smooth, and of a pale brown. The epispore, or spore coating, is of equal thickness throughout, and *not* thickened at the apex, as in many other species. There is a short hyaline stem, which soon disappears.

Its area of distribution, outside this country, includes France, Germany, Austria, Hungary, Greece, Italy, Egypt, and South Africa.

It is possible that spraying with one of the fungicides may be of a little service, but the perfection and dispersion of the spores should be prevented by picking and destroying infected leaves.

Sacc. Syll. vii. 2014; *Cooke M.F.* 213; *Cooke Hdbk.* No. 1548; *Plowr. Brit. Ured.* 141; *Grevillea*, vii. 138.

BLACK SMUT.

Sclerotinia bulborum (Wakk.), Pl. IX. fig. 135.

A pest under the name of "black smut" has appeared around Haarlem, where it has been very destructive to Hyacinth culture. It is not a "smut" according to our acceptation of the term, but a Sclerotium.

It makes its appearance after flowering, causing the leaves to turn yellow and fall off. No external mycelium is to be observed, except at the base of the leaves. The bulb is completely permeated with mycelium, and black irregular nodules appear on the surface, mixed with some that are softer and paler coloured. These are the "sclerotia," or nodules of compact mycelium. These nodules are like resting spores, and must pass through a period of quiescence, so that they will not germinate until the following spring.

If the bulbs are potted, and watered copiously, at the period when their activity should commence the sclerotia will germinate and produce the little *Peziza* cups, resembling those produced from the sclerotium of the Potato. To this Peziza-form Wakker has given the name of *Sclerotinia bulborum.* The sporidia are binucleate ($16 \times 8\ \mu$).

There is one peculiarity about these sclerotia, that when cultivated in a nutrient solution they will form a mycelium and produce secondary sclerotia.

It is needless to say that when once a bulb is attacked remedy is hopeless. Onion bulbs are also liable to attack.

Gard. Chron. May 12, 1894, p. 592; *Mass. Pl. Dis.* 380.

HYACINTH YELLOW DISEASE.

Pseudomonas Hyacinthi.

A disease affecting Hyacinth bulbs has been described under the name of "yellow disease" which appears on them in the autumn, filling the vascular bundles with a yellow slime. This mucus is said to contain immense quantities of a bacterium, to which at first the name of *Bacterium Hyacinthi* was applied.

Whilst these little bodies are embedded in the slime they remain motionless, but when removed from it they soon exhibit a lively motion, and begin to divide. In the spring they appear in the vascular bundles of the leaves.

Gard. Chron. May 12, 1894, p. 592; *Journ. R.H.S.* xxvi. 1901, p. 222; *Hart. & Som. Dis. Tr.* p. 37.

Another disease attacks principally the flowering parts and is attended by the production of a foul-smelling mucus. Upon making a close examination Dr. Heine discovered that the mucus and the tissues were full of bacteria, quite different from those of the "yellow disease," and was called *Bacillus Hyacinthi septicus*. It is reported that when healthy plants are inoculated with this the evidence of infection is manifested within twenty-four hours. When cultivated on Potato it formed a yellow slimy layer, and in a few days gave off a strong offensive smell.

Gard. Chron. May 12, 1894, p. 592.

Tubeuf contends that a common large *Peziza*, which grows on manure heaps (*Peziza vesiculosa*), attacks Hyacinths and other plants in gardens and kills them.

Mass. Pl. Dis. 162.

Convallaria Brown Spot.

Septoria brunneola (Fries), Pl. V. fig. 87.

This leaf-spot is found, not uncommonly, on living or fading leaves of Lily of the Valley, but not often in fruit, so that the spots remain sterile and harmless. It is believed, however, to be only a prelude or early stage of a more highly developed fungus (*Sphærella brunneola*).

Brown irregular spots on the leaves, which at length acquire a blackish colour, precede the receptacles of the *Septoria*, which latter subsequently appear as little dots clustered upon the spots. The sporules are long and threadlike, without division ($75–100 \times 2\ \mu$).

This parasite is known also in Sweden, Italy, and Moravia.

Sacc. Syll. 3113; *Journ. R.H.S.* xxvi. 1901, p. cxl.

Convallaria Red Spot.

Phyllosticta cruenta (Fries).

Another leaf-spot has been found in Britain on leaves of Solomon's Seal, forming oblong blood-red spots with a pallid centre, upon which the receptacles are scattered. The sporules are somewhat sausage-shaped, rounded at the ends, and curved ($14–16 \times 5\frac{1}{2}–6\frac{1}{2}\ \mu$).

This spot has also been found in France, Belgium, Germany, Italy, Portugal, Siberia, and North America.

Sacc. Syll. iii. 324; *Grevillea*, xiv. p. 74, No. 437.

Lily of the Valley Cluster-cups.

Æcidium Convallariæ (Schum.), Pl. V. fig. 81.

The Lily of the Valley is very rarely attacked by this parasite in Britain, although it is occasionally seen; but on the Continent it has the reputation of being a destructive pest.

No *Uredo* form or teleutospores have yet been affiliated to this species of cluster-cup.

The cups are clustered together on paler spots of the leaves, chiefly on the upper surface, and the white fringed cups are filled with bright orange æcidiospores, presenting under the microscope the most elegant appearance. The æcidiospores are globose, minutely warted (20–25 μ diam.).

It is to be hoped and anticipated that remedial measures will not be called for.

The area of distribution includes Belgium, Germany, Hungary, Finland, and North America.

Gard. Chron. July 5, 1884, with figs.; *Grevillea*, xiv. 2; *Sacc. Syll.* vii. 2945; *Plowr. Brit. Ured.* 264.

Snowdrop White Mould.

Botrytis galanthina (B. & Br.), Pl. VI. fig. 88.

This mould appears to have first been made known in 1873, when it was detected on the bulbs of Snowdrops, attacking the outer coats and destroying them. At first it threatened to become very destructive in the North, but has never given much trouble in the South.

The threads of the mould are shortly branched in the upper portion turning brownish. The branches are somewhat thickened upwards, bearing the obovate spores in clusters about the apices, each spore or conidium being seated upon an elongated spicule. The conidia are hyaline and subglobose or obovate (15–18 × 10–11 μ).

The mould attacks also growing plants, as soon as leaves and flowers appear above ground, stopping the flowering and the proper development of the leaves. Then a delicate white mould is seen to cover the leaves and spathes. Later on numerous minute black sclerotia are formed in the tissues of the decaying leaves and the outer bulb scales.

Some impetuous author has called this fungus *Sclerotinia galanthina* before a single cup of the *Peziza* has ever been seen, or existed, except in his own fertile imagination. We do not intend to follow him into fairyland, but adhere to the *Botrytis* until it falls away. Massee calls the mould *Botrytis cinerea*, and the Peziza *Sclerotinia Fuckeliana*.* (See fig. 10.)

Ann. Nat. Hist. 4th series, xi. p. 346; *Grevillea*, ii. 139; *Gard. Chron.* Mar. 2, 1889, p. 275; *Mass. Pl. Dis.* 159; *Sacc. Syll.* iv. 705.

Crocus White Mould.

Botrytis Croci (Cke. & Mass.).

This mould was found upon the dead leaves of *Crocus* in the autumn of 1887; but it is just possible, acknowledging its relationship, that it

* *Journ. R.H.S.* xxvi. 1901, p. 41, fig. 4, and p. xxxvii; also 1902, xxvi. p. 731 g. 306.

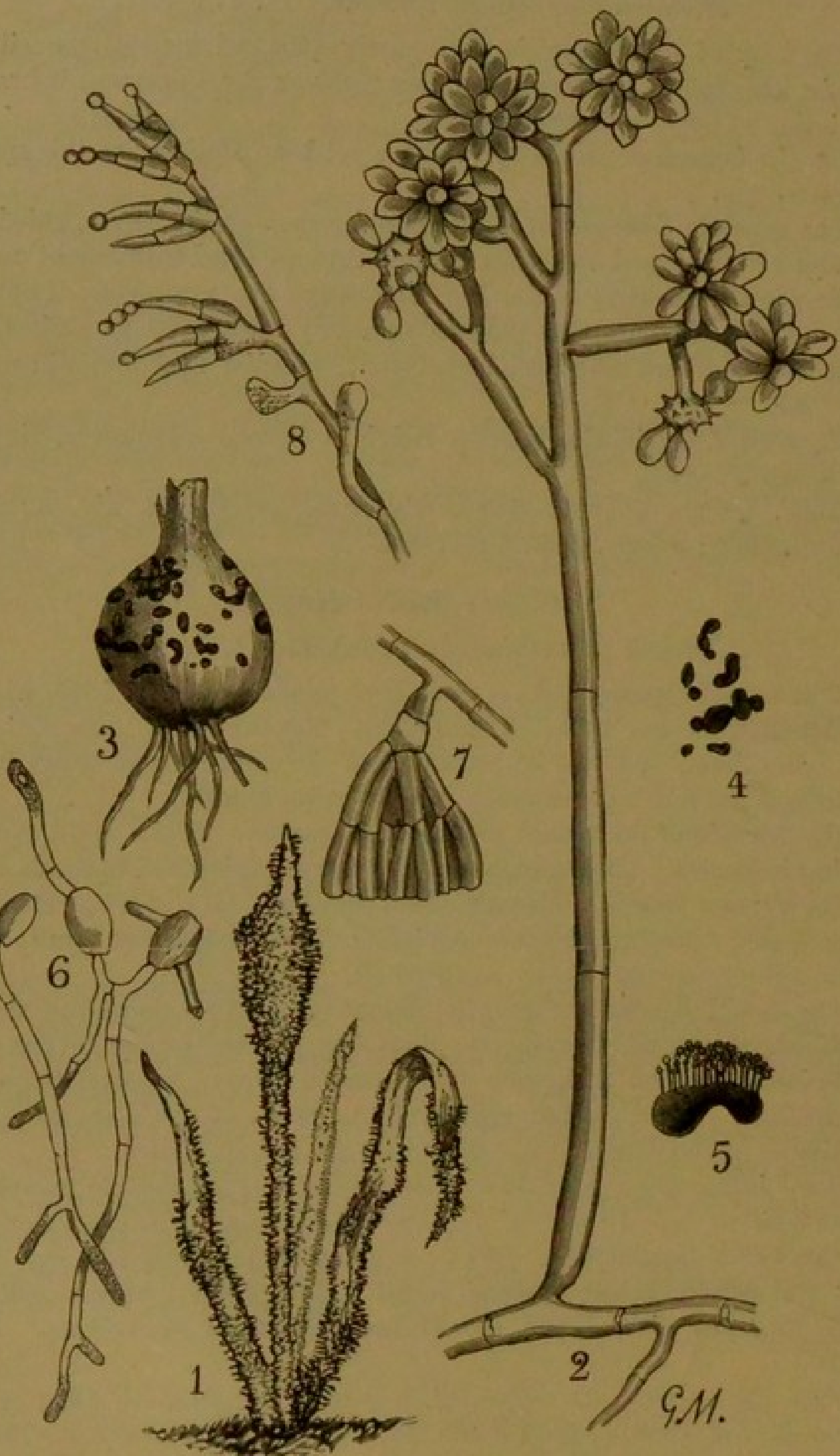


FIG. 10.—BOTRYTIS GALANTHINA, A PARASITE ON SNOWDROPS.

1. A young Snowdrop badly diseased, nat. size. 2. Fruiting branch of the *Botrytis*, or summer form of the fungus, × 350. 3. A Snowdrop bulb with sclerotia, nat. size. 4. Isolated sclerotia, nat. size. 5. A sclerotium bearing a crop of *Botrytis*, the spring following its formation, × 10. 6. *Botrytis* conidia germinating, × 400. 7. An organ of attachment of the *Botrytis*, × 400. 8. Chains of conidia, of unknown use, formed on mycelium of the *Botrytis*, × 400.

may not hesitate to attack living plants in the same way as the Snowdrop species.

It forms dark smoky tufts, which sometimes unite in a larger effused mass. The threads are comparatively thick and rather closely jointed, attenuated upwards towards the apex, where they are slightly and sparingly branched, downwards of a pale olive colour, but uncoloured in the upper portion. Conidia elliptical, hyaline ($15–18 \times 8–10\ \mu$), collected together at the tips of the threads, or of the branches, in small glomerules or clusters of from three or four to seven or eight conidia. In this respect the present species appears to be rather peculiar, since the head or glomerule of conidia in most cases contains a large number of individuals.

It has to be discovered whether this species is capable of providing itself with sclerotia and of developing therefrom the customary *Sclerotinia*.

Grevillea, xvi. 10; *Sacc. Syll.* x. 7165.

COPPER WEB.

Rhizoctonia Crocorum (DC.).

Amongst the diseases to which the *Crocus*, especially the Saffron Crocus, is subject is one which has long been known under the name of "copper web." This is due to the presence of a parasitic fungus which lives and thrives at the expense of the Crocus corm. The fungus was classed amongst the Truffles by Duhamel in 1728 and afterwards figured by Bulliard under the name of *Tuber parasiticum*, which was afterwards changed by Persoon into *Sclerotium croceum*; but it was De Candolle who finally raised it to the dignity of a genus and called it *Rhizoctonia*.

This singular parasite consists of Sclerotia-like tubercles united by byssoid filaments going from one to the other and forming a sort of subterranean web or net. It is by means of these filaments, which are attached to the rootlets of the plant or which creep over the surface of the bulbs after having pierced their integuments, that the parasite appropriates their nutritive juices after the manner of the "Dodder," and induces, if not direct death, at least a weakly development.

It was doubtful for a long time whether any real fructification was produced; and even now it is uncertain, although Broome found, on what he considered the same web on Mint, not only the hard warts, but little tawny tufts of a looser texture covered with globose or ovate spores. It seemed evident that the tufts and warts were forms of each other, but whether the spores were the true fruit, or only a secondary form of fruit, has not been determined.

Journ. R.H.S. vol. v. 1850, p. 23.

NARCISSUS BRAND.

Puccinia Schroeteri (Pass.), Pl. V. fig. 89.

The leaves of *Narcissus* have recently been found in this country to be affected with a disease which apparently originated in Italy and afterwards extended into Germany.

The spots are large and oblong, with a tawny-violet border; the pustules are produced on these spots, and either solitary or a few together, either covered with, or girt by, the remains of the ruptured epidermis.

No *Æcidium* or *Uredo* has been found associated with this disease.

The teleutospores are somewhat elliptical, from golden-yellow to chestnut-brown (38–60 × 24–27 μ), obscurely reticulated, either rounded at both ends or with the base somewhat attenuated into the very short, thick, deciduous peduncle, with a central partition dividing the teleutospore into two nearly equal cells.

Nuovo Giorn. Bot. Ital. vii. 255 ; *Sacc. Syll.* vii. 2579.

The attack of *Fusarium bulbigenum* on *Narcissus* bulbs (*Grevillea*, xvi. 49) has not been repeated.

A form of leaf-spot (*Septoria Narcissi*), with the receptacles scattered over the tips of fading leaves, has not yet been observed out of Italy.

Iris Rust.

Uredo Iridis (Thüm.).

This rust is believed to be common in gardens on the leaves of various species of *Iris* and to be quite distinct from another *Uredo* which furnishes the uredospores of *Puccinia Iridis* (DC.). This *Uredo* is supposed to have neither *Æcidium* nor *Puccinia* associated with it.

The pustules are linear-ovate, and sometimes confluent, on both surfaces of the leaves, covered at first by the cuticle and then exposed by rupture, of a chestnut-brown colour. The uredospores are almost globose, rarely somewhat pear-shaped, externally rough, brown (30–35 × 20–25 μ).

Dr. M. Foster says "it does not readily attack the broad-leaved Mediterranean forms, but I am inclined to think that almost every species would take it."

Sacc. Syll. xi. 1299 ; *Plowr. Brit. Ured.* 257.

There is supposed to be another species in North America (*Uredo iridicola*) on the leaves of *Iris versicolor*, with rough globose uredospores (25 μ diam.), of which we know nothing, and it may be the *Uredo Iridis* of Schweinitz.

Iris Brand.

Puccinia Iridis (DC.), Pl. V. fig. 91.

It is difficult to follow the mutation of names, but this we believe to be the same fungus which Berkeley called *Puccinia truncata*. It is found on the leaves of many species of *Iris*, besides *I. fœtidissima* and *I. germanica*.

The uredospores are found in crowded pustules, at first covered, then exposed, of a rusty-brown colour, crowded together, and either subglobose, elliptical, or ovoid (20–35 × 16–26 μ), externally rough, and ochraceous.

The teleutospores occur in linear, elongated, striæform pustules, which are blackish to the eye ; the spores are two-celled, club-shaped, with the apex rounded, or rather obtuse, or acuminate, with the spore-coat thickened at the apex, constricted in the middle at the septum (30–55 × 14–22 μ), smooth, pale brown, with a hyaline pedicel (12 × 5 μ).

This species is known in France, the Ardennes, Germany, Switzerland, Italy, and Siberia.

No associated cluster-cups are known.

Sacc. Syll. vii. 2284; *Cooke M.F.* p. 203; *Hdbk.* No. 1466; *Plowr. Brit. Ured.* 190.

Cluster-cups (*Æcidium Iridis*) are known in North America on leaves of *Iris versicolor.*

IRIS LEAF-BLOTCH.

Heterosporium gracile (Wallr.), Pl. V. fig. 90.

One of the most persistent and troublesome of *Iris* diseases is this mould, which appears at some seasons with astonishing vigour upon the leaves of *Iris germanica* and other species.

The upper portion of the leaves turns brown and decays or rots, and some plants are soon killed; large dark spots, becoming black, rounded, or elliptical, from half to one inch in length, with a brown border, appear on the brown parts, or on the still green leaves, velvety with the parasitic mould. In other cases the spots are smaller and more numerous, with a narrow brown margin, and simply bleached or dead tissue, on which are sprinkled a few tufts of the mould.

The mould consists of rather short and thick jointed threads in small tufts, and of a sooty-brown colour, bearing singly, or nearly always, the conidia of variable size, some of which are elliptical and without division, whilst others are elongated, and once or twice divided transversely into cells ($35–70 \times 14–20\ \mu$), and also of a smoky colour, the surface rough with minute points.

This disease seems to be known in France, Germany, Italy, the Cape of Good Hope, New Zealand, and North America.

If not too firmly established, syringing with one of the copper solutions may be of some service; but the conidia germinate freely at every joint, and if not destroyed will quickly spread the disease.

Gard. Chron. June 9, 1894, p. 718; *Sacc. Syll.* iv. 2308; *Journ. R.H.S.* xxvi. 1901, p. 450. Reported also on Narcissus, *Journ. R.H.S.* xxviii. 1904, p. 679.

IRIS BULB SCAB.

Mystrosporium adustum (Mass.), Pl. V. fig. 92.

Bulbs of *Iris reticulata* have lately been affected and frequently destroyed by the incursions of a black mould, previously unknown, and which forms black crust-like patches on the outer sheath, gradually speading to every part.

There is a profuse dark mycelium, from which arise the short branches bearing the large and much-divided conidia. These latter are elliptic-oblong or ovate, with obtuse ends, and from five to seven transverse septa or divisions, which are again subdivided by longitudinal septa in a muriform manner. The divisions are often oblique, and sometimes without longitudinal divisions ($45–60 \times 20–22\ \mu$), smooth, dark brown, and semi-translucent, produced at the tips of the threads, or at the ends of short branches.

Soaking the bulbs for two hours in a solution of one part formalin to three hundred parts of water will destroy the fungus, so long as it is external and has not penetrated deeply into the bulb.

Mass. Pl. Dis. 325, 441.

Leaf spots of six different kinds are recorded on *Iris* leaves in different countries, but none of them have yet been reported as British.

A Bacterial disease on *Iris* is noticed in *Journ. R.H.S.* xxviii. 1904, p. 662.

Gladiolus Smut.

Urocystis Gladioli (Smith), Pl. V. fig. 94*.

This smut, which in some respects resembles that of *Colchicum*, attacks the corms of *Gladiolus*, forming the spore masses within the corms. These are in rounded balls, or glomerules (40–50 μ diam.).

The teleutospores, or central fertile spores, are rounded on the outer side, but angular by compression elsewhere: they are dark brown (4–6 μ) and smooth. Externally in the glomerules are a series of colourless sterile spores or conidia, as in most other species of *Urocystis*, and in this case they are very numerous and evenly distributed.

The glomerules, or spore masses, have somewhat the appearance of large spores, divided in different directions, but in reality they consist of an agglomeration of smaller spores, closely compressed together into a ball, the inner ones being coloured and capable of germination, the outer series uncoloured and sterile. When fully matured the component cells separate under pressure, but the true function of the sterile cells has not been determined.

It might be advisable to immerse any suspected corms for a time before planting in Condy's fluid; but it is hopeless to expect any remedy when the corms are seriously attacked.

Known also in France and Germany.

Gard. Chron. Sept. 30, 1876, p. 420, fig.; *Grevillea*, v. 57; *Sacc. Syll.* vii. 1900; *Mass. B.F.* 187; *Plowr. Br. Ured.* 287; *Cooke M.F.* 232.

Gladiolus leaf-spot (*Septoria Gladioli*) and *Gladiolus* rust (*Puccinia Gladioli*) are at present unknown in Britain.

Colchicum Smut.

Urocystis Colchici (Schl.), Pl. V. fig. 94.

This is a disease of *Colchicum* which has long been known and too prominent in its manifestations to escape notice. The growing leaves are the subject of attack, and these are distorted and disfigured by the long and ugly pustules formed by the pest. These are large, thick, swollen, or bullate, at first covered by the epidermis, but at length ruptured and fringed with the remains of the torn cuticle, exposing the black, sooty-looking mass of complex spores.

The glomerules, or clusters, are nearly globose (20–33 × 16–20 μ), with the central spores few and chestnut-brown, compressed at the points of contact (10–15 μ). The sterile spores of the circumference are pale, sometimes in two strata, and also compressed where they come into contact (7–11 μ diam.). When mature the spores are sprinkled about over the foliage in an unsightly manner. The disease is liable to attack species of *Scilla* and *Muscari* if found in proximity.

Spraying the plants early with Condy's fluid has proved to be preventive.

Known in Italy, Belgium, and Germany.

Sacc. Syll. vii. 1895; *Mass. Pl. Dis.* 227, 404; *Cooke M. F.* 232; *Mass. B.F.* 186 figs. 86, 87; *Cooke Hdbk.* No. 1539; *Plowr. Brit. Ured.* 286; *Gard. Chron.* Sept. 30, 1876, fig.

Colchicum leaf-spots are also known in Italy and France.

Colchicum Rust.

Uromyces Colchici (Mass.), Pl. V. fig. 93.

At present this is solely a British product, and has for three successive seasons completely destroyed a bed of *Colchicum speciosum*, and has latterly attacked plants of *C. bavaricum* and *C. autumnale* growing in the neighbourhood.

The parasite attacks the leaves, commencing at the base of the leaf-sheath, and gradually extending towards the tip of the leaf. The oldest leaves are the first to be attacked.

The pustules are large for the genus, and often elongated on the sheaths, whilst upon the leaves they are liable to be collected in circular groups. They remain for a long time covered by the cuticle, which is finally ruptured to set the teleutospores free.

Teleutospores broadly elliptical or subglobose, with the apex slightly prominent, epispore, or spore coat smooth, dark brown, and as much as 2 μ thick (28–38 $\times$ 21–28 μ) seated upon a hyaline persistent pedicel.

Cluster-cups or *Uredo* unknown.

No remedy has been proved to be successful.

Grevillea, xxi. 6; *Mass. Pl. Dis.* 226, 406.

The species of *Veratrum* are very subject to parasitic diseases in North America.

Dracontium Cluster-cups.

Æcidium Dracontii (Schwz.).

These cluster-cups are found in gardens on the leaves of *Arum triphyllum*, and were first made known in the United States.

The spots on the leaves are pallid and broadly extended, sometimes occupying nearly the whole leaf. The cups are rather large and distinct, being scattered without order over the spots, and not clustered as in *Æcidium Ari*. The æcidiospores are subglobose and of orange-brown colour, somewhat angular by compression and minutely rough (15–16 μ diam.).

It is scarcely probable that remedies will have to be sought after for this species, as its appearance will now be problematical after so many years of absence.

Cooke Hdbk. No. 1611; *Sacc. Syll.* vii. 2962; *Plowr. Brit. Ured.* 266.

The ordinary *Arum* cluster-cups found on the leaves of wild *Arum maculatum*, and another species (*Æcidium aroideum*) which occurs in Natal, are apparently quite distinct.

Calla Soft Rot.

Bacillus Aroideæ (Town.).

This disease has recently been investigated in the United States, and declared to be Bacterial. The same organism is declared to be capable of attacking a large number of vegetables. It occupies the intercellular space in its host, and dissolves the layers which connect the cells, causing the tissue to break down into a soft slimy mass. No successful treatment discovered. *Journ. R.H.S.* xxix. 1905, p. 761.

FERN DISEASES.

The diseases of hardy Ferns under cultivation in this country are very few and unimportant, although several are recorded abroad.

Damping off.

Pythium intermedium (De Bary).

The "damping off" of the prothallia of Ferns is possibly sometimes due only to an excess of moisture; but an actual disease has been recognised in the United States, and there is no reason why it may not make its appearance amongst us, as the fungus itself is of European origin.

The affected prothallia become quite soft and limp, and darker in colour than the healthy ones.

An allied species of fungus is responsible for the "damping off" of seedlings of crucifers, whilst some authors regard them as the same species.

In structure *Pythium* resembles a *Mucor*, and produces resting spores as the result of conjugation, similar to the rot-moulds.

Bull. U.S.A. Exp. Stn. Cornell Univ. 94, p. 247, pl.; *Bot. Zeit.* 1881; *Sacc. Syll.* xi. 1400; *Mass. Pl. Dis.* 350.

Fern Rust.

Uredo filicum (Desm.), Pl. IV. fig. 79.

There are two or three kinds of Fern rust known, but only one species appears to be known in Britain, and that is not uncommon in gardens and greenhouses, especially on *Cystopteris fragilis*, appearing on the under side of the fronds, which consequently assume a sickly appearance.

The pustules are rounded or irregular, and scattered over the under surface of the fronds in bright yellow spots. The uredospores are powdery, and are of two forms, the one ovate or elliptical and spinulose above, but smooth below ($22-35 \times 13-20\,\mu$), the other somewhat angular with a thick smooth outer coating ($26-38 \times 18-29\,\mu$), and both of a bright orange colour.

Ferns on which the rust makes its appearance should be isolated, and the diseased fronds cut off and burnt, whilst the plants so left should be sprayed with Condy's fluid.

It is distributed through Belgium, Germany, Finland, Austria, Bohemia, Italy, South Africa, and North America, and appears to be the same as *Uredo Polypodii* (Pers.).

Sacc. Syll. vii. 3096, xi. 1304; *Cooke, M.F.* 112; *Proc. Amer. Acad.* 1894, p. 396; *Cooke Hdbk.* No. 1569; *Plowr. Brit. Ured.* 256.

Uredo Aspidiotus in the United States appears to be different, as also *Uredo Pteridis* in California, and *Uredo Scolopendri* in Germany and the Netherlands.

PESTS OF GARDEN VEGETABLES.

The majority of the pests which infest garden vegetables, salads, and sweet herbs are specifically distinct from those which attack garden flowers, but are equally prevalent and destructive. As, however, they are closely allied, the treatment and remedies will be found to be, in most cases, the same. It cannot be urged too often that, as prevention is better than cure, the greatest care should be taken against the introduction of fresh diseases into the kitchen garden, and any encouragement to the permanency of old ones. Wild plants—or "weeds," as they are termed—are many of them subject to fungoid diseases, which may transfer themselves to kindred cultivated plants when growing in their vicinity. As a warning to careless cultivators, wild Cruciferous or Composite weeds should not be permitted to invade the garden or its borders. Furthermore, the "rubbish heap," in an out-of-the-way corner, should be dispensed with, because the resting spores, or the winter condition of some of the most troublesome pests, will be found in the stems or other dead parts which are usually consigned to a rubbish heap instead of being burnt; and consequently the "rubbish heap" becomes a teeming emporium for the dispersion of active spores in the spring, so that from this centre a very large area may speedily be infected.

Cabbage Leaf-spot.

Phyllosticta Brassicæ (Curr.), Pl. VII. fig. 95.

Cabbage leaf spotting is not a serious calamity, but it may become annoying when excessive. The most common spot is that above named, which occurs also on rape. The spots are generally rather large and bleached, becoming white on the upper surface. The receptacles are very small and numerous, chiefly towards the centre of the spots.

The sporules are ovoid, with two nuclei ($5\,\mu$ long) expelled from the mouth of the receptacle, when mature, in small rosy tendrils.

It is known also to occur in France, Belgium, and Portugal.

Seldom of sufficient importance to demand a remedy, but in such case spraying of young plants might be beneficial.

Sacc. Syll. iii. 207.

Another species (*Phyllosticta Napi*) is known in France, but is very little different in appearance, and a slight difference in the form of the sporules.

A leaf-spot with two-celled sporules (*Ascochyta Brassicæ*) is known on the Continent, forming large irregular bleached spots, on which the receptacles are densely crowded. The sporules are fusiform, septate and nucleate (15–16 × 3–4 μ).

Cabbage Anthracnose.

Glœosporium concentricum (Grev.), Pl. VII. fig. 96, sporules.

In 1851 attention was called to this parasite by a memoir in Journal R.H.S., in which it was stated that the fungus was discovered by Dr. Greville thirty years previously. but never constituted itself a pest until the former year.

It forms on both surfaces of the leaves of Cabbage and Cauliflowers, roundish, often confluent, patches, consisting of little white specks disposed more or less concentrically, those of the centre frequently becoming yellow, and at length fading away.

The sporules are developed beneath the cuticle, and are oblong and cylindrical, often curved, containing two or three nuclei (about 20 × 7 μ) borne upon short delicate spore-bearers. These sporules are mixed with a viscid fluid, and in dry weather ooze out through the fissures in the cuticle as rude irregular tendrils. There is no trace of a perithecium, only a subcuticular cell, in which the sporules are developed. The tendrils are dissolved with moisture, and the sporules are disseminated over the leaves.

This fungus has also been found in Germany, but nowhere has it become a troublesome pest, and, as far as we can learn, is only an occasional visitor.

Sacc. Syll. iii. 3665; *Journ. R.H.S.* vol. vi. 1851, p. 117, with fig.; *Cooke, Hdbk.* 1408.

There appears to be no chance of discovering what *Cercospora Bloxami* B. and Br. can be. It was imperfectly described, and the supposed original specimens have no fruit (Pl. VII. fig. 97).

Cabbage White Rust.

Cystopus candidus (Pers.), Pl. VII. fig. 98 *a*, *b*.

This is a very old and very common offender, and is not confined to Cabbages, but extends its ravages to almost any Cruciferous plant. It was described by Berkeley in 1848 as White Rust, and was then believed, and long afterwards, to be related to the ordinary rusts, but recently, when better known, it has found a place near the Rot Moulds.

The external appearance consists of swollen, convex, white pustules, sometimes in rings and patches, and sometimes scattered over all the green parts. At first the cuticle is shining and unbroken, but at length it is irregularly ruptured, to permit the spores to escape. The base of these pustules consists of a mass of irregular, thick, knotted, mycelium, from which arise club-shaped cells, bearing a chain of globose spores, slightly attached to each other, and forming a kind of necklace, the upper one falling away, and then the next, and so on in succession, as they become matured (12–18 μ diam.).

Each spore or conidium when placed in water or a damp situation undergoes just such a change as we have already described for the conidia of the Rot Moulds (see Introduction, p. 2). From five to eight zoospores are formed in the interior, and escape by rupture of the wall of the conidium. Thus each conidium produces from five to eight active zoospores, which finally serve to disseminate the parasite by infection.

In the same manner also as in the rot mould does the internal mycelium produce resting spores, which, after a period of rest, probably through the winter, develop numerous active zoospores in the spring.

In the present species the resting spores are globose (30–50 μ diam.), externally warted with large obtuse warts, and of a brown colour.

This pest is distributed throughout Europe, and many parts of Asia, Africa, and America. It may truly be said to be cosmopolitan.

Sacc. Syll. vii. 792; *Mass. Pl. Dis.* 59; *Smith, Field Crops*, 86; *Cooke, M. F.* figs. 198–200; *Cooke, Hdbk.* No. 1564; "*White Rust*," *Journ. R.H.S.* vol. iii. 1848, p. 265, with figs.; *Tubeuf, Dis.* 123.

Cabbage Black Mould.

Alternaria Brassicæ (Berk.).

This black mould was first described by Berkeley under the name of *Macrosporium Brassicæ*, and was found by him growing on Cabbage leaves in company with the common *Cladosporium herbarum*, of which he considered it to be probably a condition. The conidia are clavate, and divided by from five to eleven septa, some of which have longitudinal divisions, and are of an olive colour (60–80 × 15–16 μ). Subsequent examination seems to have shown that the conidia are produced in short chains, attached end to end, as is the case in *Alternaria*, and hence the change of name.

It is evidently very rare as a garden pest, although it has also been found in France and Italy. The mould is developed on dry spots of dead tissue, on Cabbage leaves, and may probably be only a saprophyte, which we have never seen, and probably it has not occurred in Britain again during nearly half a century.

Tubeuf, Dis. p. 518; *Cooke, Hdbk.* No. 1733; *Sacc. Syll.* iv. 2613.

Cabbage Rot Mould.

Peronospora parasitica (Pers.), Pl. VI. fig. 30.

Sometimes found in company with the "white rust," and often independently, on the leaves of many Cruciferous plants.

We have already introduced this mould in the "Pests of the Flower Garden" (p. 21), where it is far less troublesome and dangerous than here, and to that account we have nothing to add, beyond the intimation that this disease partakes essentially of the characters of the well-known Potato disease, and that whatever remedies may have been applied with success in one instance are likely to avail in the other.

The only fungicide which has been recommended for use in the early stages of this disease is diluted Bordeaux mixture, but of course this will be of no avail where the mould is well established and the mycelium has penetrated deeply into the tissues of the host-plant so that the resting spores are in course of formation. In such case the only alternative is to prevent the spread of disease by destroying all affected plants which may contain resting spores.

Known through the whole of Europe, the greater part of America, and in Asiatic Siberia.

For development of "rot moulds" see Introduction, p. 2.

Sacc. Syll. vii. 830; *Mass. B. F.* 119; *Mass. Pl. Dis.* p. 79; *Smith, Field Crops*, 86; *Gard. Chron.* Nov. 17, 1883, figs. 109–111; *Cooke, M. F.* f. 265; *Cooke, Hdbk.* No. 1778.

Damping off.

Pythium De Baryanum (Hess.), Pl. IX. fig. 99.

This disease affects seedlings of Cress, Mustard, &c., when the plants fall over and die off, as a result of the destruction of the fundamental tissues by the attack of this parasite. The stem fails just above the surface of the ground.

The mycelium is branched, with the lateral branches thin and reflexed. The conidia are globose, with thin walls, often terminating the lateral branches (20–30 μ). The resting spores, or oospores, are also globose, with a thick smooth outer coat (25–35 μ) resulting from the conjugation of a club-shaped cell or antheridium with the globose cell which afterwards becomes the resting spore (fig. 99 *a*).

In many features of their life-history these fungi, called *Pythium*, resemble the rot moulds, and especially in the production of zoospores. The resting spores, however, are produced externally, and not within the tissues of the host plant.

This disease only occurs in very damp situations, and should be prevented by good drainage.

Sacc. vii. 924; *Ward, Dis.* p. 33, figs. 5–9; *Mass. Pl. Dis.* 54, fig. 4; *Quart. Journ. Micr. Sci.* xxiii. p. 487, t. 24, f. 1–10; *Tubeuf, Dis.* p. 116.

Young Cabbage plants are often destroyed by *Olpidium Brassicæ* when growing in damp places. The fungus is a single cell or two or three, located in the cells of the host plant. From these imbedded cells a tube is projected through the tissue so that the zoospores may escape. Resting spores are formed within the substance of the host-plant.

Mass. Pl. Dis. 53.

Cabbage Sphærella.

Sphærella brassicæcola (Duby.), Pl. VII. fig. 100.

This affection of the leaves is held to be the mature condition of the leaf-spot, which occurs earlier in the year. The leaves are disfigured by large and rather rounded or irregular bleached spots, upon which the perithecia, or receptacles, are scattered, but larger in size generally. The fructification is more complex, since, instead of naked sporules, the receptacles enclose long transparent vesicles called asci, each one of which contains eight sporidia. In this species the sporidia are oblong, and divided in the centre into two cells ($18 \times 4\ \mu$).

The mature stage of this pest, in the form of *Sphærella*, is not reached until the leaves have lain some time on the ground.

This condition of spot has also been found in France, Belgium, Germany, and Italy, but is nowhere very common.

It is scarcely likely to give more trouble than to pick off and burn the diseased leaves of the *Phyllosticta* form, as they appear.

Sacc. Syll. i. 1939.

Club Root.

Plasmodiophora Brassicæ (Wor.), Pl. IX. fig. 101.

Club Root is so well known, not only in Turnips but in Cabbages and other plants of the family, that no detailed description is necessary.

It is now admitted that the disease is caused by a kind of slime fungus, which occupies the club. It commences early in the growth of the plant affected. The rootlets are swollen in a spindle-shaped manner, usually with a smooth surface, and the plant presents a sickly appearance. At first the cells of the clubbed roots are filled with a yellowish slimy substance which is the early condition of the fungus. Later on this substance will be seen to have undergone a change into myriads of minute spherical spores. During winter these spores remain quiet, but in spring they ripen and prepare for germination. This is done by the gradual conversion of each spore into an active motile zoospore, and each atom, being free, is capable of moving as it pleases by aid of its whip-like tail in any film of moisture.

When the motion ceases, these bodies coalesce into a small slimy mass, which in turn coalesces with other masses until a large mass is formed. These viscid masses are washed out of the tissues by early rains, and move about in the moisture by pushing out little portions of their substance like legs. In this manner they come into contact with the roots of seedling plants, and the disease is communicated.

The application of quicklime destroys the germs in the soil. Thirty-five bushels per acre is enough to arrest the disease.

Sacc. Syll. vii. 1568; *Smith, Field Crops*, p. 94, figs. 34–39; *Ward, Dis. Pl.* p. 47; *Mass. Pl. Dis.* p. 334; *Journ. R.H.S.* xxvi. 1901, p. 190, xxvi. 1902, p. ccxix; xxviii. 1904, p. 636; *Tubeuf, Dis.* p. 524.

Black Rot of Cabbage.

Pseudomonas campestris (Sm.).

This disease, long known in America, has now appeared in Britain. It may appear on the plant at any period of growth. Dwarfing, or one-sided growth of the heads, or absence of head is a symptom. If the stumps of affected plants are broken, a dark ring will be seen, corresponding to the woody part of the stem; in bad cases this blackening may be traced upwards into the centre of the head. In the leaves the symptoms usually begin at the margins, with yellowing of all the affected parts except the veins, which become brown or black.

The disease is caused by a yellow bacterium, which enters the plant above ground, and usually at the margins of the leaves. Slugs and caterpillars may spread the disease by going from diseased to healthy plants.

Rotation of crops is recommended to rid the soil of the pest. Cruciferous weeds should not be permitted in the neighbourhood to harbour the disease. Removal of infected leaves in the early stages of the disease would be beneficial. It should be noted that when diseased cabbages have been converted into manure, such cabbages as have been manured with this material have exhibited the disease.

Smith, U.S. Dep. Agri. Bull. No. 68; *Mass. Pl. Dis.* 340; *Journ. R.H.S.* xxviii. 1904, p. 627; xxix. p. 759.

Turnip White Mould.

Oidium Balsamii (Mont.), Pl. VII. fig. 102.

Turnip leaves, and other garden produce, suffer from the incursions of this white mould, which makes its appearance in the manner usual to all of its kind, by spreading a thin white film of mycelium and conidia over the subjects of its attack, like a hoar frost.

It first attracted attention on Turnips in 1880, and since that time has not been uncommon. The lowermost leaves are those which are first attacked.

From the coating of white mycelium which soon covers both surfaces of the leaf arise the club-shaped branches, or fertile threads, the lower portion usually consisting of three superimposed cells, surmounted by the maturing conidium, or spore, which is of a barrel shape: that is to say, it is cylindrical, swollen a little in the centre, like a barrel, and truncate or flattened at the ends. When mature, this conidium falls, and, pursuant to the custom in this genus, the next joint pursues its growth and conversion into a conidium, in order to follow its predecessor.

These conidia germinate very readily when kept moist, the germ tube projecting at one angle. It is most common when a moist September follows a dry August.

Dusting with sulphur is one of the most effectual remedies in this kind of disease, which cannot but remind us of the *Oidium Tuckeri* of the vine.

Smith, Field Crops, 76, 77, figs. 27, 28; *Gard. Chron.* Sept. 25, 1880.

Horseradish Leaf-spot.

Phyllosticta Armoraciæ (Cooke), Pl. VII. fig. 103.

A number of specimens of this parasite were collected in a garden, fully a quarter of a century ago, and distributed, under the name of *Septoria Armoraciæ*, when the distinctions between *Septoria* and *Phyllosticta* were not recognised. The spots and their disposal upon the leaves appear to be precisely the same as in *Septoria*.

The receptacles, or perithecia, are minute and immersed in the spots

The sporules are small, oblong, and colourless (6 × 3–4 μ), and are produced in great quantity.

It is uncertain where else this species has been obtained, as we know of no record beyond the specimens above named.

The external appearance of the affected leaves is the same in the three species of *Phyllosticta*, *Ascochyta*, and *Ramularia*, as visible to the naked eye.

Cooke, Fun. Ex. 32.

Horseradish Leaf-spot.

Ascochyta Armoraciæ (Fckl.), Pl. VII. fig. 104.

As already stated, the leaf-spots caused by this disease can scarcely be distinguished from those caused by the *Ramularia*, except possibly in the recognition of the minute dot-like receptacles which are seated upon the spots.

The sporules, which are produced within the receptacles, are oblong, obtuse at the ends, and divided transversely into two cells (18–20 × 3 μ), which is the only apparent distinction between *Ascochyta* and *Phyllosticta*.

This cannot be considered a dangerous or troublesome garden pest, but if its banishment is desired, it would be well to try spraying with one of the copper solutions.

The fungus is known in the Rhine Provinces, Holland, and Italy.

Sacc. Syll. iii. 294; *Fckl. Sym. Myc.* 388.

Horseradish Spot Mould.

Ramularia Armoraciæ (Fckl.), Pl. VII. fig. 105.

This little white mould is common enough on leaves of Horseradish; although it probably does no harm to the roots, still it makes the foliage look shabby enough.

The spots are at first ochrey-white, then pallid, and somewhat circular, until they run together into a larger blotch. The fertile threads arise from the buried mycelium in small tufts, and are erect and unbranched. The conidia, or sporules, grow singly at the tips of the threads, and are rod-shaped, sometimes a little thickened at the middle, and obtuse at the ends (20 × 4).

There is hardly any appearance of mould to the naked eye, or at most only a little mealiness on the spots. Finally many of the decayed spots drop out, leaving holes in the leaves.

There is so much external resemblance in the spots caused by this species, *Phyllosticta Brassicæ*, *Ascochyta Armoraciæ*, *Septoria Armoraciæ*, and *Sphærella brassicæcola*, that it is almost impossible to distinguish them one from the other by the naked eye, and all are liable to be found on Horseradish leaves.

If applications are considered desirable, then diluted Bordeaux Mixture may be used.

Sacc. Syll. iv. 978; *Sacc. Fun. Ital.* 986; *Grevillea*, iii. 65.

Bean Rust.

Uromyces Fabæ (Pers.), Pl. VII. fig. 106.

This extremely common parasite is found on the foliage, stems, and leaves of the Garden Bean (*Vicia Faba*), as well as the Horse Bean or Field Bean, covering them with a rust-coloured powder, which consists of the scattered uredo and teleutospores.

The uredospores are first produced, and are the most profuse, bursting through little rounded pustules which elevate the cuticle. They are globose or nearly globose in form, of a yellowish-brown colour, and a roughened or shortly spiny surface ($20–30 \times 17–20\ \mu$).

These are ultimately succeeded by the teleutospores, which are of a darker colour, somewhat club-shaped, with the outer coat much thickened at the apex, and terminated by a depressed pore. They are longer and rather broader than the uredospores, and apparently smooth, with a colourless deciduous pedicel ($24–27 \times 17–30\ \mu$).

This species is known in France, Belgium, the Netherlands, Germany, Switzerland, Austria, Hungary, Bohemia, Italy, Finland, Siberia, South Africa, and North and South America.

It is difficult to suggest a remedy when none have proved really successful. How often the bean haulms covered with rust and teleutospores are left in heaps to rot, when it would be much more politic to burn them instead of leaving them to disseminate the disease!

Sacc. Syll. vii. 1921; *Mass. Pl. Dis.* p. 229; *Cooke, M. F.* 201; *Cooke, Hdbk.* No. 1512; *Plowr. Brit. Ured.* 119.

French Bean Rust.

Uromyces Phaseoli (Pers.), Pl. VII. fig. 107.
Uromyces appendiculatus, DC.

Changes of names in the Uredines have been so numerous of late years that it would seem a relief to fall back on such an old name as *Uromyces appendiculatus* again if not forbidden.

This rust is found on the leaves of most kinds of garden beans; whatever name the cluster-cups may have had, we find the uredospores to be plentiful enough in rounded pustules, of a pale cinnamon-brown. They are either round or shortly ellipsoid ($24–33 \times 16–20\ \mu$), with a rough surface.

The teleutospores occur in darker, almost black, pustules to the eye, which are soon ruptured, and the powdery spores set free. These teleutospores are either subglobose or elliptical, with the spore-coat much thickened about the apex, surmounted by an obtuse hyaline wart or papilla. Externally the spores are smooth ($26–35 \times 20–26\ \mu$).

It is recorded in France, Belgium, the Netherlands, Germany, Switzerland, Austria, Hungary, Italy, Portugal, and North America.

Spraying with potassium sulphide solution should be commenced as early as possible after the manifestation of the disease, to be of any service. There is no hope with the uredines when firmly established, and the mycelium permeates the host-plant.

Sacc. Syll. vii. 1926 ; *Mass. Pl. Dis.* 230 ; *Cooke, M. F.* 211 ; *Cooke. Hdbk.* No. 1543 ; *Plowr. Brit. Ured.* 122.

FRENCH BEAN ANTHRACNOSE.

Colletotrichum Lindemuthianum (Sacc. and Mag.), Pl. VII. fig. 108.

This disease appears on the legumes of French Beans and Peas, while still living, and often before they are mature, giving them a very unsightly appearance. The spots are roundish, becoming brown, with a reddish margin. The pustules appear in the centre of the spots, raising the cuticle, so that it seems inflated, and then splitting it.

The conidia are produced at the tips of threads collected in little bundles, the threads being nearly three times as long as the conidia, which latter are oblong, either straight or curved, rounded at the ends, and granular within ($15\text{–}19 \times 4\text{–}5\ \mu$).

The disease is very prevalent in the United States, where it is reported that " the young fruit is most subject to attack, and if the parasite gains a footing, it is very disastrous, as growth is checked, even when the pods are not conspicuously diseased." A favourable condition is dampness of soil and atmosphere, which seems to be more necessary to the development of this disease than in the majority of others. An airy dry situation for the plants is recommended as the best means of preventing an attack. The application of sulphur is said to check the disease somewhat.

Sacc. Syll. iii. 3747 ; *Mass. Pl. Dis.* p. 208 ; *Grevillea*, x. p. 48 ; *U.S.A. Rep. Agri.* 1887, p. 361, pl. vi. ; *Tubeuf, Dis.* 486, fig.

PEA POD SPOT.

Ascochyta Pisi (Lib.), Pl. VII. fig. 109.

This spot occurs sometimes upon the leaves but most commonly on the legumes of the Garden Pea, and was first called *Depazea concava* on account of the concave little spots on the pods.

The spots are round and yellowish, with a definite brownish margin in the centre of which nestle the small brown receptacles in which the sporules are produced. When mature these latter issue in a short thick reddish tendril from the mouth of the receptacle, and sometimes become confluent. When dissolved by moisture the sporules separate and flow over the matrix. They are oblong, divided in the centre into two cells, usually with a small nucleus in each cell ($14\text{–}16 \times 4\text{–}6\ \mu$).

This disease is recorded in Belgium, Germany, Portugal, and Italy.

No experiments have been recorded on the treatment of this disease, but it has been recommended that Bordeaux mixture should be tried if the affection should become troublesome.

Sacc. Syll. iii. 2197 ; *Berk. Ann. N. H.* No. 194, t. xi. f. 8 ; *Cooke, Hdbk.* No. 1355 ; *Mass. Pl. Dis.* 275, fig. 72 ; *Tubeuf, Dis.* 472.

Saccardo enumerates a species under the name of *Ascochyta pisicola*, on pea pods ; but surely it can only be the above species, as no specimen can be found in the Kew Herbarium with the other name.

Garden Pea Rust.

Uromyces Pisi (Pers.), Pl. VII. fig. 110.

The Pea rust is not so common as the "Pea mildew", on garden Peas, but it is developed in the tissues, and at length makes its appearance externally by bursting in little pustules through the cuticle of the leaves.

The earlier pustules are brown, of a paler colour than the later ones, powdery, and of a rust colour. These uredospores are rather globose, or a little elongated, with a roughened or minutely spiny surface (17 × 24).

The teleutospores are produced in similar pustules, but are darker, and of a brownish-black in the mass. They are broadly elliptical, with a suggestion of pear-shape, being narrowed downwards into a long and colourless pedicel (20–32 × 17–21 μ); the apex of the spore has the coat, or tegument, a little thickened, and the whole surface is delicately punctate when fresh, but apparently quite smooth when old or dried. The uredospores are much more common on the garden Pea than the teleutospores, which latter are comparatively rare.

Those who believe in heterœcism affirm that the cluster-cups of this rust are produced upon the leaves of the Wood Spurge (*Euphorbia Cyparissias*).

This rust occurs in France, Belgium, Germany, Austria, Bohemia, Switzerland, Finland, Italy, Sicily, and Siberia.

Sacc. Syll. vii. 1941; *Cooke, M. F.* p. 212; *Tubeuf, Dis.* 334; *Plowr. Brit. Ured.* 133.

Pea Mildew.

Erysiphe Martii (Lev.), Pl. VII. fig. 111.

Everyone with a garden knows the "Pea mildew" too well, the whitened leaves, covered on both sides, as if with hoar frost or a thin coating of whitewash, showing the sickening yellowish leaves beneath. This mildew is very common, especially towards the close of the season, destroying the last crop. Seen by the naked eye the white coating is soon sprinkled with minute black dots which are the receptacles of the final stage.

The white coating consists of a rather dense mycelium of interwoven threads so compact as to choke up the stomates of the leaves. Here and there, scattered over the mycelium and projecting from it, are little suckers, or haustoria, which enable the mycelium to retain its hold. At first the threads of the mycelium, which arise as fertile branches, only produce conidia, in chains, of the kind known as *Oidium*. Afterwards the black dots appear, which are at first orange, then brown, and finally black, seated upon and scattered over the mycelium. These are the receptacles, which, when magnified, are seen to be globose bodies, held down by little root-like filaments at the base, while a circle of flexuous threads are disposed about the lower circumference. These receptacles contain the mature fruits of the parasite, which are small colourless, nearly elliptical sporidia, enclosed in transparent sacs or asci, of a somewhat pear-shape. Each receptacle holds from 4 to 8 of these asci, each of which encloses from 4 to 8 sporidia. When quite ripe the receptacles are split open and the sporidia escape, and perpetuate the species.

The Hop mildew and the Rose mildew belong to the same family of parasites.

These fungi are, in the first instance at least, true epiphytes, making their appearance on the surface of the leaves before there is any infection or disease of the host-plant, and, as such, are more amenable to treatment.

Dry weather in the case of these fungi is usually considered as propitious to their development; hence it follows that wet checks development, and syringing or watering the leaves in dry seasons is the best moderator of its evil influence.

Sulphur is doubtless of considerable service, as it has been in the Hop mildew.

Sacc. Syll. i. No. 73; *Smith, Field Crops*, p. 266; *Cooke, M. F.* 220, figs. 237–9.

Parsley Leaf-spot.

Septoria Petroselini (Desm.), Pl. VII. fig. 112.

The leaves of the Parsley and sometimes of the Celery are liable to become spotted with this disease. It shows itself scattered over the surface in little spots, which are at first brownish and then bleached, so as to become almost white in the centre. Scattered over these spots are the little dot-like receptacles, or perithecia, which contain the sporules, the spots being already permeated by the mycelium, which produces the discoloured spots.

The sporules are long and narrow, thread-like, with a row of small nuclei, and these escape when mature, like a small tendril from a pore at the apex of the receptacle ($35–40 \times 1–2\ \mu$).

When the leaves are moistened and the dew is upon them, the little tendrils ooze out and soon dissolve, so that the sporules may be disseminated over the leaf.

A shower of rain, or watering artificially, may transfer these sporules to other and healthy leaves.

This species is recorded as known in France, Belgium, Italy, Germany, and S. America.

Sacc. iii. 2876; *Mass. Pl. Dis.* 270.

Celery Brand.

Puccinia Apii (Corda), Pl. VII. fig. 113.

Sometimes the Celery rust finds its way into gardens, where it soon creates mischief, disfiguring the leaves and stunting the plant. It has been proved that it is capable of being introduced through the medium of seed obtained from diseased plants.

The appearance of this pest on the foliage is first detected by swollen paler spots, and soon afterwards the cuticle is broken irregularly over each of these spots or pustules, and the brown powdery spores escape from the fissures like snuff and become sprinkled over the leaves.

It is customary, in these latter days, to regard the above as one of the forms of *Puccinia bullata*, but we prefer to retain the above name as a distinction for a definite disease.

The uredospores are paler than the teleutospores, irregularly rounded, and rough ($28–38 \times 20–26\ \mu$).

The teleutospores are comparatively large, elliptical in outline but constricted in the middle, where they are divided into two cells. The lower cell is a little narrowed into the pedicel, which soon falls away. Externally the surface is smooth and of a dark brown colour ($30–56 \times 17–28\ \mu$).

The best plan is to eradicate all the plants as soon as the disease makes its appearance, to prevent the germination of the teleutospores and the dispersion of the rust.

Sacc. Syll. vii. 2211; *Cooke, Hdbk.* No. 1493; *Mass. Dis. Pl.* 250; *Plowr. Brit. Ured.* 156; *Gard. Chron.* May 13, 1905, p. 293.

PARSNIP ROT MOULD.

Plasmopara nivea (Ung.), Pl. IX. fig. 114.

This rot mould is similar in character and life-history to the other rot moulds of which we have given an outline (Introduction, p. 2). It first affects the leaves, and then the mycelium descends and forms resting spores in the stems and roots.

The white mouldy patches appear first on the under surface of the leaves chiefly, forming an internal mycelium from which the bundles of branched threads arise and appear on the surface. These threads are erect, rather shorter than in many species ($250\ \mu$ long), tapering upwards and mostly once or twice forked in the upper portion, rarely three-forked, with from one to four horizontal branches near the apex, forked at the extremity, with the forked spicules spreading, each point bearing a single conidium or spore. These are nearly globose or ovoid, with a very obtuse projection or teat at the apex ($20–25 \times 15–17\ \mu$), granular within and with a slightly tawny tinge. It has also recently attacked Parsley severely, see *Gard. Chron.* Nov. 5, 1904, p. 313.

This mould has appeared in France, Belgium, Holland, Germany, Sweden, Lapland, Tyrol, Italy, and N. America.

Sacc. vii. 807; *Smith, Field Crops,* 239; *Mass. B. F.* 113, figs. 66–70; *Cooke M. F.*; *Gard. Chron.* Dec. 5, 1884, figs. 124, 125; *Cooke, Hdbk.* No. 1775.

CELERY SPOT MOULD.

Cercospora Apii (Fres.).

This black mould is known throughout Europe and North America on leaves of Celery and Parsnip causing leaf-spots which are at first yellowish, then enlarging and turning brown. In this country it has not yet been developed into a pest.

Spots almost circular (4–6 mm. diam.) with the narrow margin slightly elevated. The mould developed on the under surface in small brown tufts. The hyphæ, or threads, are either continuous or sometimes with one or two divisions ($40–60 \times 4–5\ \mu$). The conidia are thin, obclavate, or attenuated upwards, with from three to ten transverse divisions ($50–80 \times 4\ \mu$) almost colourless.

The variety on Parsnip is known in the United States and Siberia.

That on Celery occurs also in Germany, Austria, Italy, and the United States.

Sacc. Syll. iv. 2125 ; *Tubeuf, Dis.* 514 ; *Sacc. Fl. Ital.* t. 667.

Lettuce Rot Mould.

Bremia Lactucæ (Regel.), Pl. IX. fig. 115.

The mould which causes this disease appears to have been known since 1843, but it was in 1846 that Berkeley first drew attention to the pest, and considered the mould to be the cause of the rot. Afterwards it came to be known under the name of *Peronospora gangliformis* which has since been abandoned in favour of the above name.

There is an abundant mycelium present in the leaves before the mould appears on the surface. This is thick and coarse, being furnished with a number of club-shaped suckers or haustoria. From the mycelium arise the erect fertile threads through the natural orifices of the leaves. These are flattened, and from two to six times forked, without cross partitions. The tips of the final branchlets are swollen in a peculiar manner, supposed to resemble "ganglia." These swellings are somewhat of a saucer-shape, with a single spicule in the centre and three or four more growing around the edge. Each spicule bears a nearly globose spore, with a very minute teat or papilla at the apex (16–22 × 16–20 μ).

The resting spores are produced in clusters, and are plentiful in old and decayed stems. They are nearly globose, not quite even, and of a tawny colour, exceeding in size the largest dimensions of the conidia (28–34 μ).

Found chiefly throughout Europe and in the United States.

For Lettuce rotting in greenhouses see *Journ. R.H.S.* xxvi. 1901, p. 558.

Sacc. Syll. vii. 243 ; *Cooke, M. F.* t. 14, f. 265 ; *Tubeuf, Dis.* p. 131 ; *Smith, Field Crops*, 289 ; *Mass. Pl. Dis.* 74 ; *Mass. B. F.* 115, figs. 64, 65 ; *Cooke, Hdbk.* 1777.

Lettuce leaf-spots are known abroad, and anthracnose in the United States.

Potato Spindle Mould.

Fusarium Solani (Mart.), Pl. VIII. fig. 116.

Because this parasite was so commonly found upon Potatos in decay it was for a long time supposed that it was only a companion of the Potato murrain, or a consequence of decay. Latterly it has been closely watched, with the conclusion that it is really a destructive fungus on its own account, and will attack stored Potatos, whether bruised or not.

It grows either in company with the rot mould or also independently upon tubers which exhibit no trace of decay. The mycelium is similar in both, but the resulting moulds are different. The fruiting threads of the *Fusarium* or "spindle mould" are shorter, and for the most part unbranched, bearing at their tips the fusiform or spindle-shaped spores or conidia, which are a little curved, and set rather obliquely upon the threads (40–60 × 7–8 μ). Each sporule is divided by transverse partitions into four cells, which remain for a long time attached to each other, but ultimately separate and each segment becomes practically a separate germ cell. Sometimes each of the four cells will commence germination while still attached to each other, but will ultimately fall away, and each cell, now almost quadrangular, will when free assume gradually a spherical shape. They do not always germinate at once, but seem to be capable of an interval of rest of from two to three months. Germination proceeds rapidly, and may be completed in six hours. The mycelium has a putrefactive action, breaking up the cells of the host and hastening decay.

Known in Belgium, Italy, and North America.

Sacc. Syll. iv. 3386; *Smith, Field Crops*, p. 32, figs. 10, 11; *Mass Dis. Pl.* 333, 442; *Cooke, Hdbk.* No. 1870; *Journ. R.H.S.* xxix. 1904 p. 141, figs. 27, 28; xxix. 1905, p. 873.

Potato Scab.

Sorosporium Scabies (Fisch.).

Nearly fifty years since Berkeley called the attention of the Horticultural Society to one of the causes of scab in Potatos, under the name of *Tubercinia Scabies*. But it was probably known to Martius three years previously.

There are some even now who think that Berkeley made a mistake. He attributed the fungus to be closely allied to the smuts, and described it as consisting of globose bodies, composed of minute cells, in such a manner as to form a hollow globe, with one or more lateral openings.

"The fungus grows beneath the cortex of the tuber, where it forms a thin dark greenish-brown stratum, often extending over the greater part of the external surface of the tuber."

It is said that no trace of the fungus is often to be seen at the time of harvesting, but frequently shows itself during winter in stored Potatos which on digging appeared to be quite sound. In bad cases discoloured spots first appear, and these increase in size and become confluent until at length the entire skin is discoloured. Then the cuticle bursts and the spores are set free.

We have ourselves met with such scabbed Potatos in greengrocers' shops, and obtained from them the hollow bodies described by Berkeley, the existence of which has been called in question.

Berk. Journ. R.H.S. 1846, p. 33, figs. 30, 31; *Sacc. Syll.* vii.; *Smith, Field Crops*, 35; *Mass. Pl. Dis.* 225; *Cooke, Hdbk.* No. 1536; *Plowr. Brit. Ured.* 294; *Journ. R.H.S.* xxix. 1904, p. 145.

American Potato scab caused by *Oospora Scabies* is quite a distinct thing.—*Mass. Pl. Dis.* p. 299.

Potato Tumour.

Œdomyces leproides (Trabut.).

This disease made its appearance in this country in 1901, when a whole crop of Potatos was destroyed by its ravages, and it has since appeared in other districts. At first it was called on the Continent by the name of *Chrysophlyctis endobiotica* (Schilbersky), and was supposed to be an entirely new type of disease, but afterwards when specimens were brought to the notice of Dr. Magnus, he determined that it was the same fungus as that which caused tumour on Beetroot, and hence should retain the name of *Œdomyces leproides*. The Potatos when attacked are soon either wholly or partially swollen on the surface in a tuberculose manner, turning blackish, and presenting in cells beneath the cuticle a mass of large oval conidia, of a brown colour, with a short hyaline pedicel, which is swollen about the centre. Altogether the disease presents the same features as when it occurs on Beetroot, and is, of course, liable to be transferred from one to the other.

Hitherto no remedy has been discovered, and wherever it appears it would be advisable not to plant another crop of Potatos on the same soil until after the cultivation of some intermediate crop of a different character, and the soil has been disinfected from any trace of the fungus.

For further notes see "Beetroot Tumour."

Journ. R.H.S. xxvii. p. 1180; xxviii. 1904, p. 695; xxix. 1904, p. 143, fig. 29; *Gard. Chron.* Oct. 28, 1905, p. 308, figs. 120, 121; Nov. 11, 1905, p. 346.

Potato Disease.

Phytophthora infestans (De Bary), Pl. IX. fig. 118.

So many volumes have been written in connection with the Potato disease that little remains for us to say. Unfortunately, its ravages are too well known to need description, and a patent universal remedy we have not yet found.

The mycelium of this rot mould is more slender than usual, and the fertile threads are also comparatively slender, being attenuated upwards. These threads are also sparingly branched in the upper portion, with a few slender tapering branches, which are either simple or sometimes divided. On the branches are scattered swollen processes, which correspond to the points of origin of the conidia. The latter are elliptical and colourless, with a prominent papilla or teat-like projection at the apex ($25-30 + 15-20\ \mu$).

The life-history of the rot moulds is given in the Introduction. The question of resting spores in this species must still be open to individual opinion upon the strength of the evidence afforded, to which we give references.

To a certain extent spraying with Bordeaux Mixture has been of service. A damp situation is favourable to the disease, and so is a wet season.

Sacc. Syll. vii. 802; *Cooke, M. F.* f. 264; *Cooke, Hdbk.* No. 1774, *Mass. Pl. Dis.* 62, fig. 7; *Mass. B. F.* p. 111, figs. 121-126; *Grevillea*, v. p. 18, pl. 70-73; *Ward, Dis.* p. 59; *Gard. Chron.* July 1875; *Smith, Field Crops*, 275; *Tubeuf, Dis.* p. 119; *Journ. R.H.S.* xxviii. 1904, p. 600; xxix. 1904, p. 139.

Potato Sclerote.

Sclerotinia Sclerotiorum (Mass.), Pl. VII. fig. 119.

Curious hard fungoid bodies, having the nature and functions of a resting mycelium, are sometimes found within the tissues of various plants. These are called "Sclerotia," one form of which is known as "Ergot." They vary much in size and appearance, but are commonly oval or oblong with a dark outer coat, and an interior of compact cells.

Potato haulms, all the parts above ground, have been known to produce sclerotia in such numbers as to become a veritable pest. The whole plant becomes covered with a thick felt of white mycelium, within and without. The growth is very rapid, and ultimately numbers of small sclerotia are produced amid the felt, from the size of a pin's head to that of a bean. It was in 1883 that the ultimate development and destiny of these sclerotia were discovered.

When the sclerotia are placed in a favourable situation after a period of rest, they commence to germinate. In this case it was a small fungus called a *Peziza* which was produced. There was a cuplike or saucer-like head, from a quarter to half an inch in diameter, proceeding from a long slender flexuous stem, about two inches long, arising out of the sclerotium. The inside of the cup is the fertile portion, and here long cylindrical cells are closely packed side by side, each one enclosing eight spores or sporidia, which are ejected when mature. The cup or *Peziza* was called at first *Peziza postuma*, but has since acquired the name of *Sclerotinia*.

Fungicides are not likely to be of service, unless the disease is taken in a very early stage, but the precaution should be taken of burning up the diseased haulms to prevent the development of *Peziza* and spread of the germs.

Gard. Chron. Sept. 15, 1883; *Mass. Pl. Dis.* 150, fig. 32; *Tubeuf, Dis.* 263; *Smith, Field Crops*, 25, fig. 3 &c.

Potato Rhizoctonia.

A serious Potato disease is announced in North America, caused by *Rhizoctonia Solani* (Kuhn). It was first observed in Long Island in 1900, and afterwards in Colorado, and is increasing in extent, so that growers in Europe must be upon their guard.

It is reported that large vines gave promise of an abundant yield, but when digging time comes it is found that so few tubers have set that it does not pay to dig them. Many vines do not produce a single tuber. It is by no means an uncommon occurrence for the vines to set an abnormal number of small Potatos, or "little Potatos" as they are called. These often occur in compact clusters, and are so small as to be worthless. Another condition is the dying of Potato plants, all of which conditions may be produced by attacks of *Rhizoctonia*.

The hyphæ of the fungus are often found on the surface and in the scab ulcers of Potatos. These hyphæ give rise to irregularly shaped dark masses known as sclerotia, which vary in size from that of a mere speck to half an inch or more in diameter. These sclerotia resemble

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small bits of earth, but by placing the Potatos in water these bodies become black and quite conspicuous. Many of them adhere very firmly. The hyphæ spread through the soil in various directions; hence a single diseased Potato may be the means of infecting an area of considerable size.

Plants which are attacked when young, if not killed outright, are often dwarfed and frequently die long before the close of the season. The parts below ground are thoroughly infected with the *Rhizoctonia*. In some cases the disease attacks the plant just below the surface of the ground, and under favourable conditions a stem rot called "Collar Rot" or "Black Ring" is produced. When the attacks on the stem are not so severe as to cause death the injuries may prevent the assimilated food from being stored in the subterranean portion of the plant, large tops are produced, and green tubers often form in the axils of the leaves (see also *Journ. R.H.S.* xxvii. p. 1182; xxviii. 1904, p. 695; xxix. 1905, p. 876).

POTATO BACTERIOSIS.

This has been described as occurring in Germany under the name of *Bacillus phytophthorus*, App.

Deut. Botan. Gesel. 1902, p. 128; *Journ. R.H.S.* xxvii., p. 1181; xxix. 1904, p. 145.

We do not apprehend any danger to Potatos from the fungus described under the name of *Phycomyces splendens*, for surely it can only be a veritable saprophyte (see *Gard. Chron.* June 26, 1886, p. 824).

POTATO SPOT MOULD.

There has been some consternation in Europe upon the appearance of a black mould (*Cercospora concors*) on living Potato leaves, but it has not been heard of in Britain.

POTATO MACROSPORIUM, OR LEAF CURL.

Two species of *Macrosporium* have been described as affecting the leaves of plants of the Potato family, but one of these is decidedly a saprophyte and only occurs on dead leaves. The other (*Macrosporium Cookei*) attacks the living leaves of Potato in this country, and of *Lycopersicum esculentum* (*Solanum Lycopersicum*), in America, and has large conidia (60–70 + 10 μ) with from four to six transverse septa. The latter is not yet recorded as occurring in Europe. (*Gard. Chron.* Sept. 23, 1905, p. 230.)

TOMATO LEAF MOULD.

Cladosporium fulvum (Cooke), Pl. VIII. fig. 120.

This mould first made its appearance on leaves of the Tomato in the United States, and was described in 1883 from specimens received from South Carolina, since which time it has not only spread in America, but made its appearance in England, where it was first recorded in 1887.

Brown felted spots of irregular size appear on the under surface of the leaves, as the first indication of this disease. The spots gradually spread, and the corresponding upper surface acquires a yellow colour. It sometimes extends also to the fruit. On the leaves the spots soon darken, and the leaves shrivel and dry.

The mycelium consists of delicate colourless septate threads, which penetrate the tissue in all directions, and sometimes overrun the entire surface. From this mycelium arise erect fertile threads, which form dense tufts, simple or shortly branched, pointed and flexuous, with the joints swollen, and of a tawny colour. The conidia are produced at the tips of the threads, mostly elliptical, with one division in the centre, and pale brown (10–18 × 4–7 μ). Conidia may also be produced from the nodules or short branches and are sometimes met with in short chains of two to four attached end to end. They germinate readily in water by sending out germ tubes, which become interlaced in a mycelium. Spores placed on wounded fruit will produce rot.

Two or three large cultivators have assured us that they have no difficulty with this mould so long as they control temperature and ventilation. Solution of sulphuret of potassium has been recommended for spraying.

Sacc. Syll. iv. 1731; *Mass. Pl. Dis.* 311, 435, fig. 83; *Gard. Chron.* Oct. 29, 1887; *U.S.A. Rep.* 1888, p. 347, pl. iv.; *Journ. R.H.S.* xxvi. 1902, p. 733, fig. 307; xxviii. pp. 142, 302.

Tomato Black Rot.

Macrosporium Tomato (Cooke), Pl. VIII. fig. 121.

This rot was also first observed in the United States before it became known in this country. It makes its appearance at the apex, or flower end of the fruit, when the latter is from half to two thirds grown. At first a small blackish spot is seen, either around the remains of the style, or on one side of it. This rapidly increases in size, but retains a more or less circular outline. As the disease progresses the tissues collapse quite regularly on all sides, and the berry becomes much flattened. There is usually a slightly raised narrow border surrounding the diseased parts, while just outside this the cuticle retains its normal healthy colour, but appears slightly wrinkled owing to the collapsed condition of the tissues beneath. Sections show that the black discolorations extend deeply into the tissues.

The principal cause of this disease is the black mould *Macrosporium*, the mycelium of which consists of rather large septate, thick-walled, and contorted threads, at first colourless, but eventually tinged with brown, permeating all the diseased and decaying parts, and easily traced into the sound tissue. Arising from the mycelium are the olive-brown fertile threads, of variable length, which bear the large compound spores or conidia. The latter are obclavate, attenuated above, and shortly stalked below, divided transversely and longitudinally into as many as fifteen almost cubical cells, after the manner of bricks in a wall, at first olive-brown, becoming almost black (100–120 × 20–22 μ).

All diseased fruit and the old stalks and leaves should be burnt. Suggestions have been made for spraying with sulphuret of potassium.

Sacc. Syll. iv. 2552; *Grevillea*, xii. 32; *U.S.A. Rep. Agri.* 1888, p. 339, pl. iii., iv.; *Mass. Pl. Dis.* 324, fig. 89.

Tomato Leaf-spot.

Septoria Lycopersici (Speg.).

This leaf-spot is known in the United States and in New South Wales, and recently has occurred in France. It was first discovered in Argentina, but has since become widely diffused. Sporuless 70–110 μ long, septate.

Sacc. Syll. iii. 2904; *Agric. Gaz. N.S.W.* 13, 1902; *Bull. Soc. Myc. de Fr.* xxi. fasc. 3, p. 171, fig. 2.

Tomato Bacteriosis.

A bacterial disease of Tomatos has been destructive on the Continent, and since appeared in England. The fruit blackens and is at length wholly destroyed.

Another similar disease, if not the same one, has made its appearance in the United States, where it attacks the Tomato, Egg Plant, Potato, and species of *Petunia*. The disease causes the foliage to wilt, and, later on, the stem and branches become discoloured and die. In Potatos the disease passes down to the tubers, causing a brown or black rot. Possibly this may be the same as *Bacillus phytophthorus*.

Mass. Pl. Dis. 338, 342.

Sleeping Disease of Tomatos.

Fusarium Lycopersici (Sacc.).

This disease has been prevalent in Guernsey, and in other places in Britain. The leaves become dull and droop, and the stem collapses. The root is attacked first, gradually extending to the lower part of the stem. Shortly after the sleeping stage, the portion of the stem above ground is covered with a delicate white mould, of erect branched threads, which produce small two-celled conidia (*Diplocladium*). Afterwards, from the same mycelium, the spindle-shaped spores (*Fusarium*) are produced in immense numbers. Spraying appears to do no good.

Gard. Chron. June 8, 1895; *Journ. R.H.S.* xix. 1895, p. 20, figs. 1, 2, 3; xxviii. p. 301; *Mass. Pl. Dis.* 328.

Other Tomato Fungi.

After the attacks of *Macrosporium*, and sometimes meanwhile, the spindle mould (*Fusarium Solani*) will attack Tomatos as freely as Potatos, and complete the round of destruction.

The Potato rot mould (*Phytophthora infestans*) will sometimes attack the Tomato, but must be well guarded against, as it would be a fatal foe if once it came to be established.

Cultivators have been terrified by a long list of supposed Tomato diseases which has been thrust forward without any justification, except to alarm them. The majority of these are saprophytes, and only flourish at the expense of otherwise decaying vegetable matter. Such, for instance, are *Sporocybe Lycopersici* and *Dactylium Lycopersici*, which has a strong family likeness to *Tricothecium roseum*, and probably *Phoma destructiva* and *Sphæronema Lycopersici.* The latter has been renamed *Glœosporium phlomoides.* Doubtless they will all prove harmless enough for any other purpose than to allow the writer a remote chance of becoming immortal by means of strings of useless names. No fungicides will be required.

MINT RUST.

Puccinia Menthæ (Pers.), Pl. VIII. fig. 122.

All kinds of Mints are liable to infection from the common Mint rust which is plentiful on wild Mints: in gardens mostly when in damp situations.

There is very little indication on the upper surface of the leaves, but the under surface is either sprinkled or closely beset with the roundish pustules, both of the uredospores and teleutospores, usually in company, the latter darker than the former, but both of them equally powdery. The cluster-cups are rare.

The uredospores are one-celled, roundish, and of a cinnamon-brown, the surface studded with minute spines ($17–28 \times 14–19\ \mu$).

The teleutospores are nearly black in the mass, oval, divided across the middle into two cells, with a slight constriction at the suture. The apex of the upper cell is furnished with a small papillary tubercle; the lower cell is attached to a deciduous stem. The whole surface of the spore is covered with small warts ($26–35 \times 19–23\ \mu$).

Possibly should a patch of Mint become diseased, it would be well to try cutting it down to the ground and burn it, since it may prove that the disease has not extended to the roots, and the new growths may be free, especially if cut down before the teleutospores have matured and fallen to the ground.

Common nearly throughout Europe, and in South Africa and North America.

Sacc. Syll. vii. 2180; *Mass. Pl. Dis.* 240; *Cooke, M. F.* p. 204, figs. 69, 70; *Cooke, Hdbk.* No. 1474; *Plowr. Brit. Ured.* 157.

RHUBARB CLUSTER-CUPS.

Æcidium rubellum (DC.).

Rhubarb leaves in gardens are sometimes disfigured by the large patches of this parasite, although by no means commonly so. The same fungus is common on the leaves of various species of Dock, from which it may extend to Rhubarb.

It is very handsome, as far as appearance goes, and forms large crimson spots, nearly an inch in circumference, while in the centre of these spots the cluster-cups are crowded and densely packed together. The white edges of the cup are torn like a fringe, and the æcidiospores, which occupy the centre of the cup, are produced in chains in the interior, and are nearly globose and rough.

No further development has been seen upon the Rhubarb leaves, since it is affirmed that both the *Uredo* and *Puccinia* are developed upon another and quite a different species of plant, which in reality is one of the Grasses. But our disease now concerns only the Rhubarb leaves.

Sacc. Syll. vii. 2204; *Cooke, M. F.* 194; *Cooke, Hdbk.* No. 1632.

Diseases of Beetroot will be better treated in connection with Field Crops.

Spinach Black Mould.

Heterosporium variabile (Cooke), Pl. VIII. fig. 124.

The fading leaves of Spinach are liable to be invaded by a species of black mould, similar to that which affects Carnations, which is by no means so harmless as black moulds often are. The threads of the mycelium take possession of the tissues, and the fertile threads finally burst through the cuticle of the leaves.

Definite rounded or irregular spots of a paler yellowish colour first appear upon the still green leaves, caused by the mycelium of the fungus. Then the surface of the spots becomes dotted with blackish points indicating the threads of the fungus bursting through the cuticle. These threads are flexuous, slender, knotted at the points and growing in small tufts. Conidia are produced at the tips of the threads, simple at first, then with one, two, or three divisions or septa (20–50 × 7–10 μ). The surface of the conidia is minutely rough with small spines. Threads and spores are of a pale olive colour.

When fully matured the conidia germinate freely at each joint, producing a slender thread.

Spraying with Bordeaux Mixture should be resorted to in order to prevent dissemination of fertile conidia.

Sacc. Syll. iv. 2310; *Grevillea*, v. 123.

Spinach Rot Mould.

Peronospora effusa (Rabh.), Pl. IX. fig. 125.

The mould which attacks Spinach is of the same kind as that which attacks Potatos, parsnips, and other vegetables. The pest appears upon the living leaves in greyish, rather dense velvety patches, sometimes an inch in diameter, and sometimes spreading widely over the leaf. The mycelium is present in the leaf before the mould makes its appearance on the surface. The threads are produced in abundance, issuing through the stomates. The stem is undivided below, but in the upper portion it is divided in a forked manner, from two to six or seven times, the final branchlets being somewhat awl-shaped and arched. The ellipsoid conidia occur singly at the tips of the branchlets (22–30 × 16–23 μ) with a dirty-white or slightly violet membrane. When mature they fall off readily.

Resting spores are produced upon the mycelium within the tissues of the plant, and are variable in size, of a bright brown colour, which is irregularly furrowed and ribbed (25–38 μ diam.).

Known in France, Belgium, Germany, Scandinavia, Finland, Austria, Italy, and the United States.

Sacc. Syll. vii. 854; *Gard. Chron.* Ap. 11, 1885, fig. 87; *Cooke, M. F.* f. 214; 215, *Mass. Pl. Dis.* 79; *Mass. B. F.* 124; *Berlese, Icon.* xlvii.; *Cooke, Hdbk.* No. 1781.

Gourd Anthracnose.

Glœosporium orbiculare (B.), Pl. VIII. fig. 126, conidia.

This disease appears in orbicular spots on ripe gourds, melons, &c. The pustules are often run together and confluent, with a common pore or orifice. The conidia are small and oblong, tinged with pink (about $14 \times 3\frac{1}{2}\ \mu$), and are expelled in thin tendrils. The genus to which this species belongs is almost universally destructive, and affects various plants. The disease which is caused by them is known throughout the United States by the name of Anthracnose.

As to the specific differences between the two species recorded as *Glœosporium orbiculare* and *Glœosporium lœticolor* it is not of much practical importance, and some at least of American mycologists believe them to belong to the same species.

Recorded in Portugal as well as in Britain.

Every effort should be made to prevent the dispersion of the conidia of all species of *Glœosporium*, by spraying, and destruction of the affected parts.

Sacc. Syll. iii. 3759; *Cooke, Hdbk.* No. 1407; *Berk. Ann. N. H.* No. 106, t. vii. f. 6.

Cucumber Anthracnose.

Glœosporium lagenarium (Pers.), Pl. VIII. fig. 127.

To this fungus is attributed the fungus disease which attacked Cucumber plants in 1892 and 1893, but was previously known upon Gourds on the Continent. In this instance the leaves, some portions of the vines, and especially the ends of the young fruits, rotted and became pulpy. No distinct pustules could be detected, but the rotting parts contained fungus mycelium, and a great number of the sporules of the *Glœosporium.*

The pustules are disposed to occur in rings, and are rather small upon the fruits, and somewhat roseate; the conidia are ovate-oblong, often unequal-sided ($16–18 \times 5–6\ \mu$), colourless, and without division, growing on pedicels nearly as long as the conidia, oozing out when mature. The habit is certainly different from that of *Glœosporium orbiculare*, and attacks also the stems and foliage.

Among the tissue of the surface of the fruits were found the fusiform curved conidia of another pest, *Fusarium reticulatum*, which are triseptate ($40\ \mu$ long), and are constantly found in company with this *Glœosporium* upon gourds.

It is reported in France and Italy as a noxious pest.

Sacc. Syll. iii. 3757.

Another species, if really distinct, has been found on Gourds in Australia.

Cucumber White Mould.

Oidium erysiphoides (Link), Pl. IX. fig. 128.

This troublesome white mould is very apt to make its appearance on Cucumber or Melon plants in frames, or on Gourds in the open. It spreads in white blotches over the foliage and often covers the plant.

There is a profuse mycelium, and sometimes nothing more, from which arise short erect fertile branches, of a rather thick club-like shape, which are soon divided by transverse partitions into cells; each of these cells becomes a conidium and acquires a roundish or elliptical shape, and then falls away from its fellows. When quite mature they are capable of germination (30–40 × 15–20 μ).

The healthy action of the leaves is obstructed, and they soon acquire a sickly appearance, and the stems are apt to rot off at the base.

The only application which has proved effectual is that of "flowers of sulphur," as in this case the fungus is an epiphyte, and is open to similar treatment to that for the Vine mildew.

Said to be common throughout the world.

Sacc. Syll. iv. 189.

Cucumber and Melon Rot Mould.

Plasmopara cubensis (B. & C.).

This rot mould was first discovered in Cuba, whence it afterwards spread, until it was found on leaves of *Cucurbita* and *Cucumis* in Japan. More recently it became known in the United States, and afterwards in England.

It forms a delicate white mould on the under surface of the leaves. The erect branches are forked on the upper portion, with the ultimate branches straight, and not hooked as in some species. The conidia are oblong-obtuse at the ends (25 μ long).

It has been recommended to spray the under surface of the leaves with dilute Bordeaux Mixture, taking care that the under surface is reached and wetted.

Berk. and Curt. Cuban Fungi, No. 646; *Sacc. Syll.* vii. 872; *Mass. Pl. Dis.* 80; *Journ. R.H.S.* xxviii. 1904, pp. 639, 673.

Melon Leaf-spot.

Septoria Cucurbitacearum (Sacc.).

This leaf-spot has now been found in Italy, France, Austria, Portugal, and South America. The sporules are 60–70 × 1 μ.

Sacc. Syll. iii. 2860; *Bull. Soc. Myc. de. Fr.* xxi. fasc. 3, p. 163, fig. 1.

Melon Spot Mould.

Cercospora Melonis (Cooke), Pl. VIII. fig. 129.

This disease made its first appearance on the leaves of Melons in 1896, and since that time it has been even more troublesome with Cucumbers, and may now be looked upon as a constant danger.

The leaves are spotted sometimes with rather small orbicular spots with a definite margin, and of the usual bleached dirty-white colour. At other times the spots are larger, one inch in diameter, and of a smoky-grey colour. The mould appears on these spots, but hardly distinguishable to the naked eye—save to slightly darken the centre of the spots.

The erect threads are few and slender (200 μ long) and of a decided olive colour. The conidia are robust for the genus to which they belong, either cylindrical, or slightly attenuated upwards, and divided by seven or more transverse septa (80–120 × 7 μ) and a little curved, but scarcely at all coloured.

Spraying with dilute Bordeaux Mixture will probably assist, but infected leaves should be picked off and burnt.

Gard. Chron. Sept. 5, 1896, p. 271 ; *Journ. R.H.S.* xxviii. p. 142.

A Musk Melon disease is attributed to a black mould (*Alternaria*) in N. America ; see *Journ. R.H.S.* 1901, xxvi. p. 563.

Gard. Chron. July 27, 1905, p. 96, recommends vapourising with sulphur.

We know nothing whatever of the smut on Cucumber roots described under the name of *Ustilago Cucumis* in *Proc. Roy. Soc. Ed.* xv. 1887, p. 403.

Cucumber Scab.

Cladosporium Scabies (Cooke).

The disease forms dark depressed spots on the surface of the fruits, in the first instance, which gradually enlarge and expand until they become quite black and convex-like nodules, and crack either around or across, exposing the pale under stratum. At first they are about a quarter or half an inch across, and finally extend to an inch or two inches, or become confluent. The surface is from the first mealy with the conidia, which are afterwards profuse, mixed with slender hyphæ, so as to impart a grey velvety appearance. The earliest conidia are more nearly globose than afterwards, from 10 × 8 to 12 × 8 μ becoming at length as much as 25 × 8 μ, and then usually uniseptate, but with scarcely any colour. Occasionally two or three conidia are concatenate. The hyphæ are long and slender, half or two-thirds the diameter of the conidia, septate, simple, not constricted or nodulose, of a pale smoky colour, and very sparse in comparison to the conidia. The flesh of the fruit beneath the spots turns to a golden or tawny-brown. The black elevated spots resemble large scales, and hence the parasite has been called *Cladosporium Scabies* (Cooke). It is allied to the *Cladosporium* which attacks the leaves of the Tomato. All diseased fruits should be removed at once and destroyed. The remainder should be sprayed to preserve them from attack. Condy's fluid (dilute) should be tried, as less likely to injure the fruits than copper solutions.

Journ. R.H.S. xxviii. 1904, pp. clxix., clxxi.

Cucumber Sclerote.

Sclerotinia Libertiana, see Pl. VII. fig. 119.

Recently the stems of Cucumber plants have been submitted to us which called to mind very strongly a similar disease of Potato haulms. The stems contained a quantity of hard black sclerotia enclosed in a fluffy white mycelium, which caused the vines to bleed and rot. These hard substances were at first whitish, then turned brownish, and ulti-

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mately black. In all other particulars it closely resembles the Potato Sclerotium, except perhaps as to the consequences of a period of rest. We did not attempt to cultivate the sclerotia, but probably there also the results would have been the same.

This was the first time we were made acquainted with this disease on Cucumbers, but our correspondent stated that it had then been observed for three or four years, and it had been attributed in some measure to the soil and culture. Fresh soil and manure were employed in the cultivation, but the disease reappeared. We were assured that the only thing which kept the disease in check was air, and to use no more moisture than was absolutely necessary.

This disease is said to be known in the United States, where the Sclerotium has been called *Sclerotinia Libertiana*, and is closely allied to the Sclerotium of the Potato haulms, and indeed apparently the same, as it occurs also in other plants.

Sacc. Syll. vii. 798; *Mass. Pl. Dis.* p. 150.

Cucumber Black Mould.

Dendryphium comosum (Wall).

This common black mould has long been known as a saprophyte, on decaying vegetable matter. Latterly it has been detected as a parasite spreading from fragments of manure to the foliage of growing Cucumber plants. Experiments have been made to discover some substance which might be taken up by the roots of growing plants and render them immune to the attack of fungus parasites. At present sulphate of copper alone has proved effective.

Journ. R.H.S. xxviii. p. 142.

Melon Bacteriosis.

Recently some important investigations have been made into the causes of a peculiar form of Melon disease which is not uncommon in the United States. We have grave doubts whether the same disease was not present in this country in 1890, attacking Gourds and other Cucurbitaceous plants. The attacked vines are said to have varied somewhat in their appearance, but generally there was a decay of the stem, in proximity to the root, and then the whole plant wilted and failed to grow.

It is reported that an examination showed that the decomposing tissues were teeming with bacteria. Inoculation of healthy plants was made, and it was found that, with no other fungus present, the germs obtained were abundantly able to introduce a rapid decay into Cucumbers, Melons, and Squashes, Cucumbers being the favourite, and in them the decay was most rapid, running through a four-inch fruit in a single day.

The next step was the application of these germs to healthy plants in the field. When the application was made near the end of a vine, the latter rotted away in from three to four days.

Numerous other experiments were performed, and all nearly equally successful in demonstrating that the diseased virus may be communicated by inoculation to healthy vines.

Journ. R.H.S. 1891, xxvi. p. 540 ('Cucumber Wilt'), xxvii. p. cxcii.

Onion Scab.

Vermicularia circinans (B), Pl. VIII. fig. 131.

During some seasons this disease is abundant, while in others it is scarcely known.

It attacks the outer coating of the bulbs of Onions, and does them very little injury so long as they are in the ground. It usually appears when the bulbs are nearly full grown, under the form of scattered black patches formed of small black velvety tufts, and these are arranged in concentric circles or in irregular wavy lines.

These tufts consist of quantities of erect threads, each bearing a long slender slightly curved and colourless conidium or spore at its tip. Besides which, the tuft is thickly studded with long black projecting spines which gives it the velvety appearance.

Has occurred in Germany and Italy as well as in Britain.

The bulbs should be dry before storing, and none of the tainted ones should be mixed. When the diseased bulbs are separated they may be tried with a fungicide.

Sacc. Syll. iii. 1376 ; *Mass. Pl. Dis.* 273, fig. 71 ; *Gard. Chron.* 1851, . 595, figs. ; *Cooke, Hdbk.* No. 1291.

Onion Spindle Mould.

Fusariella atro-virens (Berk.), Pl. VIII. fig. 132.

Berkeley has declared his opinion that the fungus above named is at least one of the causes of the mildew which is so destructive to Onions just before they arrive at perfection. The disease originates in little dot-like spots with radiating threads, crowned with a greyish gelatinous mass ; these at length unite, and the whole of the centre is occupied by the spores ; the border keeps on increasing, and often quite fleecy, especially if it meets with any impediment, but at length the whole mass is greenish-black, and the border becomes obliterated. The threads of the mycelium are white, and the spores are fusiform and curved, so as to form about one third of a circle. There is one peculiarity in moulds of this kind : that the spores seem to be held together for some time in a gelatinous heap, and do not separate until they are quite mature, and ready for diffusion. This peculiarity is rather an advantage, as it serves to localise the attacks.

Whatever fungicide is employed is of little import, so long as it will destroy the parasite without injury to the Onion, and it is likely to prove beneficial. Very little has been known of this disease for many years.

Sacc. Syll. iv. 1876 ; *Cooke, Hdbk.* No. 1866.

Onion Rust.

Puccinia Porri (Sow.), Pl. VIII. fig. 133.

Occasionally, for many years, this rust has attacked plants of the Onion tribe and caused great trouble. In 1883 a crop of Chives was attacked at Shrewsbury and almost destroyed by its ravages. A public trial took place in Edinburgh where damage was sustained to a crop through this cause. At other times a limited number of plants have sustained injury in gardens.

There are declared to be, as usual, three stages in the history of this pest. First, the cluster-cups or *Æcidium* form, which is by no means troublesome; and then the *Uredo* form, which occurs in small reddish-brown pustules either scattered over the leaves or collected in clusters. The uredospores are either nearly globose or elliptically so, very delicately spinulose ($20–33 \times 18–27\ \mu$), of a pale orange colour.

The teleutospores are contained in flattened pustules of a darker colour, and are commonly of two kinds: one form is obovate and without any septa or division ($25–36 \times 15–23\ \mu$) and the others are club-shaped, and divided into two cells ($28–45 \times 20–26\ \mu$), of a chestnut-brown colour, and externally smooth, with a long slender pedicel. For this reason probably, this species has sometimes been called *Puccinia mixta*.

Possibly other rust will sometimes attack cultivated Onions, of which we are said to possess three species.

This is known, at any rate, in France, Germany, Finland, and Italy.

Sacc. Syll. vii. 2155; *Gard. Chron.* Oct. 15, 1891; *Plowr. Brit. Ured.* 148; *Smith, Field Crops*, p. 39.

ONION ROT MOULD.

Peronospora Schleideni (Unger), Pl. VIII. fig. 134.

Of all the destructive rot moulds scarce one is more destructive, or its attacks to be more deplored, than the present: which will fall upon a crop of young Onions and destroy them in an incredibly short space of time.

The mould forms broadly effused patches of greyish-lilac tufts, which sometimes entirely cover the leaves, so that in its early history it was known as *Botrytis destructor*.

The fertile threads arise from the mycelium in tufts, and are large and without septa or divisions. The upper portion is branched alternately, or in a forked manner, and is again and again divided until the final branchlets are strongly arched. The conidia are obovate or egg-shaped, with the apex obtuse, or a little acute, and of a pale dingy-violet ($45–55 \times 22–25\ \mu$).

The resting spores are produced on the mycelium as usual, and are broadly elliptical or globose, with a comparatively thin and smooth coating.

This is known in France, Belgium, Germany, Scandinavia, and North America.

It is recommended as a good plan to sow the Onions in the autumn, so that they are able to make a good growth before the appearance of the mould in the spring.

Berk. Ann. Nat. Hist. vi. p. 436, t. 13, f. 23; *Sacc. Syll.* vi. 857; *Cooke, Hdbk.* No. 1787; *Cooke, M. F.* fig. 263; *Mass. B. F.* p. 125; *Berlese, Icon.* xxv.; *Mass. Pl. Dis.* 75; *Smith, Field Crops*, 45.

Onion Sclerote.

Sclerotinia bulborum (Wakk.), Pl. IX. fig. 135.

This pest is liable to infest the bulbs of Hyacinths, Onions, and perhaps other bulbs, and destroy a great number. Yellowish blotches appear on the foliage in spring or early summer. These spots are soon covered with an olive-brown mould. The mycelium passes down into the bulb, and there blackish sclerotia are formed, from the size of a Mustard seed to that of a Pea, within the scales of the bulb, and sometimes covering the surface.

During the following spring the sclerotia germinate and produce the *Peziza* or *Sclerotinia*, the sporidia of which are binucleate ($16 \times 8\,\mu$).

It is recommended that the diseased bulbs should be burnt to diminish the chances of dissemination from the germinating sclerotia. The further measures recommended are spraying with Bordeaux Mixture diluted on the first appearance of the disease, or else the potassium sulphide solution.

The brownish tufts of mould are compact, the tips of the fertile branches spinulose, each spine bearing its conidium ($9\text{–}10 \times 7\,\mu$).

Known hitherto in Germany.

See also p. 69.

Gard. Chron. xvi. 1894, p. 160, fig. 25 ; *Mass. Pl. Dis.* pp. 157, 380 ; *Sacc. Syll.* viii. No. 802.

Onion Mucor.

Mucor subtilissimus (Berk.), Pl. IX. fig. 136.

The fungus about to be described is one of the kind known as *Mucor*, of which a familiar example is known upon jams and decayed matter. It is very rarely that they become parasitic.

Many years ago Berkeley found on Onions a diseased condition about the neck of the bulb, which was traversed by threads of mycelium, and among them minute black bodies like grains of gunpowder. These little bodies are compact, and of the nature of consolidated mycelium, which we have already alluded to under the name of "Sclerotia." These Sclerotia he found easy to germinate in water, and by this means he discovered that they would produce fertile branches supporting little globose heads. These heads are formed of a delicate membrane within which are clustered a number of minute oval spores, which when they are mature replace the membrane and escape. These spores themselves will also germinate and produce a mycelium, which will combine and form knots and become a new generation of sclerotia.

By this means the secrets of this disease were discovered and its cause attributed to the little *Mucor subtilissimus*, and the Sclerotium was known as *Sclerotium Cepævorum*.

Journ. Hort. Soc. iii. p. 98, figs. 1–5 ; *Cooke, Hdbk.* No. 1893 ; *Sacc. Syll.* vii. 625 ; *Mass. B. F.* p. 89 ; *Smith, Field Crops*, p. 51.

For Onion Bacterial Rot see *Journ. R.H.S.* xxix. p. 851.

Of other Onion diseases we may name a smut which has evidently escaped from North America and reached as far as France (*Urocystis*

Cepulæ). It is similar in character to the *Urocystis* on the leaves of *Colchicum*, or rather perhaps on the bulbs of *Gladiolus*. The glomerules of spores (18–20 μ diam.) do not include many central fertile spores. It is recorded on *Allium Porrum* and *A. Cepa*.

Asparagus Rust.

Puccinia Asparagi (DC.), Pl. VIII. fig. 137.

This rust has been increasing to an alarming extent in North America, and every effort is being made to cope with it. The cluster-cups are so rare with us that no one seems to have seen them.

The uredospores appear on the flowering stems in cinnamon-brown pustules, for a long time covered by the epidermis. They are either globose or elliptical (20–50 × 17–25 μ), delicately spinulose, pale brown.

The teleutospores occur in oblong or elongated pustules of a very dark brown colour. They are elliptical or clavate, long club-shaped, rounded above and below, divided across the centre into two cells (35–52 × 17–26 μ), smooth, chestnut-brown, with a rather long persistent pedicel.

In America it is the *Uredo* stage which causes the most mischief. It has been most experienced in dry sandy soils, while the beds on moist soils do not appear to have been injured.

The results from spraying were not encouraging. The best means suggested for controlling the rust is by thorough cultivation in order to secure vigorous plants, and in very dry seasons plants growing on very dry soil, with little water-retaining properties, should receive irrigation.

Sacc. Syll. vii. 2147; *Cooke, M. F.* 196; *Cooke, Hdbk.* No. 1467; *Journ. R.H.S.* 1901, xxvi. p. 501; xxix. 1905, p. 927; *Plowr. Brit. Ured.* 144.

Asparagus Copperweb.

Rhizoctonia Crocorum.

We have already referred to this disease, in its manifestations towards Crocus Bulbs (see p. 73); hence repetition is unnecessary here.

MUSHROOM PARASITES.

This will, perhaps, be the most convenient place in which to refer to the diseases to which the cultivated Mushroom is liable.

Gard. Chron. Sept. 9, 1893, p. 299.

Mushroom Tuft Mould.

Gliocladium agaricinum (C. & M.).

The mysterious ailments of Mushrooms under cultivation are often the occasion of considerable annoyance, with little prospect of relief. There is one not uncommon disease which causes the pileus or cap of mushrooms to crack into large frustular scales, which is now attributed to the parasitism of a mould. The tufts are hemispherical, or sometimes confluent, pallid, becoming white, at first gelatinous. The mycelium is branched and creeping, with erect fertile branches, the ultimate branches are produced in whorls of four, bearing clusters of conidia. The conidia themselves are nearly globose, produced in chains, and at first gelatinous (5–6 μ diam.).

Of course the Mushrooms are destroyed, with no chance of recovery. The house should thereafter be thoroughly cleansed before use for the same purpose again.

Grevillea, xvii. p. 80.

Invading Agarics.

Agarics, other than the Mushroom, sometimes invade Mushroom beds as unwelcome usurpers. Of these are *Clitocybe dealbata, Hebeloma fastibile*, and others.

Gard. Chron. Sept. 9, 1893, p. 299.

Mushroom Mould.

Mycogone alba (Letell.), Pl. IX. fig. 138.

This mould overspreads all parts of cultivated Mushrooms, and may possibly be the same as that which thickens and distorts the gills, and spoils a whole bed of Mushrooms just as it is arriving at maturity. It spreads thinly over the surface, which the mycelium penetrates and distorts like a whitish bloom. The very short branches bear at their apex rather large obovate conidia divided into two cells, of which the upper is much the larger, and almost globose, except where it is flattened by junction with the lower cell ($30 \times 20\ \mu$). The surface of the upper cell appears to be somewhat rough, but not distinctly warted.

Very probably this is the early, or conidiiferous, condition of some species of *Hypomyces*, a genus of parasitic *Sphæriaceæ*.

Grevillea, xvii. p. 80; *Letell. Champ.* t. 667, f. 2; *Gard. Chron.* Sept. 9, 1893, p. 299; *Mass. Pl. Dis.* 133.

Mushroom Bed Sclerotium.

Xylaria vaporaria (Curr.).

The presence of sclerotia in mushroom beds was observed by Curry many years ago. In 1862 he planted some in damp sand and induced germination. Since that time they have been found perfecting themselves naturally.

The sclerotia are irregular, corky, rough, and black. They produce simple or branched stems, sometimes several inches in length, reaching to the surface of the soil. The tips of the stems are expanded into a somewhat conical head, in the lower part of which the perithecia are immersed, while the upper portion is barren and of a light brown colour, the lower half darker. The contents of the perithecia consist of long, cylindrical, transparent cells, or asci, each of which encloses eight dark brown sporidia, of an almond shape (40–50 μ long).

It is not unusual to meet with these sclerotia in Mushroom beds occasionally producing these stems, and sometimes only the thickened, club-like sterile heads, they seldom being allowed to remain until the receptacles are fully developed.

Of course such beds have to be destroyed at once and the house disinfected before any attempt is made to grow Mushrooms on the spot.

Sacc. Syll. i. 1292; *Curr. Linn. Trans.* xxiv. t. 625, f. 17, 26; *Cooke Hdbk.* No. 2378; *Gard. Chron.* Dec. 20, 1879, p. 801, fig. 132.

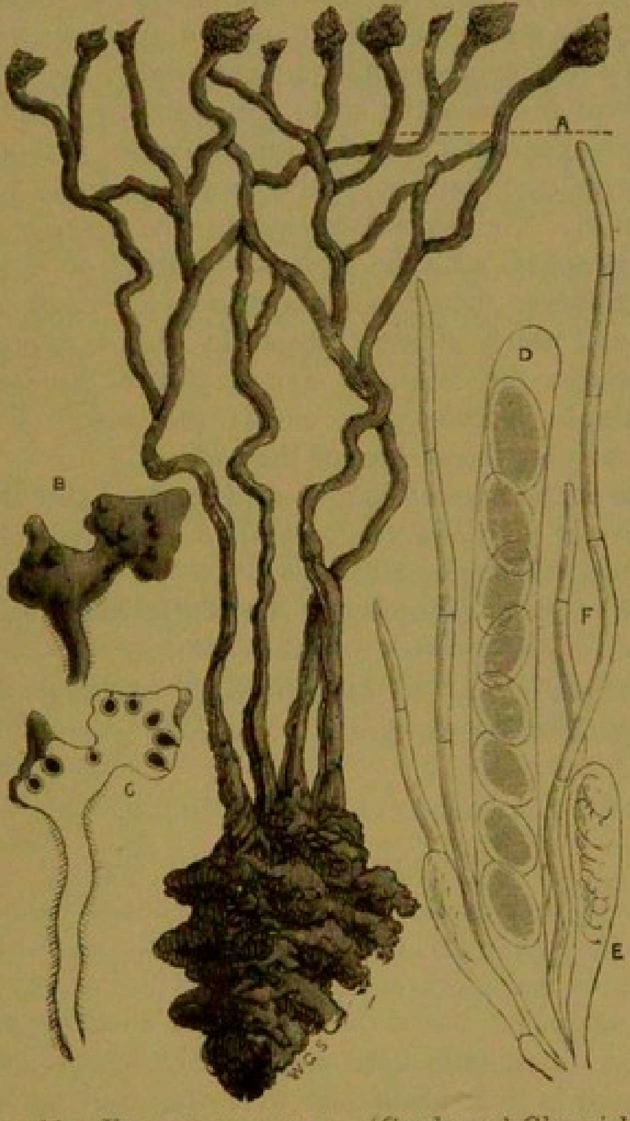

FIG. 11.—XYLARIA VAPORARIA. (*Gardeners' Chronicle.*)
A, complete plant; B, one of the fruit-bearing terminals; C, section of same showing perithecia; D, ascus with sporidia; E, young ascus; F, paraphyses.

PESTS OF ORCHARD AND FRUIT GARDEN.

Fruit-growers will find indicated in the following pages most of the pests which are likely to trouble them in their occupation. The arrangement is rather an artificial one, but it appeared to be best suited to the wants of practical men. Orchard trees will occupy the first portion, whilst the latter will be assigned to bushy and herbaceous plants with marketable fruits. Anomalies may be sometimes anticipated, as, for instance, placing Melons with Gourds and Cucumbers in the kitchen garden, and Tomatos in juxtaposition with Potatos. The Grape Vine and Pineapple, and similar tropical fruits, will have to be dealt with by themselves.

Apple-leaf Spot.

Septoria pyricola (Desm.), Pl. X. fig. 1.

Spotted leaves are common enough in the orchard and elsewhere, but they may have many causes, known and unknown, and cannot all be attributed either to insects or fungi. In most cases the spots on the leaves, although destructive to the leaf, unless very prevalent do not affect materially the general condition of the tree or the production of fruit, except in a few instances of a virulent kind.

In the present instance the spots occur on the upper surface of the leaves of Apple or Pear, and are of a greyish-white with a narrow brown margin. They are commonly somewhat rounded, from a quarter of an inch in diameter. The substance within the spot is killed by the mycelium and bleached, with the surface sprinkled or dotted with little black points not larger than the prick of a pin. Each of these points consists of a small nearly globose receptacle with a minute pore at the apex which encloses the fruit, or spores, of the fungus. When fully mature these minute sporules ooze out at the orifice in the form of a tendril and spread over the surface of the leaf.

The sporules in the present species are elongated and threadlike, with about two transverse divisions ($60 \times 3\frac{1}{2}\ \mu$) of a very pale olive tint.

Found generally throughout Europe.

Sacc. Syll. iii. 2624; *Cooke Hdbk.* No. 1320; *Seem. Journ.* iv. f. 27.

A large leaf-spot (*Phyllosticta Pyrorum*) is known in the United States, with much smaller sporules ($10 \times 2\ \mu$).

Apple-leaf Black Mould.

Coniothecium Questieri (Desm.).

This mould was first discovered in France nearly half a century ago on leaves of *Cornus*, and appeared in 1902 on fading leaves of Apple, although we have grave doubts of its being any other than a saprophyte. It occurs on the under surface of completely dead spots of the leaves, or on thoroughly dead and brittle leaves. The tufts are small and scattered in little black dots over the dead parts, but do not occur upon the merely discoloured and fading leaves.

The conidia are conglomerated in variously shaped clusters of from two to eight cells (about 10 μ diam.), of a pale brownish colour, mixed with occasional slender threads.

Sacc. Syll. iv. 2442; *Trans. Br. Myc. Soc.* (1903), p. 15.

Apple-tree White Mould.

Oidium farinosum (Cooke), Pl. X. fig. 2.

This mould was first observed in 1870 and 1871 covering the young twigs and leaves of Apple trees with a mealy coating of white mould, so that they looked as if dusted with flour or powdered chalk. Since the above it has become sufficiently common. Although it is a true epiphyte, it is capable of inflicting injury, causing the young leaves to curl, checking their growth, and distorting the tender twigs.

There is a thin and delicate but profuse mycelium from which arise the fertile branches, which are club-shaped and divided by transverse septa into short joints, which gradually contract at the suture, and then the top joint having acquired an elliptical form falls away as a conidium, to be followed successively by the other joints, so that a continuous crop of mature conidia is ensured. They are externally quite smooth and colourless ($28–30 \times 12\ \mu$).

The habit and structure of this mould are quite similar to the *Oidium* of the vine, that which precedes the Rose mildew, and the development of the different species of *Erysiphe*.

In 1890 this mould made its appearance on Apple trees in South Africa, and possibly it is the same species as one which is common east of the Mississippi in the United States.

In such cases dusting with dry sulphur is likely to be the most effectual treatment. In America the application of the ammoniacal solution of carbonate of copper is recommended.

Grevillea, xvi. 10.

Apple-twig White Mildew.

Sphærotheca Mali (Duby).

A century ago one of the fungi closely allied to that of the Rose and the Hop was imperfectly described in France under the name of *Erysiphe Mali*, but very recently it has been revived by Dr. Magnus, who has seen and figured one of the conceptacles. It was said to be broadly effused; the thin arachnoid threads of the mycelium interwoven; the conceptacles rare, and scattered, subglobose, rugulose, and black.

The mould already described here under the name of *Oidium farinosum* appears to be the mycelium and conidia of the above fungus, but at present the more perfect and complete condition with the conceptacles has not been met with in this country. In this instance we appear to have a "perennial mycelium in the host-plant, which grows along with the shoot each season, stunting its growth and eventually killing the tree." (Fig. 12.)

Journ. R.H.S. (1902), xxvi. p. 737, fig. 310; *Duby, Bot. Gall.* 869.

Fruit-tree Pustule.

Eutypella Prunastri (Pers.).

This compound *Sphæria* is only parasitic in the early stage, when spermogonia are evolved in tendrils through punctures of the bark. No one has seen the complete or true *Eutypella* stage, except on dead tissues. In this condition the perithecia are clustered together in definite pustules, some five or six, with long converging necks, which are sulcate or grooved at the extremity or ostiolum. The fructification is contained within the perithecia, consisting of eight sporidia, enclosed within a transparent ascus, of which there are several. The sporidia are cylindrical, curved, and but slightly coloured ($6–8 \times 1\frac{1}{2}\ \mu$).

The spermogonia, which are developed earlier, ooze out in tendrils from the mouths of the receptacles, and are known in this stage under the name of *Cytospora rubescens*: they are not more than half the length

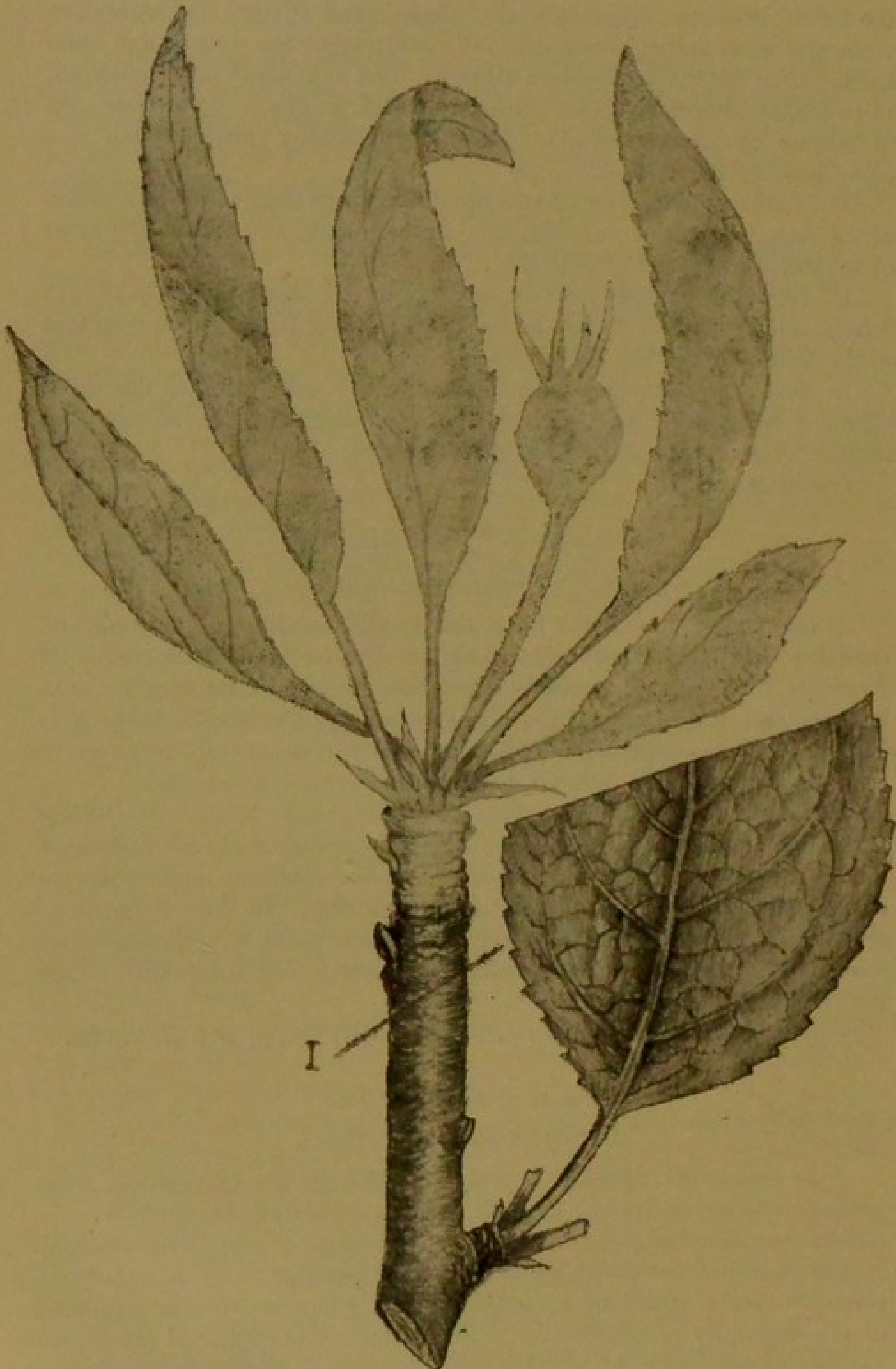

FIG. 12.—APPLE MILDEW (*Sphærotheca Mali*).

As the mycelium of the fungus appears to be perennial in the tissues, diseased shoots should be removed along the line marked I. Spraying does not check this disease. The point affected should be all cut away.

of the conidia. It is reported that this is a wound parasite, and enters the stem through wounds made by pruning, finally causing discoloration in the centre of the stem (see figs. 13 and 14). The trees will continue to grow for several years after infection.

Destructive to Apple and other fruit trees, especially Plum and Cherry.

Sacc. Syll. i. 566; *Cooke Hdbk.* No. 2460; *Journ. R.H.S.* (1902), xxvi. p. 742, fig. 313; *Ibid.* xxvii. pp. 691, 936, 1152; *Gard. Chron.* 1902, p. 235, fig. 80; *Berlese Icon.* iii. pl. 85.

Brown Rot.

Monilia fructigena (Pers.), Pl. X. fig. 12.

This rot is not confined to the Apple and Pear, but attacks most orchard fruits, especially the Cherry, to which we shall refer it later on. (See "Apricot Brown Rot.")

Thüm. Pom. p. 22; *Journ. R.H.S.* (1902), p. 738, fig. 311.

Fruit Spot.

Septoria Ralfsii (Berk.).

About the year 1854 Berkeley described a small fungus which accompanied spotting on ripe Apples; but it never seems to have been demonstrated that it was the cause of the spotting, and as nothing has transpired since which leads to the conclusion that it is really a fruit disease we can dismiss it with a brief notice.

The appearance caused is that of black patches of an irregular form on the surface of ripe Apples. Over these patches are scattered the minute points, which indicate the receptacles of the fungus. The sporules are long and slender (30 μ long) with six minute nuclei. Pears as well as Apples are said to have suffered from the same infliction.

Sacc. Syll. iii. 3028; *Cooke Hdbk.* No. 1307; *Berk. Ann. N. H.* No. 745, t. xv. f. 6; *Thüm. Pom.* p. 122.

Apple Scab.

Fusicladium dendriticum (Wallr.), Pl. X. fig. 3.

This disease appears under different forms, but in all cases it seems to be caused by the same fungus. On the leaves it comes in small olive spots, which are somewhat rounded and gradually enlarge, and become velvety and irregular; frequently two or three spots will run together and form a large irregular blotch. The mould also appears on the petioles and the young twigs. The threads of which the mould is composed have a radiating habit, from which its specific name is derived. On the fruit its appearance is similar, but as the spots increase in size the cuticle cracks and forms a light-coloured ring about their margin. The greatest vigour is towards the edge of the spots, where the fruit seems stimulated to the production of a kind of corky layer in its efforts to throw off the disease and the formation of scab. Generally the result is to produce on the fruit crackings with a thickened scabby edge.

The mycelium is rather superficial, and produces short erect brown threads at the apex of which the spores, or conidia, are produced. These

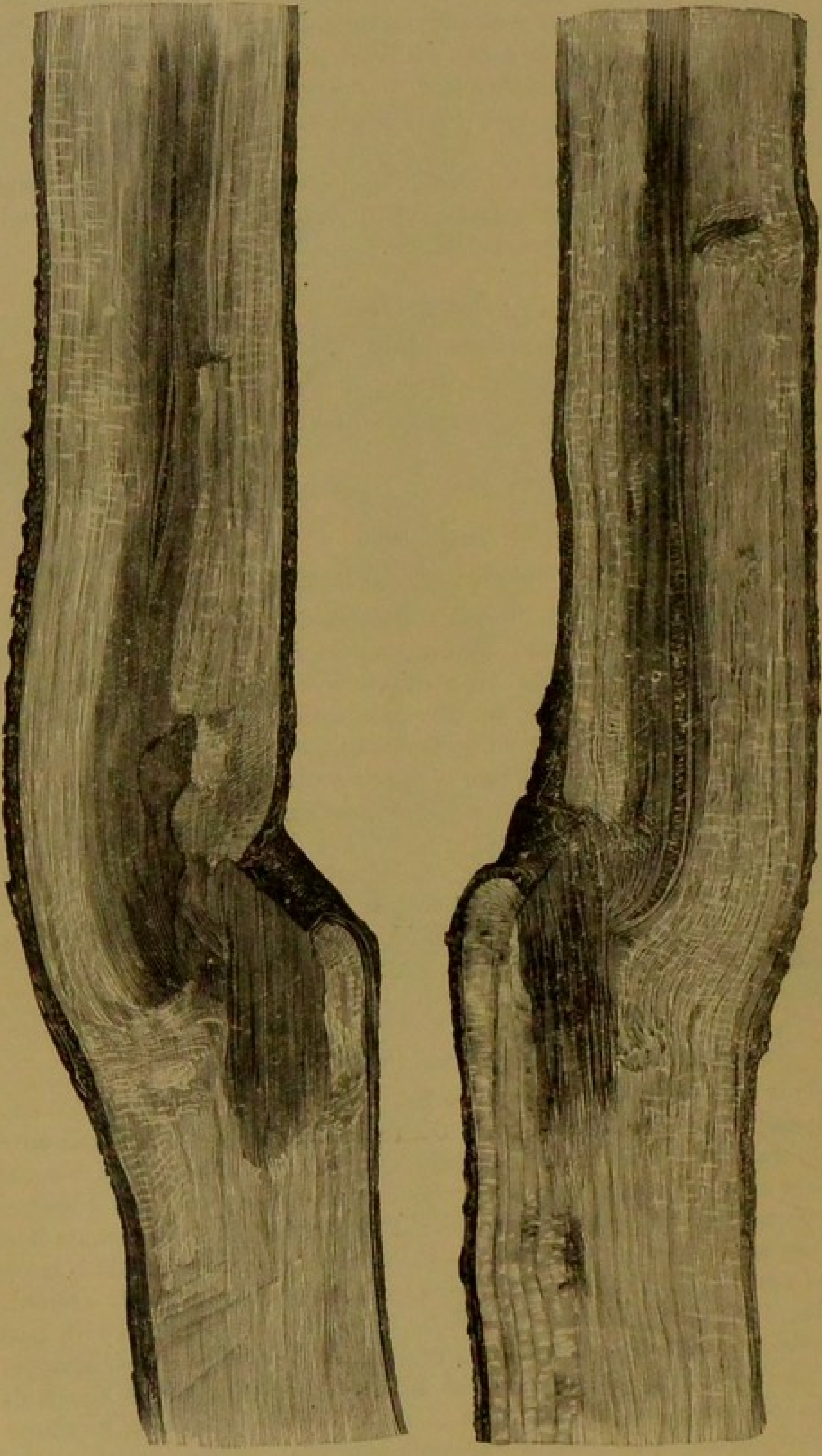

FIG. 13.—EUTYPELLA PRUNASTRI.

bodies are somewhat oval, attenuated towards each end, so as to be thickest in the middle, or they are of an elongated pear-shape, and coloured brown, like the threads, but varying much in form and size. Although usually consisting of only a single cell, the conidia are sometimes divided by a septum towards one end into two unequal cells (30×7–$9\ \mu$).

The conidia germinate rapidly in water or moist air, and scab spots on the fruit may be found covered with vast numbers of germinating spores. The germ tubes are rather thick and coloured, with frequent divisions, or septa; sometimes the germ tubes will produce secondary spores at their tips, which in turn germinate like the original spore. The conidia will germinate in pure water (50° Fahr.) within eight hours. It is believed that the mycelium is perennial, living in the fallen leaves and twigs, and especially in the fruit, during the winter.

It has been observed in America that the individual cells or joints of the mould, under favourable conditions, will push out germ tubes and develop new individuals of the species. "This method may be roughly compared to reproduction by root cuttings in higher plants."

In early spring spray thoroughly with sulphate of iron. As soon as the fruit is set apply Bordeaux mixture or a modified preparation of eau céleste.

In storing fruit especial care should be taken to separate all Apples which show any signs of "scab" from those which are sound and healthy, and store in a dry place.

This pest is recognised in France, Belgium, Germany, Austria, Italy, North America, and Australia.

Gard. Chron. Nov. 28, 1885, figs. 155, 156; *Mass. Pl. Dis.* 302. fig. 80; *Sacc. Syll.* iv. 1642; *Sacc. Fun. Ital.* t. 782; *Cooke Hdbk.* No. 1747; *U.S.A. Dep. Agri.* 1887, p. 341, with figs.; *Thüm. Pom.* p. 15; *Grevillea*, xx. p. 27; *Tubeuf, Dis.* 219, fig.; *Journ. R.H.S.* xxviii. p. 292.

Apple rot, after scab, causes serious trouble in the United States. It is attributed to the common mould, *Cephalothecium roseum*, which has always been regarded as a saprophyte in Britain. (*Journ. R.H.S.* xxviii. p. 233; xxix. 1904, p. 91.)

Bitter Rot of Apple.

Glœosporium fructigenum (Berk.), Pl. X. fig. 4.

Under the above name a disease is known in the United States which is attributed to this fungus as a cause. In this country it is rather doubtful whether the fungus is the cause of disease, since it has been affirmed that in most observed cases the fruits have been decayed before the fungus made its appearance. Still it must be conceded that nearly all the species of the genus to which it belongs are active parasites.

The pustules are circularly arranged in a cluster of a dirty rose colour, at length splitting the cuticle at the apex to discharge the contents. The conidia are cylindrical, sometimes curved, rounded at the ends and colourless (20–30×5–$6\ \mu$), produced at the tips of nearly equally long hyaline threads.

Notwithstanding that the fruit exhibits decay with us before the fungus is detected it may prove to be true that such decay has been

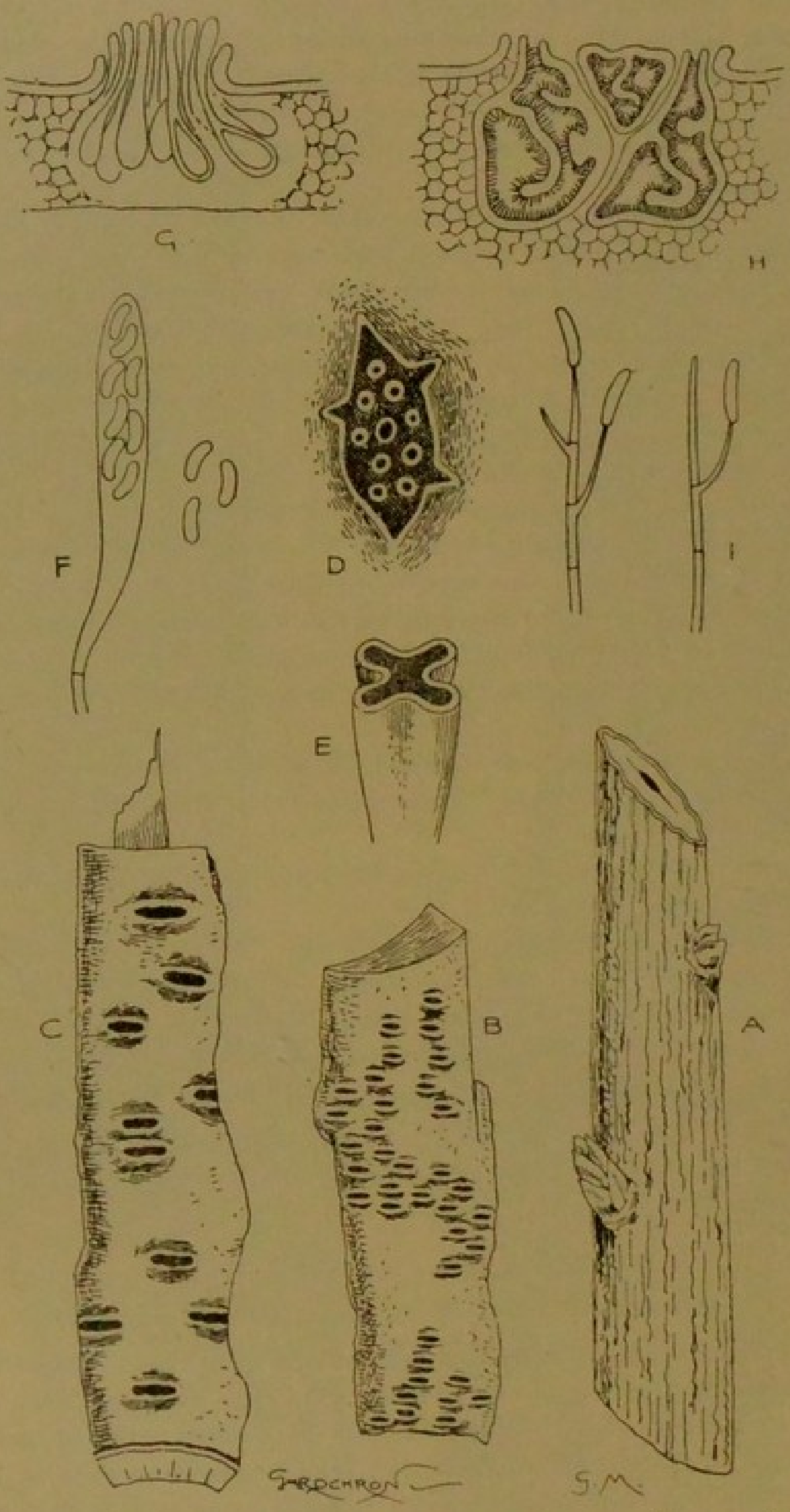

FIG. 14.—EUTYPELLA PRUNASTRI, CAUSING A DISEASE OF NURSERY STOCK.

A. A young Peach branch becoming shrivelled, indicating that the stock is dying. (Natural size.) B. The conidial stage of fruit bursting through the bark. (Natural size.) C. The second or ascigerous condition of fruit, showing at the surface through transverse cracks in the bark. (Natural size.) D. Surface of view of the second form of fruit, surrounded by the ruptured bark. (× 40.) E. Cruciate mouth of a perithecium. (× 400.) F. Ascus and spores. (× 400.) G. Section through ascigerous form of fruit. (× 80.) H. Section through conidial form of fruit. (× 50.) I. Conidia. (× 1,000.)

caused by the *Glœosporium*. In America it is said that "the affected Apple at first shows one or more black, or usually brownish, spots on any part of the surface; as these gradually enlarge their shape becomes more or less circular, and their borders somewhat sharply defined, sometimes the spots coalesce, or run together, and in this manner the entire Apple is soon affected. Towards the centre of the diseased spot there is usually a very dark, frequently almost black, discoloration. The darker portions are studded with minute black points, which are slighly raised above the surrounding tissue, imparting to their surfaces a somewhat roughened appearance; occasionally these points are arranged in circles or grouped in little clusters."

It is affirmed that the spores when sown in water germinate within ten hours by sending out one or more thickish germ tubes. In about twenty hours they will produce at their extremity globose bodies (8 μ diam.), more or less dark-coloured, which are of the nature of secondary spores. These secondary spores germinate in like manner, and produce, in a third series, the same kind of bodies as the original primary conidia. So that by an alternation of generations the old type is reverted to.

In addition to the above it has been announced that thick-walled cavities have been found at the base of the conidia-pustules, which contain minute colourless bodies resembling spermatia; what may be their purpose or destiny is still an open question. No wonder, then, that the Apple growers of the United States have been cautioned that they "have a dangerous foe to contend with," and they are on the alert.

The fungus is known in Britain, Italy, and the United States.

The remedies suggested are spraying with a solution of one half an ounce of sulphate of potassium to one gallon of water. Application at intervals of ten days. In some cases the disease was arrested after the first application. Another fungicide applied with success is the ammoniacal carbonate of copper solution.

Grapes are also liable to the same disease.

Sacc. Syll. iii. 3751; *Mass. Pl. Dis.* 281, fig. 75; *Gard. Chron.* 1856, p. 245; *U.S.A. Dep. Agri.* 1890, pl. iii.; *Cooke Hdbk.* No. 1411; *Thüm. Pom.* 59; *Tubeuf, Dis.* 482; *Journ. R.H.S.* xxviii. 1904, p. 626; xxix. 1905, pp. 746, 755.

Apple-tree Anthracnose.

Glœosporium Malicortis (Cord.).

Under the name of dead spot or black spot this new disease has made its appearance in various parts of the United States and British Columbia. Branches two or three inches in diameter are usually attacked, and the disease appears first in the autumn.

Journ. R.H.S. xxviii. p. 233; *U.S.A. St. Bd. Montana Rep.* 1902.

Insecticides for Orchard and Bush Fruit, see *Journ. R.H.S.* xxix. p. 816.

Apple Speck.

Spilocœa Pomi (Fr.).

An enumeration of the fungi which attack Apples and Pears would not be complete without reference to two or three obscure species which are reported to have occurred on the fruits. The little black specks upon ripe Apples which resemble fly-spots have not afforded any evidence of fructification. Known under the above name, they are probably only incipient conditions of "Apple scab."

The *Sphæria Malorum* of Berkeley, found upon decaying Apples lying on the ground, would be outside the bounds of our inquiry, since it is clearly a saprophyte, and possibly only *Diplodia Malorum.*

In 1878 Baron von Thümen published a work entitled "Fungi Pomicoli," in which he enumerated thirty-one fungi as growing on Apple and twenty-three on Pear trees, or their fruit. It is consoling to find that the majority of these are in no respect parasitic, and many of them common to all kinds of vegetable matter. Hence it is no guide to orchard pests.

Fr. Syst. Myc. iii. 504; *Thüm. Pom.* p. 9.

Apple Brown Spot.

Surface of the fruit and interior marked with brown spots. Cause unknown.

Gard. Chron. Sept. 9, 1905, p. 208.

Apple-twig Tumour.

Botryodiplodia pyrenophora (Sacc.), Pl. X. fig. 5.

Little swellings are sometimes to be seen on Apple twigs in which the bark cracks in an irregular manner and exhibits beneath a cluster of black

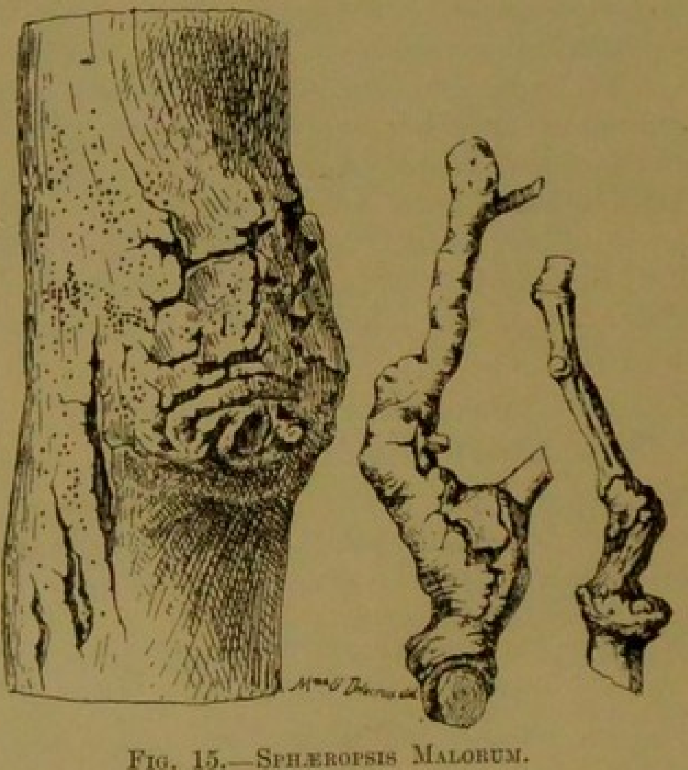

Fig. 15.—Sphæropsis Malorum.

perithecia, about the size of pins' heads, closely packed together, and seated upon a kind of cushion formed from the mycelium.

These perithecia when mature contain a mass of rather large elliptical sporules, at first one-celled and colourless, but afterwards divided across

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the centre into two cells, and then of a deep brown colour. Possibly this is only a condition of a more highly organised fungus in which the spores are contained in asci.

It seems rather doubtful whether the "chancre" attributed to *Sphæropsis Malorum* (*Bull. de la Soc. Myc. de France*, 1903, p. 134) may not be a condition, or stage, in the development of this same disease. (Fig. 15.)

At present this is a rare disease, and must be hunted after to be discovered; but it is quite possible for it to become a pest if it establishes itself in an orchard. Hitherto we have no record of its having become troublesome, and consequently no experiments have been made for its eradication.

We should certainly recommend its destruction wherever found, since it is quite capable of extending itself both by its mycelium and sporules.

Sacc. Syll. iii. 2121; *Cooke Hdbk.* No. 1254.

There is a small twig pustule, caused by *Phoma Mali*, which is not so clustered or conspicuous on the twigs of Apple and Pear trees. The sporules (8 μ long) are expelled when mature, and in some places it is looked upon with suspicion.

Apple-tree Canker.

Nectria ditissima (Tul.), Pl. X. fig. 6.

Ten or twelve years since R. Goethe propounded the opinion that canker on Apple trees was produced by the growth of the above-named fungus, which is of the *Sphæria* kind, a little resembling those clusters of red *Nectria* which are so common on Currant twigs, but smaller. Goethe claims to have demonstrated his position by cultivating the parasite both from conidia and ascospores. The same fungus he contends produces canker on various kinds of Pear trees, and the sporidia of the *Nectria* from the Apple were found to produce canker on the Beech and Sycamore, and again from these trees on the Apple.

According to Hartig the fungus enters through wounds caused by hail or the puncture of an insect. The best remedy, according to these authorities, is to cut out the diseased tissues and anoint carefully with coal tar.

The fungus consists of a number of little red dots, scarcely so large as a pin's head, growing in clusters in cracks of the bark. These minute dots are spherical and smooth, seated on a white mycelium, and when mature enclosing a kind of pulpy nucleus, like a tiny drop of gelatin, and which consists of a great number of long cylindrical tubes, or asci, each enclosing a row of eight elliptical sporidia, which are divided by a transverse septum into two cells. When ripe they are capable of germination from each cell (14×5–$6\,\mu$).

Occurs in France and Germany.

Gard. Chron. March 8 and April 19, 1884, p. 313; 1891, p. 300, figs. 66, 67; *Sacc. Syll.* ii. 4671; *Mass. Pl. Dis.* 127, fig. 24; *Grevillea*, ix. p. 116; *Tubeuf, Dis.* p. 187, figs.

APPLE-BARK VALSA.

Valsa ambiens (Fr.), Pl. X. fig. 7.

It is only during the past year or two that we have become satisfied that this usually saprophytic fungus has seriously affected living Apple trees—at least during its early or conidial condition.

The bark of living branches and trunks was observed to be roughened with little elevations from the apex of which proceeded what appeared to be a long twisted yellow filament, not thicker than a horse-hair, entangled together into a mass of golden threads. When moistened these threads dissolved into myriads of minute curved conidia (5 μ long) which had oozed out from minute punctures of the bark, and proved to be those of a fungus called *Cytospora carphosperma*, common on many orchard trees, but heretofore considered saprophytic.

The mature condition is to be found in spring on branches that have lain on the ground through the winter, and consists of clusters of receptacles, flask-shaped, with long converging necks, containing sporidia which are cylindrical, curved, and rounded at the ends (16-18 $\times$ 3-4 μ), and of these eight are produced together in a membranous sac or ascus. This mature condition is only arrived at after hibernation, and consequently upon dead branches, but the early stage is clearly parasitic and may become troublesome. The mature stage is called *Valsa ambiens*.

Certainly whenever seen oozing out of living trees the parts should be well rinsed with Bordeaux mixture, so as to destroy all the germinating power of the conidia.

Sacc. Syll. i. 512; *Cooke Hdbk.* No. 2475; *Curr. Linn. Trans.* xxii. t. 48, f. 138.

APPLE-TREE HYDNUM.

Hydnum Schiedermayeri.

Very recently this large fleshy fungus has been developed on an old Apple tree at Maldon, Essex, bursting through the bark in a long strip, extending for 3 or 4 feet in an irregular mass. It has a nodulose appearance, of an ochrey-yellow or flesh-colour. The nodules produce long spines, which are covered by the hymenium producing the spores. According to Thümen, this fungus is very frequently destructive to Apple trees, and is presumably a wound-fungus, the spores entering through a wound or fissure of the bark, and soon becoming developed.

Gard. Chron. Oct. 31, 1903, p. 299; *Mass. Pl. Dis.* fig. 39.

PEAR-LEAF CLUSTER-CUPS.

Rœstelia cancellata (Reb.), Pl. X. fig. 8.

There is hardly any parasite which appears to be such a puzzle to gardeners as the *Rœstelia* or "cluster-cups" of the Pear leaves. They have also been a puzzle to others who are not gardeners, as evidenced by the literature of the past quarter of a century. We can permit the discussion to rest and state a few conclusions.

The parasite thickens the Pear leaves at the infected spots by the internal growth of the mycelium upon this, and externally are produced a small cluster of flask-shaped pale brown bodies called *peridia*, and these are soon split lengthwise nearly to the base into thread-like filaments which are for a long time united together at the apex. The contents of these flask-shaped bodies are the æcidiospores, which are nearly globose and warted on the surface (25–40 × 18–25 μ). These spores are produced in chains, readily separating from each other.

Spots are also to be seen on the opposite side of the leaf to that which bears the *Ræstelia* and corresponding to it. These are conspicuous by their orange colour, which becomes reddish, sprinkled with blackish dots, which indicate cells containing very minute bodies called *spermatia*, which are expelled when mature.

It is recorded in Hooker's "British Flora" that when young Pear trees are planted near old trees suffering from the *Ræstelia* the young

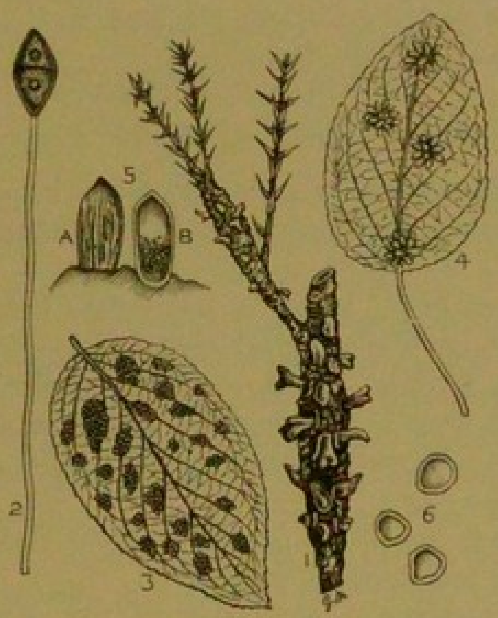

FIG. 16.—PEAR-LEAF CLUSTER-CUP.

A fungus growing on two different kinds of plant at different periods of its life-cycle.

1. The spring stage of the fungus on a living Juniper branch, reduced in size. 2. Spore of same, × 300. 3, 4. "Cluster-cup," or summer form of fungus fruit on living Pear leaves, reduced in size. 5. Two cluster-cups, one cut open, slightly ×. 6. Spores of cluster-cup condition. × 300.

trees have been observed to become much injured by the fungus. Mr. Knight sowed Pear seeds in soil infested with *Ræstelia*, and the very youngest of the seedlings showed the disease.

According to theory it is contended that this kind of cluster-cups must also have a condition analogous to the *Uredo* and *Puccinia* forms. As this is not known to take place upon the Pear tree itself, it is inferred that it must take place upon some other plant. The plant selected as fulfilling the condition is the Savin, and it is contended that the cluster-cups of the Pear tree produces those gelatinous exudations on the stems of the Savin which are known under the name of *Gymnosporangium*.

Œrsted originated this suggestion in 1865, when he intimated that he had learned that gardeners were of opinion that the Pear fungus was never seen except after the appearance of the fungus on Savin. Hence he set to work to prove by cultures that the Pear fungus would produce the Savin fungus by inoculation, and *vice versa*. (Fig. 16.)

Incidentally Stevenson records that the Savin fungus is found in Scotland, but that the other condition, the Pear-leaf fungus, is not a Scottish plant.

The advice given to gardeners by the theorists is to destroy all Savin bushes, root and branch, if they would save their Pear trees. Berkeley, however, wrote:—"If picking the leaves off carefully and burning them will not do, we may feel secure that an onslaught against the poor Savin bushes will not avail us."

Known in France, Germany, Switzerland, Austria, and North America.

Sacc. Syll. vii. 2608; *Cooke M. F.* 193, t. 2, f. 2021; *Plowr. Brit. Ured.* p. 230; *Mass. Pl. Dis.* 257; *Thüm. Pom.* 73; *Cooke Hdbk.* No. 1597; *Gard. Chron.* 1862, p. 689; *Tubeuf, Dis.* 399, fig.

Pear-leaf Blister.

Exoascus bullatus (Tul.), Pl. X. fig. 9.

The blister of Pear leaves is a disease which has long been known in this country, distorting the foliage in a similar manner to the "curl" on Peach leaves.

The under surface of the leaves is occupied by the external manifestations of the fungus, but the mycelium penetrates the leaf. The glaucous appearance of the hollows of the blisters consists of tufts of small cylindrical cells, or asci, each containing eight small ovate uncoloured sporidia (5 μ diam.). When these sporidia are mature the asci are ruptured at the apex, and they escape.

When first discovered this fungus was called *Oidium bullatum*, until the presence of asci was determined.

"In many cases these blisters formed two parallel lines on either side of the midrib, but sometimes they were irregularly scattered over the leaf. In some cases the blistered part had become black, and in others the portion of the leaf which had protruded had fallen out, so as to leave a regularly defined aperture. The cavities were found to be lined with a thin white stratum, consisting of myriads of confluent white specks of a waxy rather than a powdery appearance."

It is incumbent upon the cultivator to pick off all the blistered leaves and burn them, so as to keep a check on reproduction. Spraying young trees with Bordeaux mixture at intervals of a fortnight may be preventive.

Journ. R.H.S. ix. p. 48; *Sacc. Syll.* viii. 3343; *Mass. Pl. Dis.* 90, fig. 13; *Cooke Hdbk.* No. 2232, fig. 342.

Pear-leaf Blight.

Entomosporium maculatum (Lev.), Pl. X. fig. 10.

This disease is very destructive in the nurseries of the United States, although its presence in this country is rather doubtful.

Small red spots on the leaves first appear: these increase in size and become brown, or it may extend over the leaf, which then shrivels and falls to the ground.

The conidia, or sporules, have a very peculiar form, consisting of two nearly equal uncoloured cells attached end to end, and two smaller cells on opposite sides at the point of attachment, so as to present an unequal cross-shaped body. These conidia are produced superficially, in considerable numbers upon the leaves, extending also to the fruit ($18-20 \times 12\ \mu$).

It also attacks the leaves of the Quince. Pear fruits when attacked are liable to crack; hence a common name for the disease is "cracker."

Spraying with Bordeaux mixture holds the disease in check, using a very dilute solution. Dead leaves should be collected and burnt.

Sacc. Syll. iii. 3504; *Mass. Pl. Dis.* 276, fig. 73; *Galloway, Rep. Agri. U.S.A.* 1889, p. 357, pls. viii. ix.; *Tubeuf, Dis.* 480.

Pear-leaf spots, as distinct from those on Apple, are also recorded as *Phyllosticta pirina* and *Phyllosticta piricola* in Southern Europe, *Ascochyta piricola* in Italy, and *Septoria nigerrima* in Germany.

PEAR SCAB.

Fusicladium pirinum (Lib.), Pl. X. fig. 11.

Between the Pear scab and the Apple scab there seems to be very little difference except in name. The conidia are the same in size, and the little difference in form can scarce be material.

The external manifestations, both on the leaves and the fruit, are very similar: in the former case both form irregular velvety olive patches, which are apt to have a dendritic appearance on Apple leaves.

The threads are short and rather robust, and the conidia are typically rather fusiform, being attenuated towards each end ($28-30 \times 7-9\ \mu$), and we have never met them with a transverse division, whereas those of the Pear scab are usually of a club shape, and often divided into one large cell and one small one.

Known in Germany, Austria, Italy, Portugal, and France.

For remedies see also Apple Scab.

Sacc. Syll. iv. 1643; *Mass. Pl. Dis.* 304, fig. 81.

A mould with fusiform conidia, not unlike *Fusarium*, is recorded as affecting ripening Pears in France. It has been named *Discocolla pirina*.

AMERICAN PEAR BLIGHT.

Micrococcus amylovorus (Burr.), Pl. XI. fig. 25.

Pear blight, or fire blight, is known only in North America, and was first observed in 1780, but no description of it until 1817. "It frequently destroys trees in the fullest apparent vigour and health in a few hours, turning the leaves suddenly brown, as if they had passed through a hot flame, and causing a morbid matter to exude from the pores of the bark of a black ferruginous appearance." The results of epidemics have been most disastrous, especially the memorable year of 1844.

Various conjectures have been made as to its cause, the last of which, the bacterial, advocated by Professor Burrell, was supported by a long series of experiments by inoculating healthy branches with the juices of diseased ones and producing the disease, since which time the experiments have been confirmed.

The organism named *Micrococcus amylovorus* consists of single cells, of oval or roundish shape ($1\text{–}1\frac{1}{4} \times \frac{1}{2}\text{–}\frac{3}{4}\ \mu$) and quite colourless. For the most part they remain single, but may often be found in pairs, rarely a series of four or more, but never extending to chains.

Sacc. Syll. viii. 3887; *Amer. Nat.* xvii. 1883, p. 319; *Arthur, History and Biology of Pear Blight*, 1886, plate; *Grove, Syn. Bact.* p. 10.

MEDLAR CLUSTER-CUPS.

Æcidium Mespili (DC.).

This species of cluster-cups appears now to be recognised as distinct and alone, without *Uredo* or *Puccinia* to keep it company. It is only reported to occur on the leaves of *Mespilus* and *Cotoneaster*.

Rounded or irregular spots are formed upon the leaves, which are yellowish or reddish on the upper side, with a yellow border, thickened in the centre. The cups are cylindrical, splitting at the edge into narrow teeth or threads. Æcidiospores angular (19–24 μ diam.), very minutely warted and brown.

There is a suspicion of this species having been found in Britain, but it evidently has never given any trouble as a pest. It occurs also in France and in Germany.

Sacc. Syll. vii. 2773; *Plowr. Brit. Ured.* p. 232; *Mass. Pl. Dis.* 257.

An anthracnose attacks the leaves of the Quince (*Glœosporium Cydoniæ*) in Southern Europe, as well as two or three kinds of leaf-spot, and *Oidium Cydoniæ* in Italy.

MEDLAR WHITE MOULD.

Oidium mespilinum (Thüm.).

This white mould occurs on the living leaves of *Mespilus* in Austria, forming broad white thin patches on the upper surface, which consists at first entirely of an epiphytal web of mycelium. From this shortly arise the fertile branches, which are at first simple and club-shaped. Afterwards two or three elliptical cells or conidia are cut off from the upper portion of the branches, and form the short chain of spores ($10 \times 6\ \mu$) which ultimately acquire a pale grey colour.

It is clear that this is an epiphyte of the same character as the various species of *Oidium* which precede such mildews as that which attacks the Hop, Rose, Gooseberry, Maple, Garden Pea, and many other plants.

In the case of any trouble the application of dry powdered sulphur is the safest remedy.

Sacc. Syll. iv. 208; *Grevillea*, xvi. 58.

Another white mould (*Ovularia necans*) has damaged Quince and Medlar trees in Italy and France. Two kinds of leaf-spots are known on Medlar leaves, but neither is recorded as British. *Phyllosticta Mespili* and *Septoria Mespili* are both of them European.

Journ. R.H.S. xxviii. 1904, p. 698.

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Plum Powdery Mildew.

Uncinula Prunastri (DC.), Pl. XI. fig. 17.

This mildew resembles externally the previous species so much that it is scarcely possible to detect the difference by the naked eye. However, it is more commonly found on the wild Sloe than on the cultivated Plum.

The mycelium is thin, and spreading over the surface of the leaves, giving them a frosty appearance, but never very dense. The conidia, in the early stage, are of the *Oidium* form, and are produced in short chains.

The receptacles are globose and minute, scattered over the mycelium, and scarcely visible to the naked eye. The appendages which surround the base of the receptacles are very numerous and peculiar in their character, inasmuch as they are unbranched and curved at their tips in a hook-like manner, and are about twice as long as the diameter of the receptacle. Each receptacle contains from twelve to sixteen transparent pear-shaped sacs, or asci, each of which contains six sporidia.

This species is found also in France, Belgium, Germany, and Italy.

As an epiphyte, should this species threaten to give trouble, it should be met with the sulphur treatment.

Sacc. Syll. i. 23 ; *Cooke M. F.* 239.

Plum Gummosis.

Cladosporium epiphyllum (Link.), Pl. XI. fig. 18.

Gumming, as exhibited in *Prunus japonica*, was made the subject of investigation by Massee in 1899, and the features were so apparently identical with those which takes place ordinarily in Plum and Cherry trees as to indicate the possibility of the cause being the same.

Stout branches were mostly attacked, and the disease was indicated by tear-like drops of almost colourless gum oozing from the branches. The drops increase in size so as to form irregular masses as large as a Walnut. Soft in damp weather, but in dry shrinking and horny, they gradually change in colour from grey to black as they increase in size; but this is external, as the colour diminishes towards the centre.

A black mould (*Cladosporium epiphyllum*) was traced as the cause of this disease, as a wound parasite, entering through small wounds in the bark, or where buds have been broken off. An olive patch of the mould first appears at the wounded point, and after the conidia are dispersed the drop of gum appears, and into this gum the threads of the mould extend. The threads are at first colourless and slender, but as the masses increase the tips of the threads nearest the circumference become olive, and broken up into chains of cells, many of which produce small sclerotia or compact masses of cells with thick dark brown walls. If the mass remains damp at this stage myriads of very minute conidia are produced by the large brown cells. If the conditions remain unchanged the conidia increase rapidly by gemmation. When the mass is dissolved away to the ground the conidia continue to reproduce themselves by gemmation.

Kew Bulletin, 1899, p. 1, pl. ; *Mass. Pl. Dis.* 306 ; *Sacc. Syll.* iv. 1718.

Plum-tree Rust.

Puccinia Pruni (Pers.), Pl. XI. fig. 15.

Nearly all kinds of Plum trees are subject to the ravages of the Plum-tree rust, but those attacks are not in all cases equally virulent. One tree may be seen in an orchard with hardly a leaf untouched, whilst another tree at twenty yards' distance will scarcely reveal a pustule.

The under side of the leaves are generally closely sprinkled with the pustules, which split irregularly and discharge the spores, light brown or rusty-brown for the uredospores, dark brown for the teleutospores, in both cases powdery, and soon sprinkled over the leaf.

The uredospores are egg-shaped or Pear-shaped, and the whole surface minutely spiny (20–35×12–$16\ \mu$). These are the ordinary uredospores, or, as we might call them, the true uredospores. In order to meet a difficulty certain authors have recently professed that two kinds of uredospores are known, the second and last invented kind being elongated and of a *Uromyces* type, so much so that it has acquired the name of *Uromyces Amygdali*. Whether this is also a *Uredo* form of *Puccinia Pruni* does not interest us much, as we intend, in this place, to treat them as distinct diseases.

The teleutospores are divided in the centre into two cells, each of which is nearly globose, except at their junction, where they are flattened, the lower cell being a little the smaller. The cell coat is chestnut-brown and thickly covered with rather rigid obtuse spines (30–45×17–$25\ \mu$). At first the short uncoloured pedicels are distinct, but these finally disappear.

Known in Europe, North America, India, Cape Colony, Australia, and Tasmania.

McAlpine Fung. Dis. 23 ; *Journ. R.H.S.* xxvi. (1902), p. 963 ; *Sacc. Syll.* vii. ; *Plowr. Brit. Ured.* 193 ; *Mass. Pl. Dis.* 251, fig. 64 ; *Cooke Hdbk.* No. 1511 ; *Cooke M.F.* 211 ; *Tubeuf, Dis.* 355.

Plum Pockets.

Exoascus Pruni (Fckl.), Pl. XI. fig. 13.

Berkeley recognised this disease in 1876. The pockets, or "bladder Plums," appear soon after the fall of the flowers, attaining full size about the end of June, and then soon falling from the tree. They are at first nearly globose, soon becoming elongated, and often somewhat curved, from one to two inches in length, and a half to one inch in diameter. They much resemble the proper fruit when young, except in being yellowish or reddish in colour. With age the colour changes to grey, and the surface looks mealy or frosted, and wrinkled. Ultimately they turn nearly black, and in two or three days fall to the ground. The walls of the bladders are thick, permeated by mycelium, which also enters the hollow centre, and there is no stone. The fruits are evidently taken possession of by the fungus at an early stage, seed production arrested, and hollow bladders produced, which have some resemblance only to fruit.

The mycelium is of the usual kind, and may be found in the smaller branches in early spring before the diseased fruit appears. The fungus itself consists of small cylinders, or asci, standing side by side, closely packed, each cylinder containing eight small globose sporidia, which are ultimately ejected at the ruptured apex (4 μ diam.).

The sporidia germinate readily in water by the formation of a bud, which assumes the form of the parent spore. The secondary spore produces a bud like the first, and so on, through several generations.

It is recommended to remove the "pockets" as soon as they are formed. In the United States it is the practice to cut back the branches so as to destroy all parts likely to contain mycelium.

Sacc. Syll. viii. 3342; *Mass. Pl. Dis.* 85, fig. 12; *Ward, Dis. Pl.* p. 107; *Thüm. Pom.* p. 88; *Tubeuf, Dis.* p. 155, fig.

Plum-leaf Blotch.

Polystigma rubra (Pers.), Pl. XI. fig. 14.

These blotches are very rare upon the leaves of the cultivated Plum, but are common enough on those of the Sloe.

The blotches are orbicular or angular, of a brick-red colour, with a decisive and definite outline, thicker than the leaf, with a waxy appearance, and when mature dotted over the surface with darker minute dots, or points, which indicate the buried receptacles which enclose the fruit.

There are two stages to this fungus: the early one in the spring (*Polystigmina*) contains only stylospores or conidia, borne upon slender threads (30 μ long).

The autumnal fruit (*Polystigma*) is not matured until after a period of rest, such as is obtained by the fallen leaves upon the moist ground. Then the fruit consists of sporidia ($10 \times 6 \mu$) which are ovate, enclosed in asci, and ultimately escape when mature to reproduce the species.

Known also in France, Belgium, Sweden, Germany, Switzerland, Italy, and N. America.

Sacc. Syll. ii. 4587; *Mass. Pl. Dis.* p. 135, fig. 25; *Cooke Hdbk.* No. 2410, fig. 383; *Grev. Sc. Cry. Fl.* t. 120; *Tubeuf, Dis.* p. 189, fig.; *Hart. & Somm. Dis. Tr.* p. 97.

Plum-tree Mildew.

Podosphæra tridactyla (Wall.), Pl. XI. fig. 16.

The earliest appearance of this disease on Plum and Cherry trees is a whitish mealy, or mouldy, appearance on the living leaves, which thickens until the surface appears as if dusted with flour or powdered chalk; ultimately little orange, and then black, dots show themselves scattered over the mealy substratum.

In its first stage the pest consists solely of the branched and interwoven mycelium of delicate threads, which produce short erect club-shaped branches, soon divided into joints, which fall away from the apex, when mature, as oval conidia of the *Oidium* type.

Afterwards, when the black dots appear, it has passed into the *Erysiphe* condition, the dots representing the globose receptacles enclosing the fruit. These conceptacles are attached by delicate threads to the mycelium, and above these, in a circle around the receptacle, are ranged a circle of radiating arms or appendages, usually six or seven, standing out from the sphere. These are tawny below and colourless above, divided in a forked manner three or four times at the apex. Each receptacle contains a pear-shaped hyaline sac, or ascus, which holds the eight ovate sporidia. The variety which occurs upon Cherry leaves differs chiefly in having from eighteen to twenty appendages around the receptacle.

This is an epiphyte, and hence, like many of its kindred, may be amenable to the sulphur treatment.

Common through the whole of Europe and North America.

Sacc. Syll. i. p. 3; *Cooke Hdbk.* No. 1916, fig. 315; *Cooke M. F.* p. 239.

Cherry Brown Rot.

Monilia fructigena (Pers.), Pl. X. fig. 12.

This is the same disease which has been referred to in connection with the Apple, and also as the Apricot brown rot. However it rarely attacks Cherries in this country, although prevalent in the United States.

For fuller details see "Apricot Brown Rot," p. 135.

Cherry-leaf Spot.

Coryneum Beijerinckii (Oud.), Pl. XI. fig. 22.

The attacks of this fungus have been recognised in at least two different ways—in one as a leaf parasite and in the other as the main cause of gummosis. Under the former aspect it has been found on Cherry, Peach, Apricot, Almond, and Plum. In the spring the young leaves are found to exhibit red or rosy spots on the under surface as well as on the young shoots. Later on the tissue in such places turns brown and dies, when the fungus appears in minute black dots which are grouped on the dead spots, and in these the conidia are produced.

The dots, or pustules, are at first developed beneath the cuticle, forming compact discs, which are at length erumpent. The conidia are seated upon a kind of cushion or stroma, crowded together, and are oblong, pale olive, with three septa ($28-32 \times 11-13\ \mu$) on hyaline pedicels.

Later in the season a second form of fruit appears, and ultimately it is believed that another form appears, which has been called *Ascospora Beijerinckii*, wherein the spores are enclosed in asci.

This disease has been recognised in the Netherlands as well as in Britain.

No remedies have yet been pronounced successful, but probably spraying at the earliest period when there is any indication of the presence of the disease may be effectual.

Sacc. Syll. iii. 4058; *Mass. Pl. Dis.* 294.

Gummosis.

Gummosis is not by any means a new or uncommon disease, which has been attributed to various causes and latterly to the presence of a

FIG. 17.—TWIG OF CHERRY INFESTED WITH GNOMONIA ERYTHROSTOMA.

fungus under the name of *Coryneum Beijerinckii*. Whatever may be the cause the remedy has not yet been found.

It is contended on behalf of those who advocate the *Coryneum* theory that the disease may be communicated by inoculation; but the presence of mycelium or even more advanced fungoid growth in the morbid spots is extremely probable, apart from any active participation in the disease. Unfortunately the disease is common enough, but the presumed fungus is so rare that only one or two persons have professed to have seen it in this country. It must be remembered also that the species of *Coryneum* otherwise known are saprophytes, and the presumption is strong against the assumed cause of gummosis.

Massee contends that the cause of gummosis in *Prunus japonica* may be traced to the action of *Cladosporium epiphyllum*.

It is recommended that diseased branches should be removed or collar pruning resorted to. The soil around the trees may be treated with quicklime on the surface to destroy conidia in the soil.

Gard. Chron. Mar. 29, 1884; 1891, fig. 68; *Kew Bulletin*, 1899, p. 1, plate; *Mass. Pl. Dis.* 306, fig. 82; *McAlpine Fung. Dis.* p. 67.

Witches' Broom of Cherry.

Exoascus Cerasi (Fckl.).

Those peculiar malformations, which are known under the name of witches' brooms, are not uncommon on various trees, and amongst them the Cherry. Under these attacks the disease shows itself in the production of dense tufts of branches, growing apparently from a central point, and forming a bunch like a besom, which is very common on the Birch.

This malformation is caused by the presence of a fungus similar to that which causes the leaf curl of the Peach, and which appears as a hoary bloom on the branches. The vesicles, or asci, which contain the sporidia are slender and club-shaped ($30–50 \times 7–10\ \mu$), enclosing the nearly globose sporidia ($6–9 \times 5–7\ \mu$). These asci are supported at the base upon a distinct stem-cell ($10–16 \times 5–8$ or $3–5\ \mu$), which is divided off from the ascus by a transverse septum.

Known also in Germany, where it was first recognised and described.

The only known remedy is to cut out the tufts and burn them.

Sacc. Syll. x. 4734; *Tubeuf, Dis.* p. 163, figs.; *Mass. Pl. Dis.* 89, 358.

Cherry-leaf Scorch.

Gnomonia erythrostoma (Awd.), Pl. XI. fig. 19.

This disease sometimes makes it appearance in Cherry orchards in great numbers and proves destructive to the crop.

The leaves are attacked and soon present a scorched appearance, withering, but hanging on the tree through the winter. Long slender colourless curved conidia are produced, and in this condition it is known as *Septoria pallens*.

During the winter another and final stage is attained by the fungus produced on the dead hanging leaves (*Gnomonia erythrostoma*). In this condition the receptacles are immersed in the substance of the leaf, with a short beak, or ostiolum, which pierces the surface. Within the receptacle cylindrical cells, or asci, are produced, each of which contains eight elliptical sporidia, which are colourless and divided by a central septum into two cells (18×5–$6\,\mu$), each cell enclosing two guttules, and terminated by a curved hair-like appendage, which soon falls away. (Fig. 17.)

Known in Germany, Switzerland, and Italy.

All the dead hanging leaves should be collected and burnt. Frank says that in one district in Prussia this method was carried out for two seasons, after which the Cherry crop, which had been ruined, was restored.

Sacc. Syll. iii. 2637, i. 2214; *Mass. Pl. Dis.* p. iii. fig. 19; *Journ. R.H.S.* xxv. 1901, p. 313, fig. 162, xxvii. p. 1140; *Tubeuf, Dis.* 222.

Shot-hole Fungus.

Several species of leaf-spot have been recorded in Australia, and elsewhere, attacking leaves of Plum and Cherry, forming round spots, the dead tissue of which soon falls out and leaves a round hole in the leaf.

American shot-hole fungus (*Septoria cerasina*) occurs on Plum and Cherry leaves, and has strongly curved conidia (50–75 μ long).

Another shot-hole fungus (*Cylindrosporium Padi*) having curved filiform conidia (48–$62 \times 2\,\mu$) occurs also in the United States.

An Australian shot-hole fungus (*Phyllosticta prunicola*) affects the leaves of Apple, Plum, and Cherry in similar manner in Italy, and extends to Australia ($5 \times 3\,\mu$).

The genuine Australian shot-hole (*Phyllosticta circumscissa*), as it claims to be, attacks Cherry and Peach leaves ($8 \times 2\,\mu$).

Besides which a white mould (*Ovularia circumscissa*) is credited with forming similar shot-holes in Cherry leaves in Russia (15–18×6–$7\,\mu$).

And a black mould performs the same office (*Cercospora circumscissa*) upon Plum leaves in the south of Europe, in the United States, and in Australia ($50 \times 3\frac{1}{2}$–$4\,\mu$, 3–4 septate).

Still another shot-hole fungus, and one of the most common in Australia, is a black mould (*Clasterosporium carpophilum*) on Peach, Almond, Cherry, and Apricot ($54 \times 14\,\mu$, 4–5 septate). This is known also in Italy, Switzerland, Austria, and Portugal.

Strange that none of these should yet have paid a visit to Britain.

McAlpine Fung. Dis. p. 33.

A shot-hole fungus has been found lately, several times affecting Peach leaves in this country, but not having seen it ourselves we are unable to determine the precise species of fungus implicated.

A correspondent (*Gard. Chron.* Oct. 14, 1905, p. 282) states that he has used Campbell's Sulphur Vaporiser with good effect, but was not successful by spraying with Bordeaux mixture.

American Black Knot.

Plowrightia morbosa (Sacc.).

Although this is an American disease, unknown in Europe, it is the worst enemy of the Plum and Cherry in the United States. It forms black rough excrescences on the branches, often several inches in length.

At first the branch swells, which is followed by a longitudinal cracking and gaping of the bark. Then the surface is covered with a dark olive velvety coating of mould, which produces the conidia.

Later on in the season the olive mould disappears, and a thick outgrowth of fungus mycelium succeeds, which produces a stroma, or bed for the ensuing fungus. During the winter, cavities are formed in this stroma, and these contain cylindrical sacs, or asci, closely packed together, each enclosing eight sporidia, which are oblong, unequally two-celled ($16–20 \times 8–10\ \mu$).

As it is confined to the United States we must leave with the sufferers to adopt the best means at their disposal to exterminate the pest.

Farlow, Bull. Buss. Inst. 1876, p. 440, plates; *Sacc. Syll.* ii. 5295; *Mass. Pl. Dis.* p. 137, fig. 26.

Cherry-tree Valsa.

Valsa leucostoma (Fr.).

Cherry-trees along the Rhine have shown signs of decay, the trees having suffered through late frosts exposing them to the attacks of a sphæriaceous fungus, long known as a saprophyte under the name of *Valsa leucostoma*. Cutting away the branches affected and putting tar over the wound has been effective.

Journ. R.H.S. xxviii. p. 242.

Peach Rot, or Anthracnose.

Glœosporium læticolor (Berk.), Pl. XI. fig. 20.

This disease attacks the mature fruits and produces depressed spots which are whitish in the centre with a blackened margin. The pustules are circularly arranged towards the centre, and are rosy, seated beneath the cuticle. The conidia, which are produced in the pustules, are oblong, with the contents retracted at each end, oozing out when mature in pale rosy tendrils ($16–17\ \mu$ long).

The same disease is credited with attacking Figs when approaching maturity, although some writers have suggested that the species which attacks Figs is the same as that which attacks Apples and Grapes (*Glœosporium fructigenum*). The difference between them is mainly in the size of the conidia, whilst the precautions and remedies remain the same.

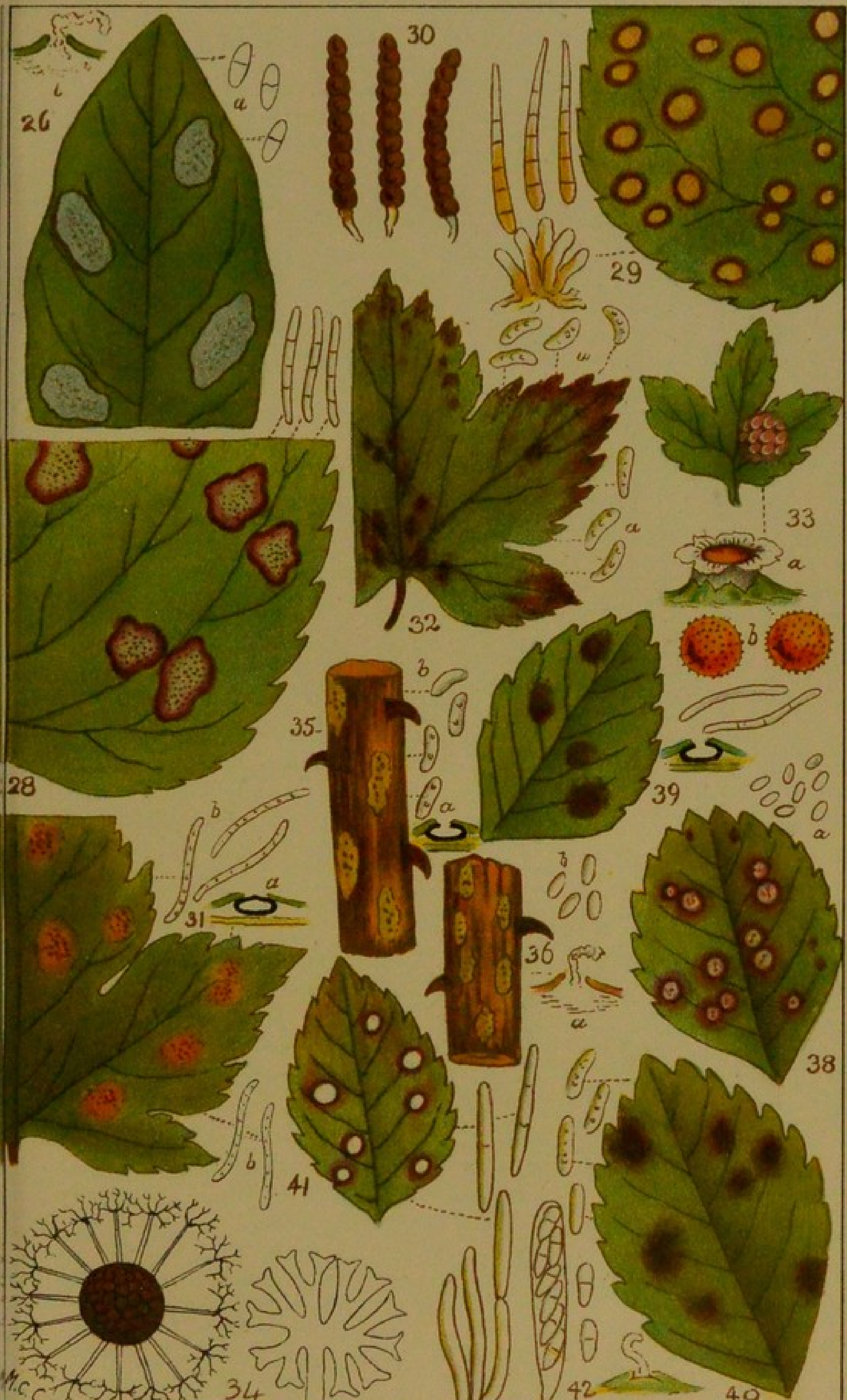
All the species of "Anthracnose," as they are termed in America, are dreadfully injurious, and are recognised as the most persistent of pests. This is possibly the same species as *Glœosporium fructigenum*.

Sacc. Syll. iii. 3753; *Gard. Chron.* 1859, p. 604, and December 6, 1890; *Cooke Hdbk.* No. 1410; *Thüm. Pom.* p. 57.

Peach Rust.

Uromyces Amygdali (Pass.), Pl. XI. fig. 21.

When the rust on the Peach leaves was first submitted to us we declined to regard it as any form of *Puccinia Pruni*, and accepted the name given by Passerini of *Uromyces Amygdali*. We are concerned with



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the rust of Peach leaves and not now with the usual form on the leaves of Plum, and it is our pleasure to treat them as distinct diseases.

The underside of Peach leaves is liable to be affected with a rust the pustules of which are small and numerous. The cuticle is soon split, and the spores scattered as a fine rust-coloured dust. The form of these spores is quite unusual for those of a uredo, but approaching the type which is common in the teleutospores of *Uromyces*. They are considerably elongated, swollen in the middle, and almost bluntly lance-shaped, quite smooth externally, with the coat of the spore considerably thickened at the apex, and continued at the base into a rather short thick pedicel (35–40 × 12 μ). In fact, more like the teleutospores of *Uromyces* than the uredospores of *Puccinia*.

Latterly it has been suggested that these *Uromyces* spores are a third kind of spore, called "amphispore," constituting the cycle of *Puccinia Pruni*, several instances now being known in which uredospore, amphispore, and teleutospore are produced in succession.

This rust is more common in the United States than it is with us but it is found also in Southern Europe and in Australia.

Cooke in Rav. Fungi Exsicc.; Cooke Hdbk. Austr. Fungi, No. 1734; see also *Gard. Chron.* Dec. 17, 1904, p. 418.

Peach-leaf Blister.

Exoascus deformans (Berk.), Pl. XI. fig. 23.

Peach-leaf blister is such a common affection that a description is scarcely necessary. Sometimes aphides or other small creatures may produce somewhat similar appearances, but the real Peach blister is an established fact.

The leaves are puffed up, blistered, and contorted in a variety of ways, and this disfigurement will proceed until it spreads gradually over the entire tree unless it is checked at once.

The under surface of the leaves, in the hollows of the blisters, assumes a hoary or frosted appearance, and when examined under the microscope is found to consist of a number of cylindrical cells formed of a transparent membrane closely packed together side by side, each cell or ascus containing the elliptical sporidia (7 × 5 μ) in the same manner as in the Pear blister and in the Plum pockets.

This disease is sometimes called the "curl," from the curling and distortion of the leaves.

Diseased or fallen leaves should be burned. Branches bearing diseased leaves should be pruned back beyond the point of infection. The disease is rampant if the leaves receive a sudden check from fall of temperature. Activity of the disease has been checked by a sudden increase of temperature.

Known in France, Germany, Belgium, Sweden, Austria, Italy, North America, South Africa, Algeria, Australia, China, and Japan.

Gard. Chron. July 9, 1887; *Mass. Pl. Dis.* 82, fig. 11; *Cooke Hdbk.* No. 2233; *Berk. Outl.* p. 376, t. i. f. 9, a. 6; *Sacc. Syll.* viii. 3341; *McAlpine Fung. Dis.* p. 13; *Journ. Q.M.C.* 1904, p. 58; *Journ. R.H.S.* xxix. p. 856; *Gard. Chron.* May 13, 1905, p. 294, fig. 121.

Peach Freckle.

Cladosporium carpophilum (Thüm.).

This disease is known in the United States as "scab" or "black spot," and was first observed in Austria in 1877, but has not been recognised anywhere else in Europe, although known in the United States and Canada and New South Wales, and is said to spread rapidly when once introduced.

The fungus is a kind of black mould which attacks ripe Peaches, forming minute round spots or freckles, which are greenish, then brownish or olive. Finally the spots run together and form a brown crust, causing the fruit to crack, shrivel, and decay. It has also been observed on the foliage. The spots are orbicular, and the threads short and slightly branched or simple, with pale ovate conidia, which are rarely septate ($20 \times 5\ \mu$).

So nearly allied to the "Apple scab" that similar treatment is recommended.

Sacc. Syll. iv. No. 1675; *Mass. Pl. Dis.* 310; *McAlpine Fung. Dis.* 49, pl. vii.

Peach-spot Mould.

Helminthosporium rhabdiferum (Berk.), Pl. XI. fig. 24.

This disease first attacked the Barrington Peach in 1864, but has never spread much since that time or proved of any great importance.

Shallow pits, about half an inch in diameter, appear on the surface of the fruit the centre of which is occupied by a dark mould bearing a profusion of spores, so as to blacken the fingers when touched. The mycelium penetrates deeply into the fruit, which if not gathered in good time becomes useless. The mycelium consists of more or less waved articulated threads which give off here and there stouter erect threads, with shorter joints, branched slightly above and producing at the tip of each joint a large spore. The spores, or conidia, are at first oblong and pale, showing one or two transverse septa. These rapidly acquire a dark tint, elongate, become more or less linear, and consist of from seven to eleven swollen divisions, of which the terminal one is mostly apiculate. Each division contains a few minute oil granules (50–80 μ long). After the spores have fallen they frequently split in the centre and give out a globular body, which is in all probability reproductive.

We strongly suspect that this fungus is not a true parasite, but made its appearance subsequently, and was not the cause of disease.

Gard. Chron. 1864, p. 938, fig.; *Cooke Hdbk.* No. 1726.

The "frosty mildew" caused by *Cercosporella Persicæ* has been known in America since 1890 on Peach leaves.

Peach Yellows.

This is one of the most mysterious of plant diseases, and although it has been known to occur in the United States for at least a century it has not found its way into Europe. In recent years "thousands of young and thrifty trees have been destroyed by it, and Peach growing has been abandoned in several parts of the country where formerly there were large and profitable orchards." The earliest symptom is the premature ripening of the fruit; then diseased dwarfed growths appear on the trunks and limbs. The limbs attacked are badly diseased the second year, the entire growth being stunted and of a sickly green tinged with yellow. After this they may languish for a few years, and then die gradually from the extremities downwards. All efforts to discover fungoid mycelium has failed, and it is only recently that the disease has been attributed to microbes. In 1889 Professor Burrill intimated that he had found "in the tissues of the root and of the old and young stems of diseased trees an organism classed with the bacteria which is not known to occur elsewhere. This organism has been frequently obtained by method of cultures under circumstances which preclude the possibility of its coming from anything except the inner cells of the tree. He had it growing in artificial media, and it exhibited all the peculiarities of a pathogenic rather than a saprophytic microbe. He found it in every set of specimens which he examined, known to be affected by the disease, and has thoroughly tried in the same manner to find it in healthy stock and failed."

Almond Twig Fusicoccum.

Fusicoccum Amygdali (Del.).

This disease has appeared in France, as pustules on living twigs of Almond-trees, breaking through the bark, and dispensing conidia $6 - 7\frac{1}{2} \times 2\frac{1}{2} - 3\,\mu$, allied to those of the common red *Tubercularia*.

Bull. Soc. Myc. de. Fr. xxi. fasc. 3, p. 180, fig. 4.

Silver Leaf.

Stereum purpureum (Fries).

This disease has been known as affecting fruit trees in this country for fully a quarter of a century, and has puzzled mycologists and pathologists to account for the cause. Recently Professor Percival has conducted some experiments which he considers will demonstrate that the disease is caused by a wound parasite, which in its fully developed form is a hymenomycetal fungus called *Stereum purpureum*.

At the same time it has been affirmed on good authority that several Horse Chestnut trees in Greenwich Park have been killed by attacks of this same fungus, which has, at any rate, been developed freely on the dead bark.

Attacks Plum, Peach, and Apricot trees.

We must still regard ourselves as sceptical as to whether the *Stereum* is the cause of "silver leaf," or the presence of too much nitrogen in the soil.

Sacc. Syll. Hym. ii. 7284; *Cooke Hdbk.* No. 910; *Journ. Linn. Soc., Bot.* xxxv. p. 390, pl. x. 1902; *Journ. R.H.S.* xxvii. (1902), p. 712; xxviii. 1904, p. clxxiv; *Gard. Chron.* Aug. 12, 1905, p. 111.

Apricot Brown Rot.

Monilia fructigena (Pers.), Pl. X. fig. 12.

This disease attacks indiscriminately a number of pulpy fruits, the Apple and Pear in this country, and the Cherry and Apricot in the

United States. In 1864, which was a very dry season, the Apricots in many gardens were attacked. Fruits were in some cases spotted whilst quite green, in other cases the attack did not seem to take place till they

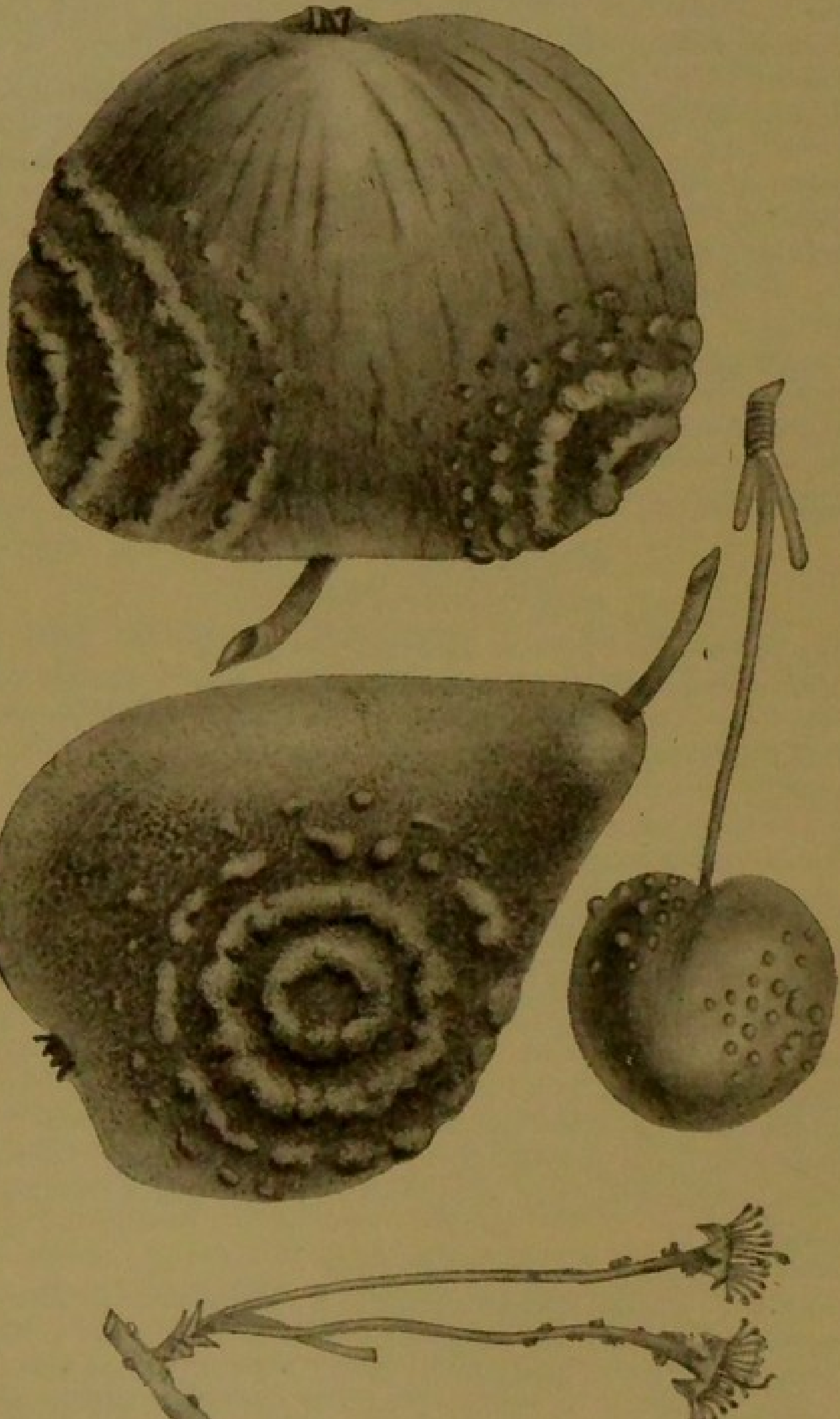


FIG. 18.—BROWN ROT OF FRUIT (*Monilia fructigena*).

were nearly ripe. The intermediate or half-ripe condition was apparently that in which the attack was most prevalent. The first indication was a little discoloured brownish spot, very slightly sprinkled with whitish minute tufts of threads, on some of which a solitary spore might be found. The subjacent tissue at this stage is traversed by multitudes of thick, succulent, branched threads. The progress of the disease is rapid, the brown spot increases in size, the centre is occupied by a dense mass of mould consisting of closely set roundish tufts the threads of which bear necklaces of spores, the central ones lemon-shaped, and as the disease spreads the little tufts often assume a concentric disposition. At length the whole fruit gives way, and either drops off or remains attached to the tree, withered and wrinkled, like a large mouldy Plum (conidia $25 \times 10\text{–}12\ \mu$). (Fig. 18.)

The methods hitherto recommended for this disease are to remove and destroy all diseased fruit and to spray the trees, so as to prevent the germination of all the spores which may be adhering to the bark. Dissolve four pounds of sulphate of iron in five or six gallons of water.

Gard. Chron. Aug. 27, 1864; *Mass. Pl. Dis.* 300, fig. 79; *Sacc. Syll.* iv. No. 157; *Cooke Hdbk.* No. 1812; *Tubeuf, Dis.* 497; *Journ. R.H.S.* 1902, xxvi. p. 738, fig. 311; *McAlpine Fung. Dis.* p. 53, pl. viii. fig. 2; *Journ. Q.M.C.* 1904, p. 61.

Walnut Anthracnose.

Marsonia Juglandis (Lib.), Pl. XII. fig. 26.

This parasite on Walnut leaves has long been known in this country, and certainly sometimes appears to take possession of nearly every leaf of a full-sized tree.

The spots appear on the under surface of the leaves, and are large, often irregular in form, being limited by the veins of the leaves, generally of a greyish colour, at length causing the leaves to fall. The pustules are seated on the spots, and are flattened and of a brown colour, at length expelling the mature conidia through a pore or fissure. The conidia are somewhat spindle-shaped, a little beaked at the apex, and divided by a septum across the centre into two cells ($20\text{–}25 \times 5\ \mu$).

It has been recorded in France, Germany, Portugal, and Italy.

Sacc. Syll. iii. 4028; *Cooke Hdbk.* No. 1233.

Fig Anthracnose.

Glœosporium fructigenum (Berk.), Pl. X. fig. 4.

In the year 1864 certain Fig orchards in Sussex were attacked by a disease, so that the whole crop became more or less affected, and the fruits dropped off before they were ripe. On this occasion the fungus appeared as a circular patch of little pustules, which were destitute of any common receptacle, but constituted little cavities which contained a mass of minute hyaline elliptical sporules, or conidia, enclosing a small nucleus at each extremity. When matured the walls of the cell contracted, and the sporules were forced out from an opening at the apex in the form of little tendrils.

We have referred to this same disease previously as attacking Apples, and must revert to it for any additional information.

Gard. Chron. 1856, p. 245, Aug. 27, 1864; *Mass. Pl. Dis.* p. 281; *Cooke Hdbk.* No. 1411.

Fig-tree Canker.

Libertella ulcerata (Mass.).

This is a disease which has recently been recognised as causing cracking and canker in the bark of Fig trees and shelling off large patches as the disease progresses.

The fruit of the fungus is produced within minute cavities of the bark, and the very small conidia ooze out to the surface like fine hairs, which are composed of conidia stuck together by a tenacious gluten which becomes dissolved by moisture and liberates the exceedingly small conidia. These conidia obtain an entrance into the bark through wounds, and thus the disease is spread.

It is recommended that all wounded surfaces should be coated with tar at once. By no means should any knife be used in pruning or trimming which has been employed in cutting out diseased parts until it has been cleaned and disinfected, as a knife with adhering germs has been known to infect a healthy tree.

Gard. Mag. July 23, 1898, fig.; *Mass. Pl. Dis.* 292.

Fig Grey Mould.

Botrytis cinerea (Pers.).

Only recently we have been made acquainted with the serious injury inflicted on green Figs by the attacks of a grey mould, which it is difficult to distinguish specifically from *Botrytis cinerea*. The mould appears in grey velvety patches at the apex of the fruit, being preceded by a softening and rotting appearance of the tissues, which are soon reduced to a pulpy mass. No trace of sclerotia has yet been observed.

The sterile hyphæ are creeping, interwoven; the fertile are erect, gregarious in broad patches, of a greyish colour, either simple or sparingly branched, with several short simple or divided branchlets near the apex, septate, a little constricted at the septa, smoky-brown (about 12–14 μ thick); conidia broadly elliptical or almost subglobose, nearly colourless (10–12 μ diam.), collected in somewhat globose heads.

It is hopeless to dream of saving the fruit when once attacked, but all diseased fruits should be burnt at once to prevent diffusion of the conidia. Spraying uninjured fruit may save them from attack.

Mass. Pl. Dis. 380; *Cooke Hdbk.* No. 1801.

Mulberry-leaf Spot.

Phleospora Mori (Lev.), Pl. XII. fig. 28.

Mulberry leaves are sometimes marked by rather large irregular spots or bleached tissue circumscribed with a definite border line of brown. The spots themselves are pale, either dirty white or tinged with ochre. Scattered over the upper surface of the spots numerous black dots indicate the small globose receptacles sunk into the substance of the leaf.

Within these receptacles are produced the elongated cylindrical conidia or sporules, which are curved, rather obtuse at the ends, and divided across by three septa, or occupied by four guttules, or nuclei, entirely colourless, and at first growing from short sporophores, or pedicels (40–50 × 4 μ).

First observed in this country at Clevedon, and since then has been found in several localities. At one time the theory was promulgated in France that this disease of the leaves was the cause of "muscardine," or silkworm disease, but for lack of evidence the theory soon gave way.

Trees when once attacked continue to suffer year after year with increasing energy. Cold weather appears to check it, but in warm seasons it extends rapidly.

The disease is known in France, Italy, Germany, Austria, and Russia.

Sacc. Syll. iii. 3136; *Grevillea*, vi. p. 72, xiv. 104; *Gard. Chron.* Nov. 1877.

MULBERRY-LEAF BLIGHT.

Cercospora moricola (Cooke), Pl. XII. fig. 29.

Nearly at the same time that the Mulberry spot appeared in this country another disease was found affecting the leaves of the Mulberry tree both in this country and in the United States. It belongs to a genus of black moulds which are really very persistent in their attacks and very troublesome to the cultivator, but not likely to be of so much importance to us as to countries where the leaves are required in connection with the silkworm industry.

The spots occur on both surfaces, and are orbicular, of a reddish-brown colour. Upon these spots are produced tufts, or bundles, of short olive threads, which burst through the cuticle and produce at the apex of each thread a long narrow spore, or conidium, which is three or four septate, and narrowed towards one end (70 × 3 μ).

No experiments have been made to control this disease, as in its present development it cannot affect the production of fruit.

Sacc. Syll. iv. 2281; *Grevillea*, xii. p. 30.

MULBERRY BLACK MOULD.

Clasterosporium parasiticum (Cooke), Pl. XII. fig. 30.

When the Mulberry-leaf spot was first found in this country it was accompanied by another fungus of a very different character, which appeared to be parasitic upon the same spots. Nearly every spot had its centre blackened by some parasite, which it was ultimately found had no relation whatever to the original disease.

This fungus consisted of cylindrical spore masses with a short stem and almost always obtuse apex divided by numerous septa, and constricted at the joints so as to be torulose, or with a beaded appearance; of a clear brown colour when mature, and not unlike a caterpillar in miniature.

We have inserted this visitant here, not because we retain any suspicion that it will prove to be a pest, but as a guide to its identification should it accompany the leaf-spot again, and in order to secure more definite assurance that it is only a saprophyte on the dead tissue of the spots.

Grevillea, vi. p. 74, with fig.

Hazel-leaf Mildew.

Phyllactinia suffulta (Sacc.).

Filberts being cultivated to a considerable extent as a table fruit, the shrub will fall more naturally into position here than in the shrubbery. The name by which the mildew was known for very many years was *Phyllactinia guttata*, but it has since suffered in the lust for change.

The under surface of the leaves is frequently covered with a delicate white mildew consisting of a creeping interwoven mycelium of thin threads with short erect branches bearing conidia. In the course of time the little dark globose receptacles make their appearance, scattered over the surface of the mildew. These little conceptacles are encircled by a ring of spine-like, pointed, divergent appendages with a swollen base, which stand around and guard the receptacles.

Each receptacle encloses from four to twenty hyaline pouches, or asci, which contain the sporidia, of which there are usually two, sometimes three or four in each ascus (40–50 × 22–25 μ).

This is one of the superficial fungi to which it is believed that the application of sulphur is beneficial, as in the case of the Hop mildew.

Sacc. Syll. i. No. 13 ; *Mass. Pl. Dis.* 98, 361, fig. 16 ; *Cooke M. F.* xi. figs. 219, 220 ; *Cooke Hdbk.* No. 1912 ; *Tubeuf, Dis.* 179, fig.

Hazel-leaf Spot.

Septoria Avellanæ (B. & Br.).

This leaf-spot was recorded by Berkeley, but does not appear to be of very common occurrence. The receptacles are found on the under surface of the dry and bleached parts of the leaves, but the sporules are rather anomalous in size and form for this kind of spot, since they are fusiform and curved (10 μ long).

The species has also been observed in Italy.

Grevillea, v. p. 56 ; *Sacc. Syll.* iii. 2717.

Hazel-leaf Blotch.

Gnomoniella Coryli (Batsch).

This fungus has long been known on Hazel leaves, and has had its name changed a great many times. It occurs on the living leaves in black shining raised patches on the under surface, resembling little drops of pitch. Each cluster is composed of several receptacles arranged in a circle and immersed in the black stroma, with long projecting necks, each neck surrounded by a white fringe-like collar.

Within the receptacles are a series of cylindrical tubes, or asci, which enclose the sporidia, eight of which are contained in each tube, and each one is colourless and oval, without any division (7 × 3 μ).

When these leaves fall to the ground the sporidia soon arrive at maturity, and are discharged to fulfil their duty in the perpetuation of the species.

There is an earlier and imperfect stage (*Leptothyrium Coryli*), in which the sporules are free in the receptacles ($18 \times 2\ \mu$), but the precise nature of their relationship is not distinctly known.

Sacc. Syll. i. 1590; *Cooke Hdbk.* No. 2736; *Tubeuf, Dis.* 224.

The above is not common enough or harmful enough to cause the least anxiety.

Root Fungi.

It has been known for the past fifty years—and Berkeley was continually reverting to it, and asserting it, in the pages of the *Gardeners' Chronicle*—that the white fleecy mycelium often seen about the roots of orchard trees was injurious to them; that it originated from dead stumps and buried wood, and attacked the roots of living trees when it was no

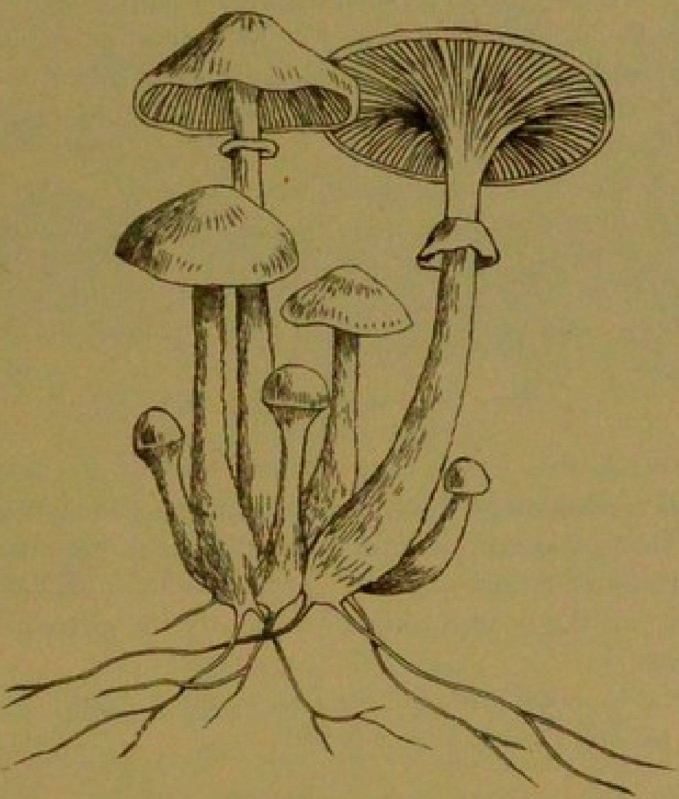


Fig. 19.—Tree-root Rot (*Armillaria mellea*).

longer a saprophyte, but became a parasite and crept up between the cortex and the wood, and ultimately killed the tree. This is now more generally acknowledged to be true, whatever the ultimate development of the mycelium might be, possibly some Agaric, and that dead wood and dead roots left in the soil when young trees are planted will sooner or later prove the source of great injury and destruction. It has been left to more recent times to demonstrate that mycelium which originally, and in ordinary cases, was only a saprophyte could under favourable conditions become a dangerous parasite.

Under such circumstances it will be seen that trees should never be planted in soil which contains the remains of dead stumps or dead roots, and whenever growing trees are discovered with this mycelium at the roots they should be removed and the soil sterilised before it is planted again. Diseased roots, if not too far infected, should be cleaned and pruned before replanting, and well washed with some fungicide, when, in some cases, they may possibly recover; otherwise they should be burnt forthwith.

Journ. R.H.S. xxix. 1904, p. xliv.

Orchard Agarics.

Armillaria mellea (Vahl).

This very common Agaric grows in large clusters at the base of stumps and old trees, and often in orchards where the mycelium extends to and becomes parasitic on growing trees, causing great mischief.

The fungus grows in dense clusters with a pale honey-coloured pileus or cap, two to three inches across and a paler stem four to six inches long, with a distinct collar or ring surrounding the stem above the middle and a profusion of white spores, which fall and settle on surrounding objects as a dense white powder. (Fig. 19.)

The black strands of mycelium, thick as fine twine, and known as "rhizomorphs," are well known, and generally belong to this Agaric.

Sacc. Syll. vi. 289; *Mass. Pl. Dis.* p. 202, fig. 47; *Cooke Hdbk.* No. 36, fig. 36; *Cooke Illus.* pl. 32.

Pholiota squarrosa (Müll.).

Dense tufts of this Agaric may often be seen at the base of trunks in orchards, and is capable of doing great injury by the mycelium becoming parasitic. The Agaric is similar in size and form to the above *Armillaria*, but both cap and stem are yellowish brown, densely clad with projecting brown scales, and the spores, and consequently the gills, are brown. The smell is strong.

Sacc. Syll. vi. 3093; *Mass. Pl. Dis.* p. 208; *Cooke Hdbk.* No. 297; *Cooke Illus.* pl. 367; *Sow. Fung.* t. 284.

Tinder Polypore.

Fomes fomentarius (Fries).

It is strongly contended by some writers that the woody Polypores which are common mostly on forest trees will attack fruit trees as wound parasites, and compass their destruction. One species is found sometimes on fruit trees, which become as hard as a wooden log. In shape it somewhat resembles a horse's hoof, with a smooth upper surface of a dark brown colour attached firmly by the back, so as to project like a bracket. The under surface is almost flat, or a little concave, pale, and punctured with minute pin-holes or pores close together all over the surface. These pores contain the spores, which are snuff-coloured and profuse, so that they fall when mature on all surrounding objects like snuff. This is a wound parasite, the spores finding an entrance into its victim tree through a wound, and afterwards developing on the surface.

One of these wound parasites is *Fomes fomentarius*, which is common on Beech trunks and occasionally on fruit trees. All such fungi should be cut away and the wound dressed with gas tar. (Fig. 20.)

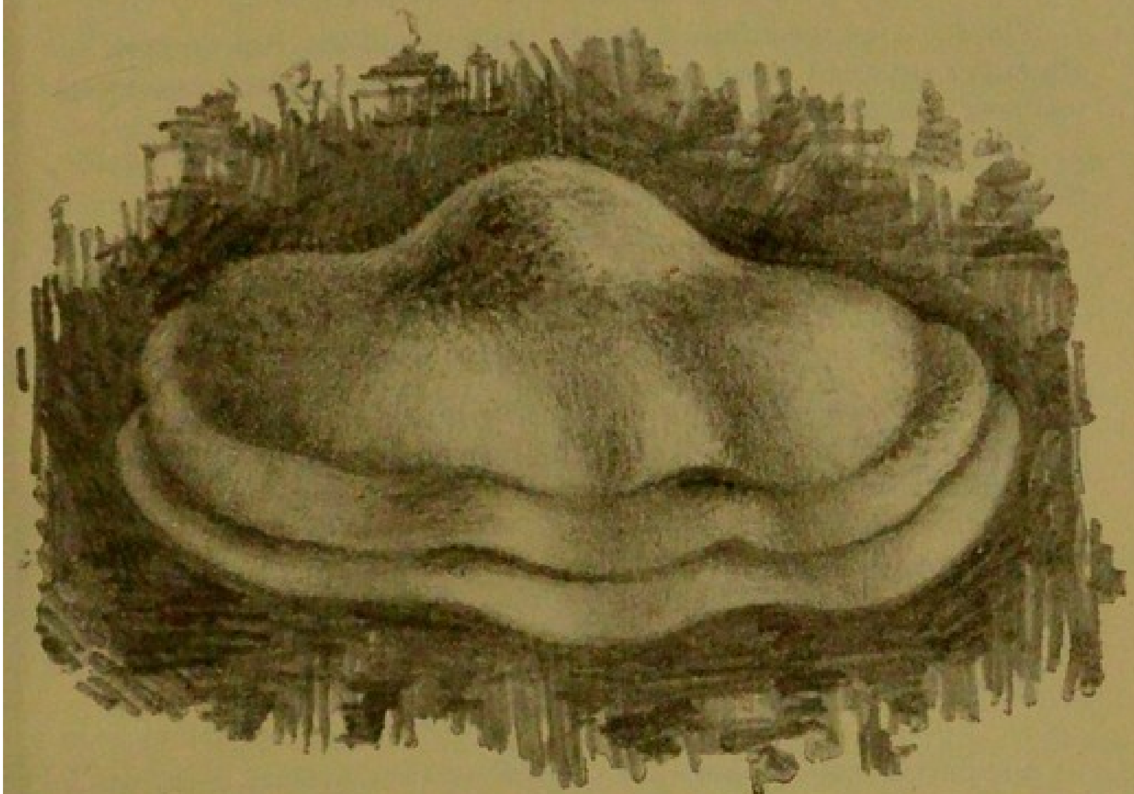


FIG. 20.—FOMES FOMENTARIUS.

The woodcut is not by any means a good characteristic figure.

Sacc. Syll. Hym. ii. 5409; *Cooke Hdbk.* No. 776; *Journ. R.H.S.* xxvi. (1902), p. 734, fig. 308; *Mass. Pl. Dis.* 185, 392.

CURRANT-LEAF SPOT.

Septoria Ribis (Desm.), Pl. XII. fig. 31.

This spot appears to be confined to the living leaves of the Black Currant, and is certainly common enough. The spots are small and irregular, brown then purplish, sprinkled with the minute dots of the innate conceptacles which are covered by the cuticle, which are exceedingly small, with a minute pore at the apex, through which the mature spores are ejected in a roseate tendril. The spores, or conidia, are very long and thread-like, curved, containing a row of guttules (50 μ long).

In common with most kinds of leaf-spot, this affection is treated generally with great indifference, the general impression being that it only affects the leaf upon which it grows, and does not in any way influence the general health of the bushes.

Known in France, Germany, and the United States. In New Zealand it is known as the Gooseberry rust. "After the crop is off Bordeaux mixture may be used, and should be again applied, full strength, before the buds break, early in the following season as a preventive. All leaves to be raked up and burned."

Sacc. Syll. iii. 2649; *Cooke Hdbk.* No. 1338; *Grevillea*, xiv. 76; *Journ. R.H.S.* xxv. (1900), p. 143, fig.

Currant Bleached Spot.

Phyllosticta ribicola (Fr.).

The spots are sometimes found on the leaves of the Red Currant, and are rather large and bleached, with a number of minute black conceptacles scattered over the surface like pin-points.

The conidia are simple and small, oblong and colourless (15–17 μ long).

Sacc. Syll. iii. 82.

Gooseberry-leaf Spot.

Phyllosticta Grossulariæ (Sacc.).

The spots on the leaves of the Gooseberry are similar to those on the leaves of the Currant, but smaller, and with a circumscribing brown line. They differ also in the smaller sporidia, which are not more than one third the length of the foregoing (5–6 $\times$ 3 μ).

This species is known in most parts of Europe and also in North America, but is treated as though it were regarded as practically harmless.

Sacc. Syll. iii. 83.

Another Gooseberry leaf-spot (*Ascochyta Grossulariæ*) is known in Europe with apparently two-celled conidia.

Currant Anthracnose.

Glœosporium Ribis (Lib.), Pl. XII. fig. 32.

Although this species of leaf-spot is tolerated without complaints, it is sufficiently common, but not so injurious as most species of Anthracnose. It generally affects the leaves of the Red or White Currant, on which it produces circular spots, sometimes confluent, and wholly brownish in colour. The pustules appear on the upper surface of the spots, concealed beneath the cuticle, being somewhat flattened and of a darker reddish-brown externally, but whitish within, and without any true conceptacle. The mass of spores is whitish, and is ejected when mature through a central opening in the cuticle. The conidia, or sporules, are oblong and curved (10 $\times$ 5 μ). In wet weather they may be seen oozing out in a tendril through the aperture in the cuticle.

It is bad policy to treat any of the species of Anthracnose with contempt, seeing that they may give trouble at any time should a favourable season occur; and it has proved to be very far from harmless in the United States, where the remedy recommended is spraying with one of the copper solutions.

Sacc. Syll. iii. 3694; *Mass. Pl. Dis.* 286; *Cooke Hdbk.* No. 1235.

Glœosporium curvatum, known in Holland on Black Currant leaves, has larger conidia (14–20 $\times$ 5–7 μ).

GOOSEBERRY CLUSTER-CUPS.

Æcidium Grossulariæ (Gmel.), Pl. XII. fig. 33.

These cluster-cups seem to be rather erratic in their appearance, as in some years they can scarcely be found at all. They occur principally on the living leaves or the green fruit.

The spots on the leaves are yellow on one side and reddish on the other, with a yellow border. The cups are clustered in the centre of the spots, and are rather long, with the usual white fringed margin. The æcidiospores are bright orange, produced in chains, but freely separating into somewhat globose spores, with a finely spinulose surface (10–20 μ diam.).

This is one of those fortunate species whose fate is not linked with any *Uredo* or *Puccinia*. Up to now no enthusiast has imagined for it a graminivorous bride, and for the present it has to run its course in single blessedness.

The species is known in France, Belgium, Germany, Lapland, Denmark, Switzerland, Asiatic Siberia, and North America.

Quite recently it has been decided by authority that the proper *Uredo* and *Puccinia* are to be found on the leaves of species of *Carex*.

Sacc. Syll. vii. 2787; *Cooke M. F.* 192; *Gard. Chron.* July 1881, figs. 15–19; *Mass. Pl. Dis.* 95; *Cooke Hdbk.* No. 1620; *Plow. Brit. Ured.* 263; *Gard. Chron.* May 13, 1905, p. 304, fig. 126.

GOOSEBERRY MILDEW.

Microsphæra Grossulariæ (Lev.), Pl. XII. fig. 34.

A little of the Gooseberry mildew appears every year, but it does not always proceed beyond the mealy or conidial stage. The living leaves become whitened and chalky, as in the allied species, from the interwoven mycelium, which spreads over the surface of the leaves. Its occurrence has been most observed in very dry seasons and on both sides of the leaves. The first stage is an *Oidium*, with its chain of conidia.

The receptacles are always few and scattered, being small and globose as usual, and attached to the mycelium by a small bundle of fibres from the base. The circle of appendages which surround the conceptacle consists of from ten to fifteen colourless radiating slender arms, which are forked near the tips, each branch being again forked, and the extremities of all the branchlets split into two teeth, which are pointed, and not thickened as in some other species.

The contents of the mature conceptacles are from four to eight ovate sacs, or asci, each of which encloses four or five hyaline sporidia, so that each conceptacle may contain from sixteen to forty spores.

The mycelium of these mildews does not in the first instance establish itself within the substance of the leaves, and never enters to any appreciable extent. Hence it is an epiphyte, and has only to be destroyed to restore the vigour of the affected plants. It is in this class of diseases that the application of sulphur is likely to prove most beneficial.

Sacc. Syll. i. 40; *Cooke M. F.* 240; *Cooke Hdbk.* No. 1922; *Mass. Pl. Dis.* 95, fig. 15; *Journ. R.H.S.* xxv. (1900), p. 145.

American Gooseberry Mildew.

Sphærotheca Mors-uvæ (Schw.).

This disease has been widely and well known in the United States for scores of years, but only recently has visited Ireland, which entitles it to notice here. As a proof of its virulence, one American writer states: "The mildew of the Gooseberry is the most serious obstacle to the successful culture of the foreign Gooseberry in the United States."

It first makes its appearance on the young half-grown leaves and the unfolding bud of the shoot. Then it has a cobwebby appearance, which soon becomes white and powdery. Soon after this patches may be found on the berries, usually on one side more than on the other. Later on the leaves, petioles, and young stems turn a rusty-brown colour, and become thickly coated with the fungus. The berries at the same time are covered with brown patches of mycelium, which may be readily peeled off.

The conceptacles are developed upon the mycelium in this species, as well as on the Hop mildew, and the sporidia (15 μ long) are in like manner developed within the asci.

Experiments made have shown that as a fungicide in this instance potassium sulphide was far more effective than Bordeaux mixture, lysol, or formalin, using one ounce of potassium sulphide to two gallons of water. Repeat the application every ten days till the fruit is nearly mature.

Sacc. Syll. i. No. 12; *Grevillea,*. iv. p. 158; *Journ. R.H.S.* xxv. (1890), p. 140, fig. 37; xxvii. (1902), p. 596, fig. 166; xxix. 1904, p. 102; *Mass. Pl. Dis.* 97, 362; *Gard. Chron.* Oct. 28, 1905, p. 305.

Gooseberry Polypore.

Fomes Ribis (Fries).

This hard woody *Polyporus* may often be found growing at the base of the stems of old Gooseberry and Currant bushes, and has now the credit of being a true parasite.

It consists of a hard woody pileus, almost hoof-shaped and often several together, one placed above the other, and from two to four inches across. The upper surface convex, yellowish-brown, and when young minutely velvety, but becoming bald and smooth when old, with concentric zones. The under surface nearly plane, and pierced with innumerable minute pores of a brownish-grey colour. When cut in section the fibrous flesh is of a rusty-brown colour.

This fungus is perennial, and lasts from year to year, but is only found on quite old bushes, which may easily be replaced by more youthful successors.

Sacc. Syll. Hym. ii. No. 5427; *Mass. Pl. Dis.* 185; *Cooke Hdbk.* No. 780.

Raspberry Cane Spot.

Phyllosticta pallor (Berk.), Pl. XII. fig. 35.

This spot on the living Raspberry canes was first observed by Berkeley many years ago, and was called *Ascochyta pallor*, albeit the conidia were not two-celled.

Roundish or elliptical paler spots are formed on the canes, over which the dot-like receptacles are scattered immersed in the substance of the spot, which is pierced by the dot-like orifice. Around this opening the substance is a little raised and blackened, so as to form a kind of ring. The conidia are sausage-shaped, narrow and slightly curved, obtuse at the ends (14–18×4–$5\ \mu$).

Has been very little observed, although apparently a true parasite. Hence it is not likely to give trouble, or it would scarcely have rested so long.

Apparently only known in Britain and Holland.

Sacc. Syll. iii. 2206 and 4912; *Berk. Ann. N. H.* No. 193, fig.; *Cooke Hdbk.* No. 1356.

Raspberry cane blight, attributed to *Coniothyrium Fuckelii*, is more or less common in the Raspberry plantations of New York State, causing the plants to die about the time that the fruit is ripening. The fungus is known in Europe.

RASPBERRY ANTHRACNOSE.

Glœosporium venetum (Speg.), Pl. XII. fig. 36.

We are not thoroughly convinced that this Anthracnose has occurred in Britain, although it is well known in Continental Europe, in the United States, and in Australia.

On the leaves it produces large marginal spots of a honey colour, margined by a distinct purplish line; towards the centre of the leaf the spots are smaller and rounded. On the petioles and young twigs the spots are more definitely elliptical and pallid, and on the young canes.

The pustules are without any true receptacle, sunk in the substance of the leaf or stem, and the conidia are produced within these cells, elliptical and colourless (7–8×2–$2\frac{1}{2}\ \mu$), often with two small nuclei, and ejected when mature through a fissure in the cuticle as a gelatinous boss or tendril.

The conidia germinate readily and spread the disease. Young canes are not killed the first season, but succumb on the second, the fruit remaining small and shrivelled. Spraying with sulphate of iron solution and diluted Bordeaux mixture has been recommended. Nothing will save the canes when thoroughly attacked, and the only alternative is to burn and prevent the spread of disease.

Sacc. Syll. iii. 3962; *Mass. Pl. Dis.* 286; *Tubeuf, Dis.* 483.

Raspberry canes are reported in Australia as suffering from attack at the roots of the mycelium of the very common clustered Agaric (*Hypholoma fasciculare*), so plentiful about old stumps in this country.

"Raspberry Cane Blight," see *Journ. R.H.S.* xxviii. p. 288.

RASPBERRY BRAND.

Phragmidium Rubi-Idæi.

This very interesting brand, or rust, of the Raspberry, more often makes its appearance on the wild than upon the cultivated plants. In fact, it never has been an orchard pest, and yet it has been long enough known to have been called by at least thirteen names.

In this stage it is more likely to submit to treatment by fungicides than in the more mature or resting condition.

Sacc. Syll. iv. 988 ; *Sacc. F. Ital.* t. 1006 ; *Mass. Pl Dis.* 107.

Ripening fruits are liable to attack from *Oidium Balsami*, already described (*ante*, p. 84).

Strawberry-leaf Blight.

Sphærella Fragariæ (Sacc.), Pl. XII. fig. 42.

When a spot first appears on a young leaf it is brownish or reddish, then becomes circular with a dead white centre (3–6 mm.) and broad purple border. Subsequently conidia are produced as already described (*Ramularia Tulasnei*), which for some time are produced in succession from the same threads. If these conidia fall on a fresh leaf surface they germinate in a few hours. In the latter part of the season the mycelium becomes compacted into sclerotia, which are capable of germinating and producing a crop of conidia in the spring.

Perithecia are developed in late autumn, but are not matured until the spring, upon the white centre of old spots. Asci are produced within these perithecia, each containing eight oblong colourless two-celled sporidia (15×3–$4\ \mu$).

The fungus passes the winter under three forms: (1) as mycelium in the leaves, (2) as sclerotia developed from the mycelium, (3) as ascospores produced in the perithecia.

The remedies suggested are a solution of sulphide of potassium one ounce to eight gallons of water. Also the copper solutions. Burning of ll spotted leaves which may carry the disease over to the spring.

Known in Europe—in France, Germany, and Italy—as well as in the United States.

U.S.A. Exp. Sta. Cornell, xiv. Dec. 1889 ; *Sacc. Syll.* i. 1951 ; *Mass. Pl. Dis.* 107, fig. 18 ; *Tubeuf, Dis.* 215, fig.

Strawberry Mildew.

Sphærotheca Humuli (DC.).

A white mould on Strawberries was recognised by Berkeley in 1854, when he imagined it was the same species as had been known on Turnips. Afterwards the occurrence of the same mildew in America led to its further investigation, and it was discovered at length to be none other than a form of the well-known mildew of the Hop. In this country only the conidial condition had been seen, which was a simple *Oidium*, somewhat like that of the Vine. On the other hand the perfect fruit was found in America, so that between 1892 and 1898 it became established that the fungus of the Strawberry mildew was that known as *Sphærotheca Humuli* (or, as formerly termed, *Sphærotheca Castagnei*), the cause of the Hop mildew. (Fig. 21.)

In the first stage it attacks the leaves, causing them to curl, so as to appear as if suffering for lack of water. At this time the mycelium spreads over the under surface as a white felted mould, from which arise the short branches which bear the chains of conidia ($30-35 \times 20-24\ \mu$). The mycelium sends suckers into the epidermal cells of the leaf whence to obtain nourishment. Subsequently to its appearance on the leaves the mildew spreads afterwards into contact with the fruit.

Later in the season the second form of fruit is developed, after the manner of the Rose mildew, Pea mildew, and others of its kind. These are in the form of minute globose conceptacles, which become dotted over the mycelium, each containing a single ascus which encloses eight sporidia.

These conceptacles are only sparingly produced, and those generally occur on the petioles of the leaves, and, like those of the vine mildew,

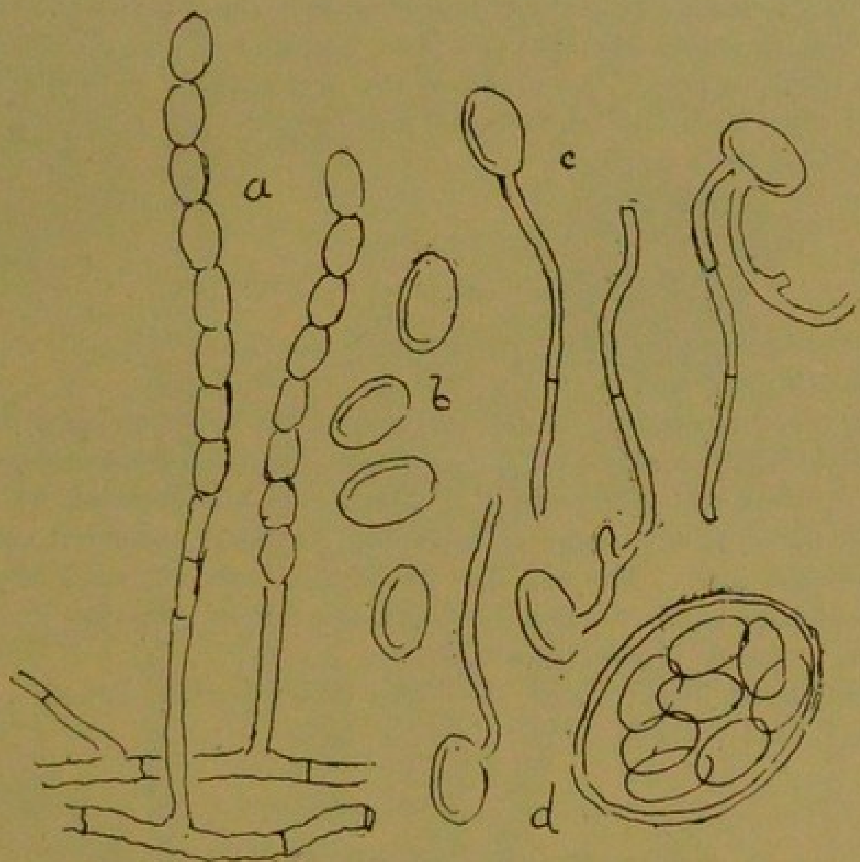


FIG. 21.—SPHÆROTHECA HUMULI.

a. Conidiophores. (× 200.) *b.* Conidia. *c.* Conidia germinating. (× 300.) *d.* Asci and spores. (× 350.)

perhaps in this country not at all. Doubtless the mildew is increasing with us, and complaints are being heard of it in Strawberry-growing localities. Some varieties stand the chances much better than others.

Predisposing circumstances are affirmed to be sudden changes of temperature, especially a decrease during the night or a cool temperature followed by sunny weather.

Experiments made by two fungicides seemed to afford satisfaction, viz. (1) one ounce of carbonate of copper and five ounces of carbonate of ammonia dissolved in a quart of hot water and then mixed with sixteen gallons of water when cold. (2) Dissolving a quarter of an ounce of sulphide of potassium in a gallon of water. Spraying with either of these mixtures is therefore recommended, especially the first; but promptitude must be used whilst the mildew is on the leaves, since it is useless when it has obtained a hold upon the fruit to attempt to save the crop.

Sacc. Syll. i. 8; *Cooke Hdbk.* No. 1911; *Berk. Gard. Chron.* 1854, p. 236; *Journ. R.H.S.* xxv. (1900), p. 132, figs. 35, 36; *Journ. Q.M.C.* 1904, p. 60.

PESTS OF THE VINERY AND STOVE

The two sections of this communication treat of the fungoid diseases (1) of the Vine, and (2) of other plants cultivated in the hothouse. The pests which flourish at this high temperature seldom cause any trouble under other circumstances; but the close, heated, and moist atmosphere of the stove is especially favourable to the development of fungus parasites, and great care should be taken to recognise their earliest appearance, and hold them in check.

Vine Leaf-spot.

Septoria Badhami (Berk.), Pl. XIII. fig. 2.

This is not a common parasite, although we met with it several times about twenty years ago.

It was first recognised in 1853, forming little brownish spots on the leaves, upon which were seated a few of the dot-like conceptacles, which occur in clusters on either side of the leaf. On one occasion we found the spots to be wholly marginal, becoming confluent around the greater portion of the leaf. The conidia, or sporules, are elongated or somewhat club-shaped (35–50 μ long), with a few minute granules, and they appear to be rarely, if ever, septate.

Sacc. Syll. iii. 2581; *Cooke, Hdbk.* No. 1309; *Berk. & Br., Ann. N.H., No.* 748, t. 15, f. 9; *Thüm. Pilz. Wein.* p. 180.

Small Vine Leaf-spot.

Phyllosticta Badhami (Cooke), Pl. XIII. fig. 1.

Not fewer than fifteen other kinds of leaf-spots have been described as occurring on living vine-leaves, in addition to nine species of anthracnose. This is a formidable list, but only one other has occurred in Britain, which answered in external appearance to the above description of *Septoria Badhami*, with the distinction that the conidia, or sporules, were minute ($6–7 \times 2\ \mu$); and, as we issued specimens of it under that name, we have since called it *Phyllosticta Badhami.* (*Journ. R.H.S.* 1878, p. 93.)

The other described species of Vine leaf-spot may be briefly enumerated here, as one or other of them may occur at any time.

Italian leaf-spot, *Phoma Negriana* (Thüm.), on living vine-leaves in Italy, has sporules $5–7 \times 3–3\frac{1}{2}\ \mu$.

Mildew leaf-spot, *Phoma succedanea* (Pass.), on vine-leaves in company with the mildew, has occurred in Italy with sporules $5 \times 2\frac{1}{2}\ \mu$.

PESTS—VINERY.

American mildew leaf-spot, *Phoma ampelogena* (Sacc.), has been found in the United States to follow the American mildew on vine-leaves. Sporules $4 \times 3\ \mu$.

Vine leaf-spot, *Phyllosticta Vitis* (Sacc.), found in Italy on living vine-leaves, with sporules $6 \times 3\ \mu$.

Labrusca leaf-spot, *Phyllosticta Labruscæ* (Thüm.), is an American species, which attacks the leaves of the Labrusca grape. The sporules are large, $9–11 \times 6–7\ \mu$, on small brown spots.

Italian Vine leaf-spot, *Phyllosticta viticola* (Sacc.), appears to be confined to living vine-leaves in Italy. The sporules are $5 \times 2\frac{1}{2}\ \mu$.

Léveillé's leaf-spot, *Phyllosticta Leveillei* (Cooke in *Journ. R.H.S.* 1878, p. 92), was described by Léveillé (in *Ann. Sci. Nat. Bot.* 1846, v. p. 279) and specimen preserved in Berkeley Herbarium, with sporules about $10\ \mu$ long. Known hitherto only in France.

Carolina vine-spot, *Phyllosticta viticola* (B. & C.), forms large spots on the leaves of *Vitis vulpina* in Carolina. Sporules $8–9 \times 4\ \mu$.

Ellis's Labrusca leaf-spot, *Ascochyta Ellisii* (Thüm.), on leaves of *Vitis Labrusca*, has bicellular sporules $6–8 \times 5–6\ \mu$.

Saccardo's leaf-spot, *Ascochyta ampelina* (Sacc.), on vine-leaves in Italy. Sporules two-celled, $10 \times 3\ \mu$.

Curtis's Vine leaf-spot, *Sacidium viticola* (Cooke, *Journ. R.H.S.* 1878, p. 92). Specimens from North America were distributed under the name of *Septoria viticola*. Sporules globose, $10\ \mu$.

Texas melanose, *Septoria ampelina* (B. & C.), on leaves of *Vitis vulpina*, known in Texas and S. Carolina, with sporules $30–50\ \mu$ long.

Small vine leaf-spot, *Septoria vinea* (Pass.), has occurred in Italy, with sporules $12–18 \times 1\frac{1}{2}\ \mu$.

Sorokin's vine-spot, *Sphaceloma ampelinum* (Sorok.), is a Russian species but little known.

Grape Red Spot.

Glœosporium rufomaculans (Berk.), Pl. XIII. fig. 3.

This spot was first recognised on Grapes in 1854, and since that time it has fortunately occurred but rarely, especially as it is one of the kind known as anthracnose, and they are virulent diseases to deal with.

It forms a rounded spot of a sienna-brown colour on the fruit, preserving constantly a definite outline. This spot separates readily from the subjacent pulp, in consequence of a copious crop of mycelium, the threads of which form the radii of a circle. The surface is rough with little raised orbicular reddish perithecia, or conceptacles, for there are no true perithecia, which are arranged in circles. The conidia are produced within the conceptacles or cells, and are oblong, without any division as yet observed, but constricted in the middle, and colourless ($15–20\ \mu$ long). In age the false perithecia fall away, leaving a little aperture, the border of which is often stained black.

We have assumed this to be a *Glœosporium*, most certainly not *Ascochyta*, as first described, but we have not been fortunate enough to meet with it. It seems to be distinct from *Glœosporium uvicolum* on

Grapes, but appears to be a form of *Glœosporium fructigenum*, which is said to occur on Grapes as well as on Apples.

Gard. Chron. 1854, p. 676 ; *Cooke, Hdbk.* No. 1358.

Australian anthracnose, *Glœosporium bicolor* (McAlp.), is the Apple-rot of Australia.

GRAPE ROT.

Glœosporium uvicolum (Berk.), Pl. XIII. fig. 4.

There is some confusion in the records of this species, which has also been called *Glœosporium læticolor*, but the proper host of that species is the Peach and Nectarine.

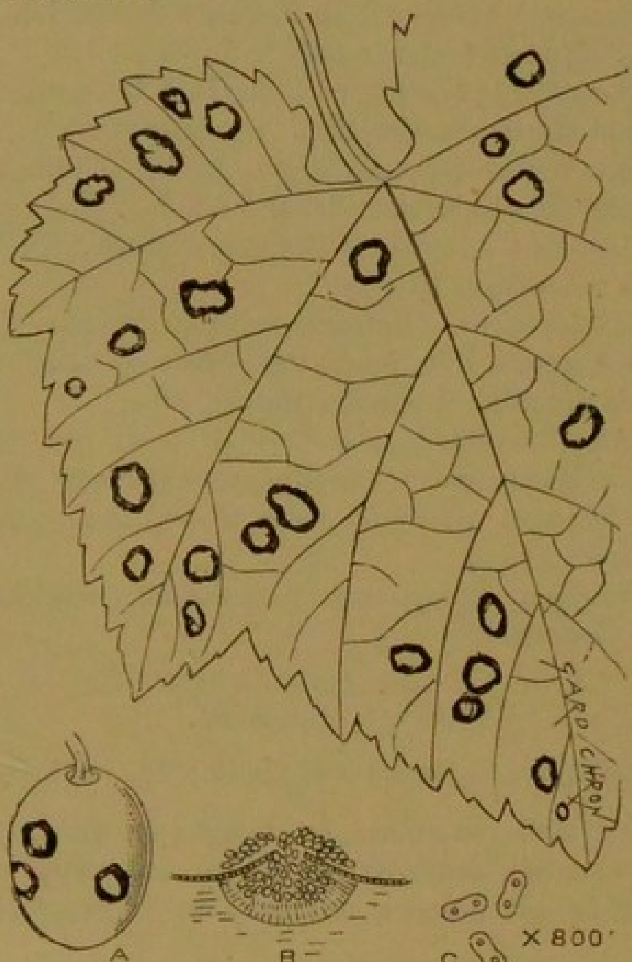


FIG. 22.—ANTHRACNOSE OF THE VINE. (*Gardeners' Chronicle.*)

The spots are always of a pale orange, with an almost white spot in the middle. The tendrils of spores, or conidia, are similar in colour, and the conidia are larger than in the species upon Peaches (25 μ long). Fortunately it is a very rare species, and is not likely to cause much annoyance.

Berk., Gard. Chron. 1854, p. 676 ; Sept. 9, 1871, p. 1162.

GRAPE ANTHRACNOSE.

Glœosporium ampelophagum (Pass.), Pl. XIII. fig. 5.

This attacks Grape vines in Italy and the United States, but until recently there has been no record of it in Britain. It attacks all the green parts, and internally exhibits very little mycelium; the pustules are without definite receptacles, and the conidia are produced on short stalks within definite cells; when mature they escape by rupture of the cuticle, and lie like a crust on the surface until dissolved by moisture ($5–6 \times 2\frac{1}{2}\ \mu$), when they float away to infect other parts. (Fig. 22.)

Gard. Chron. July 8, 1893, fig. 10; *Mass. Pl. Dis.* p. 279; *Sacc. Syll.* iii. 3755; *Thüm. Pilz. Wein.* p. 9 t. 3, f. 24; *Thüm. Pock. d. Wein.* (1880); *Tubeuf, Dis.* p. 484.

Fresh compost at the roots recommended, *Gard. Chron.* Aug. 27, 1904, p. 153.

White rot of Grapes, *Coniothyrium diplodiella* (Speg.), occurs on the fruit, leaves, and rarely on twigs. It is uncertain whether it is truly a parasite. The coloured sporules are $7–11 \times 5\frac{1}{2}\ \mu$. This pest has recently been investigated in Hungary by Istvanffi, and the results published in "Annales de l'Instit. Ampélologique Roy. Hongrois," ii. 1902, with 24 coloured plates, in which it is claimed to be a destructive parasite.

Squirt Berry, *Phoma tuberculata* (McAlp.), is an Australian species.

Grape Hendersonia, *Hendersonia tenuipes* (McAlp.), occurs on ripe Grapes in Australia, but we doubt its parasitism, and also whether it may not rather be a *Pestalozzia*, with delicate cilia not observed. It need cause no alarm in Europe.

Vine Leaf-spot Mould.

Cercospora viticola (Sacc.), Pl. XIII. fig. 6.

Massee says simply that it forms "brown spots on vine-leaves, and is most abundant during a damp season. Most abundant on the lower shaded leaves." Still we are in doubt whether he records it as British, and although we have seen foreign specimens, we have had none reputed to be indigenous.

The spots occur on both sides of the leaves, and are somewhat circular or irregular (2–10 mm.), becoming ochraceous, not distinctly marginate; threads on the under surface in tufts ($50–200 \times 4–5\ \mu$), septate, ochre. Conidia elongated, attenuated upwards, three- to four-septate ($50–70 \times 7–8\ \mu$), with a tinge of olive.

This is recorded for France, Germany, Portugal, Austria, and Italy, but must be quite distinct from *Isariopsis clavispora*, with which it has been confounded.

Sacc. Syll iv. 2200; *Mass. Pl. Dis.* pp. 319, 439.

Another species (*Cercospora Rössleri*), with shorter, obtuser, and more cylindrical conidia, is recorded on living vine-leaves for France, Portugal, Austria, and Italy ($50–60 \times 7\ \mu$).

A species called *Cercospora sessilis* (Sorok.) is recorded from Russia.

Vine Leaf-tuft Mould.

Isariopsis clavispora (B. & C.), Pl. XIII. fig. 7.

This appears to be entirely an American species, but authors have confounded it with *Cercospora viticola*, and may do so again. We are not aware that it has been found on any other living leaves than those of *Vitis Labrusca*, and was first described by Berkeley.

The spots are brown, and mostly irregular. The compacted hyphæ are closely united in the lower portion, but become loosened and flexuous near the apex. The conidia are narrowly clavate, round at the apex, and multiseptate (as many as 7–9), hyaline and attenuated downwards, but brownish above (100×5–$6\ \mu$), each cell sometimes including a small guttule.

Careful examination will convince anyone that the conidia are attached by the thin extremity, and that they can hardly be regarded as a topsy turvy condition of *Cercospora viticola.*

Sacc. Syll. iv. 2998; *Berk. & Curt.*, *Grevillea*, iii. p. 100, No. 619; *Thüm. Pilz. Wein.* 177, t. 5, f. 7 (bad).

Other black moulds, of which many have been named in connection with the Vine, appear to be saprophytes, with the exception, perhaps, of *Fumago vagans*, which has a wide range of hosts, and may soon be disposed of, if it ventures to appear in a well-ordered vinery.

English Vine Disease.

Oidium Tuckeri (Berk.), Pl. XIII. fig. 8.

The ordinary English Vine disease was first observed in 1845 at Margate by a gardener, Edward Tucker, and it is known to this day as *Oidium Tuckeri.* In 1853 it appeared in Spain, and a year later in Portugal. It was first observed in Madeira in 1851, and was not long in spreading through the continent of Europe.

The disease is too well known to need description. When the shoots are struck they become spotted with dark grey or rust colour; the leaves also become spotted, and covered with a cottony substance of fine filaments, as seen under the microscope. The Grapes are covered with what appears to be a white powder, like lime, a little darkened with brown. The mould, like other species of *Oidium*, has a creeping mycelium, which supports erect fertile threads, and these latter become differentiated into chains of colourless spores or conidia.

Some writers are of opinion that this disease is the same as the "powdery mildew" of the United States the full development of which is known under the name of *Uncinula spiralis*; but as the receptacles, or the *Erysiphe* condition, have never been found in Europe, it is still a doubtful point. It is more than probable that the *Oidium Tuckeri*, as known to us, is an imperfect fungus of which the full development would naturally be a very close associate of *Uncinula spiralis*, if not really the same species.

PESTS—VINERY, &c.

As an epiphyte, the application of sulphur has been the only successful remedy, or sulphur in combination with lime.

Gard. Chron. May 15, 1886; 1847, p. 779; 1878, p. 74. *Journ. R.H.S.* 1878, p. 68. *Thüm. Pilz. Wein.* p. 1, t. 3, f. 1.

Powdery Mildew of Vine.

Uncinula spiralis (B. & C.), Pl. XIV. fig. 13.

American botanists are generally satisfied that this vine disease of theirs is a fruitful development of the English vine disease, which we only know, in the conidial form, as *Oidium Tuckeri*, for which reason, therefore, it is entitled to some notice here.

It forms white or greyish patches on the surface of the leaves, young shoots, and fruit. This is composed of the interwoven threads of the mycelium, from which afterwards arise short erect branches, the upper portion of which becomes converted into a chain of conidia, the final one, which is the oldest, falling away when mature, giving to the white patches a still more powdery appearance.

Towards the end of the summer the globose conceptacles make their appearance amongst the mycelium, at first yellow, afterwards dark brown, attached at the base by delicate threads. Encircling the base, a series of spreading, straight, simple appendages radiate around the conceptacles, in number from ten to twenty, the tips of which are hooked or spirally twisted, and the lower part, next the conceptacles, coloured. The asci, or sacs, within the conceptacles, enclose from four to six elliptical sporidia (20×8–$10\ \mu$).

Journ. R.H.S. 1878, p. 68; *Thüm. Pilz. Wein.* p. 183; *Grevillea*, iv. 159; *Gard. Chron.* 1878, p. 74; *Mass. Pl. Dis.* pp. 93, 360, fig. 14; *Tubeuf, Dis.* p. 176.

In the United States another species of the same genus (*Uncinula subfusca*) attacks the living leaves of *Vitis Labrusca*.

Australian Vine Mildew.

Erysiphe vitigera (C. & M.).

This is the vine mildew which in Australia corresponds to the powdery mildew of the United States, and to our own *Oidium Tuckeri*. In its early manifestations, and the conidial stage, it might be taken for *Oidium Tuckeri*, and probably was so accepted before the discovery of the perfect fruit.

The first stage is the creeping mycelium and white mould, which covers the leaves, wholly or in patches, and this is followed by the presence, amongst the mycelium, of the little globose conceptacles, attached at the base, and furnished with a circle of appendages or flexuous threads, as in other species of *Erysiphe*, such as the one upon the Garden Pea, but less distinct and more interwoven with the mycelium. The receptacles contain four pear-shaped sacs or asci, each of which contains two sporidia ($18 \times 9\ \mu$), which are elliptical and colourless.

It was first made known and described in 1887.

The same remedies are recommended as have been applied in the case of the English vine mildew, and doubtless the persistent application of sulphur will bring its reward.

Grevillea, xv. 98; *Sacc. Syll.* x. 1571.

Black Rot of Grapes.

Guignardia Bidwellii (Viala), Pl. XIII. fig. 9.

Doubtless one of the most destructive of our American vine pests, which manifests itself in variable forms, found its way into Europe in 1885 with imported vines.

Young shoots and leaves are first attacked, under the form of small brownish blotches. A fortnight later the fruit shows symptoms of disease by the appearance of small blackish spots; afterwards the fruit turns black, shrivels, and becomes hard. At this stage the surface of the patches is seen to be studded with little black points, indicating what are termed the *pycnidia* form of the disease, or the summer fruits. These receptacles contain innumerable minute bodies, or stylospores, which are produced in the interior, and when mature ooze out through a pore at the apex (7–8 μ long). This is the condition which was first known, and was then called *Phoma uvicola.* The stylospores, after their escape, are carried about by moisture over the surface of healthy Grapes, where they germinate at once, enter the tissues, form a diseased spot, and thus distribute the disease.

Later on other forms of summer fruit supervene, until the final or highest form of fruit appears on the diseased Grapes lying on the ground during the winter. In this stage the sporidia are produced in cylindrical cells, or asci, and come to maturity in the spring. They are almost elliptical, without division, and colourless ($12–17 \times 4\frac{1}{2}–5\,\mu$).

In the United States spraying with Bordeaux mixture is much relied upon.

Gard. Chron. January 26, 1895, p. 101, fig. 13; *Mass. Pl. Dis.* p. 105; *Thüm. Pilz. Wein.* p. 156, f. 11; *Tubeuf, Dis.* p. 216.

Vine Sclerotinia.

Sclerotinia Fuckeliana (De Bary), Pl. XIV. fig. 11.

This vine pest appears also under two or three forms, the earliest being that of a mould, representing the conidia, and not uncommon on other plants as well as the vine. In days when it was regarded as a complete or perfect fungus, it was called *Botrytis cinerea,* and that name is found to be sometimes convenient now (pp. 71, 72).

The conidia form appears in tufts of a greyish colour, sometimes in large patches. The stems or threads are stout, erect, dingy-olive, somewhat branched in the upper portion, the tip of each branch bearing a somewhat globose tuft or cluster of broadly elliptical conidia ($8–9 \times 6\,\mu$).

The mycelium of the mould traversing the tissues of the host becomes compacted into numerous small black sclerotia, which pass a period of rest and afterwards produce again the conidial fruit, or the cup-like form.

The little fleshy cups, or *Sclerotinia*, resemble a very miniature wineglass, with a long slender stem, the cups not more than one tenth of an inch across, but the stem possibly more than half an inch long. The inner membrane of the cup consists of cylindrical asci, or cells, packed closely side by side, each containing right sporidia, which are the perfect fruit. The sporidia are elliptical, colourless (10–11 × 6–7 μ).

Spraying with dilute Bordeaux mixture destroys the conidia. Leaves and other débris likely to contain the sclerotia should be collected and burnt.

Sacc. Syll. viii. 799; *Mass. Pl. Dis.* p. 148, fig. 31; *Thüm. Pilz. Wein.* pp. 195, 197; *McAlpine, Dep. Agri. Vict.* p. 29; *Gard. Chron.* Jan. 20, 1906, p. 42.

American Downy Mildew.

Plasmopara viticola (B. & C.), Pl. XIII. fig. 10.

The American mildew is not of the same character as the English vine mildew, inasmuch as whilst the latter is a surface mould in the first instance, the former is an innate rot-mould, like the Potato and Onion diseases. Not only is it North American in its origin, but it has already found its way over to Europe and into the British Isles.

This mould attacks all the green parts of the vine. The mycelium traverses the tissue of the leaves before there is any external manifestation. In time erect threads arise from this mycelium and find their way in tufts through the stomata into the external air, and produce conidia.

From five to eight of these fertile threads will issue through a breathing pore, and form a tuft of white mould. Hence the under surface of the leaves soon exhibits downy patches of the mould, and it came to be called "downy mildew." The upper portion of the threads is branched in a peculiar manner, and the conidia are borne on little points at the tips of the branches. The primary branches alternate; the secondary branches three- to four-furcate, the ultimate branchlets pointed, straight, short, usually four, bearing the ovoid conidia (from 8 × 12 μ to 7 × 30 μ).

In time the conidia evolve from their contents five or six active zoospores, armed with two cilia, by means of which they move about.

The other mode of reproduction is by resting-spores, which are subglobose (30–35 μ diam.), with a brownish smooth or slightly wrinkled coat.

The most effectual remedy yet devised is spraying the vines with a solution of sulphate of copper and lime.

Tubeuf, Dis. p. 128; *Sacc. Syll.* vii. 806; *Mass. Pl. Dis.* 69, fig. 9, p. 354; *Gard. Chron.* January 2, 1894, July 21, 1894; *Farlow, Bull. Buss. Inst.* 1876, p. 415; *Journ. R.H.S.* 1878, p. 73; *Thüm. Pilz. Wein.* p. 166 t. 1, f. 5.

Vine Root Clubbing.

Plasmodiophora Vitis, Pl. XIV. fig. 12.

One of the latest importations of vine diseases is that known as "vine clubbing," which does not differ greatly from the clubbing in

Turnips. Probably it is quite true that some of our vine-growers have known it for years, but did not regard it in any serious light.

The vine roots in question are swollen into large somewhat globose nodules, as large as the fist, the surface being rough or warted, with obtuse projections, and when cut the cellular interior is found to contain a mucilaginous substance, not unlike the plasmodium of some species of Myxomycete.

In all essentials the new parasite conforms to the Turnip club-root, or "fingers and toes." In its earlier stages a section of the distorted root will exhibit the ordinary cells enlarged to very many times their original dimensions, and filled with a slimy mucilaginous fluid, of a yellowish colour, capable of being drawn out into slimy strings, but with no trace of the ordinary fungus threads, or mycelium, which usually accompanies fungoid parasites. Later on, towards autumn and winter, the cells present a somewhat different appearance, being no longer filled with the structureless mucilage, but differentiated into a host of nearly spherical bodies with a distinct cell-wall, and possessing all the characteristics of conidia, or fungus spores. These bodies are produced in enormous quantities, and of an extremely minute size, but without colour.

By patient research and continued investigation, it may be possible to trace the germination and development of these conidia, which, it may be presumed, do not differ materially from those of the Turnip club-root.

In the slime fungi (*Myxomycetes*) the spores or conidia on germination give origin to one, two, or more naked cells which possess the power of movement, due to the protrusion of pseudopodia, or the presence of a cilium: these are known as swarm-cells. They possess a nucleus, multiply by bipartition, and eventually coalesce to form a plasmodium in this manner. After the production of numerous swarm spores by repeated bipartition, little groups are formed, by the close approach of two or more of these bodies: these groups often disperse again, but eventually the components of a group coalesce, and lose their individuality. This coalescence results in the formation of a small plasmodium which possesses the power of attracting surrounding free swarm-cells, which at once coalesce and augment the bulk of the plasmodium. This power of aggregation and formation of a plasmodium originated the name of *Plasmodiophora*, or "plasmodium-bearer," for the present genus, the slimy mucilaginous stage being the plasmodium condition of the parasite.

By a series of gradations it has been demonstrated that each atom of protoplasm creeps out of its envelope and becomes a zoospore, with a kind of hairlike tail. It may be conjectured how these creeping bodies, when released from an old clubbing, remain in the soil, progress to other and neighbouring roots, and thus continue to perpetuate and diffuse the species. Each club root is therefore a centre from which the disease may spread. It is scarcely probable that any of the numerous fungicides will be of any avail to dislodge the parasite when once it has obtained possession. The only feasible remedy is to extirpate by burning every atom of infected roots, and not to plant again on the same spot without removing the whole of the soil, and replacing it by fresh and unpolluted earth. This may seem to be a drastic measure, but with such a foe only measures which are thorough can be effective.

Whether a Californian vine disease, which is attributed to *Plasmodiophora californica*, is the same as the present species, we are unable to determine.

Gard. Chron. June 17, 1893; *Mass. Pl. Dis.* p. 338; *Mass., Ann. Bot.* ix. p. 421, pl.; *Tubeuf, Dis.* p. 528.

Another vine-root parasite was described some years ago under the name of *Rösslera hypogæa*, which was found on vine roots after they were really dead, not only in Austria, but in this country. They were little rounded fungi, like the head and upper portion of a large pin, but unfortunately, when they were submitted to that eminent lichenologist, the late Rev. W. Leighton, he pronounced them to be a well-known lichen called *Coniocybe pallida*.

Gard. Chron. Dec. 22, 1888, fig. 105; *Thüm. Pilz. Wein.* p. 210, t. 4, f. 9.

White Root-rot.

Dematophora necatrix (Hartig), Pl. XIV. fig. 20.

This root disease, which affects the vine as well as other plants, was originally known by the above name, representing the imperfect condition in which it is usually found.

The mycelium spreads rapidly underground, and when it comes in contact with the rootlets of a plant it kills them, and gradually works its way upwards into the larger portions of the root. Sometimes, after travelling upwards, it bursts through the bark at the base of the trunk in a white woolly mass.

During its progress minute sclerotia are formed, which originate dark-coloured, rigid, bristly conidiophores bearing numerous conidia at their tips.

Another kind of fructification is sometimes found on decaying roots in the form of pycnidia, or conceptacles containing stylospores.

The highest or ascigerous form of fructification is more rare, and consists of large black perithecia which include asci and sporidia, and are surrounded by the bristly conidiophores. In this condition it has been characterised under the name of *Rosellinia necatrix* (Prill. & Del.).

Spraying is out of the question in such a case, and no cure can be hoped for when the mycelium is once established. If the disease appears, the affected plants should be isolated by trenching around them.

Hartig & Somer. Dis. p. 82, with figs.; *Viala, Mon.* with 5 plates; *Mass. Pl. Dis.* p. 118, fig. 21.

Discoloured Vine Leaves.

Discoloured Vine leaves are continually turning up without furnishing any clue to the cause. These are mostly discoloured in large bright blotches, which are sometimes yellow, as in some forms of the "Californian Vine disease;" or dark red, as in the "Sicilian Folletage;" or red, brown, and yellow, as in the Italian "Mal Nero." They appear to give evidence of some form of organic disease, and yet to evade all microscopical scrutiny, and after many years to remain as great a mystery as ever and consequently without the suggestion of a remedy.

U.S.A. Report Dep. Agri. 1892.

CONSERVATORY PARASITES.

Separate from the fungi which affect garden plants there are a few that are troublesome in the stove and conservatory, and these could not be excluded from the present enumeration. In this connection the list might have been much extended, but the persons interested would be necessarily limited, as compared with those who confine themselves to outdoor culture.

SOOTY MOULD OF ORANGE.

Fumago vagans (Pers.), Pl. XIV. fig. 21.

This black mould is familiar enough, as it occurs on the foliage of numerous trees in this country, and especially such as are subject to honeydew. It forms black patches on the leaves, to such an extent as to form a crust; but in this condition it is simply an imperfect fungus, and may develop into a species of *Capnodium* or *Meliola,* as the case may be.

The creeping mycelium is branching, and closely adnate to the matrix, sometimes confluent and forming cellular ganglia, or torulose, like a string of beads, constituting an effused thinly membranaceous stratum, which is apt to flake off when dry, and resembling a coating of soot. Short fertile branches arise from this mycelium, which are more or less branched; conidia at the tips of the branches, often forming short chains, sometimes one-celled, usually two-celled, and sometimes three-celled (5–15 μ long), dark brown.

It is found throughout Europe and North America, and in parts of Asia, but it is scarcely probable that we shall be troubled with the advanced stages in this country, whether *Capnodium*, *Meliola,* or any of their kindred.

Sacc. Syll. iv. 2618; *Journ. R.H.S.* iv. 251; *U.S.A. Dep. Agri. Bull.* 8, pl. vii.; *Mass. Pl. Dis.* p. 101, f. 17.

Specking of Citrus fruits, in Australia, has been attributed to a mould fungus *Penicillium digitatum,* causing a loss of from 2 to 50 per cent. on fruit shipped during the season.

Journ. R.H.S. xxviii. p. 243.

ORANGE SOOTY BLOTCH.

Several kinds of "sooty blotch" are recorded, but it is doubtful if any of them are British.

The Italian sooty blotch, *Meliola Penzigii* (Sacc. "Fungi Italici," figs. 1132–1135), is found in South Europe, and of this *Capnodium Citri* (Desm.) is possibly a form.

Sicilian blotch, *Meliola Citri* (B. & P.), is found on Orange leaves in Sicily.

Australian blotch, *Capnodium citricola* (McAlp.), occurs on leaves of Orange and Lemon in Australia. (*Mass. Pl. Dis.* p. 103.)

LEMON AND ORANGE SCAB.

Cladosporium Citri (Mass.).

This mould is developed on the leaves and fruit of Orange and Lemon in a manner analogous to the scab on Apples (*Fusicladium*), and is very injurious to Orange trees in Florida and Louisiana. (*Mass. Pl. Dis.* p. 310.)

Another and similar mould attacks Orange leaves in Italy. This is *Cladosporium elegans* (Penz.).

The "foot-rot" of Orange and Lemon trees, in South Europe and the United States, is attributed to *Fusarium Limonis* (Briosi).

ORANGE ANTHRACNOSE.

Glœosporium Hendersonii (B. & Br.), Pl. XIV. fig. 14.

This parasite of cultivated Oranges was described by Berkeley some years ago, but does not appear to be common. It occurs on the under surface of the leaves, and the pustules are scattered without forming any definite spots.

The conidia, which are produced in the pustules, are oblong ($12\frac{1}{2}$–15 μ long), and the mass, when extruded through the ruptured cuticle, is slightly coloured.

B. & Br. Ann. N. H. No. 1702; *Sacc. Syll.* iii. 3673; *Grevillea*, vi. 126.

There are seven or eight other species of Anthracnose which attack Orange leaves, especially in the South of Europe, but they are not recorded as British, and leaf-spots, of several genera, almost too numerous to mention, but our interest in Orange culture is comparatively small.

One Italian leaf-spot, *Sphærella Gibelliana* (Pass.), develops asci and sporidia on living Orange leaves.

ORANGE-LEAF ANTHRACNOSE.

Several species of Anthracnose have been recorded as attacking the foliage of Orange and Lemon trees in conservatories.

Glœosporium Hesperidearum forms large bleached spots on the leaves, on which the pustules are gregarious and numerous. The conidia are cylindrical, straight, rounded at the ends, without guttules ($14–18 \times 5–6\frac{1}{2}$ μ). This has been detected only in Italy.

Another Italian species is *Glœosporium depressum*, occurring also on dry spots on fading leaves, with the pustules scattered on the under surface. The conidia are elongated elliptical ($7–8\frac{1}{2} \times 2\frac{1}{2}–4$ μ), produced upon rather long fasciculate basidia (20–24 μ long).

The Belgian species has large irregular greyish-brown spots, without definite margin, on which are seated the small whitish pustules. The conidia are ejected in flesh-coloured masses, and very minute (3 μ long). It is called *Glœosporium Aurantiorum*. Another Italian species (found also in France), *Glœosporium intermedium*, has the pustules pointlike, black, without forming definite spots, with long straight conidia, rounded at the ends ($14–18 \times 4–6\ \mu$).

Yet another occurs on Orange as well as on *Hoya* leaves (*Glœosporium macropus*) without forming any definite spots, the long conidia ($18–21 \times 4–6\ \mu$) produced on very long basidia ($48–60\ \mu$ long). Any of these may be found in our conservatories at any time.

The Olive is not sufficiently cultivated in this country to render its parasites of much interest.

Fig Mould.

Botrytis cinerea (Pers.), fig. 10.

This mould, long regarded as a saprophyte, has been found destructive to ripe Figs, covering them with a dense felted mass of grey hyphæ, and bearing a profusion of oval conidia. It appears to be the same species as causes the Lily disease. For other Fig parasites see "Pests of Orchard and Fruit Garden," p. 137.

Journ. R.H.S. xxviii. p. xxxix and p. 29.

A black mould, *Cercospora Bolleana* (Thüm.), has occurred on Fig leaves, and is believed to have appeared recently in Britain.

Camellia Blotch.

Pestalozzia Guepini (Desm.), Pl. XIV. fig. 17.

This disease is far from uncommon on the leaves of Camellia under cultivation, and is so widely extended that it attacks the Tea plants in the Tea gardens of India.

It causes unsightly large blotches on the living leaves, which are mostly of a rounded form, but sometimes irregular through confluence of the blotches. They are bleached and of a silvery-white colour on the upper surface, with a strongly defined outline, and sprinkled with the black dots which indicate the pustules. There are no true perithecia, the sporules being produced in small cavities in the substance of the leaf, the surrounding cells modified and discoloured so as to form a false receptacle.

The sporules are of a remarkable kind, peculiar to the genus. In outline they are somewhat spindle-shaped, being attenuated towards each end ($20\ \mu$ long), with three or four transverse divisions, the apical cell colourless and conical, bearing a tuft of three or four long colourless hairs, which form a crest. The bottom cell is also colourless, and attenuated into a long hyaline stem equal in length to that of the sporule. The intermediate cells are coloured brown, and become at length rather opaque. When mature the sporules are discharged through the rupture of the cuticle.

It is found throughout Europe and in North America, also on leaves of *Rhododendron*, Orange, *Hoya*, *Magnolia*, *Smilax*, *Lagerstrœmia*, and Almond, but typically on Camellia.

The only check is to collect and burn all diseased leaves.

Sacc. Syll. iii. 4146; *Cooke, Hdbk.* No. 1401 with fig. 183.

Camellia Scar.

Coryneum Camelliæ (Mass.).

It must be confessed that some little mystery surrounds this parasite, which has only been detected once upon living Camellia leaves. The large blotched spots exactly resemble those which are caused in the Camellia blotch, but in that species the conidia are crowned at the apex with three or four long and spreading hairs, whilst in the present species the spores are similar in form and size, but *without* any crest of hairs. This may seem to be but a slight distinction, but it is the principal difference between *Pestalozzia* and *Coryneum*. It may be possible that this is an abnormal form of *Pestalozzia Guepini* in which the hairs are suppressed.

The pustules are numerous on the whitened spots, splitting the cuticle in a linear, triangular, or stellate manner, so as to allow of the escape of the conidia. The latter are lanceolate ($30 \times 10\,\mu$), with from two to four coloured cells in the middle, and a small triangular uncoloured apical and basal cell, supported at first on slender pedicels of the same length as the conidia.

The same remarks as to prevention apply as in the case of *Pestalozzia*, if this is not really, as we suspect, the same species.

Grevillea, xx. p. 8 (1891).

Camellia Black Mould.

Macrosporium Camelliæ (C. & M.), Pl. XIV. fig. 15.

Externally, and to the naked eye, this form of spotting the living leaves of *Camellia* so much resembles that caused by *Pestalozzia Guepini* that even an experienced eye can scarcely detect the difference until the microscope is employed. The silvery-white spots on the upper surface are of the same size, usually half an inch, and there is a distinct brown margin.

The scattered dark points are small, but when magnified are found to consist of tufts of brown or pale olive threads piercing the cuticle. The threads are flexuous (30–40 μ long), with cross divisions. Mixed with these, or supported upon them, are the club-shaped conidia, with, at first, three cross divisions, but at length double that number, with longitudinal divisions, like a brick wall ($50\text{–}60 \times 15\text{–}25\,\mu$). Downwards these conidia are attenuated into the pale olive pedicel, the whole upper part of the conidium being of a little darker olive.

This may not be an injurious pest, as many of the species are saprophytic, and the possibility would suggest itself, whether this mould has not taken possession of a dead spot, caused by the *Pestalozzia*, and become established upon it. At any rate, conidia of *Pestalozzia* were sought diligently, and not a single one could be found.

Grevillea, xvii. 42 ; *Sacc. Syll.* x. 7837.

Gardenia Canker.

Pl. XIV. fig. 16.

Tumours are formed on the stems, at the base, just above the ground, or on branches near a fork, on *Gardenia* and also on *Camellia*. They resemble other cankers, and appear to be the result of local irritation. The bark around, which was at first, perhaps, a wound, swells, becomes corky, and of a rusty-brown, covering a patch an inch or more long. When the centre of the tumour is bare, the woody tissue is seen to be dead, and occupied by black dots, which are the thin receptacles of an immersed *Phoma*, with minute narrowly elliptical conidia (7×2 μ). This is not the cause of canker, but a sequence. Sometimes several scars are confluent at the bottom of stems, and are swollen in a gouty manner by the corky transmutation of the surrounding cell.

Hoya Leaf-spot.

Phyllosticta Bolleana (Sacc.), Pl. XIV. fig. 19.

Forming spots on the living leaves of *Hoya carnosa*, which are bleached to a greyish-white, with an irregular brown margin, forming a striking contrast to the bright green of the leaf. The receptacles are scattered over the spot like minute black dots to the naked eye, containing the small elliptical sporules, which are just tinged with grey (4–5 $\times$ 2–2½ μ).

It is doubtful whether the minute fungi of this genus, which forms spots on living leaves, are to any considerable extent injurious to the plant. They may become so by disfiguring the foliage, especially if they spread themselves, but they are certainly incapable of inflicting such injury as that caused by the various kinds of Anthracnose. Their life-history is at present much involved in mystery.

Probably, should any of them prove troublesome, it would be well to submit the plants to treatment with one of the copper solutions.

Sacc. Syll. iii. 70 ; *Grevillea*, xiv. 39.

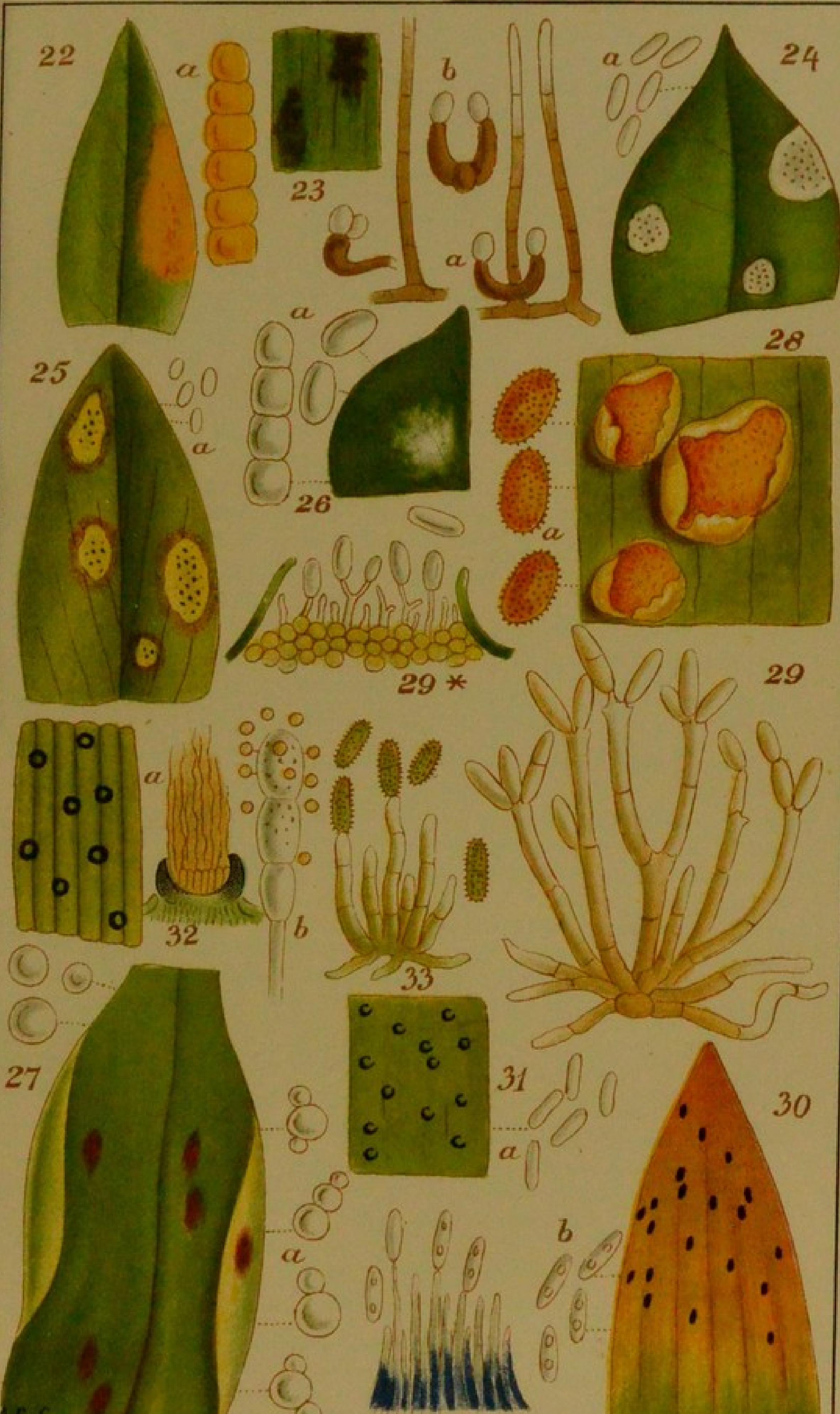
Another leaf-spot (*Septoria Hoyæ*) forms various white spots on Hoya-leaves, girt by a brownish ring, sporules threadlike (20–25 $\times$ 1–1½ μ) or a little club-shaped. In botanic gardens in Italy.

Hoya Anthracnose.

Glœosporium affine (Sacc.), Pl. XIV. fig. 18.

This spot has recently made its appearance in hot-houses at Glasgow, and may soon travel southwards. It was previously known in Italy; it belongs to a genus which is eminently destructive, and includes many pests.

The spots on the leaves are variable, both as to size and form, becoming bleached or whitened, having little pustules on the surface. These pustules are scattered, and consist of small discoloured cells, without any true or distinct outer covering or receptacle, nestling beneath the blackened cuticle. The pustules appear chiefly on the upper surface. At length an irregular opening is made, and the conidia ooze out in the form of a tendril. They are cylindrically oblong, rounded at the ends, colourless, and spring at first from the cushion-like base of the pustule, borne on short delicate basidia. Conidia of moderate size for the genus (14–20 $\times$ 4–6 μ).



PESTS OF CONSERVATORY.

The parasite occurred on leaves of *Hoya* and on *Æschynanthus*. Apparently the same species has also occurred on leaves of Orchids at Glasgow.

We can only advise strict burning of all diseased leaves.

Sacc. Syll. iii. 3707; *Grevillea*, xix. 42.

Two other species of Anthracnose are recorded on *Hoya*, in Italy, under the names of *Glœosporium sphærelloides* and *Glœosporium macropus*.

TEA AND COFFEE PESTS.

The fungoid pests of Tea and Coffee shrubs are not of much interest to the home horticulturist, although of considerable importance in the tropics, the Ceylon Coffee disease especially, *Hemileia vastatrix* (Berk.), having caused immense damage in the plantations, not only of Ceylon, but in Southern India and in tropical South America. So also has the Coffee leaf-rot, *Pellicularia Koleroga* (Cooke), in Southern India.

The Tea shrub is liable to the attacks of *Pestalozzia Guepini*, which is described above.

Gard. Chron. Oct. 25, 1879, fig. 87.

AZALEA LEAF-ROT.

Pestalozzia longiseta (Sacc.).

This species was first found in Italy on living leaves of a species of *Rubus*, but in this country it has been found on *Azalea* leaves. The spots are rufous, margined by a black line, on which are seated the point-like pustules, which are themselves black, covered some time by the cuticle. The conidia are almost fusiform, pointed towards each end ($20 \times 8\,\mu$), divided by four transverse septa. The three central cells are coloured dark brown, the two extreme cells small and colourless. From the upper cell spring three very long hairlike processes ($30–40 \times 1\,\mu$). The lower cell is attached to a slender hyaline pedicel.

Like Anthracnose, this is a deeply seated endophytal disease, and all that can be done is to prevent its spreading.

Sacc. Syll. iii. 4115; *Grevillea*, xv. p. 19.

Another leaf-spot, of an ordinary kind (*Septoria Azaleæ*), has been recorded in Italy, and is just of the kind that is likely to spread.

A rust on *Azalea* has been known in North America (*Uredo Azaleæ*) for very many years, but does not appear to have done much mischief.

JASMIN CHAIN MOULD.

Chromosporium pactolinum (Cooke), Pl. XV. fig. 22.

First described under the name of *Oidium pactolinum*, when it was found on living leaves of *Jasminum Sambac*, forming a thin stratum, as if sprinkled with gold-dust or chrome powder. The threads, if any, were not to be detected, the powder consisting of the nearly globose conidia, attached to each other in chains of from six to ten cells. Whilst remaining attached, the ends of the conidia are flattened at the point of junction, but when free they acquire a globose form (10 μ diam.), with a thin hyaline membrane, but with granular golden-yellow cell-contents.

At present this has only been recorded in Britain, and is certainly epiphytal, probably not at all injurious to the plant; at any rate it is very curious.

Grevillea, xii. 98; *Sacc. Syll.* vi. p. 633, x. p. 511.

Two or three kinds of leaf-spot have been caused upon Jasmin-leaves by imperfect fungi, but none of these have been recorded as British.

Passion-flower Black Mould.

Zygosporium oscheoides (Mont.), Pl. XV. fig. 23.

This minute black mould was first discovered in Cuba, growing on dead leaves, and was only regarded as a saprophyte, but recently it has been recorded on leaves of *Passiflora quadrangularis*, seemingly under the impression that it was a parasite, and a new species, under the name of *Cladotrichum Passifloræ* (Pim.).

The fertile threads are erect, septate ($70 \times 3\,\mu$), sooty-brown, inflated and paler at the apex, at the base emitting a semilunar sporophore. Conidia, oval or globose, produced singly or in pairs at the apex of the sporophores (5 μ diam. or 12 μ long).

The peculiarity is that the hyaline conidia are borne at the end of curved club-shaped branches, which is sufficient to identify the species.

This same mould has been found in Cuba and elsewhere on Screwpines and Palms.

Gard. Chron. Dec. 5, 1885, p. 724, fig. 164; *Sacc. Syll.* iv. 1591; *Corda, Icon.* vi.

Cactus Scab.

Diplodia Opuntiæ (Sacc.).

The injury caused by this fungus is sometimes severe, the black wart-like outgrowths constituting the sterile portion of the fungus often covering a considerable area, the surrounding tissue becoming discoloured. The mycelium is distinctly localised, and each scale is the outcome of an independent infection. The *Diplodia* form of fruit is rare but has occurred on *Phyllocactus* at Isleworth.

Gard. Chron. Aug. 12, 1905, p. 125, fig. 44.

Stephanotis Leaf-spot.

Phyllosticta Stephanotidis (Grove), Pl. XV. fig. 24.

This leaf-spot was detected on the leaves of *Stephanotis* in 1886, forming round or irregular spots, which are bleached or whitened and surrounded by a thin dark brown line. The receptacles appear on the upper surface, and are small, numerous, and scattered over the spots, nestling beneath the cuticle, which is pierced by the small orifice of the receptacle. Conidia oblong, rounded at the ends (12–16 × 4–5 μ), and colourless.

No experiments were tried, but possibly dilute spraying might be advantageous.

Journ. Bot. 1886, p. 134 ; *Sacc. Syll.* x. 5049.

Dracæna Leaf-spot.

Phyllosticta Draconis (B. & W.), Pl. XV. fig. 25.

The original occurrence of what appears to be the same pest was in Portugal, many years ago, on the leaves of *Dracæna Draco*, but the specimens then collected were immature and deficient in fruit; the external habits of the two appear to be the same.

The present specimens occurred on the leaves of *Dracæna terminalis* and *Dracæna Cooperi* in conservatories, and at present the species seems to be restricted in range and influence.

The spots occur on both surfaces of the leaves, are pallid and very irregular in form, with a distinct purple border. The little black points scattered over the spots indicate the minute spherical receptacles which are seated within the substance of the leaf, and are covered by the thin cuticle, through which they are scarcely visible to the naked eye.

The sporules are profuse, minute, elliptical, and quite colourless, escaping when mature by a pore at the apex of the receptacle (7 × 3 μ).

Generally the fading or sickly-looking leaves are those which are attacked.

Sacc. Syll. iii. 334 ; *Grevillea*, xix. p. 8.

Dracæna Anthracnose.

Glœosporium dracænicolum (B. & Br.).

This species was first described by Berkeley and Broome under the name of *Myxosporium dracænicolum* as a destructive pest on the leaves of *Dracæna*. The description is so imperfect that it would be difficult to identify, but it is said to be orange, and to have conidia which are ovate (9 × 6 μ).

At present it would appear to have been found in Britain upon cultivated *Dracæna*.

Berk. & Br., Ann. Nat. Hist. 1881 ; *Sacc. Syll.* iii. 3805.

No genuine fungoid disease has yet been detected in this country on the leaves of *Aspidistra*, although discoloured spots are not infrequent. One species, *Septoria transversalis* (Sacc.), is reported to occur in South Europe.

Caladium Mould.

Monilia pruinosa (C. & M.), Pl. XV. fig. 26.

This mould was first discovered on the fading leaves of a species of *Caladium*, but whether it was the cause of the fading was not ascertained. It formed a broadly effused thin white stratum, as if the leaf were covered with hoar-frost; from the creeping mycelium arose the fertile threads, which were rather sparse and flexuous, elongated, and septate (10–12 μ diam.), branching irregularly. Conidia united in short chains, subglobose or oval ($14\text{–}15 \times 12\ \mu$), colourless.

This has very much the appearance of an ordinary species of *Oidium*, of which the vine mildew is a familiar type, and looks suspicious, as though it were capable of doing mischief in a conservatory.

Should it make its appearance we would advise spraying with diluted Bordeaux mixture.

Grevillea, xvi. 78; *Sacc. Syll.* x. 7081.

Several other pests on Aroids have been described from time to time, but they do not appear to have attacked any of the species cultivated in Britain.

Eucharis Disease.

Saccharomyces Glutinis (Cohn.), Pl. XV. fig. 27.

This pest occurs on the leaves, petioles, and bulbs of *Eucharis subdentata* and upon *Hymenocallis adnata*, and caused some anxiety a few years ago. The examination was undertaken by Mr. W. B. Grove in 1886, and he discovered that the cause of all the mischief was a very simple little fungus allied to the yeast fungus and the microbes.

The cells of which the fungus is composed are round, oval, oblong, elliptical, or shortly cylindrical ($5\text{–}11 \times 4\ \mu$), either single or united in twos, but seldom more together. The cell membrane and contents colourless when fresh, but when moistened again, after drying, with a faintly reddish central nucleus.

This is such a deeply seated endophyte that we doubt if the application of fungicides would have any beneficial effect.

Gard. Chron. Mar. 27, 1886, figs. 74–77; *Grove, Syn. Bact.* p. 63, f. 66; *Grevillea*, xiv. 132.

Orchid Disease.

Protomyces concomitans (Berk.).

Previous to 1882, for many years, imported Orchids were known to be liable to a kind of spot which baffled efforts to ascertain its cause. At length Berkeley believed that he had solved the mystery through a species of *Dendrobium*, the whole plant, and especially the leaves, of which were much spotted. Abundant mycelium, connected with globose pale umber bodies, immersed in the parenchyma was found, and to these was attached the above name. In some places the mycelium was beaded or moniliform. (Fig. 23.)

The species of *Protomyces* are very simple in their structure, mostly lying concealed in discoloured spots and of a destructive nature. It is often that their presence is only suspected, mycelium alone being found, until upon some fortunate occasion the sporelike bodies are met with.

It need scarcely be said that in this instance the evidence is incomplete, as the details are too meagre to determine whether this is really a species of *Protomyces*, and as the observations have not since been confirmed whether it is the true cause of spotting.

Gard. Chron. Sept. 23, 1882, fig. 63.

Orchid Rust.

Uredo Lynchii (Berk.), Pl. XV. fig. 28.

Our indigenous Orchids have long been known to be subject to the attacks of a bright orange *Uredo*, which is not at all uncommon, but there is no record of its having attacked Orchids under cultivation. For this purpose another and similar rust has made its appearance, and the golden rust which from time to time is found on the leaves of more than

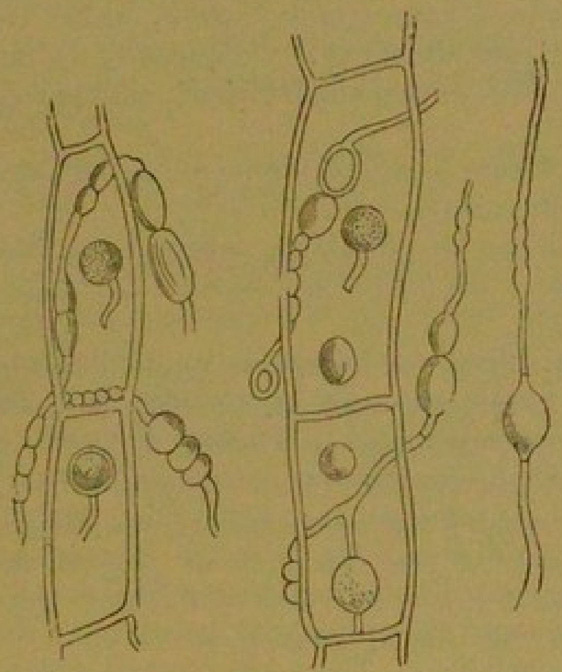


Fig. 23.—Protomyces concomitans. (*Gardeners' Chronicle.*)

one species of *Spiranthes* claims to be quite a different rust from that of wild Orchids.

The spots are small and scattered, but not numerous, sometimes not more than half a dozen pustules on a leaf. The uredospores are yellow and obovate, covered with minute spines (28–35 × 20–30 μ) and produced on short footstalks. It has made its appearance, more or less, every year in Orchid-houses, and as soon as it appears the leaf should be cut off and burnt. By such measures it has hitherto been kept in check where it has appeared.

Sacc. Syll. vii. 3069 ; *Gard Chron.* Aug. 25, 1877 ; *Grevillea*, vi. 126 ; *Plowr. Brit. Ured.* 259.

Orchid Leaf-spot.

Leptothyrium perniciosum (Berk.).

In the year 1865 Berkeley described a kind of spot on Orchids and the fungus producing it, with the above name, and this we are obliged to retain, although evidently wrong, as it is not a *Leptothyrium* at all. He says : " It begins on the young leaves, causing a brownish ill-defined spot; after a time this exhibits different shades of olivaceous-brown, and the parenchyma of the leaf becomes quite pulpy and semi-putrescent. On the underside of the leaf little raised dots are seen, which are caused by the cysts of a fungus beneath. The parenchyma is more or less traversed by hyaline mycelium with jointed threads, and each cyst or perithecium, which is of a pale umber, is surrounded by a broad border of hyaline, perfectly colourless, jointed threads, the upper joints of which are more or less swollen.

" Sometimes the leaves pass rapidly into a state of decay, but occasionally the parenchyma dries up, the spots become bleached, but are surrounded by a dark border and studded with the concentrically arranged perithecia. In these I have detected spores, which are broader at one end than the other, and uniseptate. Occasionally the disease commences again in the same leaf, so that the incipient and old stages may be compared together."

These examples were found on the leaves of *Lycaste Skinneri* and on *Odontoglossum citrosmum.*

" The fungus is in all probability merely a condition of some more perfect form, to which the provisional name of *Leptothyrium perniciosum* may be given.

" Spots at first olivaceous-brown, at length bleached; perithecia at first scattered, at length somewhat concentric, depressed, surrounded by a fringe of hyaline articulated colourless threads. Spores with two nuclei, obovate oblong, sometimes at length uniseptate.

" It is not a good *Leptothyrium* ; on the thin leaves of *Lycaste* it looks much more like. In this case the spots are sometimes six inches long, and parallel to each other, following the direction of the nerves."

We have never seen this species, but insert it in the hope that some knowledge may be obtained. There are features which lead to the conclusion that it may be a *Glœosporium* or *Marsonia*, which is far more probable than *Leptothyrium.*

Journ. R.H.S. vol. i. *N. S.* 1866, p. 25.

Orchid Black Mould.

Cladosporium Orchidearum (C. & M.), Pl. XV. fig. 29.

There need be no alarm amongst Orchid-growers respecting this new form of parasite which falls upon decaying leaves, since we are convinced that it only makes its appearance on dead or diseased tissue.

The threads are in tufts which seem to protrude through the stomata, and are short, here and there branched and septate, but slender and flexuous, and of a pale olive colour. The spores or conidia are borne at the tips of the branches, and are mostly elliptical, with a cross division in the centre forming two cells ($17–18 \times 5–6\ \mu$) of a pale olive colour. The conidia are very variable in this genus, both in size and form, some being found without a division and others with two or three, but in the present instance we have observed none with more than one division.

Gard. Chron. Oct. 11, 1890, fig. 82 ; *Sacc. Syll.* x. 7506.

Vanilla Anthracnose.

Glœosporium Vanillæ (C. & M.).
Hainesia Vanillæ (Mass.), Pl. XV. fig. 29*.

The Vanilla disease described by G. Massee has evidently no connection with Bidgood's Anthracnose, nor has it, perhaps, much interest for the English cultivator, but concerns more intimately Vanilla-growing countries. This species has been found to develop into a higher condition systematically, where it is known as *Calospora Vanillæ*, but its destructive stage is the Anthracnose.

It appears on the leaves of Vanilla in the Mauritius, Seychelles, and Reunion Islands, as well as New Granada. The pustules are small, on either surface, covered by the blackened cuticle. The conidia are elongated, elliptical, and colourless ($14–16 \times 6–7\ \mu$).

On account of some slight technical distinction, of very doubtful value, the name has recently been changed to *Hainesia Vanillæ*, but the name is of very slight importance.

Sacc. Syll. x. 6815; *Grevillea*, xv. p. 18; *Kew Bulletin*, 1892, No. 65, plate; *Mass. Pl. Dis.* pp. 113, 368.

Bidgood's Orchid Anthracnose.

Glœosporium Bidgoodii (Cooke), Pl. XV. fig. 30.

This disease has only been determined during the latter part of the year (1901), although its effects have been recognised for the past six years. The leaves attacked have been those of *Odontoglossum*. The tips of the leaves become yellow, but the spots appear to start anywhere, and now the black shining pustules have been found upon the spots, which the late Mr. Bidgood correctly indicated as those of a species of *Glœosporium*, but as he did not describe it hitherto, it was but courtesy to associate it with his name, as he devoted much time and energy to its investigation.

The pustules are rather large, and covered by the blackened cuticle, at length ruptured for the escape of the conidia. The stroma upon which the conidia are produced is also blackened, but the conidiophores become hyaline above, bearing the narrowly elliptic conidia ($18–20 \times 4\ \mu$), which have two nuclei. No direct evidence has yet been furnished that the conidia become uniseptate, although one of the microphotographs taken might give that impression.

Journ. R.H.S. xxvi. 1901, pp. cxxxix and cxli, vol. xxviii. p. 262; *Trans. Brit. Myc. Soc.* 1903, p. 15.

American Orchid Anthracnose.

Glœosporium cinctum (B. & C.), Pl. XV. fig. 31.

This species occurred on cultivated Orchids in Massachusetts, and was described by Berkeley. The pustules are minute and gregarious, covered and circled by the blackened epidermis, so as to appear like little black rings. The conidia are oblong and obtuse at both ends, sometimes curved, granular within ($10–15 \times 2\frac{1}{2}–3\ \mu$). The species of Orchid has not been recorded.

It is not clear that this species has been found in this country, since the suspicion that the species found on Orchids at Glasgow was the same is without good foundation, the size of the sporules being different, and, as far as can be ascertained, the pustules in the above species are not produced upon bleached spots.

Neither, again, can the more recent Orchid Anthracnose be referred to this species, which we have called here *Glœosporium Bidgoodii*, since the external appearance and fruiting appear to be different.

Sacc. Syll. iii. 3765 ; *Journ. R.H.S.* xxvi. 1902, p. 729, fig. 305.

Other Orchid Anthracnose.

As this seems the most fatal source of Orchid disease, we may enumerate the known species of Anthracnose found on Orchids.

Malagasy Orchid Anthracnose.

Glœosporium pallidum (Karst.).

This species was found on the leaves of Orchids from Madagascar cultivated in France. The pustules are pallid, and not blackened as is often the case, and the conidia oblong, straight, and obtuse at the ends (10–16 × 3–6 μ).

Sacc. Syll. x. 6816.

Mexican Orchid Anthracnose.

Glœosporium Orchidearum (Karst.).

In this instance the pustules are covered with the blackened cuticle, which is split longitudinally to allow the conidia to escape. Perhaps the most distinctive feature is in the form of the conidia, which are elongated fusiform, or unequal-sided (20–25 × 5–7 μ).

Sacc. Syll. x. 6817.

Cattleya Disease.

A species of *Glœosporium* has occurred around Paris on leaves of *Cattleya*.

Journ. R.H.S. xxix. p. 764.

Oncidium Anthracnose.

Glœosporium Oncidii (Oud.).

This species occurred on the leaves of *Oncidium* in the Botanical Gardens at Amsterdam. In this case the pustules are round and brownish-grey, perforated in the centre for the escape of the conidia, which are oblong or pear-shaped (14–17 × 4½–6 μ) and are ejected in a rosy mass at the orifice of the pustule.

Sacc. Syll. xi. 3658.

Orchid Hemileia.

Hemileia americana (Mass.).

A rust has made its appearance on leaves of *Oncidium*, imported from Guatemala into this country. It is kindred to the dreadful

Coffee disease, which has wrought such havoc in Ceylon and other places.

Gard. Chron. Aug. 19, 1905, p. 153, fig. 53.

Screw Pine Black Anthracnose.

Melanconium Pandani (Lev.).

Screw Pines under cultivation are liable to attack from a fungus which settles itself irrespectively upon the trunk, aërial roots, and adventitious branches, where it forms small black pustules, which are sometimes so numerous as to blacken the parts attacked. The productive cells are concealed beneath the cuticle, but there is no true perithecium or receptacle, and the conidia are formed upon a kind of cushion, or stroma, supported at first on rather long branched stalks. They are elliptical or oblong, either straight or slightly curved, often with two nuclei, but variable in size (5–9 × 3–4 μ), pale olive, oozing out, when mature, either in black tendrils or irregular inky masses.

This species was made known in 1845, but has not been much heard of since. It is allied to the species of Anthracnose, but with coloured conidia.

Another fungus, bearing the sporidia contained in asci (*Nectria Pandani*), has also been found on Screw Pine, of which it has been suggested that the above is a condition; but we think that the suggestion is of very little value, as there is no precedent for such an association.

Ann. Sci. Nat. Bot. 1845, p. 66; *Mass. Pl. Dis.* pp. 293, 431; *Sacc. Syll.* iii. 3985.

Palm-leaf Pustule.

Graphiola Phœnicis (Poit.), Pl. XV. fig. 32.

This peculiar kind of fungus is found on the living or fading fronds of Palms in conservatories, in Britain and most other parts of Europe, in North America, parts of South America, Ceylon, India, and Algeria.

The pustules appear like hard, black, superficial, round excrescences upon the leaves, being developed beneath the cuticle, but soon erumpent (1–1½ mm. diam.). They possess an outer horny coat and a thinner inner coating, which is filled with fertile threads, and numerous rather small (3–6 μ) globose yellowish uredospores, with a hyaline membrane. When the spores are dispersed the threads remain for some time in a tuft within the remains of the black outer coat, looking scarcely like either a rust or a smut.

Sacc. Syll. vii. 1915; *Cooke, Hdbk.* No. 1637; *Tubeuf, Dis.* p. 326; *Cooke, Hdbk. Austr. Fungi*, t. 28, f. 260.

The black mould *Zygosporium oscheoides* has also been found on Screw Pine and the foliage of palms in tropical countries.

Palm-leaf Black Mould.

Heterosporium minutulum (C. & M.), Pl. XV. fig. 33.

This mould is of the same nature as one which is very destructive to Carnations, and occurs on the leaves of Palms, in this instance on

Chamærops humilis. It forms dark olive velvety patches of variable size and form, sometimes considerable in extent, with a creeping mycelium. The threads are mostly collected in tufts, and are rather short, flexuous, and sparingly septate, of a pale olive colour. Conidia with one or two septa, elliptical, rounded at the ends, but not constricted at the joints, pale olive ($16–20 \times 6–8\, \mu$), and externally rough, as in other species of the genus.

This is also at present only recorded for Britain, but it belongs to such a persistent group of parasites that it will probably be heard of again.

Grevillea, xvi. 11 ; *Sacc. Syll.* x. 7767.

Palm Leaf-spot.

Exosporium Palmivorum (Sacc.).

Another palm leaf disease has made its appearance in France on *Phœnix canariensis* and other species, and is known also in the United States. The conidia have from 8 to 10 septa, and measure $75–95 \times 7–9\, \mu$. It has appeared also in Eastern Europe.

Sacc. Syll. xvi. p. 1106 ; *Bull. Soc. Myc. de Fr.* xxi. fasc. 3, p. 173, figs. 3, 4.

A small dot-like fungus, *Phoma Kentiæ* (Cooke), has been found flourishing on the dead tips of the fronds of *Kentia*, under cultivation, with sporules $8–10 \times 4\, \mu$. It is doubtless only a saprophyte. Other species, assumed to be parasitic, have been described as occurring on *Kentia* in Algeria, as *Plœospora Kentiæ* (Maubl.), *Ascochyta Kentiæ* (M.), and *Stagonospora Kentiæ* (Maubl.). All of them on living leaves. (*Bull. Soc. Mycol. de France*, xix. fasc. 3, p. 293.)

Bamboo Mould.

Oospora inæqualis (C. & M.).

This is a thinly effused white mould, found on the culms of growing Bamboos, under certain conditions of weakness. It spreads broadly but thinly like a glaucous bloom, of a pale grey colour.

The conidia are unequal in size and form, from globose to elliptical, united together, end to end, in short curved and either simple or branched threads, colourless, and when globose $5\, \mu$ diam., attaining to double that length, with the same diameter.

The specific name has since been changed to *Oospora Cookei* by Saccardo on account of the prior adoption of *inæqualis*.

It is scarcely probable that it would resist moderate spraying.

Grevillea, xvi. p. 10 ; *Sacc. Syll.* x. 7057.

PESTS OF THE ORNAMENTAL SHRUBBERY.

Notwithstanding the entirely artificial character of such subdivision, it appears to be the most practical method to separate ornamental shrubs into the two groups of evergreen and deciduous, independently of anomalies which may here and there obtrude themselves. The same parasite very rarely attacks both coriaceous- and tender-leaved plants.

PESTS OF ORNAMENTAL SHRUBBERY.

CORIACEOUS-LEAVED SHRUBS,

or Evergreens, are represented by the following.

Rhododendron Galls.

Exobasidium Rhododendri (Cram.), Pl. XVI. fig. 1.

The gall-like swellings on the leaves of *Rhododendron ferrugineum* and *R. hirsutum*, and possibly of other species, are sufficiently striking not to escape the notice of even a casual observer. They vary in size from that of a pea to that of a marble, and are often found several of them together in a cluster. At first they are of a pale yellowish-green colour, then they acquire a reddish or roseate tint, especially on the sunny side. When fully and properly mature, the surface is covered with a delicate frosty bloom, like the bloom on a plum. It is in this "bloom" that the fungus exhibits itself, for the mycelium is concealed within the tissues of the gall.

The fruiting consists in the development of erect stout spore-bearers, called *basidia*, which resemble the same organs on the gills of an Agaric. The apices of these basidia carry a definite number, usually four, apicules, each of which supports a spore, or basidiospore. These spores are colourless, elliptical ($8–10 \times 6–7\,\mu$), and readily fall away. These galls differ essentially from the Peach blister in the spores being naked and exposed, *not* enclosed in asci, and in being produced upon the outer and convex, not on the inner and concave surface.

Known also in France and Germany.

Diseased leaves should be burnt as soon as the fungus shows itself, and before spores are produced.

Sacc. Syll. Hym. ii. 7797; *Gard. Chron.* 1879, p. 119, 182; *Mass. Pl. Dis.* 168, 398, fig.

Similar galls are produced on Bay-Laurel.

Rhododendron Leaf-spots.

Several kinds of leaf-spot are known on species of *Rhododendron*, but have never caused anxiety, as they simply disfigure the leaves. Some of these may be enumerated.

Phyllosticta Saccardoi, forming orbicular spots with a tawny margin, and small sporules ($4 \times 1\,\mu$), in France and Portugal.

Phyllosticta rhododendricola, with large irregular grey spots having a brown margin, and larger sporules ($8–10 \times 3\,\mu$), in France.

Phyllosticta Rhododendri, with rusty-brown spots, chiefly marginal, and the sporules oozing out in flesh-coloured tendrils. Found in Belgium and Britain.

Phyllosticta maxima, with large brown spots with dark margin, and rather large sporules ($10–12 \times 6–8\,\mu$), confined to North America; with

Septoria Rhododendri, having orbicular pallid spots girt by a dark purple margin, and thread-like sporules ($40\,\mu$ long), and a similar

Septoria solitaria, with sporidia half as long, on *Rhododendron occidentale* in California.

There are also two species of anthracnose known.

Glœosporium Rhododendri, with large irregular spots, which are zoned, and have a black margin, the sporules $15–20 \times 4–5\ \mu$, found in Italy, but not certainly British. And

Glœosporium succineum, with sporules about the same size, but globose and yellowish. Altogether a doubtful Siberian species.

Rhododendron Brand.

Puccinia Rhododendri (Fckl.).

This brand has been found on the under surface of the leaves of *Rhododendron ferrugineum* in the Tyrol, but there is no record of it elsewhere. The teleutospores are ovate, slightly constricted at the middle ($26 \times 18\ \mu$), brown.

Sacc. Syll. vii. 2474.

A rust on the leaves of *Rhododendron ferrugineum, dauricum*, and *hirsutum*, distinct from the above, has been found in Italy, France, Germany, and Asiatic Siberia. It is known as *Chrysomyxa Rhododendri* (DC.). Teleutospores ($10–14\ \mu$ broad) obtusely rounded above. Uredospores warted, orange-yellow ($17–28 \times 15–22\ \mu$).

Sacc. Syll. vii. 2660.

Leather-leaved Bristle Spore.

Pestalozzia Guepini (Desm.), Pl. XIV. fig. 17.

This disease attacks numerous plants with coriaceous leaves, besides Rhododendrons, such as *Hoya, Camellia, Citrus*, and *Magnolia*.

Greyish spots are formed on the leaves, often near the apex, usually with a distinct and perhaps elevated margin. The pustules are scattered like little black specks over the spots. The conidia are large, produced within the pustules, and extruded when mature. They are somewhat narrowly elliptical ($20–25\ \mu$ long), attenuated at each end, and divided by three or four transverse septa; the end cells smallest, conical, and colourless, and the intervening cells brown. The apical cell furnished with three or four long divergent hairs, as long as the conidia, the basal cell attached to a colourless footstalk or peduncle.

Diseased leaves should be collected and burnt before the sporules are matured.

Sacc. Syll. iv. 4146; *Cooke, Hdbk.* No. 1401; *Mass. Pl. Dis.* p. 432.

Oleander Leaf-spots.

On the Continent, where *Nerium Oleander* is cultivated much more extensively than in this country, its pests and parasites are of far more interest, whereas we have no record of a single occurrence.

Phyllosticta Nerii has rather large sporules ($15–18 \times 5–6\ \mu$).

Ascochyta Oleandri, with septate sporules rather smaller ($11–15 \times 2 – 2\frac{1}{2}\ \mu$).

Septoria neriicola has short thread-like sporules, and so also has *Septoria oleandrina*, both of which are known in Italy; and *Rhabdospora*

Oleandri which is parasitic on the twigs, and not upon the leaves, in Algeria. The latter is apparently the *Septoria Oleandri* of Montagne.

Arbutus Leaf-spot.

Phyllosticta Arbuti (Desm.), Pl. XVI. fig. 2.

The parasites of the Strawberry tree are, for the most part, confined to the ordinary leaf-spots of small importance, and of these the most common is the above-named, which forms small dingy spots scattered over the leaves.

The receptacles are very small and sprinkled like little dots over the upper surface of the spots, sometimes densely clustered together. The sporules are also very minute, ovoid, and colourless ($5 \times 3\,\mu$), often exhibiting two small nuclei. The attacked leaves are in most instances at first fading.

This has been recognised in France and in Britain.

To pick off and burn infected leaves is to help preventing the spread of the parasite.

Sacc. Syll. iii. 118; *Grevillea*, xiii. 72.

Another species has been detected in Portugal and Algiers (*Phyllosticta microsticta* Dur.) with small spots which soon become white, with a distinct dark brown margin. The sporules are even smaller than in the above.

Arbutus Purple Spot.

Septoria Unedonis (Rob.), Pl. XVI. fig. 3.

This is apparently the most common of the *Arbutus* parasites, and causes small whitish spots upon the leaves, which are circumscribed by a broad purple margin. The receptacles are scattered over the upper surface of the spots, and the sporules are elongated and thread-like ($25 \times 1\frac{1}{2}\,\mu$), but without indication of septation.

It is recorded for France, Portugal, Italy, and Austria, as well as in Britain.

Sacc. Syll. iii. 2661, x. 6282; *Cooke, Hdbk.* No. 1322.

A form of leaf-spot has been found in Italy, supposed to be a variety of the above, although that seems to be doubtful, since the sporules are twice as long and distinctly septate (50–80 μ long).

Another leaf-spot (*Septoria Arbuti*) has been found in Italy, which much more resembles the above type than the assumed variety, since the sporules are almost the same.

Arbutus Tuft Mould.

Cercospora Molleriana (Wint).

The only mould which is recorded as attacking the foliage of the Strawberry tree has occurred in Portugal, but its appearance in any other part of Europe is open to doubt. The spots are normally circular, but often marginal, and pallid grey, with a distinct margin. The mould appears in tufts upon the spots, with quite short threads, but the conidia are elongated, slightly curved and attenuated upwards, divided transversely into numerous cells ($95 \times 3\frac{1}{2}\ \mu$). Both threads and conidia are tinged olive.

Sacc. Syll iv. 2269.

MAGNOLIA LEAF-SPOT.

Phyllosticta Cookei (Sacc.), Pl. XVI. fig. 4.

As might be anticipated, the fungus attacks on *Magnolia* are far more numerous in America than in England, and even those which we do recognise are but seldom to be met with. The one above named, when first found, was called *Phyllosticta Magnoliæ*, but that name was afterwards found to have been previously appropriated. The pale bleached spots on the leaves are rather large and without any definite margin. The minute receptacles are scattered over the spots, on the upper surface; and the sporules are narrowly elliptical ($8\text{–}12 \times 3\text{–}4\frac{1}{2}\ \mu$) and uncoloured.

There is no probability of this ever becoming a troublesome pest in this country on the leaves of *Magnolia grandiflora*, on which it was first discovered.

Grevillea, ix. 94, xiii. 72; *Sacc. Syll.* iii. 130 *bis*.

The older *Phyllosticta Magnoliæ* is very similar in external appearance, and has occurred in Italy, but the sporules are not one half as large ($4 \times 1\frac{1}{2}\text{–}2\ \mu$).

Phyllosticta glauca on leaves of *Magnolia glauca* is exclusively American.

Spots caused by species of *Ascochyta* and *Septoria* are also known, but not hitherto as British.

EVERGREEN LEAF-SPOTS.

It is somewhat fortunate that the Evergreen shrubs, which are so commonly and extensively cultivated in this country, are remarkably free from leaf-spotting fungi.

Aucuba japonica can boast of several in Continental Europe, but not a single British record.

Prunus lusitanica is just as fortunate, or it has not been found out.

Prunus Laurocerasus has its fungi on fallen leaves, but not upon the living, except in other parts of Europe.

Laurus nobilis sometimes exhibits spotted leaves, but hitherto there is no evidence that they result from the incursions of parasitic fungi, elsewhere than in Italy or Portugal. (*Phyllosticta Lauri*, Sacc. 84.)

Ilex Aquifolium. Even the Holly escapes the incursions of leaf-spots of fungoid origin, although the leaves may sometimes show traces of *Fumago vagans* or the mysterious *Capnodium Footii* and have occasionally been visited by *Phyllosticta ilicicola*.

LEAF SOOTY MOULD.

Capnodium Footii (Harv.), Pl. XVI. fig. 5.

This very common black mould is found upon the leaves of a great variety of plants, and often upon leathery leaves, such as Holly, Ivy, Cherry Laurel, &c., forming thin sooty spots on the upper surface with much the appearance of *Fumago vagans*. The creeping mycelium is composed of a mixture of colourless and brown threads, divided into chains of cells. The receptacles are erect and bristle-like, acute, and fringed at the mouth, but genuine sporidia have never been found, so that it remains a doubtful species. Minute sporules or conidia have been met with, but the life-history of the parasite is still very much of a mystery.

It is advisable to pick off and burn these sooty leaves, which are usually conspicuous.

Journ. R.H.S. iv. p. 254, f. 10; *Sacc. Syll.* i. 352; *Cooke, Hdbk.* No. 2807.

Laurustinus Leaf-spot.

Phyllosticta tinea (Sacc.), Pl. XVI. fig. 6.

The spots are formed on the upper surface of Laurustinus leaves, and are either roundish or irregular, and bleached, becoming whitish. The receptacles are dot-like and flattened, scattered over the surface. The sporules are minute and oblong ($4-5 \times 1\ \mu$).

Except in Britain this parasite is only recorded for Italy, where it was first discovered.

Sacc. Syll. iii. 75.

Another spot (*Phyllosticta tineola*) of a similar kind is known to occur on leaves of Laurustinus in France. The spots are vague and ochraceous, but the sporules are cylindrical, and very much larger ($15 \times 3\ \mu$).

A third species has also been recorded in France (*Phyllosticta Roumeguerii*), with grey indefinite spots, and medium-sized sporules ($7\text{-}8 \times 3\frac{1}{2}\ \mu$).

Privet Leaf-spot.

Phyllosticta Ligustri (Sacc.), Pl. XVI. fig. 7.

Although Privet has the reputation of suffering from the attacks of at least a dozen different species of fungi, it is seldom that it is a victim in this country, escaping both cluster-cups and rust, for occasional leaf-spots.

The above common species has variable spots which are soon pale and encircled by a tawny margin. The receptacles are dot-like and minute, and the sporules are narrow, rounded at the ends, with two nuclei ($6\text{-}8 \times 3\mu$).

It has occurred in Italy and Portugal.

Sacc. Syll. iii. 107; *Grevillea*, xiii. 72.

The most probable other form of leaf-spot is caused by *Septoria Ligustri*, but that has not hitherto been recorded for Britain, although known in France and Belgium. Similar spots have been found upon leaves in this country, but sporules have never been discovered.

The Privet cluster-cup, *Æcidium Ligustri* (Str.), has only been found in Germany, and a *Uredo* has also been observed in the same country.

Box Leaf White Spot.

Phyllosticta limbalis (Pers.), Pl. XVI. fig. 8.

The only leaf-spot on the common Box is itself not so very common, although conspicuous. There may be some half-dozen other kinds of leaf-spot, at one time or other described, on so widespread a plant, but they are not British, and the present one is rather a curiosity than a pest.

The spots are of ivory whiteness, and marginal, so as to appear like a broken ring, or fragments of a ring around the edge of the leaves. The receptacles, when present, are minute and scattered, sometimes conspicuously absent, but when fertile they enclose subglobose colourless sporules, enclosing each a minute guttule (3–4 μ diam.).

This species has been found in Britain, France, Belgium, Germany, and Italy.

Fungicides will scarcely be required, as it is rarely to be met with.

Just such a similar leaf-spot, which is not to be distinguished from it by the naked eye, has been found in Portugal and Italy, the sporules of which (15×2 μ) are long and narrow, and divided across the centre into two cells; but this is called *Ascochyta limbalis*.

Sacc. Syll. iii. 124; *Grevillea*, xiii. 72; *Cooke, Hdbk.* No. 1350.

Box Leaf-rust.

Puccinia Buxi (DC.), Pl. XVI. fig. 9.

Occasionally the leaves of Box shrubs are seen plentifully sprinkled with the brand or rust, but unaccompanied by either cluster-cup or uredo. The pustules are usually very formally discoid and cushion-like, compact and not powdery, of a very dark brown colour, and on both surfaces of the leaves. The teleutospores are oblong-clavate, rather thickened and obtuse at the apex, the lower cell almost wedge-shaped, and longer than the upper, constricted at the division ($55–90 \times 20–35$ μ), even, and of a bright cinnamon colour. At first with a long uncoloured pedicel.

Known in Britain, France, Belgium, Switzerland, Germany, Italy, and Portugal.

Pick off and burn infected leaves whenever observed.

Sacc. Syll. vii. 2372; *Cooke, M. Fr.* p. 201; *Cooke, Hdbk.* No. 1514; *Sow. Fun.* t. 439.

Ivy Leaf-spot.

Phyllosticta hedericola (Dur. & Mont. f.), Pl. XVI. fig. 10.

This spot has been known for many years on Ivy leaves and occurs on the upper surface, causing round bleached spots with a rather broad brownish margin. The small receptacles are dotted over these spots, and enclose the oblong hyaline sporules ($6 \times 2\frac{1}{2}$ μ).

Although first recognised in Algeria, it has since been recorded in Britain, France, Italy, and Austria.

Sacc. Syll. iii. 100; *Grevillea*, xiii. 71.

Two other species of the same genus of leaf-parasites have occurred on Ivy leaves in Europe: *Phyllosticta Hederæ* on large brown spots, with

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smaller sporules ($4 \times 1 \mu$), in France and Belgium, and *Phyllosticta concentrica* with broad pallid spots, on which the receptacles are disposed concentrically, with sporules which are nearly globose (10×8–9μ), only at present recognised in Italy.

Ivy Brown Spot.

Septoria insularis (B. & Br.), Pl. XVI. fig. 11.

This parasite was first recognised by Berkeley as causing large brown spots on languid Ivy leaves in Britain, sometimes occupying a large portion of the leaf. The receptacles are scattered over the spots, raising and afterwards splitting the cuticle. The sporules are long and thread-like, slightly curved, but without division (38μ long).

Berk. Ann. N. H. No. 747, t. 15, f. 8 ; *Sacc. Syll.* iii. 2646 ; *Grevillea*, xiv. 76 ; *Cooke, Hdbk.* No. 1308.

Ivy Ringed Spot.

Septoria Hederæ (Desm.), Pl. XVI. fig. 12.

This is a much more common species than the above, and forms smaller, almost circular, bleached spots, encircled by a broad purple margin. The receptacles are seated on the upper surface, and the sporules are similarly thread-like (30–40×1–2μ), the difference being chiefly in the character of the spots.

It has been known in Britain, France, Belgium, Italy, and Germany.

Sacc. Syll. iii. 2644 ; *Grevillea*, xiii. 76 ; *Cooke, Hdbk.* No. 1316.

Ivy Leaf Anthracnose.

Glœosporium paradoxum (De Not.), Pl. XVII. fig. 13.

Of the two species of European anthracnose on Ivy, one has been reported to have been found in Britain. This was apparently first observed in Italy, and occurs on both surfaces of the leaves, without forming any definite spots. The pustules are honey-coloured and flattened, covered by the cuticle. When mature the conidia escape by rupture of the cuticle (8×5–6μ), produced in clusters, each supported by a colourless pedicel, which is nearly double the length of the conidia.

This is reported to be an early and imperfect stage of an asci-bearing fungus, which appears on the dead leaves after they have fallen

The species is also known in France, Belgium, Germany, Portugal, and Italy.

Sacc. Syll. iii. 3697 ; *Cooke, Hdbk.* No. 1407, note.

Another species, which occurs on Ivy, has brownish spots with larger conidia (*Glœosporium Helicis*), and has been found in France and Holland.

Myrtle Leaf-spot.

Phyllosticta nuptialis (Thüm.), Pl. XVII. fig. 14.

The only parasite on Myrtle which we have yet encountered in this country has been the occurrence, on one or two rare occasions, of the above species. The spots are somewhat rounded and bleached, either white or of a pale ochre, with a broad violet margin showing brown on the under surface. The receptacles are scattered over the upper face of the spots and enclose the very minute subglobose sporules ($2–2\frac{1}{2} \times 1\frac{1}{2}$ μ).

This species was first detected in Portugal.

Sacc. Syll. iii. 32.

A black mould (*Cercospora Myrti*) has been detected upon leaves under cultivation at Stockholm, but this seems to be the only record.

Phillyrea Leaf-spot.

Phyllosticta Phillyreæ (Sacc.), Pl. XVII. fig. 15.

This spot is found on the leaves of *Phillyrea media* and *Phillyrea latifolia*, affecting the upper surface, and producing variedly shaped spots, of an ochraceous-grey colour, with a reddish margin. The receptacles are scattered over the spots, and enclose the oblong, almost spindle-shaped sporules ($6–7 \times 3$ μ), each containing two minute guttules.

It has been recorded in France and Italy, as well as Britain, and should be treated as other leaf-spots.

Sacc. Syll. iii. 113 ; *Grevillea*, xiii. 72.

Another species is known in Portugal (*Phyllosticta phillyrina*), occurring on leaves of *Phillyrea obliqua*, but with smaller sporules ($4–5 \times 2–2\frac{1}{2}$ μ).

Phillyrea Rust.

Uredo Phillyreæ (Cooke), Pl. XVII. fig. 16.

This uredo is found sometimes rather plentifully on shrubs of *Phillyrea media*, not only in Britain but also in Germany, Italy, and in Algeria. The pustules are round, yellow, and either solitary or collected together, arranged in rings. At first covered by the cuticle, but at length exposed. Uredospores globose, pear-shaped, or elliptical, delicately spinulose or almost smooth, orange ($17–28 \times 12–16$ μ), without definite pedicels, and with a thick hyaline outer coating.

Sacc. Syll. vii. 3090 ; *Plowr. Brit. Ured.* 258.

Phillyrea Cluster-cups.

Æcidium Phillyreæ (DC).

These cluster-cups, which appear to be independent of uredo or teleutospore, occur on the leaves and twigs of *Phillyrea media* and *latifolia*, sometimes contorting and deforming the latter.

The cups are clustered in roundish patches on the leaves, for the most part crowded, with the margins nearly entire. Æcidiospores very variable in form, being sometimes globose, or elliptical, or pear-shaped ($18–35 \times 14–20$ μ), externally warted, orange-yellow. On the stems the clusters are more elongated, thickened, and distorted.

Known in France, Germany, and Italy.

Sacc. Syll. vii. 2852.

COTONEASTER SPOT.

Phyllosticta sanguinea (Desm.), Pl. XVII. fig. 17.

This species, which is usually found on the dead leaves of the Bird Cherry, has occurred in this country on the living leaves of *Cotoneaster frigida*. The spots are roundish and brown, girt by a darker line, outside which the tissue is stained of a blood red. The receptacles are scattered over the spots, and are black, point-like, and shining. The sporules are ovate, with two nuclei (8 μ long), and uncoloured.

Known in France and Britain.

Sacc. Syll. iii. 14; *Grevillea,* xiii. 71.

BUTCHER'S BROOM SPOT.

Phyllosticta ruscicola (Dur. & Mont. f.), Pl. XVII. fig. 18.

This pest occurs on the phyllodes of the Butcher's Broom, *Ruscus aculeatus*, and other species. The spots are roundish or indistinct, whitish, with a brown border, and the perithecia, which are seated upon these spots, are at first covered. The sporules are oblong and colourless ($7–8 \times 3\frac{1}{2}$ μ).

Probably this is an imperfect condition of an ascomycete, which is developed on the dead phyllodes.

It is not only common in Britain, but is known also in France, Belgium, Portugal, Austria, and Italy.

Sacc. Syll. iii. 819; *Cooke, Hdbk.* No. 1346.

As the phyllodes are persistent, this may be regarded for our purposes as an evergreen shrub.

MAHONIA LEAF-SPOT.

Phyllosticta Mahoniæ (Sacc. & Speg. f.), Pl. XVII. fig. 19.

Mahonia leaves are rather given to discoloration and sometimes to spotting, but in this instance no definite spots are formed, and the receptacles are scattered over the surface. In British specimens the leaves were still living and adhering to the plant, but the receptacles were rather larger than usual, containing broadly elliptical sporules ($4–6 \times 3–4$ μ).

It has been found also in France and Italy.

Sacc. Syll. iii. 131; *Grevillea,* xiii. 72.

Another spot is known to occur on the leaves of *Mahonia japonica*, in which large bleached spots occur with a brownish margin. The sporules are scarcely different in size ($4–4\frac{1}{2} \times 2\frac{1}{2}–3$ μ), but the spotting is quite distinct. It has been found at present only in Portugal.

The ordinary leaf-spots (*Phyllosticta Berberidis* and *Septoria Berberidis*) on leaves of the common Berberry have not yet been observed in Britain.

Grevillea, xiii. 72.

Æcidium Berberidis sometimes occurs on the leaves and berries of *Mahonia.* See *Smith, Field Crops,* fig. 87.

DECIDUOUS-LEAVED SHRUBS

here enumerated are succeeded by a small subsection, which includes coniferous and allied shrubs, to which, perhaps, should have been added some of those hereafter included with *Coniferæ*, under the "Pests of Forest Trees."

Berberry White Mould.

Ovularia Berberidis (Cooke), Pl. XVII. fig. 20.

This mould occurs on the fading leaves of *Berberis asiatica*, forming greyish-white patches, reminding one of *Oidium*. The short, slender, unbranched threads are collected in tufts, bearing about their apices the elliptical, uncoloured conidia ($15–18 \times 8–9\ \mu$).

These moulds are susceptible to the influence of fungicides, should they prove troublesome.

Sacc. Syll. x. 746; *Grevillea*, xvi. 62, xiii. 98.

Berberry Anthracnose.

Glœosporium Berberidis (Cooke), Pl. XVII. fig. 21.

This anthracnose on the leaves of *Berberis asiatica* was first observed in this country in 1884. The spots are on the upper surface, and are broad, somewhat circular, brown, with a reddish margin. The pustules are numerous upon the spots, convex, at length splitting at the apex to liberate the conidia, which are ovoid and colourless, comparatively small ($5 \times 3\ \mu$).

Sacc. Syll. x. 6756; *Grevillea*, xiii. 98.

Purple Berberry Spot.

Phyllosticta asiatica (Cooke).

This spot was found on the leaves of *Berberis asiatica* about the same time as the anthracnose, which to some extent it resembles externally. The spots are circular or irregular, and pale brown, with a broad purplish margin, which becomes crimson as it passes into the leaf. The receptacles are seated on the upper surface upon the spots, and are very minute and point-like. Sporules very small, hyaline ($4 \times 1\frac{1}{2}\ \mu$).

Sacc. Syll. x. 4865; *Grevillea*, xiii. 91.

Berberry Leaf Mildew.

Microsphæra Berberidis (DC.), Pl. XVII. fig. 22.

The Berberry Mildew is a common pest of *Berberis vulgaris*, and partakes of the character of the mildew of the Gooseberry, the Garden Pea, and the Dogwood. The leaves are at first covered with the thin white creeping mycelium, which imparts a chalky appearance, and is then epiphytal; soon the erect branches become jointed, and the cells become conidia, which fall away successively, and add to the mealy appearance of the leaves. This stage is the *Oidium*, but whether it is the *Oidium*

Berberidis of Thümen is not fully determined. If so, the conidia are reported to be oval and rather small ($7\text{–}8 \times 3\text{–}3\frac{1}{2}\ \mu$).

Succeeding this stage the globose receptacles appear on the surface of the mycelium, dotted about like little black points. Each receptacle is surrounded by a circle of about ten appendages, the apex of each twice or more forked, the branches spreading, with the tips obtuse. Each receptacle encloses about six asci, and each contains from six to eight sporidia.

This mildew is recorded for Britain, France, Belgium, Germany, Finland, and Italy.

Should it be required, the sulphur remedy is applicable.

Sacc. Syll. i. 47 ; *Cooke, M. F.* p. 219 ; *Cooke, Hdbk.* No. 1921.

Berberry Cluster-cups.

Æcidium Berberidis (Gmel.), Pl. XVII. fig. 23.

These cluster-cups have the merit of being historical, since it is over them that the battle has been fought which has sought to establish the theory that cluster-cups may be produced on one species of plant, such as the leaves of the Berberry, while the uredospores and teleutospores belonging to the same cycle may be produced upon quite a different species of plant, such as the leaves of Wheat. We have no cause to espouse or reject that theory here, since we have only to regard the cluster-cups as a disease of the Berberry shrub, and leave the diseases of the Wheat plant to take care of themselves.

It is in the spring that the leaves of *Berberis vulgaris* exhibit the thickened discoloured spots (2–5 mm. broad), which ultimately are fissured to allow of the extrusion of the cluster-cups, such spots being somewhat orbicular and convex. The cluster-cups are rather elongated and closely packed side by side upon the spots. The margin of the cups is white, spreading, and toothed. The æcidiospores are produced in chains from the base towards the apex of the cup, and are somewhat globose, becoming angular by compression ($14\text{–}26\ \mu$), with a smooth surface, and of an orange colour.

Spermogonia are produced in small clusters on honey-coloured spots, and are supposed to have some influence in the cycle of which they are believed to form a part. With the spermogonia and the cluster-cups the story, in so far as the Berberry is concerned, comes to an end.

They are produced on the leaves and fruits of several species of *Berberis*, and on *Mahonia*.

This fungus is reported for the greater part of Europe, North America, Asiatic Siberia, and uncertainly for parts of the Southern Hemisphere.

Certain theorists are at war with the Berberry bush on account of the Wheat mildew, and, whether with *Æcidium* or not, cry aloud for its extirpation.

Sacc. Syll. vii. 2191 ; *Cooke, Hdbk.* No. 1612 ; *Cooke, M.F.* 195, t. 1, f. 7–9 ; *Mass. Pl. Dis.* p. 247 ; *Smith, Field Crops*, p. 159, figs. 82 to 86 ; *Plowr. Brit. Ured.* 163.

It may be noted that another species of *Æcidium* (*Æ. graveolens*) has been discovered on the leaves of the same species of Berberry in Switzerland, with the cluster-cups scattered over the surface of the leaf, and having an appreciable odour.

Sacc. Syll. vii. 2716; *Cooke, Fungi, their Uses*, p. 201.

And yet another species (*Æ. magelænicum*), also on the leaves of *Berberis vulgaris*, in Hungary, Austria, Germany, and the Straits of Magellan, also with the cluster-cups scattered over the leaves.

Sacc. Syll. vii. 2715; *Berk. Hook. Fl. Ant.* ii. 450.

Buckthorn Leaf-spot.

Phyllosticta Rhamni (West).

The leaves of the Buckthorns are rather subject to spotting. This spot is to be found on the leaves of *Rhamnus Frangula* and *Rhamnus Alaternus* in Belgium, Portugal, and Italy, and sometimes in Great Britain. The spots are variable in form, ochraceous, with a brown marginal line. The receptacles are gregarious in the centre of the spot. Sporules ovoid ($5–6 \times 3–4\ \mu$), with a tinge of olive.

Sacc. Syll. iii. 62; *Grevillea*, xiv. 71.

A similar species (*Phyllosticta rhamnigena*) occurs on *Rhamnus cathartica* in France, Portugal, and Italy, with dirty white circular spots and small sporules ($4\frac{1}{2}–5 \times 3\mu$), which seems to be very little different.

The Italian species on *Rhamnus catharticus* has the roundish spots, with a reddish-brown margin, and the sporules larger ($10 \times 4\ \mu$) and uncoloured.

In Belgium a spot is known on the leaves of *Rhamnus Frangula* in which the round spots are brown, then grey (*Phyllosticta Frangulæ*), with a vinous-red margin.

Buckthorn Cluster-cups.

Æcidium crassum (Pers.), Pl. XVII. fig. 24.

The cluster-cups of the different species of *Rhamnus* now lose their identity under the name of *Puccinia coronata*, because the presumed teleutospores are to be found on the leaves and culms of grasses. Fortunately we are privileged to retain the old name, as we regard it solely as a disease of Buckthorn leaves.

The cups are clustered upon thickened yellowish spots, and are cylindrical, with a spreading margin, which is finely toothed and white. The æcidiospores are angular by compression ($17–26 \times 13–21\ \mu$), warted, and of an orange colour.

This disease is reputed to prevail over the greater part of Europe, in North America, and in South Africa.

Should it be found necessary to check the spread of this parasite, it will doubtless be found sufficient to pick off and burn the diseased leaves, which are seldom numerous.

Sacc. Syll. vii. 2192; *Cooke, M. F.* p. 196; *Plowr. Brit. Ured.* p. 164; *Cooke, Hdbk.* No. 1613.

BUCKTHORN POWDERY MILDEW.

Microsphæra divaricata (Wallr.), Pl. XVII. fig. 25.

This mildew makes its appearance on the leaves of *Rhamnus Frangula*, and very often, as in this country, proceeds no further than the production of conidia. The mycelium is thin and evanescent, producing the usual erect septate threads, which separate in joints, and constitute the conidia. The receptacles are minute and globose, with a few divergent appendages, about five times as long as the diameter of the receptacles. About four asci are contained within each mature receptacle, each of which encloses four sporidia.

It is found in France, Germany, Belgium, and Finland.

Subject, like other epiphytes, to the influence of sulphur.

Sacc. Syll. i. 37; *Lev. Ann. Sci. Nat.* 1851, xv. t. 8, f. 18.

GUELDER ROSE LEAF-SPOT.

Septoria Viburni (West).

This leaf-spot is to be found both on *Viburnum Opulus* and *Viburnum Lantana*. The spots are on the upper surface, and are of irregular form, whitish in the centre and brown at the circumference. The receptacles are minute, like black dots, and the sporules cylindrical, obtuse at the ends with from five to seven guttules.

Known in Belgium and Italy.

Sacc. Syll. iii. 2657; *Cooke, Hdbk.* No. 1321; *Grevillea*, xiv. 101.

GUELDER ROSE MEALY MILDEW.

Microsphæra Hedwigii (Lév. f.), Pl. XVII. fig. 26.

The leaves of *Viburnum Lantana* are subject to the mealy mildew, which covers them with a thin mycelium, giving a frosty appearance for a time, but finally vanishes. The receptacles are minute and globose, as usual, scattered over the mycelium. The appendages which surround the receptacles are few, and a little longer than the diameter of the receptacles.

The number of asci in each receptacle is limited to four, and each encloses four sporidia.

This mildew is known in Belgium, Italy, Germany, and North America.

Sacc. Syll. i. 35; *Cooke, Hdbk.* No. 1918, fig. 316.

SPINDLE-TREE RUST.

Cæoma Euonymi (Gmel.), Pl. XVII. fig. 27.

This golden rust has been several times found on the leaves of *Euonymus europæus*, seated upon paler spots; the pustules are small, and densely aggregated, sometimes disposed in circles, becoming confluent in large masses, of a pale orange colour, and powdery. No æcidiospores or teleutospores are known to be associated with it. The uredospores are produced in chains, somewhat as in *Æcidium*, and are globose or ovate ($17-28 \times 12-24\ \mu$), very variable in size, and delicately punctate.

It has been recorded in Belgium, Germany, Switzerland, Italy, and Russia.

Sacc. Syll. vii. 3140; *Cooke, M. F.* p. 216; *Cooke, Hdbk.* No. 1576*a*.

About fourteen different kinds of leaf-spots have been described on species of *Euonymus*, but they have not been observed in Britain, excepting *Phyllosticta Euonymi* on *Euonymus europæus*.

Sacc. Syll. i. 68; *Grevillea*, xiii. 71.

The latest of these is *Oidium Euonymi-japonicæ* (Sacc.). See *Journ. R.H.S.* xxix. 1905, p. 434, fig. 139.

Spindle-tree Mildew.

Microsphæra Euonymi (DC.), Pl. XVII. fig. 28.

This common mildew is not unusual in autumn on uncultivated plants of *Euonymus europæus*, although, like others, it has had to suffer a change of name from *Microsphæra comata*, by which it has long been known.

The delicate thin mycelium attacks the upper surface of the leaves, and imparts a chalky appearance, at first sprinkled with the conidia. Later on the little globose receptacles are scattered over the mycelium, as in other species. Each of these encloses eight pear-shaped asci, which contain four sporidia. The appendages which surround the receptacles are six times as long as the diameter of the receptacles.

It is reported for Britain, France, Belgium, Germany, and Italy.

Sacc. Syll. i. 38; *Cooke, M. F.* p. 226; *Cooke, Hdbk.* No. 1923.

Cornel Leaf-spot.

Phyllosticta cornicola (DC.), Pl. XVII. fig. 29.

This form of leaf-spot is by no means uncommon on leaves of *Cornus sanguinea* and other species. The spots are rather large, and dark blood-red, turning pale in the centre. The receptacles are rather larger than usual, and the sporules oblong, narrowed towards each end ($7-9 \times 3-4\ \mu$), enclosing two guttules.

It has been recorded in France, Italy, Siberia, and North America.

Sacc. Syll. iii. 103; *Grevillea*, xiii. 72.

Another species (*Phyllosticta Corni*) is known on the leaves of *Cornus alba* in Belgium with very dark brown spots, becoming white in the centre, and only from three to six receptacles scattered over each spot. Sporules elliptical ($10 \times 5\ \mu$).

Cornel Grey Leaf-spot.

Septoria cornicola (Desm.), Pl. XVIII. fig. 30.

The leaves of *Cornus sanguinea* are often spotted by this parasite, which produces roundish grey spots on the leaves, with a dark purple

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margin. The receptacles are scattered over the spots on the upper surface. Sporules cylindrical, or rod-like, curved (35–40×2–$2\frac{1}{2}\ \mu$), with two to four obscure septa, expelled when mature in whitish tendrils.

It is common in Western Europe.

Sacc. Syll. iii. 2652; *Grevillea*, xiii. 76; *Cooke, Hdbk.* No. 1312.

Dogwood Mildew.

Erysiphe tortilis (Wallr.), Pl. XVIII. fig. 31.

The powdery mildew of the Dogwood is by no means an uncommon infliction, the thin white mycelium entirely overspreading the leaves, with an evanescent coating. The conidia are first produced as in other species, and these are followed, later on, by the small globose receptacles, which are scattered over the mycelium. The appendages are very long, and even ten times as long as the diameter of the receptacles, but neither branched nor divided at the apex. The number of asci in each conceptacle is four, and each encloses four sporidia.

This mildew is recorded for France, Belgium, Germany, and Italy.

May be checked by the application of powdered sulphur.

Sacc. Syll. i. 65; *Cooke, Hdbk.* No. 1929; *Cooke, M. F.* f. 245, 246.

Lilac Leaf-mould.

Ovularia Syringæ (Berk.), Pl. XVIII. fig. 32.

This white mould on lilac leaves was first observed by Berkeley in 1881. The flocci are for the most part decumbent, surmounted by the simple conidia, which are at first subglobose, with a terminal wart or papilla; at length they become elliptic and then ovate, being very large for such a mould (50–$70\ \mu$ long).

It was discovered in Scotland, but is very little known, and has never come under our observation.

Sprinkle with Bordeaux mixture.

Sacc. Syll. iv. 747; *Gard. Chron.* 1881, fig. 135; *Grevillea*, 1882, x. 115, xi. 15.

A black mould (*Cercospora lilacis*), of a destructive character, is known in France, Belgium, Austria, and Italy, but at present has not been recognised in Britain. It forms grey or reddish oblong spots, and has pointed septate olive conidia (15–$25\ \mu$ long).

Lilac Leaf-spot.

Phyllosticta Syringæ (West).

One of the most common causes of the spotting of Lilac leaves is the above-named parasite, which forms broad bleached spots of an irregular form, with a brownish margin. The receptacles are seated on the upper surface of the spots, and are minute and dot-like. The sporules are oblong ($8 \times 3\ \mu$), with two guttules, and uncoloured.

It is known in France, Belgium, Portugal, and Italy.

Sacc. Syll. iii. 109; *Grevillea*, xiv. 72.

Another species (*Phyllosticta syringicola*) is known in France with reddish-brown spots and larger sporules ($12–15 \times 2\ \mu$).

Tea-tree Mildew.

Microsphæra Lycii (Lasch.), Pl. XVIII. fig. 33.

This powdery mildew is very common on the leaves of *Lycium barbarum*, but in this country it is rarely seen proceeding beyond the conidial stage, when the leaves are covered with *Oidium*. The mycelium is persistent, adhering by means of suckers, or haustoria, entirely covering the leaves and twigs with a coating of white. When the receptacles make their appearance they are minute and flattened, globose, with a great number of spreading appendages, twice as long as the diameter of the receptacles, about four times forked at the apex, with the tips obtuse. Each receptacle contains from twelve to sixteen asci, and each ascus only two sporidia.

It is recorded in France, Germany, Italy, and in North America.

If necessary, sprinkle with powdered sulphur.

Sacc. Syll. iii. 33; *Cooke, M. F.* p. 240.

Sida Leaf-spot.

Phyllosticta sidæcola (Cooke).

Hitherto only this kind of leaf-spot has been observed in this country on leaves of *Sida* and *Hibiscus*, and this upon leaves of *Sida Napæa*, forming brown indistinct spots, pallid in the centre. The sporules are minute and elliptical ($4 \times 2\ \mu$).

Grevillea, xiv. p. 39, 72.

There is another species found on the leaves of *Hibiscus syriacus* in Portugal and Italy, but we have not heard of it in Britain (*Phyllosticta syriaca*). The spots are bleached, with a broad tawny margin, and the sporules are almost ellipsoid ($7 \times 3–4\ \mu$).

Calycanthus Leaf-spot.

Although *Calycanthus* is not uncommonly cultivated in gardens, it appears hitherto to have escaped the pests which attack it on the Continent.

Phyllosticta Calycanthi (S. & S.) occurs in Italy and causes variable spots, which become bleached, and bear the usual small perithecia, which contain ellipsoid sporules ($7–9 \times 5–6\ \mu$).

Sacc. Syll. iii. 35.

Ascochyta Calycanthi (S. & S.) also is found in the same country, forming variable bleached spots on the leaves, and producing uniseptate sporules ($11–14 \times 2\frac{1}{2}–3\ \mu$).

Sacc. Syll. iii. 2165.

Septoria Calycanthi (S. & S.) is yet another Italian leaf pest which forms ochraceous spots on the leaves of *Calycanthus*, and evolves numerous thread-like sporules ($15–25 \times 1\frac{1}{2}–2\ \mu$), with one central division or septum. It has also been found in Portugal.

Sacc. Syll. iii. 2639.

Staphylea Leaf-spot.

Although *Staphylea* is common enough, it seems to have escaped attack from fungus parasites in this country, although liable abroad. Leaf-spot caused by *Septoria Staphyleæ* (Pass.) is known in Italy, where it produces rufous spots bearing the small perithecia, which eject thread-like sporules ($16–20 \times 1\ \mu$).

Sacc. Syll. iii. 2585.

Forsythia Leaf-spot.

The leaves of *Forsythia* do not appear to suffer from spot in this climate, although *Phyllosticta Forsythiæ* (Sacc.) is recorded in Italy. The spots are rounded, ochraceous, with the small perithecia concentrically disposed upon them. The sporules are small ($5–7 \times 2\frac{1}{2}–3\ \mu$), with two minute guttules.

Sacc. Syll. iii. 139.

A species of *Phoma* has been found in Britain on dead twigs, but not as a parasite.

Garrya Leaf-spot.

Phyllosticta Garryæ (C. & H.).

This leaf-spot was first recognised on leaves sent from North America, but has since been found upon shrubs under cultivation in this country. The spots are elliptical, grey, with a purple margin. The receptacles are scattered over the upper surface and are point-like, as usual. The sporules are narrowly elliptical ($10–12 \times 2–2\frac{1}{2}\ \mu$) and uncoloured.

Grevillea, ix. 84 ; *Sacc. Syll.* iii. 121.

Another leaf-spot has been found on the leaves of *Garrya elliptica* in France, which has variable spots encircled by a black line, and two-celled sporules (*Ascochyta Garryæ*), which are fusiform and slightly greenish-yellow ($8–10 \times 3\ \mu$).

Sacc. Syll. iii. 2167.

Yet another leaf-spot has been discovered on *Garrya elliptica* in France, which has bleached spots (*Septoria Garryæ*) and rod-like sporules ($15–18 \times 1\frac{1}{2}\ \mu$). Whether there is any connection between these three species we cannot say.

Sacc. Syll. iii. 2701.

Deutzia Pink Mould.

Fusidium Deutziæ (Cooke), Pl. XVIII. fig. 34.

This delicate little mould affected the under surface of the leaves of *Deutzia* and appeared to be parasitic, forming small convex tufts of a flesh colour. The conidia spindle-shaped, straight (16–20 × 3–4 μ), supported on very short pedicels or spore-bearers.

Although this is a kind of mould which is apt to be troublesome, we have not heard of it lately; should it appear, the effect of spraying with Bordeaux mixture should be tried.

Grevillea, xvi. 48, 58.

A kind of leaf-spot is known on *Deutzia scabra* in France (*Septoria phyllostictoides*), which may find its way into this country.

Mezereum Anthracnose.

Glœosporium Mezerei (C. & M.), Pl. XVIII. fig. 35.

This species was not recognised until 1890, when it was found to produce small brown pustules on the upper surface of the leaves, without definite spots, but mostly upon fading leaves, probably induced by the presence of the parasite.

The sporules are somewhat elliptical or almond-shaped, with one or two guttules, and colourless, produced at the apex of short pedicels (15 × 6 μ).

Sacc. Syll. x. 6768; *Grevillea*, xix. 8.

The above can scarcely be the same species as the French anthracnose (*Marsonia Daphnes*), which has been found upon greenish and afterwards brownish spots, and has ovoid curved sporules (20 × 4–5 μ), acute at each end, and divided into two unequal cells. This has been recorded for France and the Netherlands.

Hawthorn Leaf-spot.

Phleospora Oxyacanthæ (Kze.), Pl. XVIII. fig. 36.

This common leaf-spot has been known to occur on Hawthorn for many years. The spots are mostly yellowish, or scarcely distinct, the receptacles are seated on the upper surface, from which the mature sporules are extruded in yellowish tendrils. Sporules rod-like, a little thickened downwards (70–80 × 6–8 μ), at first with granular contents, afterwards divided by from six to eight transverse septa.

Known in Sweden, Germany, Austria, Portugal, and Italy.

Sacc. Syll. iii. 3139; *Cooke, Hdbk.* No. 1299.

Hawthorn Powdery Mildew.

Podosphæra Oxyacanthæ (DC.), Pl. XVIII. fig. 37.

It is by no means uncommon to see the leaves of Hawthorn whitened with this mildew, which sometimes does not pass beyond the *Oidium* stage, and the leaves are powdered with the fallen conidia. When the receptacles appear they are minute, globose, and scattered over the mycelium. The appendages which surround the receptacles are from eight to ten, and about equal in length to the diameter of the receptacles. They are shortly branched at the apex, with the tips of the branchlets dilated and rounded. Only one ascus is contained in each receptacle, and this encloses eight hyaline ovoid sporidia.

This mildew is believed to be found over the whole of Europe, extending into Algeria. Formerly known as *Podosphæra clandestina*.

Sacc. Syll. i. 1; *Cooke, Hdbk.* No. 1917; *Cooke, M. F.* p. 239.

Hawthorn Cluster-cups.

Ræstelia lacerata (Mer.), Pl. XVIII. fig. 38.

It is usual in these days to call this species of fungus *Gymnosporangium clavariiforme*, because it is believed to be the first stage, or cluster-cups, of a gelatinous exudation from the branches of the common Juniper. For our purpose it is better to continue to call it the Hawthorn cluster-cups, and regard it as a disease of the Hawthorn.

The leaves, and sometimes the fruits, are swollen in places, and from these swellings burst out the tufts of cluster-cups, seated on orange spots. The cups are at first flask-shaped, then cylindrical, and split nearly to the base in reflexed filaments enclosing the chains of yellowish æcidiospores, which are separately nearly spherical, compressed, angular ($22–45 \times 10–35\ \mu$), and warted.

It is reported for France, Belgium, Germany, Finland, Austria, Hungary, Dalmatia, Italy, and North America.

Sacc. Syll. vii. 2606; *Cooke, M. F.* figs. 22–26; *Cooke, Hdbk.* No. 1599; *Gard. Chron.* 1861, p. 336; *Sow. Fun.* t. 318.

Laburnum Leaf-spot.

Phyllosticta Cytisi (Desm.), Pl. XVIII. fig. 39.

Living leaves of Laburnum are subject to spotting from the attacks of this parasite, which produces circular bleached spots, turning brownish, but with scarcely a distinct margin. The receptacles are dot-like, and scattered over the spots. Sporules oblong, rounded at the ends, curved, containing one guttule ($6 \times 3–4\ \mu$).

In addition to Britain this fungus is known in France, Belgium, Austria, and Italy.

Sacc. Syll. iii. 40; *Cooke, Hdbk.* No. 1347.

Another spot, caused by an allied species (*Phyllosticta laburnicola*), has been observed in Italy. There are no definite spots, and the sporules are smaller ($3–5 \times 1\ \mu$).

Not an uncommon fungus on branches of Laburnum is *Cucurbitaria Laburni* (Pers.), which has been claimed as a wound parasite, but it is commonly seen on dead twigs.

Hart. & Som. in Dis. Trees, p. 87; *Sacc. Syll.* ii. 3937.

Laburnum Anthracnose.

Glæosporium Cytisi (B. & Br.).

This anthracnose was first recognised by Berkeley on leaves of Laburnum in Scotland, but does not appear to have spread southward.

The spots are whitish, and at one time or other circled with red. Pustules minute, seated on the spots. Sporules small, elliptical.

This is another of the species which appears to have been hurriedly described from a single set of specimens, and has not been seen again.

Berk. & Br. Ann. N. H. No. 1897; *Grevillea*, x. 1881, p. 49; *Sacc. Syll.* iii. 3686.

Parasites do not appear hitherto to have caused much trouble with *Colutea arborescens*, notwithstanding its extensive cultivation, so that we have no record of any British species.

Mountain Ash Cluster-cups.

Rœstelia cornuta (Gmel.), Pl. XVIII. fig. 40.

Under the name of *Gymnosporangium juniperinum*, the presumed teleutospores which succeed these cluster-cups on twigs of Juniper, the original name is concealed. Our parasite, or at any rate that part of it which concerns us, makes its appearance on the leaves of the Mountain Ash and *Amelanchier*. They are seated in tufts upon yellow spots, on the upper surface. The cups are long horn-like tubes (up to 8 mm. long), which are curved, and whitish at first, then yellowish or reddish, with a toothed margin. The æcidiospores are spherical, then compressed and angular, of a brownish-yellow colour ($20–28 \times 16–24\ \mu$), delicately warted on the surface.

The pest is known in Britain, Belgium, Germany, Finland, Switzerland, Italy, Austria, and North America.

Sacc. Syll. vii. 2607; *Cooke, M. F.* f. 18, 19; *Cooke, Hdbk.* No. 1598, f. 218; *Sow. Fun.* t. 319.

Sumach Leaf-spots.

Leaf-spots are numerous, and common, on various species of *Rhus* in North America, but we have no record of their occurrence in Britain. There are not less than fifteen species of leaf parasites that are known and described, but probably not five of them are European.

GYMNOSPERMS.

Savin Jelly-rust.

Gymnosporangium Sabinæ (Dicks), Pl. XVIII. fig. 41.

According to theory, the proper cluster-cups of this pest are produced upon the leaves, twigs, and fruits of the Pear tree, and it was formerly known as *Rœstelia cancellata*. The teleutospores are exuded in a gelatinous mass from the branches of *Juniperus Sabina*. We deal with the cluster-cups as a disease of the Pear tree.

The teleutospores cause gouty swellings in the branches of the host-plant, and at length break through in irregular conical or cylindrical, obtuse, gelatinous, orange-coloured masses, sometimes compressed, and sometimes divided (10 mm. long) like little flabby tongues. This gelatinous mass consists of teleutospores with their stems adhering together.

The former are ellipsoidal (38–50 × 23–26 μ), divided transversely into two cells, and of an orange-brown colour. The stems or pedicels are very long and colourless.

Each cell is capable of germination, as in *Puccinia*, and produces a filament, called a promycelium, the extremity at length divided off into three or four cells, each of which develops a secondary spore.

Journ. Q.M.S. 1871, t. xix. fig. 2 ; *Sacc. Syll.* vii. 2608 ; *Plowr. Brit. Ured.* p. 230 ; *Journ. R.H.S.* 1902, xxvi. p. 724, fig. 303 ; *Cooke, Hdbk.* No. 1517 ; *Berk. Outl.* t. 2, f. 4 ; *Hart. & Som. in Dis. Trees*, p. 158.

Confounded Savin Jelly-rust.

Gymnosporangium confusum (Plowr.), Pl. XVIII. fig. 42.

This is another gelatinous rust which affects the twigs of the Savin, which is said to resemble so closely the other species that it cannot be distinguished from it ; hence we are at a loss to discover how its sponsors are to recognise it. The difference is said to exist in its life-history ; that its first stage, or cluster-cups, are found upon the Medlar, Quince, and Hawthorn. No one can tell how to distinguish the teleutospores on the Savin from the teleutospores of the other and original species. It is a pretty fairy tale, and should be kept in the nursery.

Teleutospores smooth, oval or elliptical, generally acute at both ends, of two kinds, the more numerous with hyaline spore-walls and orange-yellow contents, the other with dark brown thick walls (40–50 × 20–25 μ) with from two to four germ tubes, pedicels long (80–100 μ), hyaline.

Plowr. Brit. Ured. p. 232, t. iv. figs. 13, 14 ; *Mass. Pl. Dis.* p. 287.

Gymnosporangium tremelloides has its teleutospores on *Juniperus communis*, and its æcidium form on *Pyrus Aria* in the Bavarian Alps.

Hart. & Som. in Dis. Trees, p. 159.

Savin Leaf-dot.

Coryneum Berkeleyi (Cooke), Pl. XVIII. fig. 43.

In the English Flora, Berkeley described a parasite on the leaves of *Juniperus Sabina*, which he called *Podisoma foliicola*. In 1871 we demonstrated that this was not a *Podisoma* at all, having examined his specimens, so that we applied the name of *Sarcostroma Berkeleyi*. Since that time we have doubted whether it had not better be referred to *Coryneum*. In no form is it recognised in Saccardo's " Sylloge."

It makes its appearance in spring, on living leaves, as small subelliptic black excrescences, not larger than the head of a pin. Internally it consists of a tremelloid stroma, from which radiate long hyaline peduncles, surmounted each by an elliptical or subfusiform spore or conidium, of a dull brown colour when mature, and divided by three, or rarely five, transverse septa (30 × 8 μ).

This parasite does not appear to have been observed anywhere else, and only on rare occasions in this country, so that it has not really developed into a pest.

Journ. Q.M.S. 1871, pl. xix. fig. 4 ; *Cooke, Hdbk.* No. 1518.

JUNIPER JELLY-RUST.

Gymnosporangium clavariiforme (Jacq.), Pl. XVIII. fig. 44.

The proper cluster-cups of this species are said to be produced on the leaves and fruits of the Hawthorn, and were formerly known as *Rœstelia lacerata.*

The teleutospores are developed on the living twigs of *Juniperus communis,* which are previously swollen, and then the fungus issues through fissures in the bark in soft gelatinous club-shaped orange tongues, often flattened, sometimes forked, and curved or flexuous.

The teleutospores are oblong-fusiform, divided across the centre into two cells, and yellowish ($70–120 \times 14–20\ \mu$), on very long colourless pedicels.

Each cell is capable of germination, in the same manner as the Savin rust.

It has been recorded for France, Belgium, Germany, Finland, Austria, Hungary, Dalmatia, Italy, and North America.

The teleutospores are nearly twice as long as in *Gymnosporangium juniperinum.*

Journ. Q.M.S. 1871, t. xix. fig. 1 ; *Cooke, M. F.* p. 214 ; *Sacc. Syll.* vii. 2606 ; *Plowr. Brit. Ured.* p. 233 ; *Cooke, Hdbk.* No. 1516 ; *Hart. & Som. in Dis. Trees,* p. 158.

JUNIPER JELLY-MASS.

Gymnosporangium juniperinum (Linn.), Pl. XVIII. fig. 45.

This jelly fungus has its reputed cluster-cups on the leaves of Mountain Ash, under the former name of *Rœstelia cornuta,* and the teleutospores are developed on the branches of *Juniperus communis.* Thus it will be observed that two similar gelatinous fungi are produced on the branches of the same kind of Juniper.

The gelatinous masses in this species are more expanded than in the preceding, at first mostly hemispherical, then pear-shaped, pleated in folds or collapsing, at first tawny-yellow, and afterwards golden-yellow. The teleutospores are ellipsoid or oblong, narrowed towards each end, and divided across the centre into two cells ($40-75 \times 17-27\ \mu$), on very long slender pedicels. This species was the only one originally called a *Gymnosporangium.*

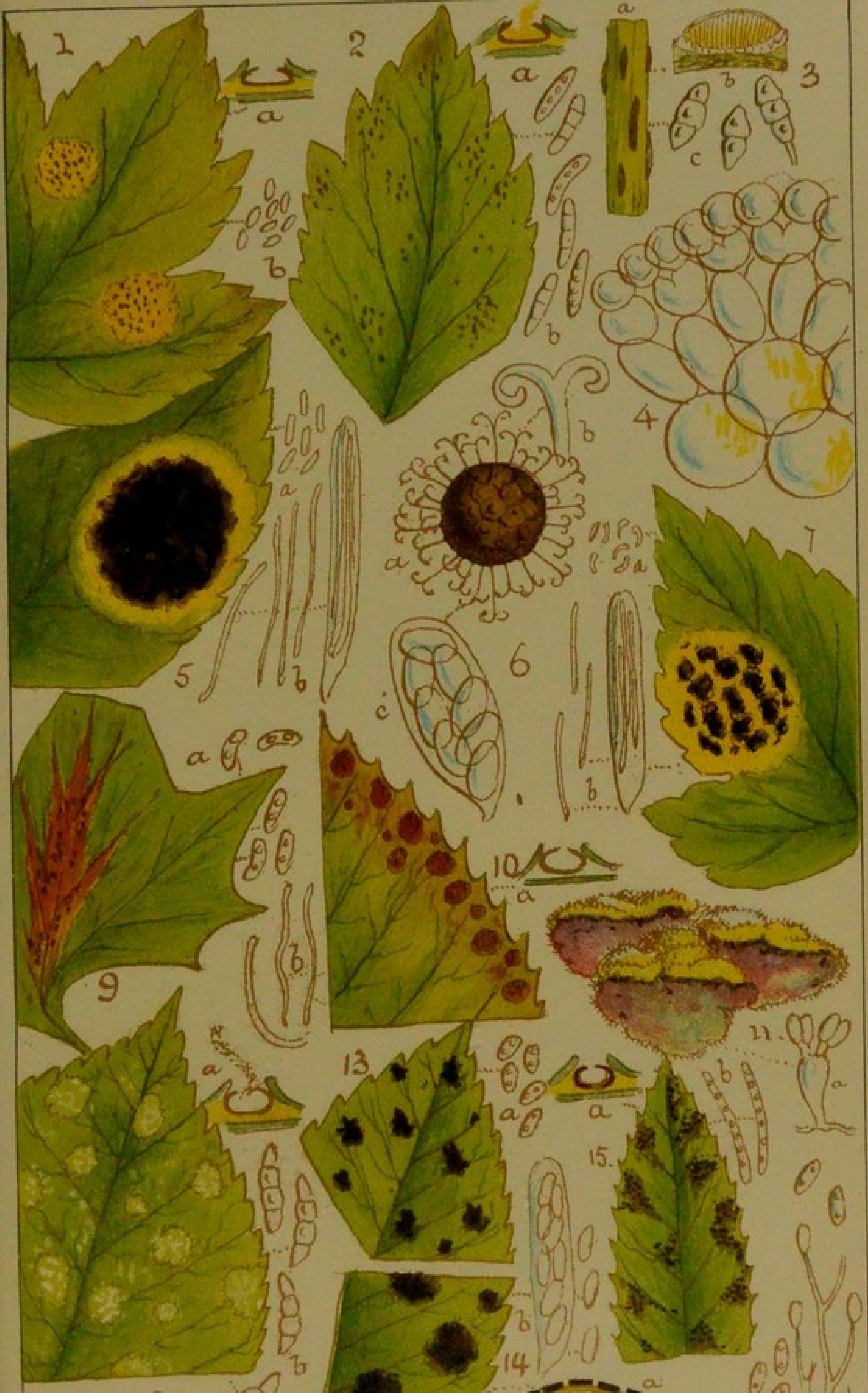
Known in Belgium, Switzerland, Germany, Finland, Austria, Italy and North America, and sometimes called *Gymnosporangium conicum.*

Journ. Q.M.S. 1871, t. xviii. fig. 2 ; *Cooke, M. F.* p. 214 ; *Plowr. Brit. Ured.* p. 235 ; *Cooke, Hdbk.* No. 1515 ; *Berk. Outl.* t. 2, f. 5 ; *Hart. & Som. in Dis. Trees,* p. 157.

YEW LEAF SPHÆRELLA.

Sphærella Taxi (Cooke), Pl. XVIII. fig. 46.

This parasite was first observed in the South of England, where it was at work destroying Yew trees by infesting all the leaves, and it has since



PESTS OF FOREST TREES.

been observed elsewhere. The black prominent receptacles, like pins' heads in size, thickly cover the green leaves, over entire branches, so as speedily to complete the work of destruction. The receptacles are nearly globose, immersed in the leaves, and enclose a gelatinous nucleus, which consists of a mass of cylindrical tubes or asci, each containing eight sporidia. These sporidia are elliptical, colourless ($18–20 \times 5–6\,\mu$), and divided by a transverse septum into two cells. Asci ($70–75 \times 12–14\,\mu$) without paraphyses.

This is so deep-seated an endophyte that it is doubtful whether the application of fungicides would make any impression. We can only advise the removal of all affected twigs, as soon as discovered, and burning them.

Sacc. Syll. i. 1836 ; *Grevillea*, vi. 128.

FUNGOID PESTS OF FOREST TREES.

We have illustrated some of the most prominent pests of forest trees, but they are very numerous, and not of so much interest to horticulturists as other sections ; hence we have not considered it incumbent upon us to enumerate other than those which are most likely to present themselves under ordinary circumstances. Those persons who are specially interested in forestry will not find our list by any means exhaustive, but simply suggestive, except in so far as regards the trees which surround, or are included in, large gardens and shrubberies.

Ochry Maple Spot.

Phyllosticta Aceris (Sacc.), Pl. XIX. fig. 1.

The ordinary leaf-spots are not any considerable damage to forest trees, unless they are unusually plentiful ; in any case they must be regarded as diseases. The common Maple is very subject to one which forms nearly circular bleached ochraceous spots on the leaves, over which are scattered the dot-like receptacles immersed in the tissues. The sporules, which are contained within these receptacles, are ovoid, and rather small ($5 \times 3\,\mu$) with two guttules, which are extruded from the receptacles through a minute orifice when mature.

The above species was first recorded for Italy, and in no other country except Britain.

It is almost impossible to suggest any remedy for these leaf-spots, since spraying is out of the question with objects of this size, although it may be adopted whilst the trees still remain as seedlings.

Sacc. Syll. iii. 61 ; *Grevillea*, xiv. 71.

Quite twenty other species of leaf-spot, caused by *Phyllosticta* and *Septoria*, have been recorded in different parts of the world on leaves of *Acer*.

Maple-leaf Phlœospore.

Phleospora Aceris (Lib.), Pl. XIX. fig. 2

This parasite is found commonly on living leaves of *Acer campestre* and other species. It occurs upon small spots on the under surface of the leaves, and the pustules are destitute of any proper conceptacle, but are produced beneath the cuticle in special cavities or cells, and are of a brown colour. The conidia are long and straight (22–28 × 5 μ), very distinctly divided by three transverse septa, extruded, when mature, from the orifice of the pustule in small pallid tendrils.

This was called *Septoria Aceris* by Berkeley when the genus *Septoria* was imperfectly defined. Whilst the trees still remain shrubby it may be possible to pick off and destroy the affected leaves.

This species is known also in France, Italy, and Austria.

Sacc. Syll. iii. 3135 ; *Cooke, Hdbk.* No. 1300 ; *Grevillea*, xiv. 104.

Maple-leaf Asteroma.

Asteroma Aceris (Rob.).

Forming spots on both surfaces of the leaves of *Acer campestre.* The small perithecia are seated on very thin radiating brown fibrils, and contain minute continuous sporules.

Sacc. Syll. iii. 1234 ; *Grevillea*, xiv. p. 75, No. 444.

Maple-twig Blight.

Septoglœum Hartigianum (Sacc.), Pl. XIX. fig. 3.

This parasite occurs on the living twigs of *Acer campestre*, and the year-old branches, especially those forming the crown, to the ultimate destruction of the tree. In the month of May the cuticle of the diseased shoots is split longitudinally, exposing the layer which bears the conidia.

The pustules are at first innate, then erumpent, loosely gregarious, oblong-linear, margined by the ruptured cuticle (1–2 mm. long). The stroma is white, bearing on its surface the crowded conidia which are ovate-oblong, with obtuse ends, almost straight, and typically two-septate (42–36 × 10–12 μ). The threads which bear the conidia are cylindrical with an inflated base (30–35 × 6–7 μ), colourless.

This fungus is really equivalent to what has been called Anthracnose, with septate conidia.

It is known also in Bavaria.

It is recommended to cut out the diseased shoots in the beginning of May.

Sacc. Syll. xi. 3745 ; *Mass. Dis. Pl.* 297 ; *Hart. & Som. Dis. Trees*, p. 141, fig. 80.

Another species (*Septoglœum acerinum*) on living leaves of *Acer campestre* is known in Italy, with curved trinucleate or biseptate conidia (20 × 4 μ), and probably also in Belgium.

Sycamore White Mould.

Botrytis deprædans (Cooke), Pl. XIX. fig. 4.

First discovered on living leaves of *Acer Pseudo-Platanus* in a damp wood. Several young trees had nearly every leaf affected, and the next year they were dead. Greyish spots were formed on the leaves, which were sometimes large and confluent. The threads were flexuous and septate, simple, crowned at the apex with elliptical basidia-like cells, ultimately two-lobed. The glomerules of conidia globose and compact. Conidia globose, $12\,\mu$ diam.

After the leaves had fallen to the ground, and lain for a short time, numerous minute black sclerotia were formed, the ultimate development of which was never ascertained.

Certainly a most destructive pest, but it does not appear to have been recognised elsewhere, at home or abroad. This parasite has never been thoroughly investigated, and, as it has occurred so seldom, there has been no opportunity for experiment on remedies.

Sacc. Syll. iv. 691 ; *Cooke, Journ. Q.M.C.* ii. 1885, p. 138, t. x. f. 4.

In damp years Maple seedlings are liable to destruction by a black mould, *Cercospora acerina.*

Hart. & Som. Dis. Trees, p. 135.

Sycamore-leaf Blotch.

Rhytisma acerinum (Fr.), Pl. XIX. fig. 5.

The large black pitchy-looking blotches on the leaves of Sycamore and Maple are so common and so well known that they scarcely need description. Sometimes nearly every leaf on a tree is infected, and then considerable injury must be caused by preventing the leaves performing their proper functions.

Whilst still attached to the tree the fungus remains in its first stage. The patches are yellow when they first appear about June, soon changing to black and corrugated. Within this stroma are cells, or cavities, in which the conidia are produced, which are narrow and curved (6–$9 \times 1\,\mu$). In this stage it is known as *Melasmia acerina.*

After the leaves have fallen to the ground and passed the winter a second stage or condition is reached, in which the contents of the cells or cavities in the stroma are occupied by sporidia contained in asci. This is the true *Rhytisma* stage, and the sporidia are matured in the spring. These sporidia are needle-shaped (60–$80 \times 1\frac{1}{2}$–$2\frac{1}{2}\,\mu$) and uncoloured.

Known also in France, Germany, Belgium, Sweden, Finland, Italy, and North America.

So long as the leaves are permitted to remain on the ground, and perfect the fruit of the parasite, it will remain as a pest.

Sacc. Syll. iii. 3390, vii. 3083; *Mass. Pl. Dis.* 142, fig. 28; *Cooke, Hdbk.* No. 2279; *Grev. Sc. Cr. Fl.* t. 118, f. 1; *Hart. & Som. Dis. Trees*, p. 105, fig. 50.

Maple Mildew.

Uncinula Aceris, Pl. XIX. fig. 6.

The Hedge Maple is apt to have its foliage nearly covered with the white mealy-looking mycelium of this pest, so that they seem to have been drenched with a thin coating of whitewash. This mycelium is creeping and at first superficial, and gives origin to the conidial form, or *Oidium*, the conidia of which, falling on the leaves, increase the mealy appearance. Later on the little dot-like globose conceptacles appear on the surface, as in the Pea mildew.

In this species the conceptacles are surrounded by a series of appendages which are either simple or forked, and hooked at the apex. These each enclose eight asci, which contain eight sporidia. A similar species is also common on Willows. This was formerly called *Uncinula bicornis*, but the name has been changed, during the craze after priority names, and to gratify the vanity of priority-hunters.

The species is recorded for the whole of Europe and Algeria.

Sulphur and lime is the recognised application.

Sacc. Syll. i. 27; *Cooke, M. F.* t. xi. f. 225–228; *Cooke, Hdbk.* No. 1914.

Another species, *Uncinula Tulasnei*, occurs in the Rhine Provinces, and *Uncinula circinata*, an American species, on Acer leaves, in the United States.

Maple-leaf Blotch.

Rhytisma punctatum (W.), Pl. XIX. fig. 7.

This blotch resembles in many respects that of the Sycamore leaves, and occurs on the leaves of *Acer campestre*, *Pseudo-Platanus*, and *spicatum*. There are the same kind of yellow spots, caused by the mycelium, but the black scab, or crust, which appears on the surface is not one continuous black blotch, but consists of a number of closely crowded small frustules.

The early stage also prevails whilst the leaves are still attached to the tree, and the cells or cavities of the stroma enclose only conidia, which are sausage-shaped and small ($4–5 \times 1\ \mu$). This condition is known as *Melasmia punctata*.

The final stage, which only succeeds the wintering of the affected leaves upon the ground, in like manner produces clavate asci, which are narrowed at the tip, and enclose eight needle-shaped sporidia, which are blunt at the base, and pointed at the apex, collected in a parallel cluster or bundle ($35–40 \times 1\frac{1}{2}–2\ \mu$).

This parasite is recorded also in France, Belgium, Germany, Sweden, Italy, and North America, but is not so common as *Rhytisma acerinum*.

Sacc. Syll. iii. 3391, vii. 3084; *Mass. Pl. Dis.* p. 142, 378; *Cooke, Hdbk.* No. 2280.

WHITE ROOT-ROT.

Dematophora necatrix.

Rosellinia necatrix (Pr. & Del.), Pl. XIV. fig. 20.

This scourge has also been called *Dematophora necatrix* (Hart.), and has occurred in its earlier stages in this country. It attacks vines, fruit trees, Maples, Oaks, Beeches, and Conifers.

The mycelium spreads rapidly underground, attacking the rootlets of almost any plant with which it comes into contact, ultimately killing them. In trees the mycelium travelling upwards bursts through the bark as a fluffy snow-white mass. Minute sclerotia are formed in the diseased rootlets, which produce conidia upon dark-coloured hyphæ. The mycelium, at first white, at length becomes brownish, and produces pear-shaped swellings, which are reproductive.

The highest form of reproduction is rarely developed, and consists of large black perithecia, surrounded by bristly conidiophores, and enclosing asci containing eight dark brown sporidia.

The soil should be well drained, affected plants isolated by trenching around the roots. Dead trees and roots should be removed as soon and as completely as possible, as all the fragments of mycelium are liable to disseminate the disease.

Hart. & Som. Dis. Trees, p. 82; *Mass. Pl. Dis.* p. 120, f. 21.

PLANE-LEAF NERVE ANTHRACNOSE.

Glœosporium nervisequum (Fckl.), Pl. XIX. fig. 9.

A common anthracnose on Plane leaves, forming irregular bleached spots on either side of the midrib and principal veins of the leaves. The pustules are scattered over these spots, on the under surface, and are round or oblong, brownish and at length black, splitting longitudinally or irregularly. The conidia are oblong or pear-shaped ($12–15 \times 4–6\,\mu$), hyaline, seated upon long, colourless, and slender footstalks ($20–25\,\mu$ long).

This species reaches its full development, as far as at present known, whilst the leaves are still attached to the tree. Wherever it is possible to reach and remove the diseased leaves they should be collected and burnt.

Recorded also in France, Germany, and Italy.

Grevillea, xiv. p. 124, No. 616; *Sacc. Syll.* iii. 3716; *Mass. Pl. Dis.* 284, fig. 76; *Hart. & Som. Dis. Trees*, p. 140.

PLANE-LEAF ANTHRACNOSE.

Glœosporium Platani (Mont.).

This second species of anthracnose occurs also on living leaves of Plane trees, but does not form spots along the midrib and nerves, but the minute pustules are scattered over discoloured portions of the leaves, which may be marginal or otherwise. The conidia have a tendency to become fusiform or sometimes oblong ($14–15 \times 5–6\,\mu$) with many small nuclei. The pedicels are short and slender (not exceeding $5–6\,\mu$).

The same remarks apply to this species as to *Glœosporium nervisequum*.

Known also in France, Belgium, Holland, and Italy.

Sacc. Syll. iii. 3717 ; *Grevillea*, xiv. p. 124, No. 617.

Two or three ordinary kinds of leaf-spot, caused by *Phyllosticta* or *Septoria*, on Plane leaves have been recorded, but not yet as British.

Horse Chestnut Leaf-spots.

Septoria Hippocastani (B. & Br.), Pl. XIX. fig. 10.

Common enough on the living leaves of Horse Chestnut in Britain, but scarcely recognised elsewhere except in Italy.

The spots are at first minute and scattered, then becoming confluent, and forming broad rufous patches. Receptacles dot-like and scattered, sporules, long, rod-like, curved and flexuous with divisions ($55–60 \times 3\ \mu$) ejected in thin, delicate, pale tendrils.

Presumably the Horse Chestnut trees are not much injured by this leaf-spot, and we know of no remedies which have been applied.

Sacc. Syll. iii. 2578 ; *Berk. A.N.H.* No. 434 ; *Cooke, Hdbk.* No. 1305.

Horse Chestnut Stereum.

Stereum purpureum (Fries), Pl. XIX. fig. 11.

Several trees have been destroyed in Greenwich Park, the trunks of which have borne this *Stereum*, and it has been contended that this fungus has entered as a wound parasite and destroyed the trees. This should be confirmed by experiment, as the same fungus has been credited with causing " silver leaf " in stone-fruit trees.

Sacc. Syll. vi. 7284 ; *Cooke, Hdbk.* No. 910 ; *Mass. Fun. Fl.* i. 132, fig. 14 ; *Journ. R.H.S.* xxviii. p. xxii (1903).

A leaf-spot (*Phyllosticta Paviæ* Desm.) has been found occasionally in this country on the leaves of *Æsculus indica* syn. *Pavia indica*. The sporules are cylindrically elliptical, biguttulate ($11–12\ \mu$ long).

Known also in France and Belgium.

Sacc. Syll. iii. 2 ; *Grevillea*, xiv. p. 71, No. 365.

Elm-leaf Phlœospore.

Phleospora Ulmi (Fr.), Pl. XIX. fig. 12.

One of the commonest parasites on leaves of the Elm, sometimes occupying nearly every leaf on a tree. The spots are small and brownish on the under surface, over which the pustules are scattered. The conidia are profuse, cylindrical, rounded at the ends, at first nucleate, and then divided into five cells ($55 \times 6\ \mu$), exuding from the orifice of the pustule in whitish tendrils, and diffusing themselves over the surface of the leaf. Known in older books under the name of *Septoria Ulmi*, and supposed to be an early stage, or condition, of *Phyllachora Ulmi*.

No suggestion can be offered to check this parasite, from which many healthy trees constantly escape. Recorded throughout Europe and in North America.

Sacc. Syll. iii. 3138 ; *Cooke, Hdbk.* No. 1297 ; *Grevillea,* xiv. 105.

A leaf-spot, caused by *Asteroma Ulmi* (Klotsch), has been recorded on Elm leaves in Britain, France, and Portugal, but the fruit does not appear to be known.

Cooke, Hdbk. No. 1369.

Elm-leaf Scab.

Piggotia astroidea (Berk.), Pl. XIX. fig. 13.

Berkeley first made known the details of the structure of this parasite, and applied to it the name which it now bears. It occurs on the upper surface of living Elm leaves as small blackish scabs formed from the aggregation of minute tubercles, clustered in a stellate manner, and at first covered by the cuticle. The tubercles or receptacles are flattened, thin, and dark olive. The conidia are oblong, truncate at the base, and rounded at the apex ($8–10 \times 5–6\ \mu$), containing from two to four minute guttules, and generated at the apex of short pedicels which are fasciculate.

The presumed phases, or stages, in the life-history of this fungus, are recorded in the following note on the "Elm-leaf blotch."

Sacc. Syll. iii. 3387 ; *Cooke, Hdbk.* No. 1296 ; *Berk. A. N.H.* No. 503, t. v. f. 3 ; *Grevillea,* xiv. 106.

Elm-leaf blister, caused by *Taphrina Ulmi* (Joh.), occurs on leaves of Common Elm, and Wych Elm, but is doubtfully British.

Mass. Pl. Dis. p. 92.

Elm-leaf Blotch.

Phyllachora Ulmi (Fckl.), Pl. XIX. fig. 14.

This blotch is not unusual on Elm leaves, which is supposed to pass through three stages, all of which have been recognised as different and distinct parasites, but are now assumed to be three conditions of the same species. The first stage, which has been termed the *spermogonia*, is still generally known as *Phleospora Ulmi.* The second stage, called the *pycnidia,* is known as *Piggotia astroidea,* both of which have been described here as different diseases. And the last is the perfect *Phyllachora Ulmi,* in which the spores are produced in asci, and become matured on the dead leaves after remaining upon the ground.

The blotches are rounded, convex, nearly black, and somewhat rough on the surface, on the upper face of the leaves. Within these excrescences are white cavities or cells, in which the fructification is produced. Numerous cylindrical sacs or asci ($60–70 \times 8\ \mu$) are developed, side by side, each enclosing eight oblong, colourless, sporidia ($10–11 \times 5\ \mu$), which are extruded, when mature, through an opening at the apex of the cell. The stroma or blotch is greyish after maturing upon the ground.

Found also in France Belgium, Holland, Sweden, and Italy.

The dead leaves should be collected and burnt to prevent the sporidia communicating infection.

Sacc. Syll. ii. 5091 ; *Sow. B. F.* t. 374, fig. 3 ; *Cooke, Hdbk.* No. 2412.

Brown Ash-leaf Spot.

Phyllosticta fraxinicola (Curr.).

Not uncommon on living leaves of the Ash, in circular or irregular brownish spots, with a blackish margin. The receptacles are very minute, as usual, like small black dots scattered over the spots. The sporules are elliptical or curved ($5-7\frac{1}{2}\,\mu$ long) and colourless.

It was first described by Currey as a simple *Sphæria*, but the sporules are not enclosed in asci.

Known also in France and Germany.

Sacc. Syll. iii. 106 ; *Grevillea*, xiv. 72, No. 381 ; *Curr. Simp. Sph.* No. 388, fig. 148.

A great number of leaf-spots, caused by fungi of several genera, have been recorded on Ash leaves in Europe and America, but they do not appear to have been regarded as inflicting any serious injury.

Common Ash-leaf Spot.

Septoria Fraxini (Desm.), Pl. XIX. fig. 15.

This leaf-spot, on living leaves of the Ash, is common and affects almost every leaf of any tree which it attacks. The conceptacles are very minute, and immersed in the substance of the leaf, forming irregular patches, sometimes covering the entire leaflet. The sporules are cylindrical, obtuse at the ends, with a row of small nucleoles.

Known also in France, Belgium, Germany, Portugal, Italy, and North America.

Sacc. Syll. iii. 2672 ; *Cooke, Hdbk.* No. 1331 ; *Grevillea*, xiv. 101, No. 482.

Several species of anthracnose are recorded as occurring on Ash leaves in the United States, but not hitherto in Europe.

Heartwood-rot.

Polyporus hispidus (Fries).

This large polypore is a wound parasite, and will attack various broad-leaved trees. In orchards it seems to prefer the Apple, and we have seen it commonly upon the Ash. It often attains a large size, nearly a foot across, fixed by a broad base, and extending in a semicircular manner. It is of a dark brown colour, and the upper surface is coarsely velvety or hairy, and the internal substance soft and fibrous. The under surface is paler, of a yellowish-brown colour, punctured with innumerable pores. Whilst growing these pores exude water, which drips away in considerable quantity even in dry weather.

It can only obtain access to a tree through a wound, when the mycelium attacks the heartwood, the trunk soon becomes hollow, although the tree may continue to live for some years. It is by medium of the spores that healthy trees are inoculated, and hence to prevent the diffusion of spores all specimens of the polypore should be at once destroyed.

Sacc. Syll. vi. 5165; *Cooke, Hdbk.* No. 768; *Mass. Pl. Dis.* p. 191, fig. 44; *Sow. Fung.* t. 345; *Hussey,* i. t. 29, 31; *Mass. Fun. Fl.* i. p. 243.

Living Ash trees in this country have been attacked and killed by a sphæriaceous fungus, *Rosellinia ligniaria* (Nitschke). Specimens were exhibited by W. Carruthers at the Linnean Society, December 16, 1897.

Mass. Pl. Dis. p. 122; *Sacc. Syll.* i. No. 991; *Greville, Sc. Crypt. Fl.* pl. 82.

Small Oak-leaf Anthracnose.

Glœosporium umbrinellum (B. & Br.), Pl. XIX. fig. 16.

This anthracnose has been found occasionally on Oak leaves in Britain, whilst some persons think it is the same species as one which has occurred in Belgium, France, and Germany, although the conidia are twice as large.

The spots are irregular and angular, minute, and of a brown colour, upon which are seated the almost inconspicuous pustules, from which the conidia are expelled when mature in pallid irregular tendrils. The conidia themselves are oblong (10–15 μ long), with two nuclei, and at first seated upon long and sometimes forked pedicels.

Sacc. Syll. iii. 3731; *Cooke, Hdbk.* No. 1412; *Berk. & Br. A.N.H.* No. 1141, t. 3, f. 5; *Grevillea,* xiv. 124, No. 61.

There are a host of leaf-spots on Oak leaves, which have been referred to fungi of different genera as the cause, but they do not appear to be of sufficient importance as "pests" to require notice.

Oak-leaf White Mould.

Microstroma album (Desm.), Pl. XX. fig. 17.

This is a small white mould which attacks the under surface of Oak leaves, appearing to the naked eye somewhat like hoar-frost. The very short threads are developed in tufts, which form confluent patches. The conidia are oblong ($5–7 \times 3\,\mu$), unequal-sided, containing one or two small guttules; the basal threads about three or four times as long as the conidia.

We have observed it mostly upon the leaves of young seedling Oaks, and in coppices.

Known also in France, Germany, Belgium, Italy, Moravia, and South Africa.

Sacc. Syll. iv. 17; *Cooke, Hdbk.* No. 1831.

Oak-leaf Curl.

Ascomyces Quercus (Cooke).

This, and one or two other species of *Exoasci,* attack Oak leaves.

Journ. R.H.S. xxix. 1905, p. 848.

Not less than eighty species of fungus parasites have been recorded as occurring on various species of *Quercus*, at home and abroad, but not many of them are British.

OAK-LEAF RUST.

Uredo Quercus (Brond), Pl. XX. fig. 18.

This parasite occurs, but not commonly, on the under side of the leaves of young Oak saplings when about three or four feet high, but probably without inflicting any serious injury. Nothing is known of any other stage than that of the uredospores.

The pustules are rounded and small, and either scattered or in clusters, yellow at first, and afterwards approaching orange. The uredospores are nearly globose, rough externally, and orange-yellow ($15–25 \times 12–15\ \mu$).

It has been assumed, rather prematurely, that this is an early condition of some species of *Melampsora*.

Known also in France, Belgium, Germany, Switzerland, and Italy.

Sacc. Syll. vii. 2126 ; *Plowr. Brit. Ured.* 257 ; *Cooke, Hdbk.* No. 1573 ; *Cooke, M.F.* p. 216.

Seedling Oaks are liable to the attacks of a fungus at the roots, which develops into a disease resembling the white root-rot, and in its mature condition is known as *Rosellinia quercina* (Hart.).

Hart. & Som. Dis. Trees, p. 78, figs. 26–28 ; *Mass. Pl. Dis.* p. 121.

VEGETABLE BEEF STEAK.

Fistulina hepatica (Fr.).

This well-known fungus is often to be seen flourishing year after year upon the same living Oak tree, and is gathered promptly, on account of its esculent properties. It is somewhat variable in form, being rounded, semicircular, tongue-shaped, and often two or three together, liver-coloured, not unlike a piece of bullock's liver, soft and easily cut, and internally mottled somewhat after the manner of Beetroot, and juicy, with a rather acid taste. The under surface is a little convex and paler, perforated with innumerable pin-holes which are mouths of tubes, closely packed side by side, bearing the spores on the inner surface. These spores are salmon-coloured and nearly round. Sometimes specimens have been found attaining a weight of thirty pounds, but usually only three or four pounds.

It is doubtful to what extent this fungus is a cause of injury to Oaks, as it is always found on dead parts.

Found throughout Europe, in North America, Australia, and Northern India.

Sacc. Syll. vi. 4849 ; *Cooke, Hdbk.* No. 841 ; *Sow. B.F.* t. 58 ; *Grev. Sc. Crypt. Fl.* t. 270 ; *Mass. Fun. Fl.* i. p. 256, figs. 8–10.

SULPHURY WOOD-ROT.

Polyporus sulfureus (Fries).

This large and attractive-looking polypor is a wound parasite on several trees, such as Oak, Alder, Willow, Poplar, and even Pear and

PESTS OF FOREST TREES.

Apple, as well as Larch. It commences as a round fleshy knob, but soon expands into an irregularly flattened body, with a crisped and waved margin, and often with several overlapping pilei, one above another. It is not unusual to find well-grown specimens of a foot in expanse, and wholly of a bright sulphur colour, the upper surface quite smooth, paler as it grows old. The flesh is nearly white, soft, and easily broken; the under surface bright sulphur colour, and punctured with innumerable short pores; the whole fungus with a faint and rather disagreeable smell.

This is an annual, which grows rapidly and decays in the autumn. The spores obtain access through a wound, broken branch, or unprotected pruning. The spores soon produce a mycelium which attacks the heart-wood, which changes to a clear reddish-brown colour.

Conidia are also produced in abundance from the mycelium in cavities of the wood.

It is important, therefore, to protect the ends of broken branches, or parts exposed by pruning, by use of some fungicide. Also, to prevent dispersion of the spores, all specimens found should at once be destroyed.

Sacc. Syll. vi. 5050; *Mass. Fun. Fl.* i. p. 240; *Mass. Pl. Dis.* p. 193, fig. 45; *Cooke, Hdbk.* No. 752; *Grev. Sc. Crypt. Fl.* pl. 113; *Sow. Fungi,* t. 135; *Hart. & Som. Dis. Trees,* 200; *Marshall Ward, Timbers, &c.* p. 165, figs. 17–19.

Wound Parasites.

Other of the large Hymenomycetal Fungi have the reputation of being destructive to forest and orchard trees as wound parasites, but we are inclined to think that the injury they cause is proportionately small, as only individual trees are affected, and only those which have suffered previous injury.

Tinder Fungus.

Fomes fomentarius (Fries).

This woody fungus is said to be a wound parasite of Beech and Elm as well as old fruit trees. The pileus is shaped somewhat like a horse's hoof, from three to seven inches across, dingy-brown, marked with concentric ridges, smooth, and at first whitish at the edge. The under surface is almost flat, whitish, then brown, densely perforated. The substance is rust-coloured and fibrous, and rather spongy, but dry, and may be beaten out into the substance known as amadou or German tinder. The spores are oval and brown.

Sacc. Syll. vi. 5409; *Mass. Pl. Dis.* pp. 185, 392; *Cooke, Hdbk.* No. 776; *Sow. B.F.* t. 133: *Journ. R.H.S.* xxvi. 1902, p. 734, fig. 308; *Mass. Fun. Fl.* p. 220.

False Tinder Fungus.

Fomes igniarius (Fries).

This also is reputed to be a wound fungus of the Oak, as well as some other trees. It resembles *Fomes fomentarius* externally and superficially, but is minutely velvety when young, becoming blackish and cracking. The under surface is cinnamon-coloured, and the flesh is very hard, rusty-brown, and zoned. The spores almost globose and uncoloured, which serves to distinguish it from the other species above named.

Sacc. Syll. vi. 5412; *Mas. Pl. Dis.* pp. 187, 393; *Cooke, Hdbk.* No. 778; *Sow. B. F.* t. 132; *Mass. Fun. Fl.* i. p. 221; *Hart. & Som. Dis. Trees*, p. 201.

Fomes nigricans Fr. is also charged with the destruction of Birch timber.

Journ. R.H.S. xxix. 1905, p. 754.

Oak Polypore.

Polyporus dryadeus (Fries).

This large polypore is said to attack the Oak, but too rarely to be of much interest. It is expanded from the trunk in a semicircular manner, is thick, and attached by a broad base, measuring up to ten inches across, brown, rugged, with a paler margin which exudes drops of water. The flesh is rusty and fibrous, somewhat zoned. Under surface porous; spores elliptical, colourless ($5 \times 3\,\mu$).

Hart. & Som. Dis. Trees, p. 201; *Sacc. Syll.* vi. 5196; *Mass. Pl. Dis.* pp. 197, 391; *Cooke, Hdbk.* No. 771; *Mass. Fun. Fl.* p. 243.

There are other species which have the same kind of reputation, but not troublesome enough to be regarded as pests.

Stereum Wood-rot.

Stereum hirsutum (Fries), Pl. XX. fig. 19.

This is one of the most common of saprophytes on dead branches, trunks, and stumps of all kinds; but it has also the reputation of being a destructive wound parasite. It is a tough leathery fungus, of a shell shape, attached by the edge to the bark, spreading at right angles, with the upper surface coarsely velvety, dingy-yellow, marked with zones, and the margin often crisped and wavy. The under surface, which bears the spores, is ochraceous-yellow. Mostly these pilei grow one above another in an imbricated manner. The mycelium is perennial, and having once obtained admission continues to spread, until all the living tissue is destroyed. Spores globose, $5\,\mu$ diam.

When found growing on living trees, it should be cut away, and the wound washed with paraffin and afterwards painted with tar.

Mass. Pl. Dis. p. 175; *Cooke, Hdbk.* No. 911; *Ward, Trans. Roy. Soc.* clxxxix. p. 123, pl. 17–21 (1898); *Mass. Fun. Fl.* i. p. 131; *Hart. & Som. Dis. Trees*, p. 205.

Partridge Wood.

Stereum frustulosum (Fries), Pl. XX. fig. 20.

This is another saprophyte which sometimes becomes parasitic, and attacks various forest trees. It differs from the above in being closely attached to the bark, with no portion free, the whole substance forming a cracked, hard crust, of a cinnamon colour on the surface, becoming grey with age. Spores elliptical, $4 \times 3\ \mu$.

Mass. Pl. Dis. p. 172, fig. 37 ; *Mass. Fun. Fl.* p. 134.

Black Wood Nodules.

Daldinia concentrica (De Not.).

Large black nodules, from the size of a Walnut to that of an Orange, have been known for a century to occur on dead wood, especially of Ash, and only recently has it been suggested that the fungus producing them is a wound parasite liable to infest with its spores, or conidia, growing and living forest trees, entering through wounds in the bark. We have met with it scores of times, but never on other than thoroughly dead wood, such as gate-posts, rails, rustic seats, &c., and are not yet convinced of its parasitism. The mature fungus is globose, depressed at the base, smooth and shining, and of a jet-black colour. When cut in sections, the interior is grey, rather firm, forming concentric rings. Hence its old name of *Hypoxylon concentricum*, and its newer one of *Daldinia concentrica*. The periphery everywhere consists of closely packed cells, or perithecia, containing the large, oval-shaped, dark brown sporidia in asci ($12–15 \times 7–10\ \mu$), which are ejected when mature, and form a dense sooty covering over the entire nodule.

Very recently M. Molliard has announced the discovery of conidia suggested and figured by Tulasne, in the form of a white mould, to which he has given the name of *Nodulisporium Tulasnei*, possibly a form of *Botrytis*, with conidia $7–8 \times 4\frac{1}{2}–5\ \mu$, colourless or slightly grey.

Tulasne, Fungi Carp. Selec. t. ii. pl. xiii. figs. 14–16 ; *Gard. Chron.* 1861, p. 72 ; *Sacc. Syll.* i. 1515 ; *Cooke, Hdbk.* No. 2384.

Oak Canker.

Diaporthe taleola (Sacc.), Pl. XX. fig. 21.

The disease which is called Oak Canker is said to prevail until trees are forty years old. It is characterised by brown patches of the bark, which are usually of large size, and on different sides of the tree, whereby the bark is killed, and the tree dies. Pustules are formed in the dead bark, and consist of a kind of cushion, or stroma, imbedded in it, of an almost black colour, in which are cavities or cells, in which are first developed curved or sickle-shaped conidia. Afterwards flask-shaped receptacles are formed, in small groups, within these same pustules, on the same stroma, and the necks of two or three of these receptacles unite, and grow together into a common neck or opening which extends to the surface of the pustule. Within these receptacles asci, or cylindrical sacs, are formed ($150 \times 14\ \mu$), which each contain eight sporidia which are oblong, divided in the centre into two cells ($18–24 \times 7–8\ \mu$). From the median division projects a hyaline spine on each side, and one at each end of the spore. Both conidia and spores are capable of infecting a healthy tree, by entering a wounded spot in the bark.

The fungus is known in France, Belgium, Germany, Sweden, and Italy.

It is suggested that young trees thus infected should be felled to save the rest.

Sacc. Syll. i. 2426; *Mass. Pl. Dis.* p. 112; *Hart. & Som. Dis. Trees*, p. 99, figs. 46–49; *Cooke, Hdbk.* No. 2502.

Beech-leaf Anthracnose.

Glœosporium Fagi (Desm.).

This occurs on the under surface of Beech leaves, forming rather rounded tawny spots on the upper, and greenish on the under surface. The pustules are minute and honey-coloured, seated upon the spots. The conidia are oblong or sometimes rhomboidal ($15–20 \times 7–8\ \mu$), with two or three small guttules, produced at first at the apex of pedicels collected in bundles, within the pustules, and expelled when mature in tendrils.

Known also in France, Belgium, Austria, and Italy.

Sacc. Syll. iii. 3728; *Grevillea*, xiv. p. 124, No. 620.

The leaves are liable to show brown blotches caused by *Sphærella Fagi*.

Beech Seedling Rot-mould.

Phytophthora omnivora (De Bary), Pl. XX. fig. 21.

This rot-mould has a habit of attacking almost indiscriminately a large number of plants, among which are included the seedlings of Beech. Gaps are often made in seed-beds by this pest, which spreads rapidly when once it gets a footing. At first dark-coloured blotches appear on the cotyledonary leaves, with dark lines on the stem. The mycelium is furnished with minute roundish suckers, which pierce the cells to obtain nutriment. The threads are variously branched, but sparingly, and on one side, sometimes inflated in nodules at intervals, below the apex. Conidia ellipsoid or lemon-shaped ($50–60 \times 35–40\ \mu$), with a prominent papilla at the apex, when mature liberating as many as fifty zoospores. Resting-spore globose, smooth, yellowish-brown ($24–30\ \mu$ diam.), often clustered together.

Known also in Germany.

Diseased plants should be at once removed from the seed-beds. Oospores will retain vitality for four years; hence the soil which has produced diseased plants should not be used again.

Sacc. Syll. vii. 803; *Mass. Pl. Dis.* p. 66, fig. 8; *Hartig & Som. Dis. Trees*, p. 58, figs. 14–16; *Marshall Ward, Timbers, &c.* p. 271, figs. 42–44.

Beech Agaric.

Armillaria mucida (Schr.).

The slimy-white, or greyish-white, Agaric seen so commonly on dead Beech trees has been charged with being a wound parasite, capable of attacking a healthy branch, when broken or wounded, and causing death and decay.

The cap is from one to four inches across, hemispherical, then flattened, whitish or greyish-white, very glutinous, often growing in clusters from the trunk or branches of Beech trees, with a stem from two or three to five inches long, rather slender, but thickest at the base, whitish, sometimes with dark scales, with a broad distinct ring or collar surrounding the stem, above the middle. Gills very broad and white. Spores elliptical ($14–16 \times 8–9\ \mu$), very slimy and unpleasant to the touch, but very delicate eating when cooked.

Found throughout Europe and North America.

All wounds and cut branches should be protected by applying a coating of tar. Infection only by means of the spores, hence all the Agarics should be collected and eaten or destroyed.

Sacc. Syll, vi. 310; *Cooke, Hdbk.* No. 37; *Cooke, Illus.* t. 16; *Mass. Pl. Dis.* p. 204.

Hydnum diversidens (Fr.) is apparently a wound parasite, which has occurred on Beech in Epping Forest; it is an interesting species, but so rare as to be a curiosity.

Sacc. Syll. 6697.

Hornbeam Anthracnose.

Glœosporium Carpini (Desm.), Pl. XX. fig. 23.

The anthracnose on living and fading leaves of Hornbeam as developed on the under surface on olive-brown, irregular, and indefinite spots. The pustules are very minute, pale brown, and scarcely conspicuous. The conidia are cylindrical and curved or sickle-shaped ($10–15 \times \frac{1}{2}\ \mu$), and very narrow and thread-like, oozing from the orifice in whitish tendrils.

Known also in France, Germany, Italy, and Austria.

Sacc. Syll. iii. 3722; *Grevillea*, xiv. p. 124, No. 619; *Sacc. F. Ital.* fig. 1021.

Another species (*Glœosporium Robergei*) is known on the Continent, on leaves of the Hornbeam, but not recorded for Britain. This tree is much favoured in immunity from fungus parasites.

Hornbeam-leaf Blotch.

Gnomoniella fimbriata (Anc.), Pl. XX. fig. 24.

It is not unusual to see living leaves of Hornbeam disfigured by prominent black convex blotches, which are themselves tuberculate with elevated warts, each of which indicates and covers an immersed cell or receptacle, and terminates in a spine-like neck, which is surrounded at the base by a white collar or fringe. These receptacles contain the fructification, which consists of oblong sacs or asci, each enclosing eight ellipsoid sporidia ($10–11 \times 5\ \mu$), which, when mature, escape through the elongated neck of the receptacle.

It is believed that earlier in the season the conidia are developed under the form of an anthracnose, formerly considered a distinct species, and known as *Glœosporium Carpini*, which has cylindrical curved conidia ($10–15 \times 1\ \mu$), expelled when mature in whitish tendrils.

This blotch is known throughout Europe and in North America.

No remedy is suggested, except picking off and burning as many infested leaves as possible to prevent dispersion.

Sacc. Syll. i. 1589; *Cooke, Hdbk.* No. 2735.

Melampsora Carpini is recorded as attacking the leaves of Hornbeam.

Birch-leaf Spot.

Phyllosticta betulina (Sacc.), Pl. XX. fig. 25.

Possibly this leaf-spot bears the receptacles of the earliest stage, or spermogonia, of a species of leaf sphæria (*Sphærella maculiformis*) which is not uncommon on the dead leaves of various kinds of forest trees. There are no definite spots, but the receptacles are densely clustered together in large groups, which have the appearance of spots. These are globose, and immersed in the substance of the leaves, and contain minute curved sporules ($4-6 \times 1-1\frac{1}{2}\ \mu$), which are ejected when mature.

Recorded also in France and Italy.

Sacc. Syll. iii. 170; *Grevillea*, xiv. 72, No. 398.

Another leaf-spot on Birch is attributed to *Asteroma Betulæ*, which occurs in Britain, but is not reputed to cause any serious injury.

Sacc. Syll. iii. 1241; *Grevillea*, xiv. p. 75, No. 446.

Birch-leaf Rust.

Melampsora betulina (Pers.), Pl. XX. fig. 26.

This rust is common on Birch leaves from May to November. Hitherto all efforts to discover the cluster-cups of this species, presuming them to exist, have been unavailing.

The pustules of the uredo are small, pale orange, roundish, and rather powdery. The uredospores are ovate or oblong ($25-40 \times 10-20\ \mu$), finely rough, and orange-yellow.

The pustules which contain the teleutospores are at first yellow, then they become brown, and ultimately black. The spores are cylindrical, partaking of the typical form of the genus, closely packed side by side, and slightly wedge-shaped ($50 \times 16\ \mu$), pale yellow-brown.

Reported also in France, Belgium, Netherlands, Germany, Finland, Lapland, Austria, Hungary, Switzerland, Italy, and Asiatic Siberia.

Sacc. Syll. vii. 2118; *Plowr. Brit. Ured.* p. 243; *Cooke, Hdbk.* No. 1559; *Cooke, M. F.* 219, figs. 189, 190; *Hart. & Som. Dis. Trees*, p. 171.

Birch Polypore.

Polyporus betulinus (Fr.).

Although this polypore has long been known as a saprophyte on dead Birch trees, it has only recently been demonstrated that it will attack and destroy living trees, producing at first a brown discoloration and afterwards causing cracks in the decaying wood, which is replete with the white mycelium.

The complete fungus, when seen attached to the trunk, is hoof-shaped, with the upper surface smooth and at first soft, white, or greyish, and often brownish as it advances in age, when the brown cuticle often cracks and peels off. The under surface is flat, or a little concave, pierced all over with minute pores; the margin thick and curved inwards. When young, the substance is soft enough to be cut like cheese, and is persistently white; when older it becomes firmer, but is always rather soft. In size it varies from three to seven or eight inches across.

Common in Europe, Asiatic Siberia, and North America.

The fungus should be removed and destroyed whenever found, to prevent the dispersion of the spores. As it is probable that the mycelium is perennial, there is no hope of saving a tree after the appearance of the polypore.

Sacc. Syll. vi. 5207; *Mass. Pl. Dis.* p. 189, fig. 43; *Cooke, Hdbk.* No. 772; *Sow. B. F.* t. 212; *Mass. Fun. Fl.* i. p. 248; *Hart. & Som. Dis. Trees*, p. 206.

Witches' Broom of Birch.

Exoascus turgidus (Sad.).

The peculiar bunches of stunted twigs often to be seen on Birch trees are familiar enough, and so is the name of 'Witches' Brooms' or 'Witches' Besoms,' but it is not everyone who knows that it is a disease caused by minute fungi.

The naked asci, or sacs, which contain the sporidia are developed in spring and summer on the under surface of the leaves, which curl up, lose their fresh green colour, and at length appear covered with a greyish-white hoariness, like hoar-frost. The asci ($46–50 \times 15\ \mu$) have a stem cell ($16-17 \times 15\ \mu$) at the base, and they diminish gradually downwards so that they penetrate the epidermal cells. The sporidia, which are enclosed in the asci, are globose ($3–4\ \mu$ diam.).

Known also in Germany, Denmark, Sweden, and Finland.

Sacc. Syll. viii. 3347; *Phil. Br. Disc.* p. 484; *Hart. & Som. Dis. Trees*, p. 133.

Birch-leaf Blotch.

Dothidella betulina (Fries), Pl. XX. fig. 27.

This parasite on the living leaves of Birch has many features in common with the Elm-leaf blotch, with which it corresponds in the mature fruit not being developed until after the leaves have fallen, and are laid on the ground. The blotches are rather small ($\frac{1}{2}$ mm.), at first covered by the epidermis, at length naked, prominent, rather angular, with an uneven surface, black and shining, containing white cavities or cells, in which the fruit is matured. The asci are elongated ($70 \times 10\ \mu$), each enclosing eight sporidia, which are ellipsoid, obtuse at the ends, and divided into two nearly equal but sometimes unequal cells ($10 \times 5\ \mu$), of a very pale yellowish colour, discharged, when mature, through the prominent mouth at the apex of the cell.

Reported also in France, Germany, Sweden, Finland, Italy, and Asiatic Siberia.

Sacc. Syll. ii. 5256; *Cooke, Hdbk.* No. 2413; *Grev. Sc. Crypt. Fl.* t. 200, f. 2.

Lime-tree Sooty Mould.

Fumago vagans (Pers.), Pl. XIV. fig. 21.

The leaves of the Lime are often blackened with this "sooty mould," which sometimes quite encrusts the leaves. It also occurs, but less commonly or profusely, on Oak, Elm, Birch, Willow, and other deciduous trees. It is commonly preceded by honey-dew, upon which the mould thrives and flourishes apace.

The mould consists of brown creeping hyphæ, which are branched or fasciculate, sometimes confluent and forming cellulose ganglia, constituting a thin membranaceous stratum, of a blackish colour. The fertile threads are short, ascending, and branched in the upper portion. Conidia terminal, forming short chains, for the most part two-celled, rarely one-celled, or three-celled (from 5–15 μ long), brown.

Doubtless a state or condition of more complex fungi, such as *Capnodium.*

Causes injury by closing the pores or stomata of the leaves, but usually so universal over all the foliage as to defy remedy.

Sacc. Syll. iv. 2618 ; *Berk. & Desm. Journ. Hort. Soc.* iv. 251.

Lime-tree Leaf-spot.

Septoria Tiliæ (West.), Pl. XX. fig. 28.

Perithecia on both surfaces of the leaves, seated on tawny spots, which become pallid in the centre. Sporules straight or curved, 3–4 septate ($35–40 \times 2–2\frac{1}{2}$ μ, or sometimes longer).

Known also in Belgium, Italy, and Austria.

Sacc. Syll. iii. 2562 ; *Grevillea,* xiv. p. 76, No. 466.

Alder Leaf-spot.

Septoria alnicola (Cooke), Pl. XX. fig. 29.

This parasite was first found in Britain on living Alder leaves, and afterwards in Italy. The spots are pallid, brown or tawny, roundish (5–7 m.). The receptacles are minute, black, dot-like, scattered over the spots. The sporules oblong, and straight or curved (about $20–26 \times \frac{3}{4}$ μ).

Sacc. Syll. iii. 2735 ; *Cooke, Hdbk.* No. 1339 ; *Seem. Journ. Bot.* iv. p. 97, f. 23 ; *Grevillea,* xiv. 101, No. 488.

This is supposed to be a different species from *Septoria Alni* and *Septoria alnigena,* both of which are found on Alder leaves in Italy, but it is doubtful whether at least one of them is not the same.

Alder-leaf Black Mould.

Passalora bacilligera (Fres.), Pl. XX. fig. 30.

This mould occurs on living and languishing leaves of the Alder, occupying the under surface, forming small olive tufts. The threads simple, collected in bundles, flexuous and obtuse, olive-coloured, septate, often twisted and interwoven amongst themselves. Conidia produced at the tips of the threads, somewhat narrowly club-shaped, with one transverse division near the centre ($30-50 \times 5-7\ \mu$).

Known also in France, Germany, Belgium, and Italy.

Sacc. Syll. iv. 1640; *Sacc. Fl. Ital.* t. 788; *Cooke, Hdbk.* No. 1748.

Alder Disease.

Valsa oxystoma.

Found on all diseased Alder-trees in Pomerania.

Journ. R.H.S. xxix. 1905, p. 739.

Alder-leaf Blister.

Taphrina Sadebeckii (Joh.).

The fungus causing this disease was at first called *Ascomyces Tosquinetii*, but that name has now been abandoned for the above.

It produces blisters on the upper surface of the leaves of the Alder, and the naked asci or spore-sacs produce a hoary appearance. These asci are truncate, or abrupt, at each end ($41-55 \times 15\ \mu$), and contain eight spherical sporidia, which are colourless ($5-6\frac{1}{2}\ \mu$ diam.).

Known in Germany, Belgium, and Sweden, as well as in Britain. Sometimes called *Exoascus flavus.*

Sacc. Syll. viii. 3338; *Phil. Br. Dis.* p. 403; *Grevillea*, vi. p. 25; *Mass. Pl. Dis.* p. 91; *Hart. & Som. Dis. Trees*, p. 133.

Alder Catkin Blister.

Exoascus alnitorquus (Tul.).

This species attacks the female catkins of the Alder, which are thereby much deformed. It occurs also sometimes on the leaves, which become yellowish and primrose, blistered and contorted. The asci, or spore-sacs, are clavate ($31-37 \times 6-7\ \mu$), with a basal cell attenuated downwards until it becomes acute ($11-20 \times 6-7\ \mu$). The globose sporidia are small ($3-5\ \mu$ diam.) and numerous.

Known also in France, Belgium, Germany, Sweden, and North America.

Sacc. Syll. viii. 3345; *Phil. Br. Disc.* p. 403; *Grevillea*, v. p. 62; *Hart. & Som. Dis. Trees*, p. 133, fig. 72.

Alder-root Tubercles.

Plasmodiophora Alni (Wor.).

This disease of Alder roots was first-called *Schinzia Alni*, but it does not appear to differ greatly from the club-root of Crucifers. The roots become swollen and deformed, exhibiting a mass of small tubercles as large as the seed of a Vetch, or sometimes larger, and 2–10 cm. diam., which tubercles contain numerous globose spores aggregated in clusters or bunches ($8\ \mu$ diam.) and of a mucous consistency when cut.

Known in Germany, Poland, and Italy

Sacc. Syll. vii. 1569; *Gard. Chron.* Oct. 6, 1894, p. 398; *Hart. & Som. Dis. Trees*, p. 39.

Tree-root Rot.

Armillaria mellea (Fr.).

The blackish cord-like strands of mycelium long known under the name of *Rhizomorpha* are for the most part connected with this Agaric, which is common everywhere at the roots of trees. This mycelium consists of blackish cord-like strands of the thickness of fine twine, which creep over the roots, and the base of the trunk, close to the ground, radiating on every side until they come in contact with other roots, which are attacked. The rhizomorphs do not enter the roots, but give off delicate branches which enter the roots and form white sheets of mycelium between the bark and wood.

The complete fungus grows in dense clusters at the foot of trees, and is an Agaric, of the Mushroom form, with a cap two or three inches across, of a honey-yellow colour, generally clad with darker scales. The stem is from three to six inches long, smooth, and rather paler than the cap, darkest at the base. Gills white when young, becoming creamy with age. The stem above the middle is surrounded by a white frill or ring. The spores are white ($9 \times 6\,\mu$) and are produced in great profusion, falling and settling on the grass and surrounding objects like a dense white powder.

Care should be taken in orchards not to wound the roots of trees with the spade. All clumps of the Agaric should be destroyed. Affected trees should be isolated by digging a trench around them.

Sacc. Syll. vi. 289; *Cooke, Illus.* No. 32; *Mass. Pl. Dis.* p. 201, fig. 47; *Cooke, Hdbk.* No. 36, fig. 36; *Journ. R.H.S.* xxvi. 1902, p. 735, fig. 309; *Marshall Ward, Timbers &c.* p. 154, figs. 15, 16.

Poplar Leaf-spot.

Septoria Populi (Desm.), Pl. XX. fig. 31.

This common leaf-spot on Poplar leaves occurs on the upper surface, and is characterised by small orbicular spots, which are sometimes confluent, whitish or bleached, greyish towards the circumference, with a brown border. The receptacles are few and pale at first, becoming blackish when dry. Sporules rod-shaped, obtuse at the ends, and curved ($45 \times 3\,\mu$), with a single septum.

Recorded in France, Belgium, Portugal, Italy, and Siberia.

Sacc. Syll. iii. 2712; *Cooke, Hdbk.* No. 1317; *Grevillea,* xiv. 101, No. 485.

Poplar-leaf Anthracnose.

Marsonia Populi (Lib.), Pl. XX. fig. 32.

This parasite appears to be the same as that described by Berkeley many years ago under the name of *Asteroma labes*, and is found on the leaves of *Populus nigra, italica,* and *alba.*

The spots are on the upper surface, and are somewhat rounded, often confluent, brown, with a dark margin, upon which the pustules are scattered. Conidia somewhat pear-shaped ($20 \times 12\,\mu$), divided by a transverse septum into two cells, expelled when mature in whitish tendrils.

Recorded for France, Belgium, Germany, Austria, and Italy.

Sacc. Syll. iii. 4024; *Cooke, Hdbk.* No. 1409; *Grevillea*, xiv. 126, No. 644; *B. & Br. A.N.H.* No. 203, t. ii. f. 6.

Aspen-leaf Anthracnose.

Glœosporium Tremulæ (Lib.), Pl. XX. fig. 33.

The leaves of the Aspen (*Populus tremula*) are liable to the attacks of an anthracnose which causes greyish spots on either surface, which are either rounded or oblong, with a tawny margin. The pustules are found also on both surfaces, and are either scattered or disposed in rings. The epidermis of the leaves above the pustules is often blackened and rough. The conidia are curved ($10–15 \times 2\ \mu$), seated upon short thread-like pedicels.

Recorded also in Sweden, France, Germany, Austria, and Italy.

Sacc. Syll. iii. 3719; *Grevillea*, xiv. p. 124, No. 618.

Aspen-leaf Rust.

Melampsora Tremulæ (Tul.), Pl. XXI. fig. 34.

This parasite is common enough on the leaves of *Populus tremula* from June to November. It has been said that the cluster-cups are to be found on the leaves of *Mercurialis perennis*, having been known hitherto under the name of *Uredo confluens*.

The uredospores are produced in small pustules on the under surface of the leaves, or larger when upon the young twigs. The spores are subglobose or ovate, rough, and of an orange colour ($15–20 \times 14–16\ \mu$).

The teleutospores are also found on the under surface, forming abundant flattened, compact pustules, at first reddish-brown, becoming black. The spores are closely compressed together, side by side, and are elongated, attenuated downwards, almost wedge-shaped ($45–50 \times 10–12\ \mu$).

Rostrup contends that the cluster-cups of this rust are to be found in the species called *Cæoma pinitorquum*, which occurs on young Pine seedlings.

It has been found in France, Germany, Switzerland, Netherlands, Finland, Austria, Bohemia, Italy, and Portugal.

Sacc. Syll. vii. 2111; *Plowr. Brit. Ured.* 240; *Cooke, Hdbk.* No. 1560; *Cooke, M. F.* 219; *Hart. & Som. Dis. Trees*, p. 164, fig. 96.

White Poplar Rust.

Melampsora æcidioides (DC.), Pl. XXI. fig. 35.

This rust occurs on the leaves of *Populus alba*, and has evidently been united hitherto with *Melampsora populina*, from which it is probably distinct. It has been suggested that the cluster-cups are to be found on the leaves of *Mercurialis perennis*, which Dr. C. B. Plowright thinks that he has demonstrated.

The uredo occurs in small roundish pustules, surrounded by a white wreath of large crowded paraphyses. Uredospores, spherical or elliptical, with a colourless rough coating, and orange contents (17–24 × 15–17 μ). Paraphyses clavate (40–60 × 15–20 μ).

Teleutospores forming small brown crusts, cylindrical, cohering laterally, and truncate at the apex (50 × 10 μ), of a brown colour.

Has been recorded for France and Germany.

Sacc. Syll. vii. 2112; *Plowr. Brit. Ured.* p. 241.

BLACK POPLAR RUST.

Melampsora populina (Jacq.), Pl. XXI. fig. 36.

This endophytal parasite occurs commonly on the living leaves of *Populus nigra, balsamifera,* and *italica.* It has been affirmed that the cluster-cups are to be found on the Clematis, but this has not been confirmed by those whose unbounded faith rests upon artificial cultures.

The pustules of the uredo are found on the under surface, are roundish, and at first covered by the epidermis, brown. The uredospores are elongated elliptical, or ovate, and rough (28–40 × 15–20 μ), of an orange-yellow colour, mixed with capitate paraphyses.

Teleutospores in flat pustules, generally crowded and often confluent, forming reddish-brown and then blackened crusts. The spores are cylindrical, closely packed side by side, and angular by compression, so that they are polygonal in section, a little attenuated downwards (40–50 × 10–15 μ), pale brown in colour.

Known also in France, Belgium, Netherlands, Germany, Finland, Bohemia, Austria-Hungary, Switzerland, Italy, Portugal, Asiatic Siberia, and North America.

Sacc. Syll. vii. 2113; *Plowr. Brit. Ured.* p. 242; *Cooke, Hdbk.* No. 1561; *Cooke, M.F.* p. 219, figs. 195, 196.

POPLAR-LEAF BLISTER.

Taphrina aurea (Fr.), Pl. XXI. fig. 37.

This blister on Poplar leaves has long been known on *Populus nigra,* forming roundish blisters, which are convex on the upper surface and concave beneath, where they acquire a golden-primrose appearance. The asci are clavate, attenuated at the base, and truncate at the apex (92–100 × 16–25 μ). The sporidia are globose (4 μ broad).

The same fungus, apparently, produces pocket-like growths on the ovary of *Populus tremula* and *P. alba* (*H. & S.* fig. 74).

Known also in France, Germany, Sweden, Finland, and Italy.

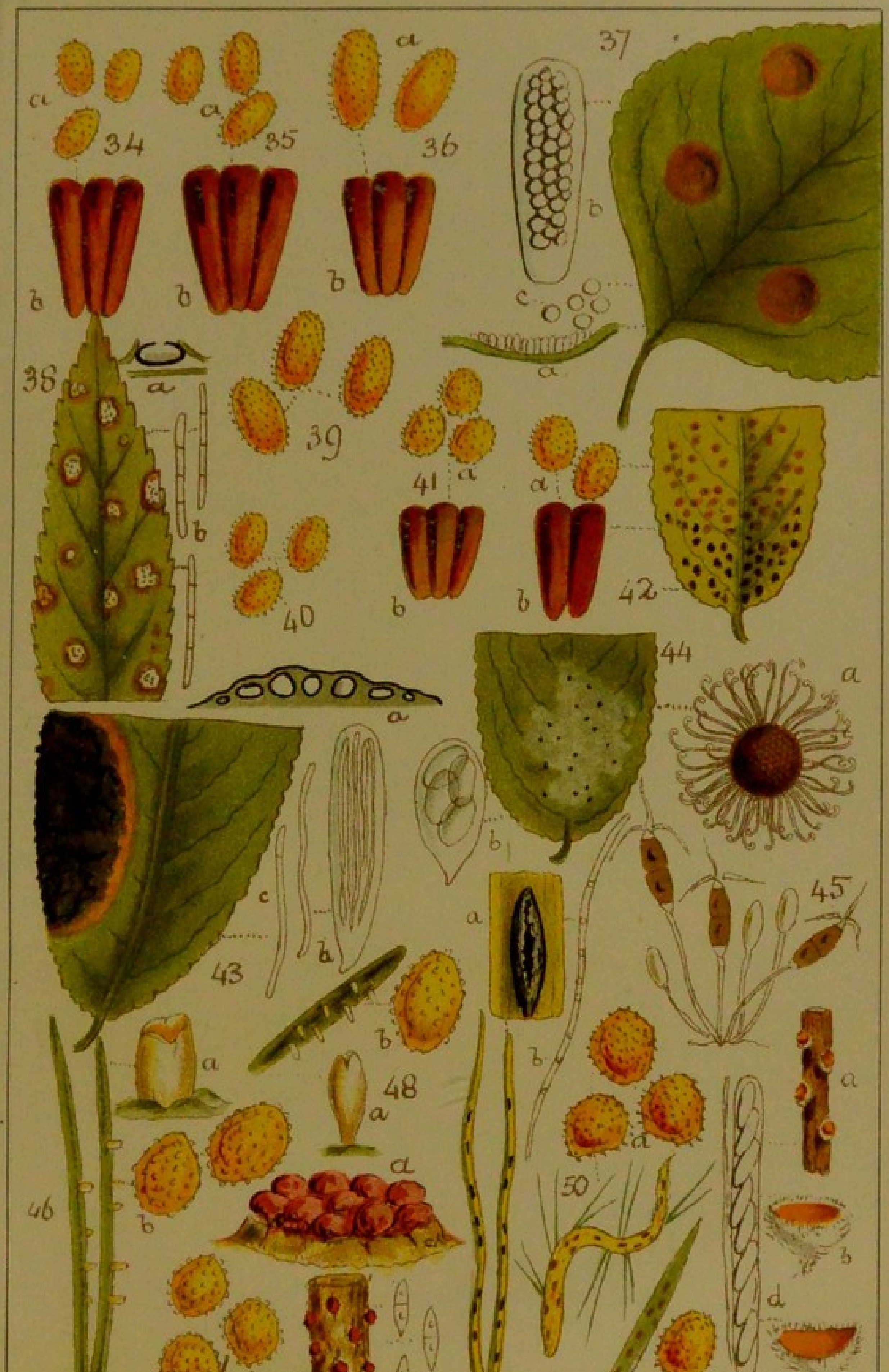
Sacc. Syll. viii. 3325; *Sacc. F. Ital.* fig. 1281; *Hart. & Som. Dis. Trees,* p. 135, figs. 73, 74; *Mass. Pl. Dis.* p. 91.

Another blister (*Taphrina Johansonii,* Sad.) attacks the carpels of the Aspen, causing them to swell and become of a bright golden-yellow. Not as yet determined to be British, unless it proves to be the above form of *Taphrina aurea.*

Mass. Pl. Dis. p. 92.

The Lombardy Poplar is attacked by *Didymosphæria populina,* which produces a disease met with in many parts of France and Germany.

Hart. & Som. Dis. Trees, p. 104.



PESTS OF FOREST TREES.

Willow Leaf-spot.

Septoria salicicola (Fries), Pl. XXI. fig. 38.

This spot is generally found on the leaves of *Salix cinerea* and *S. viminalis*, but it occurs also upon other species. The spots are rounded and white with a brownish margin, upon which are scattered the minute and dot-like black receptacles. The sporules are rod-like and curved ($10–50 \times 3\,\mu$), with three transverse septa.

Recognised also in Sweden, France, Austria, Italy, and Siberia.

Sacc. Syll. iii. 2711; *Grevillea*, xiv. 101, No. 484.

Septoria salicella (Berk.) is now called *Rhabdospora salicella*, and appears to be confined to dead twigs and branches.

Osier Rust.

Melampsora Vitellinæ (DC.), Pl. XXI. fig. 39.

This rust is found on both surfaces of the leaves of *Salix pentandra fragilis, triandra, viminalis,* and *vitellina.* The uredo appears to be the only stage which is perfectly known, and this was originally called *Uredo Vitellinæ* and *Lecythea saliceti.*

The pustules of the uredo are small, round, soon becoming powdery, and golden-yellow. The spores are elliptical or ovate, rough, and orange ($25–28 \times 15–20\,\mu$), mixed with globose paraphyses attenuated at the base.

The teleutospores are said to be confined to the under surface, and occur in small crusts, at length dark brown.

Reported in France, Belgium, Germany, Italy, and Asiatic Siberia.

These species of *Melampsora* on Willows appear to be sadly in need of thorough investigation and disentanglement.

Sacc. Syll. vii. 2110; *Plowr. Brit. Ured.* p. 240; *Cooke, Hdbk.* No. 1593; *Cooke, M. F.* p. 221.

Purple Willow Rust.

Melampsora mixta (Thüm.), Pl. XXI. fig. 40.

This fungus is found on the leaves of *Salix triandra* from May to November. The uredo was formerly known as *Lecythea mixta.* There is at present no insinuation as to its cluster-cups.

The pustules of the uredo are found on the under surface, and are crowded and powdery, of an orange colour, larger, and sometimes confluent when occurring on the young twigs. Spores elliptical or nearly so, rough, and of an orange colour ($14–18 \times 12–15\,\mu$), mixed abundantly with capitate paraphyses.

Teleutospores also on the under surface, in small blackish crusts.

Has been found in France, Germany, Italy, and South Africa, and is reputed to occur on *Salix hastata* and *S. silesiaca.*

Sacc. Syll. vii. 2109; *Plowr. Brit. Ured.* p. 239; *Cooke, Hdbk.* No. 1592; *Cooke, M. F.* p. 221.

Crack Willow Rust.

Melampsora epitea (Kze.), Pl. XXI. fig. 41.

This parasite on the leaves of *Salix viminalis* is at present without any accredited cluster-cups. The uredo is generally found on the under surface, in minute orange powdery pustules. The uredospores are globose, rarely somewhat elliptical, rough, and pale yellow (20μ diam.), mixed with numerous clavate paraphyses.

Teleutospores also on the under surface, very small, at first brown, then nearly black, crowded and somewhat hemispherical, and compact. Spores cylindrical, pale brown ($30-34 \times 12-14\ \mu$) and smooth, with a thick coat.

Recorded also in France, Belgium, Germany, Italy, and Asiatic Siberia, probably in North-Western India.

This species is also said to be found on *Salix alba*, *S. incana*, *S. purpurea*, *S. nigricans*, and *S. retusa*.

Sacc. Syll. vii. 2108; *Plowr. Brit. Ured.* p. 239; *Sow. Fung.* t. 398, f. 1; *Cooke, Hdbk.* No. 1558, pp.

Goat Willow Rust.

Melampsora farinosa (Pers.), Pl. XXI. fig. 42.

The final stages of this rust are found on the leaves of *Salix Caprea*, *cinerea*, *aurita*, and *reticulata*; it was formerly known as *Melampsora salicina*, and although it has been suspected that the cluster-cups would be found on the leaves of *Euonymus*, it has not been demonstrated.

The uredospores are found on the under surface in roundish pustules, which are either scattered or clustered together, sometimes in a circular manner, powdery, and of an orange colour. The spores are more or less globose, rough, with a hyaline coat and golden - orange contents ($17-22 \times 13-15\ \mu$), mixed with numerous clavate paraphyses.

The teleutospores occur on the upper surface, covered by the epidermis, in clusters which are often confluent and form thick flat crusts, which are at first orange, then brown, and at length nearly black. The spores are cylindrical, slightly narrowed downwards, and closely packed side by side ($40-45 \times 16-17\ \mu$), pale brownish.

Found also in France, Belgium, Germany, Finland, Austria, Switzerland, Italy, Asiatic Siberia, and North America.

This appears to be the same as *Melampsora Caprearum*.

Sacc. Syll. vii. 2106; *Plowr. Brit. Ured.* 238; *Cooke, Hdbk.* No. 1558; *Cooke, M. F.* p. 219, figs. 191, 192.

Willow-leaf Blotch.

Rhytisma salicinum (Pers.), Pl. XXI. fig. 43.

This blotch in some respects resembles that which is so common on Sycamore and Maple, forming large, thick, pitchy-black blotches on the leaves of the Goat Willow, *Salix Caprea*, and several other species.

The early stage, whilst the leaves still remain attached to the tree, is known as *Melasmia salicina* and is the conidial condition. The blotches are large but variable, convex and rugulose, rather shining, and pitchy-black, but internally the stroma or substance is white.

The mature stage only accrues after the leaves have remained upon the ground through the winter, and is perfected within the same blotches as contained the conidia in the summer. The asci are clavate, containing eight thread-like sporidia, which are curved and colourless ($60–90 \times 1\frac{1}{2}–3\,\mu$).

This also is known in France, Belgium, Germany, Sweden, Italy, and Siberia.

Sacc. Syll. vii. 3085; *Cooke, Hdbk.* No. 2278, fig. 357; *Grev. Sc. Crypt Fl.* t. 118, fig. 2.

Willow Mealy Mildew.

Uncinula adunca (Wallr.), Pl. XXI. fig. 44.

This mildew attacks the foliage of Willows, Poplars, and sometimes of Birch, giving it the usual mealy or frosted appearance. The mycelium is spreading, rather thin and white, giving rise to conidia of the *Oidium* form, the joints of which fall away as they mature, and increase the mealy appearance of the leaves.

The conceptacles are globose and scattered or sometimes gregarious, minute and dot-like, surrounded by a rather dense circle of appendages, which are unbranched, and hooked at the apex. Each conceptacle encloses from eight to twelve asci, containing four sporidia.

Known throughout Europe, in Asiatic Siberia and North America.

Sacc. Syll. i. 20; *Cooke, M.F.* t. xi. f. 221–224; *Cooke, Hdbk.* No. 1913.

Conifer Seedling Disease.

Pestalozzia Hartigii (Tub.), Pl. XXI. fig. 45.

This disease is reported to destroy the seedlings of Spruce and Silver Fir in immense numbers. The young plants lose their colour and die. The bark just above the ground is destroyed, and exhibits the mycelium, with the receptacles of this fungus which contain the conidia.

The pustules are immersed, springing from a flattened stroma. The conidia are extruded in black masses. They are at first colourless and undivided, then oblong, with three transverse divisions. The two central cells large, coloured, containing guttules, the terminal cells small and colourless (18–20 μ long), bearing at the apex from one to four slender bristles ($20 \times 1\,\mu$), and attached at the base to slender pedicels.

The only remedy we have heard of is to remove and burn all diseased seedlings.

Mass. Pl. Dis. 297, 432; *Hartig & Som. Dis. Trees*, p. 136, figs. 76, 77.

The cortex of the Silver Fir is attacked by *Phoma abietina* in the Bavarian forests and the Black Forest.

Hart. & Som. Dis. Trees, p. 138, fig. 79.

Conifer Disease.

Herpotrichia nigra (Hart.).

Has been recognised in this country.

Journ. Board Agri. June 1905; *Gard. Chron.* July 1, 1905, p. 16.

Pine Cluster-cups.

Peridermium Pini (Wallr.), Pl. XXI. fig. 46.

These peculiar cluster-cups are found on the leaves and young branches of *Pinus sylvestris,* in about May and June. Those on the leaves differ somewhat from those on the branches; the former are scattered or in small groups, and are cylindrical or compressed laterally. The mouth is torn irregularly (2–2½ mm. high). Those on the young twigs form swellings, from the presence of the mycelium the cups are larger, crowded, whitish, with the mouth spreading and much torn (5–6 mm. broad). The æcidiospores are spherical or angular by compression, of an orange colour, and coarsely and thickly warted ($30–40 \times 18–30\ \mu$).

The remaining stages of this parasite are affirmed to be passed upon the leaves of different species of Ragwort, as *Senecio vulgaris, viscosus,* and *Jacobæa,* and has generally been known as *Coleosporium Senecionis.*

Recorded also in France, Belgium, Netherlands, Germany, Russia, Bohemia, Hungary, Transylvania, Switzerland, Italy, Asiatic Siberia, and North America.

Sacc. Syll. vii. 2633; *Plowr. Brit. Ured.* p. 249; *Cooke, Hdbk.* No. 1600; *Cooke, M.F.* p. 191, t. ii. f. 27, 28; *Hart. & Som. Dis. Trees,* p. 172, fig. 102; *Marshall Ward, Timbers &c.* p. 256, figs. 37–39.

Pine Witches' Broom.

Peridermium elatinum (A. & S.), Pl. XXI. fig. 47.

This parasite produces on the branches of *Pinus Pinea* that peculiar form of distortion known as Witches' Broom. The mycelium causes fusiform swellings in the branches affected, from which arise the deformed shoots, bearing pale green swollen leaves.

The cups are whitish, opening irregularly. Æcidiospores elliptical or angular, coarsely warted ($16–30 \times 15–17\ \mu$).

Known in Germany Belgium, Hungary, and North America.

Sacc. Syll. vii. 2932; *Plowr. Brit. Ured.* 271; *Cooke, Hdbk.* No. 1601; *Cooke, M.F.* p. 104; *Hart. & Som. Dis. Trees,* p. 179, figs. 109–111.

Silver Fir Cluster-cups.

Æcidium pseudo-columnare (Kuhn), Pl. XXI. fig. 48.

This is the species which has been known in this country as *Peridermium columnare,* but which Dr. Plowright affirms is not that species, but another which is known by the above name. It occurs on *Abies pectinata, Nordmanniana, amabilis,* and *cephalonica,* as well as on Spruce.

The cluster-cups appear in two rows on the under side of the affected leaves, which are not otherwise altered, except that they are paler in colour. They are either spherical or elongated, with the edges irregularly torn. Æcidiospores white, finely warted, ovate or long elliptical, sometimes irregular, angular, and even triangular in section ($33–37 \times 18–25\ \mu$).

Recorded for Germany and Britain. The teleutospore condition is known as *Melampsora Goeppertiana*.

Sacc. Syll. vii. 2937; *Plowr. Brit. Ured.* p. 271; *Cooke, Hdbk.* No. 1602; *Cooke, M. F.* p. 194, figs. 27, 28.

Pine Branch Twist.

Cæoma pinitorquum (Br.), Pl. XXI. fig. 50.

This disease is prevalent throughout Germany, often attacking Pine seedlings. The infection is said to be caused by the teleutospores of *Melampsora Tremulæ*.

Pustules linear (up to 2 cm. long), either solitary or crowded, orange-yellow. Uredospores rounded or ovoid, angular by compression, warted (15–20 μ diam.), pale reddish-yellow.

Sacc. Syll. vii. 3141; *Mass. Pl. Dis.* p. 236, fig. 60; *Hart. & Som. Dis. Trees*, p. 166, figs. 97–99.

Spruce Nectria.

Nectria cucurbitula (Fries), Pl. XXI. fig. 51.

This common *Nectria* occurs usually as a saprophyte, but it also becomes a wound parasite, and attacks the Spruce, or less commonly the Silver Fir. The red perithecia burst through the back, which is killed, and ultimately the wood dries up and dies. The perithecia produce colourless sporidia contained in asci ($14–18 \times 6–7$ μ), uniseptate and binucleate.

Hart. & Som. Dis. Trees, p. 89, figs. 37, 38; *Mass. Pl. Dis.* p. 130; *Cooke, Hdbk.* No. 2349; *Sacc. Syll.* ii. 4680.

Spruce Woolly Sphæria.

Trichosphæria parasitica (Hart.).

This parasite of the Spruce and Silver Fir appears on the young branches, spreading to the under side of the leaves, and is well known in parts of Europe.

Hart. & Som. Dis. Trees, p. 72, fig. 18; *Mass. Pl. Dis.* p. 114.

Black Woolly Sphæria

Herpotrichia nigra (Hart.)

is destructive to Spruce in the Bavarian forests.

Hart. & Som. Dis. Trees, p. 76, figs. 24, 25; *Mass. Pl. Dis.* p. 113.

Conifer Root Rot.

Fomes annosus (Fr.).

This has the reputation of being one of the most destructive fungi which attack Conifers. Germinating spores gain an entrance into the living tissue of the roots and form a thin white mycelium between the bark and the wood. The cell contents change to a brown colour, and the wood soon assumes a pale yellowish-brown colour, with scattered white patches, each with a black spot in the centre.

The complete fungus is variable in size and form, sometimes resembling a thin white cake, with the porous surface uppermost, and one or two inches in diameter. When perfect, the pileus is expanded, thin and overlapping one above another, the upper surface brown, irregularly tuberculose and wrinkled, sometimes concentrically zoned, silky at first but afterwards smooth. The substance is white, hard, and woody; the under surface white and porous. Sometimes six inches across, and once we found a confluent mass upwards of fourteen inches in diameter.

Diseased trees should be removed, with all the roots and fragments of diseased roots, and all examples of the polypore destroyed.

Common in Europe, North America, and Cuba, and is known also as *Trametes radiciperda.*

Sacc. Syll. vi. 5487; *Mass. Pl. Dis.* p. 183, fig. 41; *Cooke, Hdbk.* No. 788; *Hart. & Som. Dis. Trees,* p. 187, figs. 119, 120; *Marshall Ward, Timbers &c.* p. 142, figs. 11, 12.

Douglas Fir Blight.

Botrytis Douglassii (Tub.).

Seedlings and young trees of the Douglas Fir and *Wellingtonia* are liable to have their leading shoots destroyed by this mould, which makes its appearance as a brownish-grey mould on the branches, which soon curve and die. The threads are brownish, either solitary or in tufts, branched towards the summit, with the branchlets dilated, and toothed or spinulose at the tips. Conidia grouped in heads, oval, colourless, $9 \times 6\,\mu$. Minute sclerotia are formed on the dead branches.

With rather more zeal than judgment, Mr. Massee has called this species *Sclerotinia Douglassii,* although he does not know that a *Peziza* cup or sclerotinia has ever been produced, only that it *might* have been. He seems to have forgotten that biology is a science of facts, and not of dreams, and that we have no right to assume a fact until it can be proved. Moreover, we have every reason to believe that this is no other than *Botrytis cinerea.*

Known also in Holland and Germany.

Spraying with Bordeaux mixture at an early stage would destroy the conidia and check the disease. When badly infected the plants should be burnt at once.

Sacc. Syll. x. 536; *Mass. Pl. Dis.* p. 160; *Hart. & Som. Dis. Trees,* p. 130, fig. 71.

Botrytis cinerea attacks seedlings of Conifers in Germany. It is possible that the above may be the same species with another name.

Journ. R.H.S. xxix. 1905, p. 775.

Hypoderma nervisequum (DC.)

is a common disease on the leaves of the Silver Fir in the Erzgebirge. The leaves become yellowish-brown on the under side; the midrib bears a black longitudinal ridge.

Hart. & Som. Dis. Trees, p. 108, figs. 52, 53; *Sacc. Syll.* ii. 5787.

Spruce-leaf Redness

Hypoderma macrosporum (Hart.)

is produced on the leaves of the Spruce, also in the Erzgebirge, and in Switzerland.

Hart. & Som. Dis. Trees, p. 109, fig. 51; *Sacc. Syll.* ii. 5789.

Spruce Shoot Disease.

Septoria parasitica (Hart.).

This new disease has manifested itself on the Continent in young Spruce woods and in seed-beds.

Hart. & Som. Dis. Trees, p. 143, figs. 81, 82.

Pine-leaf Cast.

Lophodermium Pinastri (Chev.), Pl. XXI. fig. 52.

This little parasite has long been known on the leaves of Conifers, but only recently has it been charged as a special disease, especially on seedlings. Hartig says its presence is often indicated by the appearance of brown blotches on the primary leaves, the rest of the leaf being purple-red. The early condition of spermogonia appears first on the leaves as small black spots, often killing them.

In the final stage the conceptacles are scattered, at first innate, elliptical or elongated, black, smooth, split lengthwise so that the mouth opens like a pair of lips when moist, and discloses a livid-coloured disc, which is composed of myriads of cylindrical asci, closely packed side by side, the apices of which form the disc ($115–150 \times 14–16\ \mu$). The sporidia, of which eight are enclosed in an ascus, are thread-like, thickened at the apex, collected in a parallel bundle ($100–140 \times 1\frac{1}{2}–2\ \mu$), the asci mixed with a number of slender paraphyses which are curved at the tips. This final stage only matures after the leaves have fallen to the ground.

Known in France, Belgium, Germany, Sweden, Finland, Italy, and North America.

Hart. & Som. Dis. Trees, p. 110, figs. 56, 57; *Mass. Pl. Dis.* p. 139, fig. 27; *Sacc. Syll.* ii. 5819; *Cooke, Hdbk.* No. 2302; *Grev. Sc. Crypt. Fl.* t. 60.

Conifer Rot Polypore.

Polyporus Schweinitzii (Fries).

This large brown polypore has the reputation of being destructive to Larch, Scotch Fir, and Weymouth Pine.

The pileus is thick, soft, and spongy, of large size (6–9 inches diam.), but variable in form, rounded or angular and deformed, flattened or depressed, tomentose or coarsely velvety, bright brown, supported upon a thick, short stem of the same colour, which is sometimes nearly suppressed. Under surface punctured with large pores, which are torn at the edge, and at first greenish-sulphur colour. Spores ovoid ($7–8 \times 3\frac{1}{2}\ \mu$).

Substance, when in good condition, soft and spongy, becoming harder with age, and fragile when dry, of a rhubarb-brown colour.

Known in Pine woods throughout Europe, North America, Cuba, and the Himalayas.

Hart. & Som. Dis. Trees, p. 198; *Cooke, Hdbk.* No. 739; *Sacc. Syll.* vi. 4938; *Mass. Pl. Dis.* p. 196.

Another woody fungus called *Trametes Pini* has a like reputation, but it is too rare in this country to require notice.

On the light sandy soil of France and Germany, the roots of Conifers are attacked and killed by the mycelium of *Rhizina undulata* (Fries).

Hart. & Som. Dis. Trees, p. 124, figs. 61–69.

Larch Rust.

Cæoma Laricis (West), Pl. XXI. fig. 53.

Found early in the year on the foliage of the Larch, but so inconspicuous that it is easily overlooked.

The pustules are seated on yellow spots, and are surrounded by the remains of the ruptured epidermis and a circle of barren cells. The uredospores are subglobose, or somewhat elliptical, minutely rough ($15–25 \times 12–18\ \mu$), and of an orange-yellow colour.

A suggestion has been offered that this rust is connected with a form of *Melampsora Tremulæ*, but at present the evidence of such a relationship, beyond the fact of their growing in proximity, is confined to Hartig.

Known also in Belgium and Germany.

Sacc. Syll. vii. 3128; *Plowr. Brit. Ured.* p. 262; *Grevillea*, xiii. p. 73; *Hart. & Som. Dis. Trees*, p. 169, fig. 100.

Hysterium laricinum is liable to infest the leaves of Larch. It is more accurately called *Lophodermium laricinum* (Duby).

Sacc. Syll. ii. 5821.

Larch Canker.

Dasyscypha calycina (Fckl.), Pl. XXI. fig. 54.

The *Peziza* which establishes itself on the twigs and branches, and declared by some observers to be the cause of the Larch disease, consists of pretty little cups ($\frac{1}{2}$ to 1 line broad) which are either clustered or scattered, are at first hemispherical, soon manifestly stipitate, and of a waxy consistency, externally white and hairy. The disc is orange-yellow, with an entire margin. Stem short and rather stout, expanding upwards into the base of the cup. The asci, or spore-sacs, are cylindrical, closely packed to form the disc, enclosing eight oblong, elliptic sporidia ($18–22 \times 7\ \mu$), mixed with thread-like paraphyses, scarcely thickened upwards.

Recorded in Germany, France, and Italy, where it is sometimes called *Peziza Willkommii*.

Sacc. Syll. viii. 1822; *Phil. Br. Disc.* p. 241; *Hart. & Som. Dis. Trees* p. 117, figs. 58–60; *Mass. Pl. Dis.* p. 145, fig. 30; *Cooke, Hdbk.* No. 2034 *Marshall Ward, Timbers &c.* pp. 227, 34–36.

PESTS OF FIELD CROPS.

It will be more convenient, in enumerating the parasites of field crops, to group the cereals, and other graminaceous plants, separately from the cultivated dicotyledonous plants.

A. Cereals and Grasses.

The parasites of grasses, especially of the uncultivated, are so numerous that only the most usual or important could be included here. This will scarcely be regretted in a work devoted rather to horticulture than to agriculture, whilst it must be taken into account that the value of many recent species, so called, is enigmatical.

Loose Smut of Wheat.

Ustilago Tritici (Jens.), Pl. XXII. fig. 1.

Those who retain any knowledge of, or sympathy with, the mycology of a quarter of a century since will not be surprised that we should protest against the wholesale and mostly unnecessary changes of the scientific names, especially the Uredines, which have swept like an epidemic over the past few years. For the present the "faddists" carry the day, through the rage for novelty, but let us hope that the time is not far distant when reason will resume its sway. We are old enough to remember the rise and fall of many such epidemics during the past fifty years, like the fluctuations of such physical epidemics as cholera, plague, and influenza.

This was once known as *Ustilago carbo*, and also as *Ustilago segetum*, but is now converted into several species. In this one the mass of spores is dark olive-brown, soon becoming free and powdery, like soot. Spores ovoid, ellipsoid, and subglobose ($5–7 \times 5–6\frac{1}{2}\mu$) very minutely warted, and somewhat olive. In germination the promycelium is branched.

Thus far it has been recorded for Europe and North America.

A difficult disease to combat, the hot-water method not being effective. Seed should be obtained from a locality free of disease.

Sacc. Syll. ix. 1163; *Smith, Field Crops*, p. 255; *Mass. Pl. Dis.* p. 213; *Cooke, M.F.* p. 229, figs. 98, 99; *Cooke, Hdbk.* No. 1520; *Plowr. Brit. Ured.* 273.

Stinking Smut, or Bunt.

Tilletia Tritici (Wint.), Pl. XXII. fig. 2.

This also was once known as *Tilletia caries*, and is in appearance very like a smut, or *Ustilago*. It occurs within the grains of Wheat, and has a fœtid odour when the grain is crushed, and then the whole interior is filled with a dark olive-brown, almost black, powder.

The grains appear to be rather plumper and darker coloured than usual. The spores with which they are filled are globose (14–20μ mostly 17μ diam.), and the surface is reticulated by a network of raised veins (each pit about 3μ diam.) and of a dark brown colour, seemingly black. When the spores germinate, as they do readily, they produce secondary spores or sporidiola which are long and thread-like. These sporidiola copulate, or become united by a transverse process, something like a capital H, and as a result a smaller or shorter tertiary spore or secondary sporidiolum is produced.

Much less common in this country than formerly. The seed grain may be sprinkled with a solution of one pound of corrosive sublimate to fifty gallons of water, taking care that the grain is wetted all over.

This bunt is recorded for France, Belgium, Switzerland, Austria, Germany, Finland, Italy, and North America.

Sacc. Syll. vii. 1760; *Cooke, Hdbk.* No. 1519; *Cooke, M. F.* figs. 84–91; *Mass. Pl. Dis.* p. 218, fig. 52; *Mass. B. F.* figs. 53–56; *Plowr. Brit. Ured.* p. 283; *Smith, Field Crops,* p. 246, figs. 114–116.

Another species (*Tilletia lævis*) with quite smooth spores is most common in the United States.

Summer Wheat Mildew.

Puccinia graminis (Pers.), Pl. XXII. fig. 3.

This very common mildew on the leaves and culms of Wheat and grasses retains its old name, but it has gained the reputation of having its first stage, or cluster-cups, on the leaves of *Berberis* and *Mahonia*.

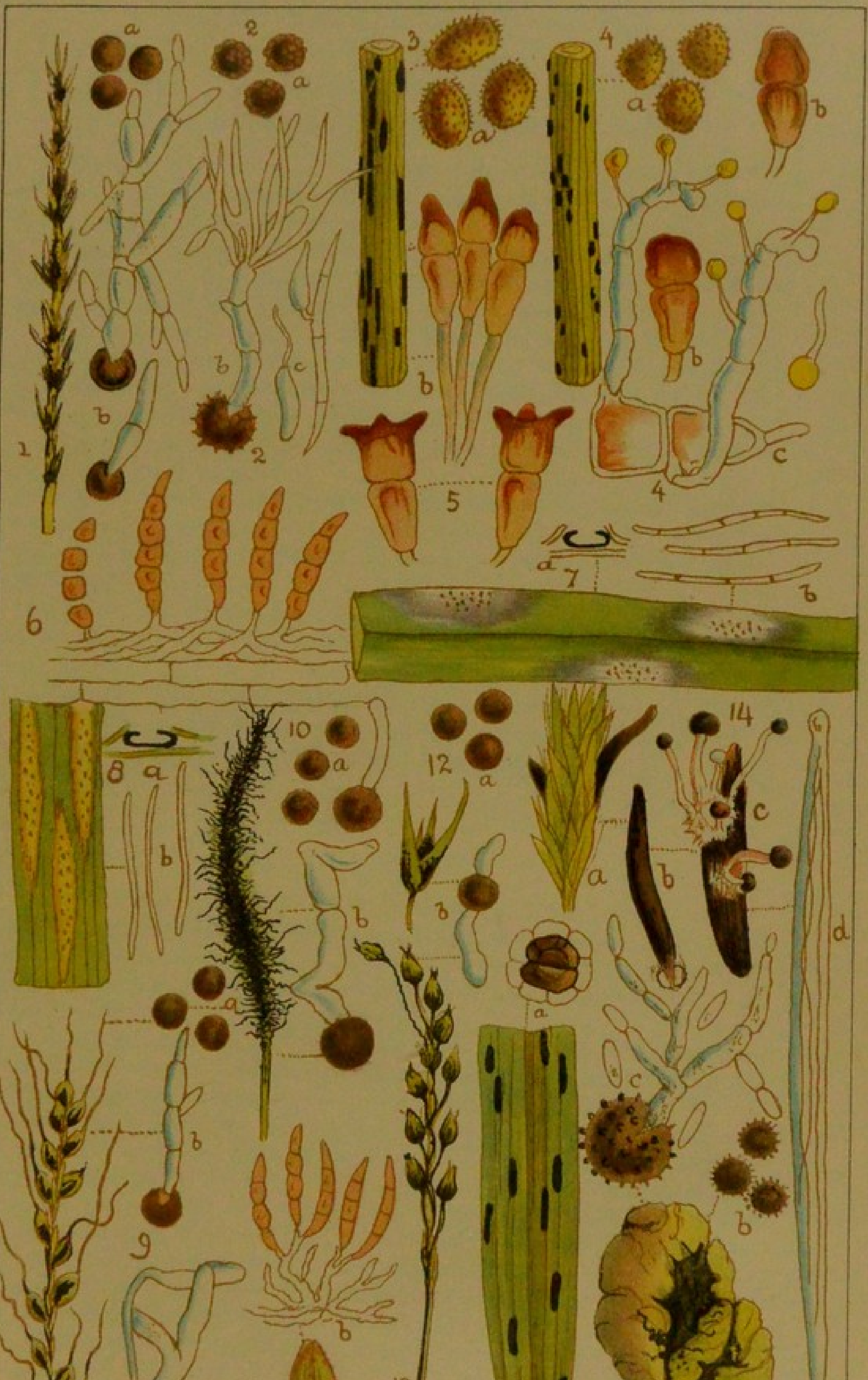
The uredospores are produced in elliptical or linear pustules, of a rusty-brown colour, and in older times were known as *Uredo linearis*. They are for the most part ellipsoid, sometimes clavate (24–45 × 14–21μ), rough externally, of a tawny-yellow colour, at first with a short colourless pedicel. This is commonly known as the "Wheat rust."

The teleutospores are later, and are produced in elongated or linear, nearly black pustules, which are crust-like, through the teleutospores adhering together, and not becoming powdery like the rust. The spores are club-shaped, or somewhat fusoid, with the apex rounded, or teat-like and obtuse, attenuated downwards, and divided by a cross partition into two rather unequal cells, the lower one narrowed into a persistent and rather long pedicle; surface smooth, pale tawny-yellow (34–60 × 12–22μ), spore coat rather thickened at the apex, and mostly darker.

Known in France, Belgium, Germany, Sweden, Finland, Switzerland, Austria, Italy, Asiatic Siberia, North America, La Plata, Australia, New Zealand.

Early sown and early ripening varieties escape rust best.

Sacc. Syll. vii. 2191; *Smith, Field Crops,* p. 147, figs. 72–81; *Mass. Pl. Dis.* p. 247, fig. 63; *Ward, Ann. Bot.* ii. (1888), No. 6; *Grevillea,* x. p. 33; *Gard. Chron.* Feb. 17, 1866, March 6, 1886; *Cooke, M. F.* p. 202, figs. 57–59; *Cooke, Hdbk.* No. 1462; *Plowr. Brit. Ured.* p. 162.



PESTS OF FIELD CROPS.

Spring Corn Mildew.

Puccinia Rubigo-vera (DC.), Pl. XXII. fig. 4.

This corn mildew occurs on Wheat, Rye, Barley, Oats, and several grasses. The cluster-cups are supposed to occur on *Anchusa*, *Pulmonaria*, *Borago* and other genera of *Boraginaceæ*.

The uredo pustules are elliptical, oblong, or linear, and were originally known as *Uredo Rubigo-vera*. The uredospores are globose or ellipsoid ($20-32 \times 17-24\mu$), externally rough, on short pedicels, orange-red.

Teleutospores in small elliptical pustules, or linear and confluent, black, for a long time covered by the epidermis; spores oblong or clavate, flattened at the apex, or laterally apiculate, lower cell attenuated downwards into the short pedicel ($26-80 \times 16-24\mu$) even, chestnut-brown.

Known over the greater part of Europe, in Asiatic Siberia, Ceylon, North and South America.

This is called "spring rust" because the uredo generally appears between March and May. It is not so well known or so devastating as the summer rust which precedes *Puccinia graminis*, and does not appear until June or July.

Plowr. Brit. Ured. p. 167; *Sacc. Syll.* vii. 2194; *Smith, Field Crops*, p. 135, figs. 62–69; *Mass. Pl. Dis.* p. 249; *Cooke, M. F.* p. 202 (*straminis*).

There is a supposed species (*Puccinia glumarum*) found on Wheat, Barley, Oats, &c., in which the spores are developed on the leaves and chaff, considered by others as a variety of the above.

Crown Rust.

Puccinia coronata (Corda), Pl. XXII. fig. 5.

This mildew or rust is found on the leaves of Barley, and on various kinds of grasses, such as *Alopecurus*, *Festuca*, *Aira*, *Lolium*, &c., but the cluster-cups are reputed to be developed on the leaves, petioles, &c., of different species of *Rhamnus*, and will consequently appear as a disease of the Buckthorn.

The pustules of the uredo are lance-shaped or linear, sometimes confluent, uredospores irregularly globose or elliptical ($19-28 \times 16-21\mu$), externally rough, tawny-orange.

The pustules of the teleutospores are oblong, or linear, or confluent, for some time covered by the epidermis, dark brown. Teleutospores club-shaped, flattened at the apex, darker, and toothed, the acute teeth crowning the spore ($35-60 \times 12-21$), a little constricted at the division of the cells, smooth, pale brown, with a short and rather thick pedicel. The crowning of the teleutospores is very characteristic.

Known in France, Belgium, Germany, Finland, Switzerland, Austria, Italy, Portugal, North America, and South Africa.

It is occasionally met with on Wheat, Barley, and Rye, but less commonly than on grasses.

Sacc. Syll. vii. 2192; *Mass. Pl. Dis.* p. 249; *Cooke, Hdbk.* No. 1465; *Cooke, M. F.* p. 203, figs. 60–62; *Plowr. Brit. Ured.* p. 164.

Red Mould of Wheat.

Fusarium culmorum (W.G.S.), Pl. XXII. fig. 6.

This is one of the gelatinous red moulds which Worthington Smith contends are more injurious to growing corn than has been supposed. It forms a pale orange-yellow gelatinous stratum over the ears, or some portion of the ears, of growing Wheat, and glues the spikelets together.

The mycelium is effused, gelatinous, yellow or orange, and sparingly septate. The conidia are fusiform, or spindle-shaped, attenuated towards each end, and slightly curved, with from three to five transverse septa, and of an orange colour ($40 \times 7\mu$).

In common with most other species the conidia will sometimes germinate from any one of the cells whilst still in position, or the cells will separate and each assume a globose form (8μ diam.).

Smith, Field Crops, p. 208, figs. 91–92; *Sacc. Syll.* xi.; *Mass. Pl. Dis.* p. 333.

Wheat is also subject to Bacteriosis, caused by *Micrococcus Tritici*, which is indicated externally by a rose or purple colour.

Mass. Pl. Dis. p. 339.

Wheat Leaf-spot.

Septoria Tritici (Desm.), Pl. XXII. fig. 7.

This leaf-spot occurs on the leaves of Wheat, and also several grasses, especially of *Festuca* and *Glyceria fluitans*. The spots occur on both surfaces and are elongated and linear, whitish, with a dark purple margin. The receptacles are very minute and scattered over the spots, almost inconspicuous. The sporules are cylindrically fusoid, and slightly curved (60–$65 \times 3\frac{1}{2}$–5μ) with from three to five septa. Ejected when mature in flesh-coloured tendrils through the mouths of the receptacles.

Known in Britain, France, and Italy. Probably not injurious to the Wheat crop.

Sacc. Syll. iii. 3042.

Wheat Knot Spot.

Septoria nodorum (Berk.).

This spot was first observed by Berkeley on the nodes of Wheat straw previous to the maturing of the grain. The spots are pallid ochraceous, with a brownish line or margin. The receptacles are at first reddish-brown, becoming black. The sporules, elongated, slightly curved or irregular.

Sacc. Syll. iii. 3044; *Gard. Chron.* 1845, p. 601; *Cooke, Hdbk.* No. 1304.

Grass Leaf-spot.

Septoria graminum (Desm.), Pl. XXII. fig. 8.

This was called by Berkeley *Depazea graminicola*, and occurs on the leaves of Wheat, as well as on some of the common grasses. The spots are more or less elongated, pallid, and often with a narrow fuscous margin, limited by the veins. Perithecia covered, scarcely visible, except under a lens. Sporules straight or slightly curved, minutely nucleate ($55–75 \times 1–1\frac{1}{2}\mu$).

Known also in France, Italy, Austria, and North America.

Sacc. Syll. iii. 3068; *Cooke, Hdbk.* No. 1315.

Barley Smut.

Ustilago Hordei (Kell.), Pl. XXII. fig. 9.

This is part of the original *Ustilago segetum* or *Ustilago carbo*, and appears to be confined to the ovaries of Barley, which are converted into a rather hard, persistent mass of spores.

The mass of spores is black and rather compact. The spores themselves are globose and obtusely angular ($6\frac{1}{2} \times 7\frac{1}{2}\ \mu$ diam.), smooth, and dark brown. In germination the promycelium becomes three to four jointed, producing a sporidiolum at each joint.

Recorded for Europe and North America, but it is uncertain to what extent it is found in Britain, as the common and prevalent form is loose and powdery.

Steeping the seed in half per cent. copper solution is recommended as preventing the disease.

Sacc. Syll. ix. 1165; *Smith, Field Crops*, p. 117; *Mass. Pl. Dis.* p. 214, fig. 51.

Naked Barley Smut.

Ustilago nuda (Jens.), Pl. XXII. fig. 10.

This is one of two species of smut which are now believed to infest the ovaries of Barley. It is in the United States that their differences have been more specially investigated.

The mass of spores is olive-brown, loose, and soon free. The spores themselves are ovoid, ellipsoid, or sub-globose ($5–7 \times 5–6\frac{1}{2}\mu$), somewhat olive. In germination the promycelium is sparingly branched, with the apices sometimes inflated.

Recorded for Europe, North America, and Japan.

Very resistent to fungicides. Differs from the other species in the spore masses being powdery and easily dispersed.

Sacc. Syll. ix. 1164; *Mass. Pl. Dis.* pp. 215, 401.

Barley Rust.

Puccinia simplex (Eriks.).

This supposed species occurs on the leaves of Barley, but the cluster-cup stage is unknown, and hitherto unsuggested.

The uredo pustules are very minute, and are sparingly scattered on the upper sides of the leaves and of a pale yellow colour. The uredospores are globose, or broadly elliptical, externally rough (19–22 diam. or $22–27 \times 15–19\mu$), pale and yellowish.

The pustules of the teleutospores are also minute, blackish, and scattered over the leaves and the leaf sheaths. Teleutospores, mostly one-celled, and irregular in form ($24–30 \times 16–18\mu$), sometimes two-celled, club-shaped, blunt at the apex, or narrowed ($40–48\mu$ long) basal cell narrowed ($16–18\mu$ broad), the upper cell ($19–24\mu$ broad).

Mass. Pl. Dis. pp. 250, 414.

Red Mould of Barley.

Fusarium Hordei (W. G. S.), Pl. XXII. fig. 11.

This gelatinous mould, described by Worthington Smith, he considers more injurious to Barley, and more common, than is generally supposed. Possibly it is the same as the *Fusarium graminearum* of the *Journal* of the Royal Microscopical Society (June 1883, p. 321). The fungus chiefly attacks Barley of poor quality, and ill-conditioned crops and ears.

The mycelium is rose-coloured or crimson, effused, forming a thick gelatinous stratum. The threads are septate, and somewhat torulose. The conidia are spindle-shaped, narrowed to each end, with from one to three septa, slightly curved ($30 \times 4\mu$) and rose-coloured or red. Sometimes these conidia will germinate from any one of the cells whilst still attached to the threads. At other times they will separate at the joints, and each cell assume a rounded form, becoming, in fact, a globose spore (5μ diam.).

Said to be met with in Europe, South Africa, and the United States.

Smith, Field Crops, p. 210, figs. 93, 94; *Sacc. Syll.* xi. 4165; *Mass. Pl. Dis.* p. 331.

Another species, *Fusarium Lolii* (W. G. S.), occurs on *Lolium perenne.*

Sacc. Syll. xi. 4166 ; *Smith, Field Crops*, p. 213.

Loose Smut of Oats.

Ustilago Avenæ (Jens.), Pl. XXII. fig. 12.

This is the old form of *Ustilago segetum* on Oats, and is found converting the grains into a loose sooty powder.

The mass of spores is rather lax, and dark brown. The spores themselves are globose, or shortly ovoid ($6–8\mu$ diam., or $7–9 \times 6–7\mu$), very delicately warted or punctate. In germination the promycelium is pointed, producing at the joints oblong sporidiola.

It will be seen how much reliance is placed by modern authors on the peculiarities of the promycelium in germination.

This form is recorded for Europe and North America.

Recent experiments have proved that sprinkling the seed grain with a 1 per cent. solution of either lysol or formalin entirely prevents the smut.

Sacc. Syll. ix. 1161 ; *Smith, Field Crops*, p. 255, figs. 117–119 ; *Mass. Pl. Dis.* p. 210, fig. 50 ; *Journ. R.H.S.* xxvi. 1902, p. 728, fig. 304.

RYE SMUT.

Urocystis occulta (Wallr.), Pl. XXII. fig. 13.

This is the *Uredo parallela* of Sowerby and Berkeley, and occurs principally on the leaves of Rye, but also sometimes on Barley, Wheat, and a few grasses.

The pustules usually form long streaks on the leaves and stems, and are at first covered by the epidermis and then greyish, afterwards ruptured and then black and powdery. The spores unite in clusters or glomerules, which are globose or elliptical (17–24 × 15–20μ). The central fertile spores, from one to three, opaque brown (12–18μ diam.), globose or flattened, even. The sterile or peripheral spores, globose or flattened, in an interrupted stratum (4–6μ diam.), pale brown. Fertile spores soon germinating and producing a slender promycelium, bearing at the apex from two to six cylindrical sporidiola.

Known in France, Belgium, Germany, and North America.

If the seed grain be immersed for five minutes in hot water (127° Fahr.), it is affirmed that the occurrence of the disease may be prevented.

Sacc. Syll. xiii. 1891 ; *Mass. B. F.* p. 185 ; *Plowr. Brit. Ured.* p. 285 ; *Cooke, M. F.* figs. 167–188 ; *Mass. Pl. Dis.* p. 221, fig. 53 ; *Cooke, Hdbk.* No. 1540.

ERGOT OF RYE.

Claviceps purpurea (Tul.), Pl. XXII. fig. 14.

Ergot is a condition of the seeds of the cereals and grasses in which the grain is taken possession of by a fungus, and enlarged or distorted, and converted into a kind of compact mycelium or resting stage, termed a sclerotium. This is best known, as it is most prominent in Rye, but occurs only on Wheat, Barley, and a large number of grasses, and is injurious to animal life.

An early viscid condition of Ergot has the character of *Oidium*, and has been called *Oidium abortifaciens*.

In Rye the ergot assumes an elongated, black, horn-like form, two or three times as long as the normal Rye seeds, which project from the ear of corn, and they may be kept through the winter, but when placed under favourable conditions of moisture, &c., will germinate in spring.

On germination each ergot may produce several bodies with a contorted stem, and a globose head of a purplish colour. The globose head is dotted with little elevations which indicate the receptacles which are developed beneath. These receptacles or cells contain numerous cylindrical tubes or sacs, termed asci, packed closely side by side. Each of these asci encloses eight long thread-like sporidia (50–76 μ long), which are expelled when mature.

These sporidia, floating in the air when the Rye is in flower, attach themselves thereto, and germinate, infecting the ovary with the virus of the ergot, and developing a new generation.

It is known in France, Belgium, Germany, Finland, Italy, North America, and Auckland.

In order to prevent spreading, the ergots should be collected.

Smith, Field Crops, p. 215, figs. 97–106 ; *Sacc. Syll.* ii. 5005 ; *Mass. Pl. Dis.* pp. 122, 372, fig. 22 ; *Cooke, Hdbk.* No. 2324.

MAIZE SMUT.

Ustilago Maydis (DC.), Pl. XXII. fig. 15.

The most imposing of all the smuts is that which affects Maize, and attacks the ovaries so that they swell, become distended into large bags of sooty powder, distorting the whole cob in an extraordinary manner. It will also attack the leaves, sheaths, and male flowers.

The spores are soon powdery and nearly black in the mass, globose, or nearly so ($8–13 \times 8–11\mu$), with the surface sightly rough. On germination the promycelium is cylindrical and comparatively thin, producing oblong fusiform sporidiola, or secondary spores. It is chiefly by means of these secondary spores that the disease spreads so rapidly. Inoculation takes place originally from spores that remain over a year in the soil, or secondary spores which continue to reproduce themselves by germination.

Appears to occur wherever Maize is cultivated, and plants may be inoculated at any age.

It is known in Britain, France, Belgium, Germany, Austria-Hungary, Italy, North America, and Chili.

It has been observed to be most abundant where fresh manure has been used.

Sacc. Syll. vii. 1723 ; *Mass. Pl. Dis.* p. 213 ; *Cooke, M. F.* p. 230, fig. 108 ; *Cooke, Hdbk.* No. 1525 ; *Plowr. Brit. Ured.* p. 278.

POWDERY MAIZE SMUT.

Ustilago Reiliana (Kulm), Pl. XXIII. fig. 16.

This smut occurs on the male florets of Maize, and was first observed by us on specimens sent over from Lahore (India) and called *Ustilago pulveracea*, but it was afterwards discovered to have had a prior name, as above, and made its appearance in Britain and other parts of Europe.

The pustules are formed in the inflorescence, at first enclosed in a silvery membrane, then becoming powdery, blackish-brown. Spores subglobose, and delicately rough on the surface ($9–12\mu$ diam.), clear brown. Promycelium on germination septate, producing elliptical sporidiola, or secondary spores. It has been demonstrated that the spores will germinate after a period of eight years.

This species has been found in Britain, Italy, Germany, Hungary, Egypt, and N.W. India.

All that can be done is to prevent its spreading by consuming all the diseased parts, and spraying to prevent the germination of any scattered spores.

Sacc. Syll. vii. 1720 ; *Grevillea*, iv. 1876, p. 115 ; *Mass. Pl. Dis.* p. 402.

PESTS OF FIELD CROPS.

Maize Blight,

caused by a black mould, *Helminthosporium inconspicuum* (C. & E.), is often destructive to the foliage of Maize in South Europe, Queensland, and the United States.

Mass. Pl. Dis. p. 313, fig. 84.

Red Gelatinous Mould.

Fusarium heterosporum (Nees), Pl. XXIII. fig. 17.

Some authors consider this a distinct species, whilst others contend that *Fusarium Hordei* and *Fusarinm Lolii* are only varieties. Let each be persuaded in his own mind. This species occurs on the fruits and glumes of *Lolium perenne*, on Rye, and on several grasses.

The clusters are reddish, somewhat tremelloid exudations, which consist of the mycelium, and the short conidiophores with their conidia. The latter are at first almost globose, then they become fusiform (30–35μ long) and from three to five septate. This parasite is often found in company with ergot.

It has been recognised in Germany, Italy, Cuba, Argentina, and North America.

Sacc. Syll. iv. 3343; *Mass. Pl. Dis.* p. 331, fig. 91; *Cooke, Hdbk.* No. 1676.

Timothy Grass Rust.

Puccinia Phlei-pratensis (Eriks.).

This is a recently constituted species found upon the leaves and sheaths of *Phleum pratense*, but which is believed to have been confounded previously with some other species.

The pustules are elongated and confluent, erumpent, and dark brown. Teleutospores fusoid-clavate, slightly constructed in the middle, and either rounded or acute at the apex, of a chestnut-brown colour ($38–52 \times 14–16\mu$).

The uredospores have also been observed, and rather imperfectly described as oblong pear-shaped, rough externally, and yellow ($18–27 \times 15–19\mu$).

It has been recorded for Sweden and Denmark.

Sacc. Syll. xi. 1161; *Mass. Pl. Dis.* pp. 249, 414.

Grass Mildew.

Erysiphe graminis (DC.), Pl. XXIII. fig. 18.

This mildew is familiar on the leaves of most grasses, and commences with the patches of thin creeping white mycelium, common to all these kinds of mildew, the *Oidium* stage, in which the erect branches bear chains of colourless elliptical conidia. Before the advanced condition was known this condition was called *Oidium monilioides* (Pl. XXIII. fig. 19).

Afterwards the globose receptacles appear dotted over the mycelium, like little points. The appendages which usually surround the receptacles are in this instance quite simple, usually depressed and interwoven with the threads of the mycelium. Each of the mature receptacles encloses pear-shaped asci containing eight elliptical uncoloured sporidia.

This parasite has almost a world-wide distribution, since it is found throughout Europe, in Asia, many parts of America, and in Australia.

Sacc. Syll. i. 74 ; *Cooke, M. F.* p. 241, figs. 235, 236 ; *Cooke, Hdbk.* No. 1926.

Grass Black Blotch.

Phyllachora graminis (Pers.), Pl. XXIII. fig. 20.

The leaves of many grasses, whilst still living, are apt to be infested with the black shining blotches of this parasite, the fructification of which does not really mature till the leaves are dead and decaying.

The spots are mostly oblong, or variable, sometimes confluent, prominent and convex, black and shining with a rough or rugulose surface. The receptacles are immersed in this black stroma, and consist of cells in which the cylindrical asci are closely packed side by side, each containing eight ovoid, simple, and colourless sporidia in a single row ($8\text{–}12 \times 4\text{–}5\mu$).

Before these asci and sporidia are developed the cells are occupied by curved spermatia ($16 \times 1\frac{1}{2}\text{–}2\mu$), which are not produced in asci, but at the apex of short delicate threads.

Known in Britain, France, Belgium, Germany, Sweden, Finland, Portugal, Italy, Siberia, Cuba, Ceylon, India, North and South America.

There is no remedy for such a deep-seated endophyte, and all efforts must be confined to prevention. It seldom causes any widespread destruction.

Sacc. Syll. ii. 5132 ; *Cooke, Hdbk.* No. 2418.

Similar species are known in Europe on various kinds of grasses, but not yet found in Britain.

Floating Grass Ergot.

Claviceps Wilsoni (Cooke), Pl. XXIII. fig. 21.

This ergot has been chiefly found on the ovaries of the floating grass *Glyceria fluitans*, and was discovered by Mr. Stephen Wilson, of Aberdeen, in so far as its ultimate development is concerned. The ergots are smaller than in the Rye, corresponding more with the same kind of ergot on grasses.

When these ergots germinate, they produce three or four stems, and the heads are usually club-shaped and of a yellowish colour. The receptacles are exposed, and nearly free, grouped about the heads, almost bluntly conical in form, and of the same colour as the clubs. As in the other species the receptacles enclose a great number of long cylindrical tubes or asci, each of which contains eight very long thread-like sporidia.

Hitherto it has not been recorded out of Britain.

Sacc. Syll. ix. 4000; *Smith, Field Crops*, p. 233, figs. 107-111; *Grevillea*, xii. 77.

Grass Culm Smut.

Ustilago hypodytes (Fr.), Pl. XXII. fig. 22.

This very common smut attacks the culms and sheaths of a great number of grasses, being developed within the sheaths, and extending up the culms in a black powdery crust, chiefly on coarse grasses.

The spores are globose or ellipsoid, sometimes irregular or angular ($3-6 \times 3-4\frac{1}{2}\mu$), with a smooth surface, blackish in the mass, but individually of an olive-brown colour.

Known in Britain, France, Germany, Belgium, Netherlands, Hungary, Italy, Northern Africa, and North America.

Sacc. Syll. vii. 1641 ; *Cooke, M. F.* p. 229, figs. 100-101 ; *Cooke, Hdbk.* No. 1524 ; *Plowr. Brit. Ured.* p. 273.

Another smut attacks the leaves of *Glyceria aquatica* and *fluitans*, forming long parallel streaks (*Ustilago longissima*) of a greyish-olive colour. But these cannot be considered as cultivated grasses.

Grass Bunt.

Tilletia striiformis (West.), Pl. XXIII. fig. 23.

This appears to be the same species as was described by Berkeley under the name of *Ustilago Salveii*, and it occurs on the leaves, sheaths, and culms of various grasses, such as *Anthoxanthum*, *Holcus*, *Festuca*, *Poa*, *Agrostis*, and *Lolium*.

The pustules are dark brown, disposed in long lines ; at first covered, and then exposed and powdery, spores spherical or elliptical, sometimes rather irregular, but rarely oblong ($10-13-17 \times 8-12\mu$), the exterior spinulose, connected in a network at the base, olive-brown. Germinating and producing secondary spores after the same type as in Wheat Bunt.

Known also in France, Belgium, Germany, Finland, Austria, Italy, and North America.

Often found on Cock's-foot (*Dactylis glomerata*), from which it is liable to spread to pasture grasses.

Sacc. Syll. vii. 1774 ; *Cooke, M. F.* p. 230, figs. 117–119 ; *Cooke, Hdbk.* No. 1528 ; *Plowr. Brit. Ured.* p. 284.

Poa Grass Rust.

Uromyces Poæ (Rabh.), Pl. XXIII. fig. 30.

This is another of the fertile progeny of the species of cluster-cups found on Buttercups, which are said to be responsible for several rusts, parasitic on grasses. The present species is found on several species of *Poa*.

The pustules of the uredo are rounded, elliptical, or linear, at first covered, then splitting longitudinally, orange. Uredospores rounded or elliptical, finely echinulate ($16-26\mu$ diam.), orange-yellow.

The later pustules are brown, small, dot-like or elongated, covered by the epidermis. Teleutospores generally irregular in form, often elliptical or ovate, with a smooth epispore, pale brown ($17-25 \times 25-40\mu$), on long and rather persistent pedicels.

Some authors consider this a form of *Uromyces Dactylidis*, otherwise called *Uromyces graminum*, and perhaps they are right after all.

It has a wide European distribution.

Plowr. Brit. Ured. p. 131 ; *Sacc. Syll.* vii. 1939.

Sweet Grass Rust.

Puccinia Anthoxanthi (Fckl.).

This is one of the recently recognised species which occurs on *Anthoxanthum odoratum*. At present no cluster-cups have been associated with it.

The pustules of the uredo are either elliptical or linear, and of a dusky-orange, soon exposed. Teleutospores in very small pustules, which are mostly linear, and dark brown. Spores either elliptical or almost pear-shaped. Upper cell thickened at the apex, or a little apiculate, lower cell rounded, rarely wedge-shaped, smooth, of a chestnut-brown colour ($25-40 \times 15-20\mu$), on long persistent pedicels.

Recognised in Britain and Germany.

Plowr. Brit. Ured. p. 194 ; *Sacc. Syll.* vii. 2306.

This and the two following, with two or three others enumerated in this work, are of such doubtful value as species, that we have not attempted to give figures, since the distinctions relied upon for their discrimination are not morphological, but are dependent upon some feature in their life-history. We may be wrong, but we are fain to believe that features which are too subtle to be portrayed by the pencil should scarce be recognised by the pen.

Foxtail Grass Rust.

Puccinia perplexans (Plowr.).

This parasite is developed on *Alopecurus pratensis*, and owes its name and existence to the discovery of what are believed to be its cluster-cups found on *Ranunculus acris* ; hence it is a creation of experimental culture, and not of definite morphological character.

The pustules of the uredo are oblong or rounded, sometimes confluent and linear, of a golden-yellow. Uredospores globose, oval or somewhat ovate, finely spinulose, and orange ($20-25 \times 30-35\mu$).

The final pustules are small, sometimes round, but generally elongated or linear, covered by the cuticle, often in clusters, sometimes confluent, black. Teleutospores very irregular in form and size, either club-shaped, spindle-shaped, or oblong ; upper cell rounded, either truncate or pointed, often obliquely ; lower cell mostly wedge-shaped, clear brown ($40-60 \times 10-12\mu$), on short pedicels.

At present only recorded as British.

Plowr. Brit. Ured. p. 179 ; *Sacc. Syll.* vii. 2207.

Poa Grass Rust.

Puccinia Poarum (Niels).

This rust is developed on several species of *Poa* and has its accredited cluster-cups on the leaves of the Coltsfoot (*Tussilago Farfara*).

The uredo pustules are small, round or elliptical, and orange, uredospores spherical or elliptical, echinulate (20–30μ diam.), yellowish.

Teleutospores in small black persistent pustules, usually somewhat circinating, covered by the epidermis. Spores elliptical or club-shaped, very variable, flattened at the apex, or conically thickened, dark brown ($35–45 \times 18–25\mu$), on very short persistent brownish pedicels.

The teleutospores germinate after a very short period of rest.

Found in Britain, Switzerland, Italy, Austria, Germany, Finland, Lapland, and Siberia.

Plowr. Brit. Ured. p. 168 ; *Sacc. Syll.* vii. 2195.

Red Grass Gelatinous Mould.

Isaria fuciformis (Berk.), Pl. XXIII. fig. 24.

This parasite was first named by Berkeley from specimens received from Australia in 1873, but since then it has occurred freely in the southern counties of England on pasture grasses, especially *Festuca ovina*, from September to January.

The fungus springs from a pinkish gelatinous mycelium, which has a tendency to glue together the different parts of the grass on which it locates itself. From this mycelium arise the tufts of pink or blood-red filaments, sometimes thickened or flattened upwards and shortly branched, and altogether fleshy and gelatinous when moist, rather horny when dry.

The whole fungus consists of parallel cells or agglutinated septate threads, bearing, about the tips of the threads and branches, innumerable minute globose conidia.

Found in Britain and Australia. Apparently the same as *Isaria graminiperda* (Berk. & Mull.).

Sacc. Syll. iv. 2839 ; *Smith, Field Crops*, p. 57, figs. 17–20 ; *Cooke, Austr. F.* 1993, fig. 325 ; *Gard. Chron.* 1873, p. 596.

Creeping Grass Mould.

Fusarium insidiosum (Berk.), Pl. XXIII. fig. 25.

It is some years since Berkeley called attention in the *Gardeners' Chronicle* to a small mould which attacked some seedling grasses, and especially *Agrostis pulchella*. At first delicate threads spread from plant to plant, and all were soon involved in destruction. These threads were found to be closely attached to the leaves of the grass, were sparingly branched and jointed, and giving off more or less closely compacted tufts of necklace-like threads, terminated by curved, somewhat apiculate conidia, which, according to their age, were from one to five septate. When perfectly grown each joint is somewhat swollen, and sometimes perfectly developed conidia had but three septa. Conidia about 50μ long.

We have not discovered any record of this species elsewhere than in Britain.

Gard. Chron. 1860, p. 480, with fig.; *Sacc. Syll.* iv. 3346; *Cooke, Hdbk.* No. 1869.

Grass Black Mould.

Scolecotrichum sticticum (B. & Br.), Pl. XXIII. fig. 26

This mould sometimes makes its appearance upon still living leaves, but more often is developed on the fading or dead leaves of various grasses.

The tufts are small and black, point-like, and dotted over the leaves. The threads grow in little bundles, and are nodulose or irregular, bearing at the apex oblong-clavate conidia (40μ long), which are divided by one septum, and slightly coloured.

It has never yet been troublesome as a pest, being confined to a few plants. If it ever gets beyond this, spraying can scarcely be applicable over an entire field.

Sacc. Syll. iv. 1660; *Cooke, Hdbk.* No. 1719.

Another species (*Scolecotrichum graminis*) occurs on the fading leaves of *Alopecurus* and *Brachypodium* in France, Germany, and Italy.

Reed Mace Fungus.

Epichloë typhina (Pers.), Pl. XXIII. fig. 27.

This peculiar-looking parasite is not uncommon on the culms of various grasses, which it surrounds for the space of two or three inches like a crust of wax, at first whitish and then yellow, dotted with darker points, which indicate the buried receptacles.

In the first stage, whilst still white, the surface bears ovoid conidia ($4–5 \times 3\mu$), which condition has been named *Sphacelia typhina.* The stroma becomes yellowish or reddish, sprinkled with dots. These dots are the mouths of the imbedded receptacles, which, like those of the final stage of ergot, contain numerous long cylindrical tubes, or asci, which each encloses eight long thread-like sporidia closely packed together side by side. Each sporidium ($130–150 \times 1–1\frac{1}{2}\mu$) either contains a row of nuclei, or is faintly divided by numerous delicate septa.

Known in Britain, France, Sweden, Germany, Belgium, Finland, Italy, Siberia, and North America.

Difficult to eradicate because so abundant on wild grasses.

Sacc. Syll. ii. 5057; *Mass. Pl. Dis.* pp. 125, 372, fig. 23; *Cooke, Hdbk.* No. 2326, fig. 370.

Reed Smut.

Ustilago grandis (Fr.), Pl. XXIII. fig. 28.

Reeds are a sufficiently commercial product in some counties for us to regard "reed beds" as field crops, in a liberal sense. The reed smut attacks the culms and beneath the sheaths of growing reeds in a manner similar to *Ustilago hypodytes*, but on a much grander scale, extending sometimes for several inches, in a broad blackish powdery belt.

The spores are globose, oblong, sometimes angular ($7–12 \times 6–9\mu$), smooth, with a yellow-brown coat. The promycelium, on germination, is cylindrical, with two or three septa; the sporidiola are terminal or lateral, and broadly fusiform.

This was originally called *Ustilago typhoides* by Berkeley.

Known in Belgium, Germany, Finland, and Hungary.

Berk. Not. Br. F. No. 480; *Sacc. Syll.* vii. 1642; *Cooke, M. F.* p. 229, figs. 128, 129; *Cooke, Hdbk.* No. 1527; *Plowr. Brit. Ured.* p. 275.

Reed Mildew.

Puccinia Phragmitis (Schum.), Pl. XXIII. fig. 29.

Originally known as *Puccinia arundinacea* (Hedw.) and developed on the leaves and sheaths of the common Reed. The cluster-cups supposed to belong to this species are found on Dock leaves, Sorrel, and Rhubarb; the uredospores are produced in oblong tawny sori, and the spores are elliptical or broadly ovate ($26–35 \times 15–22\mu$), brownish-warted. Teleutospores developed on both surfaces of the leaves, sheaths, or culms, and are erumpent, elevated, compact, oblong, linear or confluent, dark brown. Teleutospores crowded, elliptical or oblong, subfusoid ($40–75 \times 16–26\mu$), constricted at the middle, apex thickened and conoid, smooth, dark yellowish-brown, on very long hyaline pedicels, which are often persistent.

Found also in Italy, France, Switzerland, Germany, Belgium, North America and South Africa.

Sacc. Syll. vii. 2204; *Cooke, Hdbk.* No. 1463.

B. On Dicotyledonous Plants.

Turnip White Mould.

Oidium Balsamii (Mont.), Pl. VII. fig. 102.

This mould, which is not uncommon on leaves of Turnips, and other plants, has already been described under "Garden Vegetables" (p. 84) and figured on Pl. VII. fig. 102.

Gard. Chron. Sept. 25, 1880; *Smith, Field Crops*, p. 76, figs. 27, 28.

Turnip Rot Mould.

Peronospora parasitica (Pers.), Pl. VI. fig. 30.

This rot mould, which attacks Turnips and Cabbages, and is capable of causing great destruction, has already been described amongst "Pests of Garden Vegetables" (p. 81) and figured on Pl. VI. fig. 30.

Sacc. Syll. vii. 830; *Smith, Field Crops*, p. 80; *Cooke, Hdbk.* No. 1778.

TURNIP WHITE RUST.

Cystopus candidus (Pers.), Pl. VII. fig. 98.

This disease, which affects the foliage of most Cruciferous plants, has been described and illustrated as "Cabbage White Rust" amongst "Garden Vegetables" (p. 80), and figured on Pl. VII. fig. 98.

Sacc. Syll. vii. 792; *Smith, Field Crops,* p. 86; *Mass. Pl. Dis.* p. 59, fig. 6.

TURNIP CLUB ROOT.

Plasmodiophora Brassicæ (Wor.), Pl. IX. fig. 101.

This club root, which also affects Cabbages, has already been described and illustrated as "Cabbage Club Root" amongst "Garden Vegetables" (p. 83). It is also known as "Anbury" and "Fingers and Toes" in rural districts.

Land which has produced club root in any one season should not be cultivated with Cruciferous plants for at least four or five succeeding years (see also *Gardeners' Chronicle*, November 21, 1903, p. 351).

Sacc. Syll. vii. 1568; *Mass. Pl. Dis.* p. 334; *Smith, Field Crops,* p. 94, figs. 34–39.

DAMPING OFF.

Pythium DeBaryanum (Hesse), Pl. IX. fig. 99.

This disease is liable to attack seedlings of Turnip, Rape, Mustard and other Cruciferous plants, as well as Clover, Mangold, &c. It has already been described, under "Pests of Vegetable Garden" (p. 82), and figured on Pl. IX. fig. 99.

Sacc. Syll. vii. 924; *Mass. Pl. Dis.* p. 54, fig. 4.

BEETROOT RUST.

Uromyces Betæ (Kuhn), Pl. XXIII. fig. 34.

The leaves of Garden Beet and Field Mangold are liable to the attacks of a rust to such an extent that the crops are often seriously injured. All three stages of æcidium or cluster-cups, uredo, and teleutospore are recorded as occurring in proper order. Not having resided in the country for many years, we must confess never to have seen the first stage.

The cluster-cups are collected on yellowish orbicular spots; the cups being cup-shaped with a torn margin; æcidiospores globose or oblong, but angular by compression (22–26 × 16–22μ), orange, and smooth.

The pustules of the uredospores are common enough about June, rather small, but freely scattered over the leaves, and of a cinnamon or chestnut-brown colour. The uredospores are elliptical or subglobose, (23–32 × 17–24μ), yellowish-brown, and slightly rough or almost smooth, and, being powdery, are soon scattered over the leaves.

The teleutospores appear about August, and the pustules are either scattered or disposed in circles. The teleutospores are ovate or ellipsoid, with a wart-like projection at the apex (26–35 × 19–25μ), of a brown colour, and smooth, at first with a thin hyaline pedicel, which soon falls away.

This pest is known in France, Germany, Austria-Hungary, and South Africa.

Spraying is recommended early in the season with Bordeaux mixture, or potassium sulphide, to arrest the spread of the disease.

Sacc. Syll. vii. 1928 ; *Mass. Pl. Dis.* p. 228, fig. 57 ; *Cooke, M. F.* p. 218 ; *Cooke, Hdbk.* No. 1587 ; *Plowr. Brit. Ured.* p. 127 ; *Grevillea*, vii. 136.

Beetroot Tumour.

Œdomyces leproides (Trab), Pl. XXIV. fig. 35.

Beetroots were observed in 1901 affected by tumour such as had not been observed before, and which appeared to be similar to, if not identical with, a tumour which had been found on Beetroot in Algeria.

The tumour consisted in a large nodulose outgrowth from the side of the root, about the size of a hen's egg, attached by a narrow isthmus to the root. When cut it was observed that the flesh was precisely similar, the coloured rings being continued through the isthmus and concentrically around the tumour. Externally there was also no difference in colour or appearance, save here and there a darker stain ; internally, where these stains occurred the flesh was blackened for some little distance inwards, but no hyphæ or spores could be found.

In the original Algerian specimens it is stated that " in the substance numerous cavities were found filled with dark-coloured spores, which were subglobose, produced at the apex of a hypha, which bore a large vesicular swelling just below the spore." None of the cavities, spores, or hyphæ were observed in the British specimens. Probably this may be accounted for by the climatic differences of the two countries.

Although we regard the tumour on Potatos as the same species, some authors are of a different opinion.

Mass. Pl. Dis. p. 225, fig. 55.

The young leaves of Beet and Mangold are liable to attack, on the Continent, by the rot mould *Peronospora Schachtii* (Fckl.).

Mass. Pl. Dis. p. 79.

Beetroot and Mangold Rot.

Phoma tabifica (P. & D.).
Sphærella tabifica (P. & D.), Pl. XXIV. fig. 36.

For the past two years this disease has attacked the Beet crop in Germany and France, and has at length made its appearance in Britain. At first, about August, the largest leaves droop, and exhibit discoloured patches bordered by an orange-brown zone, and finally the tissue becomes dead. The disease then passes to the root, penetrating to the heart, killing the young heart-leaves. Minute perithecia appear on the dead parts of the leaf-stalk, containing numerous minute conidia. This is the *Phoma* stage.

Later in the season the *Sphærella* condition appears on the dead petioles, often accompanied by black moulds.

The relation between the mould and *Sphærella* (if any) has not been determined.

All diseased leaves should be collected and burnt, otherwise the disease may return the following year. It is recommended that the crop be lifted when the disease appears on the leaves, and before it reaches the root. Diseased roots must not be stored.

Prill. Mal. Pl. Agri. ii. p. 263 (1897); *McWeeney, Journ. Roy. Agri. Soc.* vol. vi. pt. 3, 1895, with figs.; *Mass. Pl. Dis.* p. 110.

Root Tubercles.

The root tubercles of the *Leguminosæ* have been the source of considerable speculation for many years, but the general impression now is that they are not at all of fungoid origin.

Clover-leaf Cups.

Pseudopeziza Trifolii (Lib.), Pl. XXIV. fig. 37.

This little parasite is not uncommon on fading leaves of different species of Clover, chiefly upon the upper surface. Although, in its form, it is a little fleshy cup-shaped *Peziza,* it differs in being produced beneath the cuticle, and bursting through by rupture of the cuticle, which then encircles it with its rough torn margin cups about ½ mm. broad, a little concave, smooth, and honey-coloured. The disc composed of compacted cylindrical asci, pressed side by side, and each enclosing eight elliptical sporidia ($10–15 \times 5–7\mu$), containing two nuclei.

It has been reported from France, Belgium, Germany, Portugal, Italy, and North America. In Britain it is very widely distributed.

Sacc. Syll. viii. 2970; *Phil. Disc.* p. 199; *Cooke, Hdbk.* No. 2270; *Mass. Pl. Dis.* p. 144, fig. 29.

A similar species (*Pseudopeziza Medicaginis*) occurs on the living leaves of Lucerne, but it is uncertain whether it has occurred in Britain.

Clover Sclerote.

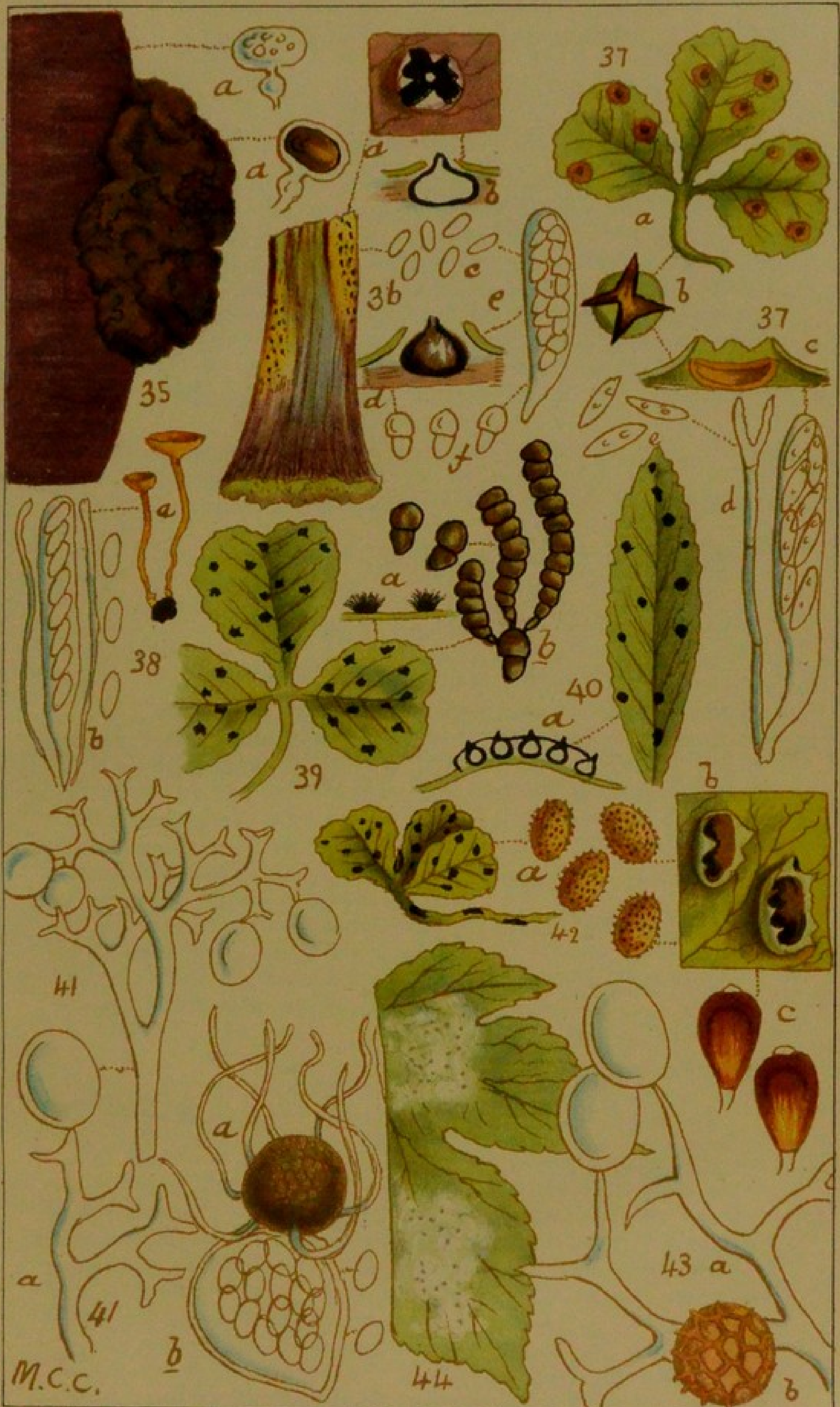
Sclerotinia Trifoliorum (Erik.), Pl. XXIV. fig. 38.

In some seasons Clover is subject to attacks from this parasite, as are also Sainfoin, Lucerne, and others of the family. The leaves are at first frosted with a delicate white mycelium, and finally shrivel and decay. In the winter minute black sclerotia are formed on the dead leaves and roots. With the spring and summer these sclerotia germinate and produce one or two small *Pezizæ*, or cup-shaped fungi, of the *Sclerotinia* type, with a long and slender stem, bearing at the apex a small fleshy brown cup, the inner or concave surface composed of a compact layer of cylindrical cells or asci, placed side by side, and each of them enclosing eight colourless elliptical sporidia ($16–18 \times 6–8\mu$). When these sporidia germinate in their turn, they are competent to inoculate other Clover plants, and perpetuate the disease.

When this disease appears in a field it would be advisable to relinquish a Clover crop for several years.

Recorded in Germany and Scandinavia.

Sacc. Syll. viii. 800; *Mass. Pl. Dis.* p. 155; *Phil. Disc.* p. 118; *Prill. Mal. Pl. Agri.* ii. p. 413, with figs.; *Gard. Chron.* Mar. 17, 1906, p. 176.



PESTS OF FIELD CROPS.

Clover Black Mould.

Polythrincium Trifolii (Kunze), Pl. XXIV. fig. 39.

This black mould is not at all uncommon on the under surface of living Clover leaves, and has the credit of being the imperfect condition of some more highly organised fungus, possibly of *Phyllachora Trifolii.*

The clusters are convex and cushion-like, with a powdery appearance, and of a dark olive-brown, almost black colour, often seated upon yellowish spots. The threads are erect, collected in bundles, flexuous and beaded, or shortly jointed and constricted at each joint, thickened upwards, blackish in the mass. The conidia are obovate, or rather narrowed downwards, and divided transversely into two cells ($20–24 \times 9–12\mu$), pale olive in colour.

Reported in France, Germany, Finland, Bohemia, Italy, Asiatic Siberia, and North America.

Probably would be dispersed by spraying with dilute Bordeaux mixture.

Sacc. Syll. iv. 1664; *Cooke, Hdbk.* No. 1743; *Grev. Sc. Crypt. Fl.* pl. 216.

Clover-leaf Blotch.

Phyllachora Trifolii (Pers.), Pl. XXIV. fig. 40.

This is not an uncommon parasite on the leaves of *Trifolium repens*, and may be the more perfect condition of the Clover black mould, but this is not determined.

It occurs on the under surface, forming oval or elongated, small, shining, black, pitchy-looking convex blotches. These stroma, or pustules, enclose one or more cells with whitish contents. When mature these contain club-shaped sacs or asci, packed side by side, each of which encloses eight elliptical colourless sporidia.

The fungus is recorded for Sweden, Finland, France, Germany, Italy, Asiatic Siberia, and North America.

It is doubtful whether spraying would have any beneficial effect.

Sacc. Syll. ii. 5184; *Cooke, Hdbk.* No. 2416.

Clover-rot Mould.

Peronospora Trifoliorum (De Bary), Pl. XXIV. fig. 41.

The Clover-rot mould attacks numerous plants, but especially *Trifolium, Lotus, Medicago,* and *Melilotus*, covering the entire under surface of the leaves with a delicate greyish film. The fertile threads are six or seven times forked, or sometimes trifurcate, and the ultimate branchlets are pointed and slightly curved. The conidia are elliptical, obtuse, and of a faint, dirty-lilac colour ($18–27 \times 15–20\mu$). The resting spores are globose and brown, with a smooth surface ($25–38\mu$).

It is unnecessary to repeat here the details, which will be found recorded in the "Introduction," of the modes of reproduction and distribution of the rot-moulds, and the formation of the resting spores.

The best means of combat, which in this case is difficult to employ, is to burn up the stems and roots so as to consume the resting spores.

Sacc. Syll. vii. 841 ; *Mass. B. F.* p. 121 ; *Cooke, Hdbk.* No. 1783 ; *Cooke, M. F.* p. 216.

Clover Brand.

Uromyces Trifolii (Hedw.), Pl. XXIV. fig. 42.

The foliage and stems of all the Clovers are liable to the attacks of this parasite, which is unsparing in its work of destruction. All the stages have been observed on the same kind of plant, although it is doubtful whether the cluster-cups have been observed in this country.

The uredo pustules are round or elliptical, and scattered ; after the cuticle is ruptured the remains encircle the spores like a lacerated cup. The uredospores are irregularly globose, or shortly elliptical ($22–26 \times 18–20\mu$), of a brown colour, and minutely spinulose.

The pustules of the teleutospores are smaller on the leaves, larger on the petioles, and elongated, darker brown, and puffed out or bullate, for a long time covered by the cuticle. Teleutospores ellipsoid, or almost globose or pear-shaped, with the epispore or coating thickened at the apex, and bearing a paler-coloured wart ($20–35 \times 15–22\mu$), smooth brown, with a deciduous peduncle.

Known in France, Belgium, Germany, Holland, Switzerland, Finland, Austria-Hungary, Italy, and North America.

Sacc. Syll. vii. 1925 ; *Cooke, M. F.* p. 212 ; *Plowr. Brit. Ured.* p. 124.

Years ago we found on Clover a brand, mixed with uredospores, which was two-celled (*Puccinia fallens*), but it has since been condemned as a freak, since it would not "fit in" with a preconceived theory.

Clover White Mould.

Ovularia exigua (Smith).

This little white mould, which attacks Clover, was first described by Worthington Smith, under the name *Peronospora exigua* ; but there is no direct evidence that it is a rot mould of that genus, as there is no indication of resting spores, and the mode of attachment of the conidia is rather that of *Ovularia* than *Peronospora*.

This parasite appears as a minute white mould on the foliage of Clovers, and is affirmed to cause putrescence. The fruiting threads of the mould are frequently simple, but sometimes once or twice branched. The conidia are terminal and lateral, being borne on minute lateral spicules. The conidia are nearly globose, and borne singly, not in clusters, falling off readily when mature, and of a very pale grey colour ($8 \times 6–7\mu$). These conidia germinate from the side, but do not generate zoospores in their interior.

It may be inferred that the encroachments of this pest may be met, more effectually than in the case of the true rot moulds, by fungicides, such as Bordeaux mixture.

Sacc. Syll. xi. 3841 ; *Smith, Field Crops,* p. 12, fig. 2.

Pea Mildew.

Erysiphe Martii (Lev.), Pl. VII. fig. 111.

The mildew which infests the Garden Pea attacks also the Field Pea, and hence the description to be found under "Garden Vegetables" (p. 88) will also be applicable here.

Field Pea Rust.

Uromyces Pisi (Pers.), Pl. VII. fig. 110.

The rust of the Field Pea is the same as that which attacks the Garden Pea, and will be found noticed in the section devoted to "Garden Vegetables" (p. 88).

Field Bean Rust.

Uromyces Fabæ (Pers.), Pl. VII. fig. 106.

The rust of the Field Bean is equally common to the garden varieties, and will be found described amongst "Garden Vegetables" (p. 86), hence it needs not to be repeated here. It has a wide distribution throughout Europe.

Lima Bean Mildew.

Phytophthora Phaseoli (Thaxter).

This rot mould, which is closely allied to the Potato mildew, has proved very destructive to the Lima Bean in the United States, and should be guarded against as possible to attack French Beans and runners in Europe. It attacks chiefly the legumes.

Thax. Bot. Gaz. xiv. p. 273, 1889; *Mass. Pl. Dis.* p. 65.

Lucerne Tumour.

Urophlyctis Alfalfæ (v. Lagerh.).

This disease appears to have originated in Ecuador. In 1902 it appeared in Alsace, where it soon spread into several districts, and thence it travelled into Italy. Early in 1906 it was found near Herne Bay in Kent, and has become a British pest. Evidently allied to the tumour on Potato, it attacks the crown of the root, forming gall-like excrescences three-quarters of an inch across, consisting of cells containing a crowded mass of brownish spores (40 μ diam.). No remedy has yet been tried, but infested spots have been ploughed up.

Gard. Chron. Feb. 24, 1906, p. 122.

Vetch Rot Mould.

Peronospora Viciæ (Berk.), Pl. XXIV. fig. 43.

This pest occurs on the under surface of the leaves of the Field Bean, Field Pea, Vetch, and Melilot; often forming a dense felt of a whitish, then greyish colour. The erect fertile threads are produced in tufts, and are forked six or eight times. The final or ultimate branches are rather short and pointed. The conidia are elliptical, rounded at the apex, and of a pale dingy-violet colour (25–28 × 15–18μ).

The resting spores are globose, and of a pale yellow-brown colour, with a rough surface, the ridges forming a kind of wide meshed network.

The life-history and transformation of this kind of mould are detailed in the "Introduction."

Known in France, Belgium, Germany, Finland, Italy, North America, and Australia.

Berk. Journ. Hort. Soc. i. 31; *Sacc. Syll.* vii. 819; *Cooke, M. F.* t. 15, f. 266, t. 10, f. 212; *Cooke, Hdbk.* No. 1779; *Mass. B. F.* p. 117.

Hop Mildew.

Sphærotheca Castagnei (Lev.), Pl. XXIV. fig. 44.

Although sometimes called *Sphærotheca Humuli*, this pest is extensively well known, and needs no description, as it is one of the worst foes with which the Hop-grower has to contend.

The first stage is that in which the leaves are invested with the dense whitish felted mycelium, the erect branches of which become divided off into conidia of the *Oidium* type, which fall on the leaves, and increase their mealy appearance.

Subsequently the globose receptacles appear scattered over the mycelium, at first yellowish, and at length almost black, surrounded by numerous appendages or flexuous threads, which are intertwined amongst themselves or with the threads of the mycelium, and are somewhat coloured. Each of these receptacles encloses but a single, nearly globose ascus, or membranaceous cell, which contains eight elliptical and uncoloured sporidia.

This mildew is found nearly all over Europe, and wherever the Hop is cultivated in Asia and North America.

Sacc. Syll. i. 8; *Cooke, M. F.* p. 238, fig. 216; *Mass. Pl. Dis.* p. 95; *Cooke, Hdbk.* No. 1911.

Hop Sphærella.

Sphærella erysiphina (Berk.).

This little parasite accompanies the Hop mildew and has only been found associated with it. Probably, therefore, it inflicts little injury itself, and will disappear with the mildew.

The receptacles are minute and scattered, often superficial, and of a brown colour, almost dot-like. They enclose cylindrical asci or vesicles, which each contain eight colourless elliptical sporidia, divided across the centre into two cells (12–13μ long).

Sacc. Syll. i. 1975; *Journ. Hort. Soc.* ix. pp. 65, 67, 68, fig. 8; *Cooke, Hdbk.* No. 2766.

The Hop is also liable to become infested with the common Black Mould, *Fumago vagans*, which is to be found on so many other plants, and often accompanies the Honeydew.

Flax Wilt.

Fusarium Lini (Boll.), Pl. XXIV. fig. 33.

This disease has long been known in Holland, Belgium, and Northern France. It exists also in Ireland and in Germany, but is hardly known in Russia. When the soil is impregnated, after successive crops, and the flax becomes "wilted," the land is said to be "Flax sick."

The plants are attacked at all ages, and die early or late in the stage of growth. If the soil is much infected, most of the plants are killed before they get through the surface of the ground. Young plants two to five inches high suddenly dry up and decay. Old plants which are quite woody take on a sickly, weak, yellowish appearance, wilt at the top, slowly die, turn brown, and dry up.

The fungus which causes this disease was first detected by H. L. Bolley, and called by him *Fusarium Lini*, and is thus described: Vegetative hyphæ light-coloured, septate, branching irregularly, ramifying the tissue of the stems and roots of the host. Spore tufts (*sporodochia*) erumpent, compact, slightly raised, pale cream or flesh-coloured. Sporophores short and closely branched, or conidia sometimes arising from wart-like protuberances upon a compact bed, or stroma. Conidia four-celled, fusiform, slightly curved or falcate ($27 \times 3\mu$ to $38 \times 3\frac{1}{2}\mu$), living in the humus of the soil, able to attack the Flax plant, and causing the disease.

Living normally as a decay form (saprophyte), it can also invade the living tissue of its host. It can live and increase upon the decaying matter found in the soil, especially on old roots and stems of the Flax plant, and can readily thrive there for a long period. It may remain in the soil for more than four years, without the presence of a Flax crop. If any of the filaments come in contact with a young Flax plant, they penetrate at any point, through the seed, leaves, stem, or roots. When the plant dies it becomes food material for the fungus.

The results of experiments show that a rather strong solution of formaldehyde, acting a short time, will work satisfactorily on Flax seed. The proper strength to be used in sprinkling and shovelling methods is about 1 part to 330 parts of water (approximately 1 pound to 40 gallons). The seed should be spread on a tight floor and sprayed with a small amount of the liquid, then raked over rapidly, until all the surfaces of the seed are evenly moist and not wet enough to gum, but evenly damp; then continue to shovel the grain so as to get it dry as soon as possible. Avoid any excess of moisture.

Cease sowing Flax on the same land year after year. Put at least one cultivated crop and two or more other crops between Flax crops. Burn as much of the old Flax straw and stubble which remain upon the ground as possible. Avoid the evil effects of deep planting. The Flax disease does more injury to seedlings when the seed is placed deep in loose soil than when planted shallow. One-half inch to three-fourths is the best depth.

Bolley, in. U.S.A. Agri. Exp. Sta. N. Dakota, Bull. 50, 1901; *Journ. R.H.S.* vol. xxvii. p. 751.

Flax Rust.

Melampsora Lini (DC.), Pl. XXIV. fig. 32.

This is a destructive pest to cultivated Flax, and is very common on the little wild species of purging Flax.

The pustules of the uredo are small, rounded, and scattered, of a bright orange colour on the leaves, stems, and sometimes on the flower buds. Uredospores almost spherical, or egg-shaped ($15–24 \times 14–18\mu$), orange-yellow, and externally rough.

The pustules of the teleutospores form rather large blackish patches on the stems, quite smooth and shining. The teleutospores are wedge-shaped, and closely packed side by side, covered by the epidermis ($45–60 \times 17–20\,\mu$). They act very effectively, as resting spores, to carry the pest through the winter and provide for the reappearance of the uredo in the spring.

It has been observed in France, Germany, Belgium, Holland, Switzerland, Finland, Russia, Dalmatia, Austria-Hungary, Bohemia, Italy, Siberia, and in South Africa, Australia, and North America.

Burning the stems, or any portions which exhibit the patches of teleutospores, should be insisted upon, if the disease is to be kept in check.

Sacc. Syll. vii. 2107; *Mass. Pl. Dis.* p. 238; *Cooke, M. F.* figs. 165–167; *Cooke, Hdbk.* No. 1596.

Hemp Leaf-spot.

Phyllosticta Cannabis (Kirch.), Pl. XXIV. fig. 31.

On the living and languishing leaves of the Hemp plant. Spots on the upper surface, somewhat circular, tawny, becoming paler; perithecia punctiform and scattered; sporules hyaline, elliptical, straight or curved, very minute, with one or two guttules ($4–6 \times 2–2\frac{1}{2}\mu$), hyaline.

Has occurred in Northern Italy and Bohemia.

Sacc. Syll. iii. 294.

FUNGICIDES

are mixtures which are applied to diseased plants either to prevent or mitigate the ravages of fungoid parasites—if in a fluid form by sprinkling, spraying, or sponging the foliage; and if in powder by dusting it over the plants or the soil, as the case may require. See also Journ. R.H.S. xxix. 1905, p. 900.

Fluid.

Ammoniacal Carbonate of Copper.—Mix three ounces of sulphate of copper and three ounces of carbonate of soda with one quart of concentrated ammonia, and as soon as all action ceases dilute with twenty-two gallons of water. Some persons advocate the dilution with twenty-eight gallons of water as being less injurious when applied to fruit.

May be used in greenhouses, and is especially useful in epiphytic diseases, such as Rose mildew, Hop mildew, and other *Erysiphæi* and surface moulds, like *Oidium*.

Arsenical Solution.—One ounce of arsenic dissolved in a little alcohol and mixed with 100 gallons of water.

This is recommended in America for spraying Carnation rust, but it must not be used on fruit trees or plants, on account of its poisonous nature.

Berichonne Mixture.—Dissolve six and a half pounds of sulphate of copper in four gallons of hot water. In another vessel dissolve seven and a half pounds of carbonate of soda. When cold mix the two solutions and add one pint and three quarters of liquid ammonia. Dilute with water to make forty-four gallons.

Similar in use to ammoniacal carbonate of copper.

Bordeaux Mixture.—Sulphate of copper sixteen pounds dissolved in twenty-two gallons of water. Thirty pounds of lime dissolved in six gallons of water. When the lime-and-water is cold mix the two solutions together slowly and thoroughly.

The above is the original formula, of which the following is a modification :—

Sulphate of copper six pounds, dissolved in four gallons of hot water. Four pounds of lime dissolved in four gallons of cold water. When the solutions are cold mix thoroughly, and when desired for use dilute to twenty-two gallons with cold water.

Air-slaked lime should never be used, since it injures the foliage.

This is considered to be the cheapest and best all-round fungicide; indeed general testimony is that "it is the most effective fungicide known." JOURN. R.H.S. xxviii. 1904, p. 654.

Condy's Fluid.—See Potash Permanganate.

Eau Céleste, or *Blue Water.*—Dissolve one pound of sulphate of copper in three or four gallons of warm water. When completely dissolved, and the water has cooled, add one pint of liquid ammonia, then dilute to twenty-two gallons. The concentrated liquid should be kept in a keg, or some wooden vessel, and diluted when required for use.

The following is a modified formula :—

Sulphate of copper two pounds, carbonate of soda two and a half pounds, ammonia one and a half pint, to twenty-two gallons of water.

Dissolve the sulphate of copper in two gallons of hot water; in another vessel dissolve the carbonate of soda in a similar manner; mix the two solutions, and when all chemical reaction has ceased add the ammonia and dilute to twenty-two gallons.

Gastine Mixture.—Dissolve in one pint and three quarters of liquid ammonia two or two and a half ounces of carbonate of copper. To be diluted when required for use to twenty-two gallons by the addition of water.

Gishurst Compound.—A well-known preparation which is useful in some cases and has been recommended.

Iron Mixture.—Prepare a solution by dissolving two pounds of sulphate of iron in five gallons of water and apply by sprinkling.

Another form: Water fifty gallons, sulphuric acid one pint, iron sulphate twenty-five pounds. Pour the sulphuric acid upon the iron sulphate, and then add by degrees the fifty gallons of water.

A metal vessel must not be used in the preparation, as it would be acted upon by the sulphuric acid.

This mixture may be used with great advantage, where a disease has previously existed, to destroy the resting spores. In spraying fruit trees &c. it should be done in the winter, otherwise the foliage would be completely destroyed.

Jeyes's Fluid.—Watering with Jeyes's fluid in the proportion of one ounce to a gallon of rain water is beneficial in sterilising the soil, which should be thoroughly wetted and allowed to remain a week before anything else is planted.

Liquid Grison is prepared by boiling six pounds of sulphur and three pounds of lime in six gallons of water, until the whole is reduced to two gallons. Allow it to settle, pour off the clear liquid, and bottle it until used. For use mix one part of the liquid with one hundred parts of water.

Paraffin.—A wineglassful to two gallons of water has been used with effect to check the spread of the *Chrysanthemum* rust, and would doubtless be applicable to other rusts.

Potash Permanganate.—This is the well-known fluid called "Condy's fluid." It is more economical to buy the potassium permanganate, in the form of crystals, which dissolve readily in water. The solution should be pale-rose colour.

It has proved effectual in arresting the spread of rust, and was employed successfully to Hollyhock seedlings when the brand was in full activity. Rusted Carnations may be sponged with it.

Potassium Sulphide.—Dissolve one ounce of potassium sulphide, popularly known as "liver of sulphur," in a quart of hot water, then make it up to two and a half gallons with cold water. Useful to check the spread of an epidemic, and proved successful against *Chrysanthemum* rust.

Sulphate of Copper Solution.—Dissolve one pound of sulphate of copper in twenty-five gallons of water, and spray with the solution.

For notes on "Soda Bordeaux," "Formalin," and "Kerosene Emulsion," see JOURN. R.H.S. xxviii. 1904, p. 654.

POWDERS

may be applied by dredging from a flour dredger, or pepper pot, or enclosed in a canvas bag.

David's Powder.—Dissolve four pounds of sulphate of copper in as little water as possible. Slake fifteen pounds of lime in the smallest amount of water necessary, then mix the two preparations thoroughly and let the compound dry, after which it is crushed and sifted and applied in the form of powder.

Sulphatine.—Mix two and a half pounds of anhydrous sulphate of copper with fifteen pounds of finely powdered sulphur and ten pounds of air-slaked lime. Apply in powder.

Sulphur.—This is used as a dry powder in the condition known as "flowers of sulphur." It is most effective against the fungi which are epiphytic, in which the mycelium is entirely superficial, forming a dense white felt on the surface of the leaves, as in the Hop mildew, Rose mildew, and Pea mildew. Sometimes finely powdered quicklime may be mixed with the sulphur.

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THE ROYAL HORTICULTURAL SOCIETY.

Privileges of Fellows.

1.—Anyone interested in Horticulture is eligible for election, and is invited to become a Fellow.

2.—Candidates for election are proposed by two Fellows of the Society.

3.—Ladies are eligible for election as Fellows of the Society.

4.—The Society being incorporated by Royal Charter, the Fellows incur no personal liability whatsoever beyond the payment of their annual subscriptions.

5.—Forms for proposing new Fellows may be obtained from the Offices of the Society, Vincent Square, Westminster, S.W.

6.—If desired, the Secretary will, on receipt of a letter from a Fellow of the Society suggesting the name and address of any lady or gentleman likely to become Fellows, write and invite them to join the Society.

FELLOWS.

A Fellow subscribing Four Guineas a year (or commuting for Forty Guineas) is entitled—

1.—To One Non-transferable (personal) Pass and Five Transferable Tickets admitting to all the Society's Exhibitions, and to the Gardens.

N.B.—Each Transferable Ticket or Non-transferable personal Pass will admit three persons to the Gardens at Wisley on any day *except* days on which an Exhibition or Meeting is being held, when each Ticket or Pass will admit One Person only. The Gardens are closed on Sundays, Good Friday, and Christmas Day.

2.—To attend and vote at all Meetings of the Society.

3.—To the use of the Libraries at the Society's Rooms.

4.—To a copy of the Society's Journal, containing the Papers read at all Meetings and Conferences, Reports of trials made at the Gardens, and descriptions and illustrations of new or rare plants, &c.

5.—To purchase, at reduced rates, such fruit, vegetables, and cut flowers as are not required for experimental purposes.

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7.—Subject to certain limitations, to obtain Analysis of Manures, Soils, &c., or advice on such subjects, by letter from the Society's Consulting Chemist, Dr. J. A. Voelcker, M.A., F.I.C.

8.—To have their Gardens inspected by the Society's Officer at the following fees:—One day, £3. 3*s.*; two days, £5. 5*s.*; *plus* all out-of-pocket expenses.

9.—To exhibit at all Shows and Meetings, and to send seeds, plants, &c., for trial at the Society's Gardens.

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[*Bonâ fide* Gardeners earning their living thereby, and persons living permanently abroad, are exempt from the payment of the Entrance Fee.]

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[*This Form can be easily detached for use.*]

THE ROYAL HORTICULTURAL SOCIETY.

Established A.D. 1804. Incorporated A.D. 1809.

VINCENT SQUARE, WESTMINSTER, S.W.

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Description ....

Address ....

....

being desirous of becoming a FELLOW of the ROYAL HORTICULTURAL SOCIETY, we whose Names are underwritten beg leave to recommend him (her) to that honour; he (she) is desirous of subscribing * .... Guineas a year.

Proposed by ....

Seconded by ....

* Kindly enter here the word *four* or *two* or *one*.

It would be a convenience if the Candidate's Card were sent at the same time.

Signed on behalf of the Council, this .... day of .... 190.....

.... CHAIRMAN.

[P.T.O.