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ERRATA

Page 6	line 4	for '*C. alborubrum*'	read '*G. alborubrum*'
12	27	,, 'McLean (F. J.).'	,, 'McLean (F. T.)'
19	46	,, '*Corticum*'	,, '*Corticium*'
34	20	,, 'Miège (M. E.).'	,, 'Miège (E.).'
36	10	,, 'Equador'	,, 'Ecuador'
38	38	delete 'it'	
44	1	for '*corium*'	,, 'corium'
70	33	,, '*Beurmani*'	,, '*beurmanni*'
73	7	,, '*europeum*'	,, '*europaeum*'
92	31	,, '*abietinium*'	,, '*abietinum*'
101	31	,, '*apivorus*'	,, '*apiovorus*'
128	lines 39 and 42	,, '*Rhyncosporium*'	,, '*Rhynchosporium*'
170	line 44	,, 'McFarland (F. S.).'	,, 'McFarland (F. T.).'
206	13	,, '*hevea*'	,, '*heveae*'
217	38	,, '*willkommi*'	,, '*willkommii*'
224	15	,, '*Pseudolpidum*'	,, '*Pseudolpidium*'
276	34	,, 'Haensler'	,, 'Haenseler'
284	34	,, '*chromatosporum*'	,, '*chomatosporum*'
285	8	,, '*Fabrea*'	,, '*Fabraea*'
309	26	,, '*Asclepiadaceae*'	,, 'Asclepiadaceae'
327	6	,, '*lachrymans*'	,, '*lacrymans*'
354	lines 7 and 9	,, '*europea*'	,, '*europaea*'
374	line 28	,, '*Medicago*'	,, '*Melilotus*'
389	38	,, 'forsøksspøritninger'	,, 'forsøkssprøitninger'
401	25	,, 'Cn'	,, 'Cu'
415	45	,, 'hypopyhllous'	,, 'hypophyllous'
422	26	delete 'and' after *polygoni*	
455	48	for '*Cronatium*' read '*Cronartium*'	

IMPERIAL BUREAU OF MYCOLOGY

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Chevalier (A.). **Sur une Maladie des Agaves.** [Note on a Disease of Agaves.]—*Rev. de Bot. Appliquée*, i, 1, pp. 21–23, 1921.

Sisal plants in Indo-China and the French Sudan have been attacked by a fungus which Patouillard has identified as *Colletotrichum Agaves* Cav. Elliptical brown patches, more or less confluent, appear in the lower leaves, which are rendered useless by the decay of the tissue. Similar symptoms have been observed in a park near Marseilles on *Agave americana* L., *A. Salmiana* Otto, and their varieties. *A. applanata* Lem. ex Jacobi appears to be immune. The author regards the disease as identical with the anthracnose of Sisal reported from India in 1913 by Shaw.

Verslag over het Jaar 1920. Dept. van den Landbouw in Suriname. [Report of the Dept. of Agric., Surinam, for the year 1920.] Pp. 16–20, 48, & 63–64. Issued 1921.

A great many Liberian coffee-trees were attacked by the sieve-tube disease (phloëm-necrosis), while two specimens of *Coffea arabica* were also affected by it for the first time. *Sclerotium* disease also occurred sporadically, but did not cause much damage. The importance of this disease is apt to be under-estimated, since it can easily become epidemic under favourable weather conditions. Bordeaux mixture should be applied as a preventive.

During the period covered by the report, a bacillus was isolated from some coco-nut palms attacked by bud-rot disease. Externally the bacillus corresponded with that isolated by Johnson from coco-nut palms. With this organism, cultivated on agar and shaken up in water, the young leaves of thirty-six coco-nuts and twelve oil-palms (*Elaeis guineënsis*) were inoculated by pouring the suspension between the youngest leaves. After some months all the oil-palms were dead, but not a single coco-nut. This merely proves, however, in the author's opinion, that the bacillus cannot infect coco-nut palms in the particular manner described, not that it is incapable of pathogenic action under other conditions.

At the end of 1920 only thirteen oil-palms remained out of 130 African trees mentioned in the 1919 report as being attacked by bud-rot. The prevalence of this disease among palms imported from Africa is such that their cultivation in Surinam cannot be recommended. The course of the disease is so rapid that combative measures are of no avail. The native varieties of oil-palm produce annually a much greater number of clusters, but the weight of these is less than in the African palms.

Investigations in the Philippines have shown that bud-rot of coco-nut palms can be produced by the fungus *Phytophthora Faberi*, which also causes cacao canker and black rot of cacao fruit. A number of coco-nut palms—some young and others eight years old—were infected with spores of *P. Faberi*, the method employed being the same as in the bacterial inoculations, and very quickly exhibited large watery spots, 1–2 cm. in diameter, on the youngest parts of the leaves. Microscopical examination revealed the typical *P. Faberi* mycelium, and after a day in a moist atmosphere the first conidiophores were visible. These experiments were not carried out until the end of the year, so that definite information as to the presence of bud-rot cannot be included in this report, but it is certain, at any rate, that *P. Faberi* is capable of penetrating the young tissue of the Surinam coco-nut palms, and it is possibly responsible in part for the bud-rot disease.

Erythrina glauca has been severely attacked by a fungus, not yet identified, which causes a bark disease. The tissues are penetrated by numerous white rhizomorphs, which finally pierce the wood and continue to develop in the medullary rays and parenchyma. Exposed to the air, the rhizomorphs turn sea-green. As soon as the decay reaches the base of the trunk the trees fall.

There have been cases of a disease of Bourbon sugar-canes closely resembling, and probably identical with, the Yellow Stripe or Mosaic disease, which is so widespread in Porto Rico. The leaves were typically striped, and there were canker-like spots on the internodes. The disease is commonly transmitted by insects, though it may also be propagated by setts.

Frequent inquiries are made by planters as to the desirability of planting *Lagarto* cacao (*Theobroma pentagona*) on account of its resistance to curl-disease (*Marasmius perniciosus*). Experiments have shown that this variety is not absolutely immune, though its powers of resistance are very considerable. Planted in an infected environment, however, a small proportion of the plants succumb. Like *Theobroma bicolor*, *Lagarto* is less susceptible to the disease than the ordinary variety (*Theobroma cacao*).

SMALL (W.). **Annual Report of the Government Botanist for 1919–1920.**—*Annual Report of the Dept. of Agric.* (Uganda Protect.), pp. 42–44, 1921.

Fungous diseases of the following plants are referred to:—

COFFEE. Many reports of die-back were received, and species of *Colletotrichum*, *Phoma*, and *Fusarium* associated with the disease were isolated and used for inoculation. The results are being separately published. [See next abstract.]

It has been shown that the Variegated Bug carries the pycnospores of the same *Phoma* as is found on the coffee branches. This fungus also occurs on the broken cotyledons in the condition known as 'broken beans', thus leading to the conclusion that the insect is implicated in the damaging of the beans.

HEVEA. The present immunity of Hevea rubber from Brown Root Disease (*Hymenochaete noxia* Berk.), Wet Root Rot (? *Sphaerostilbe repens* B. and Br.; *Poria* sp.), and *Ustulina zonata* (Lév.) Sacc., is ascribed to its being grown on elephant-grass land instead of forest-land, where decaying stumps constitute favourable breeding grounds for the diseases in question. Growers are warned not to leave Hevea roots in the ground after the thinning of the trees.

Bark and cortex diseases have been prevalent, but microscopic examination of the diseased tissues, particularly of what is known as Brown Bast, has failed to disclose the presence of any mycelium or other part of a fungus. Further investigation is in progress.

CACAO. It has been shown that the cacao *Colletotrichum* is capable of infecting coffee. Rotting cacao-pods with pink spore masses of *Colletotrichum* should be burnt as they are a danger to coffee.

NATIVE CROPS. Areolate mildew (*Ramularia areola* Atk.) and boll-anthracnose (*Colletotrichum gossypii* Southw.) of cotton have been reported from various districts. Rust (*Puccinia graminis* Pers.) and loose smut of wheat (*Ustilago tritici* Jens.) were also found.

ORNAMENTAL AND SHADE PLANTS. Wilts of carnations, larkspurs, and love-in-a-mist, all from the same garden, were due to a single species of soil *Fusarium*.

Wet Root Rot, previously known on Hevea, ceara, tea, coffee, cacao, and guava, has now also affected *Casuarina equisetifolia*, *Hibiscus*, *Eucalyptus*, and mango.

Albizzia moluccana, planted as coffee shade, has succumbed to root disease in two instances. In one, *Fomes lucidus* Fr. was found on the collar of a tree which had been dead for some time, and in the other, *Rosellinia*-like fructifications on the under sides of the main roots, near the trunk of the tree. Neither fungus has attacked the interplanted coffee.

Grevillea robusta is subject to a die-back, which is accompanied by gummosis. The leading shoot or any branch on any part of the tree may be affected. An Ascomycete, obtained from diseased trees, has been identified as *Nectria flocculenta* v. Hoen., and is most probably the cause of the disease.

SMALL (W.). **Notes on Species of *Colletotrichum* and *Phoma* in Uganda.**—*Kew Bull. Misc. Inform.* 2, pp. 57–67, 1921.

A species of *Colletotrichum* causing leaf-blotching and gradual withering of branches of *Coffea arabica* was first recorded in Uganda about 1908. Massee had proposed the name of *Colletotrichum coffeae* for this fungus, but his description has never been published, and there is every likelihood that it was identical with the widely-distributed *Colletotrichum coffeanum* Noack, described in 1901 from Brazil, as the latter has been found to occur regularly on Uganda coffee in association with the disease known as 'die-back'.

Gloeosporium coffeanum Del., in the writer's opinion, is probably the same fungus. Another species of the same genus, *C. incarnatum* Zimm., which probably is identical with *C. coffeanum*, has been known for several years in the former German East African colony, and has also been given as the cause of a die-back of *Coffea robusta* in Ceylon.

Of late years there has been a tendency to ascribe all coffee die-back to the work of *Colletotrichum*, but it was pointed out in 1915 that other fungi were found commonly on die-back branches, and it was also emphasized that various physiological factors were involved in the causation of the disease. Among other forms found at times on die-back coffee branches in Uganda are *Periconia byssoides* Pers., *Fusarium coffeicola* Henn., *Fusarium* sp., and *Tubercularia* sp., all of which are regarded as saprophytic, together with a *Phoma* which has a *Coniothecium*, and possibly an ascigerous stage on the branches, a *Glomerella*, which is the perfect stage of the *Colletotrichum*, and the perithecia of the sooty mould fungus, *Capnodium brasiliensis* Putt. Cultures were obtained of *Colletotrichum coffeanum*, *Phoma*, *Fusarium coffeicola*, and *Fusarium* sp., these fungi being more consistent in their presence on die-back branches, and seeming to be more implicated in the production of the disease, than any other forms.

The characters of *Colletotrichum coffeanum* in culture are described. The formation of setae takes place comparatively seldom; in the acervuli of *Colletotrichum* on twigs in a damp chamber setae frequently do not develop at all, or they may appear late, when conidial production is slackening down; on sterilized coffee leaves no setae are produced by the fungus, and this is also the case in nature when the fungus attacks the leaves. On the berries, again, setae may or may not occur. The presence or absence of setae is thus an inconstant character, and, though it has been usual to refer setaeless acervuli to the genus *Gloeosporium*, the writer's opinion is that the acervuli and conidia of *Gloeosporium* on the leaves (*G. coffeanum* Del.) and the *Colletotrichum* on the stems are indistinguishable, and that the two species may well be the same. It is generally agreed that the separating line between *Colletotrichum* and *Gloeosporium* is a narrow one, and that the basis of distinction is artificial, and it would appear that the presence or absence of setae is governed more by physiological conditions than by a hard and fast morphological rule.

Inoculations were made with pure cultures either by wounds and punctures on twigs at the nodes, in the course of the internodes, and at the tender growing-point of the stem, or by placing the inoculum on both surfaces of leaves, on the unwounded bark of nodes and internodes of twigs, and upon the apical growing-point. Leaf inoculations were far more successful than any of the others, in some cases giving 100 per cent. positive results. Older, tougher leaves were as susceptible as younger ones, and the upper surfaces as the under. The first signs of leaf-infection were noticeable after fifteen or sixteen days, and the mycelium of the fungus was traceable through the leaf-petioles into the stems. Later, numerous acervuli developed on the twigs bearing the inoculated leaves and on the leaves themselves after about ten days in a damp chamber.

The only successful stem inoculation was made through a punctured wound in the growing-point. Twelve days after inoculation the stem apex began to blacken; this was followed by the collapse of the apical pair of leaves and by the extension downwards of the discoloration. *Colletotrichum* was afterwards recovered from the affected stem.

The fungus is not an aggressive parasite of coffee, requiring favourable conditions or weakness of the bushes to bring on an attack. Over-bearing, neglect of cultivation, and the attack of *Hemileia* are predisposing causes.

After the lapse of from fifteen to twenty days, certain of the pure cultures of *Colletotrichum coffeanum* show caespitose perithecia of a species of *Glomerella*. These succeed the acervulus stage; in nature they may be found on die-back twigs after the lapse of a few months. This *Glomerella* has been identified at Kew as *G. cingulata* S. & v. S.

The author compared *C. coffeanum* with *C. incarnatum* Zimm. and *C. theobromicolum* Del., which occurred on rotted and hardened cacao pods, and concluded that the morphological differences between them seem too slight to justify their separation into distinct species. Furthermore, cross-inoculations proved that *C. coffeanum* is capable of vigorous growth on cacao pods and twigs: its effects were indistinguishable from the usual cacao-pod rot of Uganda, and the *Colletotrichum* and *Glomerella* on the pods and twigs were morphologically indistinguishable, the former from *C. coffeanum* or *C. incarnatum*, the latter from the *Glomerella* on coffee twigs. Cultures from *Colletotrichum* conidia from rotted cacao pods still on the trees were used to inoculate coffee leaves, and all gave positive results; an asetose *Colletotrichum*, indistinguishable in other respects from *C. coffeanum*, was recovered in all cases.

Colletotrichum camelliae Mass., the fungus causing Brown Blight of tea, is found in Uganda on tea leaves of all ages: the *Glomerella* stage has not yet been met with in nature, and the fungus has not been studied in pure culture, nor have cross-inoculations been carried to a successful conclusion. The writer, therefore, does not find it possible to assert that the tea *Colletotrichum* stands in the same relationship to *C. incarnatum* or *C. coffeanum* as the latter two stand to each other, but he points out that, morphologically, *C. camelliae* is as similar to *C. coffeanum* as this latter to *C. incarnatum*. It is mentioned that Tunstall has shown that the *Colletotrichum* which causes Brown Blight of tea in Assam is the conidial stage of *Glomerella cingulata*.

Species of *Colletotrichum* have been found on garden plants of *Codiaeum* and *Eranthemum* which were dying back. They are morphologically similar to each other and to *C. coffeanum*, but as yet their relationships have not been experimentally tested.

A certain amount of the cotton crop in Uganda is yearly lost in consequence of anthracnose of cotton-bolls, caused by *Colletotrichum gossypii* South. Its perfect stage, *Glomerella gossypii* Edg., is to be found only at times, for the conidial condition is much more common than the perithecial.

Gloeosporium musarum Cke. & Mass. sometimes occurs on ripe bananas in Uganda, causing black spots which eventually lead to a complete rot. *Gloeosporium albo-rubrum* Petch occurs on green shoots of *Hevea*, and causes them to die back. In this way it is responsible for the entry into the tree of *Botryodiplodia theobromae* Pat. *C. albo-rubrum* is frequently found in close association with *Phyllosticta ramicola* Petch. Other species of *Colletotrichum* (*Gloeosporium*) occur on mangoes, guavas, pomegranates, and species of *Citrus*, but they have not yet been investigated.

The *Phoma* from coffee twigs suffering from die-back was obtained in pure culture, and its cultural characters are fully described. It has a *Coniothecium* stage which has also been found on the twigs, but never, so far, in the tissues. No further stage in its development has been observed.

Out of a series of sixty inoculations on coffee trees with material from *Phoma* cultures, only one was successful; in it pycnospores had been placed on the unbroken internodal bark of a branch, the apical branches of which began to droop after two months. Mycelium was found in the branch tissues near the point of inoculation, and *Phoma* was subsequently recovered. Still, the author thinks that infection in another way may be more frequent. One of the most dangerous coffee diseases is caused by the Variegated Bug (*Antestia orbitalis*, Westw., var. *faceta*, Germ.), which punctures and sucks the juices from the twigs, buds, and berries. In order to test the theory advanced in 1916 that this pest is actively implicated in the transmission of fungous infection, the author prepared cultures from its legs and beak. In all the cultures, except one which was productive of bacteria and moulds only, *Phoma* mycelium appeared aerially in forty-eight hours. If, as appears probable from these experiments, the bug commonly carries spores of *Phoma* in or on its beak, with which it pierces the tender tissues of the plant, it is not unlikely that it is responsible for the presence of the fungus in tissues which the latter might be otherwise incapable of penetrating. There is also no reason why other scale insects, aphis and borers known on Uganda coffee, none of which has yet been examined on these lines, should not carry and introduce into the tissues both *Colletotrichum* and *Phoma*.

The inoculation results show that *Phoma* by itself is not an aggressive parasite, and there is no Uganda evidence of such a *Phoma* disease of coffee as that described by Dowson in British East Africa. The recommendations made with regard to the coffee die-back with which *Colletotrichum* and *Phoma* are implicated consist of measures designed to produce a healthy and resistant tree.

The only other species of *Phoma* found on a plant of economic importance is *Phoma Heveae* Petch, which occurs on *Hevea* branches, apparently without causing any harm.

NOBÉCOURT (P.). **Action de quelques alcaloïdes sur le *Botrytis cinerea* Pers.** [Action of certain alkaloids on *Botrytis cinerea* Pers.]—*Comptes Rendus de l'Acad. des Sciences*, clxxii, pp. 706–708, 1921.

As part of a research on the causes of immunity in plants, the writer tested the action of several alkaloids on *Botrytis cinerea*, which is known to attack certain plants (cinchona, tobacco, *Atropa*

Belladonna) rich in these substances. The result showed that nicotine and atropine had no effect on the fungus at concentrations probably higher than is ever found in the plant. Quinine is unfavourable at fairly high doses, and aconitine at feeble doses. The fungus which causes the 'Maladie de la Toile', shown by Beauverie (*Études sur le polymorphisme des Champignons*) to be a sterile race of *Botrytis cinerea*, was found to be less resistant to alkaloids, and the strengths which inhibit growth are such as to suggest that aconite should be quite immune, and tobacco very resistant, to this disease, while atropine had less effect.

GLEISBERG (W.). ***Botrytis*-Erkrankungen.** [The causation of disease by *Botrytis*.]—*Gartenflora*, lxx, 1–2, pp. 13–19, 1921.

The occurrence of sharply-defined brown spots on primula leaves, sometimes isolated and sometimes confluent, led to the investigation of a curious phenomenon connected with the biology of *Botrytis cinerea*.

Careful examination of the primulas in question (*P. Kaschmiriana*, *P. Veitchii*, and *P. veris*) showed that some of the spots were covered with the decayed blossoms of a *Robinia pseudacacia* standing near by. These blossoms, which adhered closely to the leaves on which they fell, were also found on ivy, *Picea pungens*, and *Abies concolor*. In the two latter cases, however, there was no discoloration. Conidiophores of *Botrytis cinerea*, emerging in fascicles from the stomata, were visible on the under side of the spots.

The fact that similar spots occurred on elm and dandelion leaves, as a result of falling elm seeds, disposes of the theory that *Robinia* alone is responsible. Experiments also proved that the formation of the spots was not due to any chemical peculiarities of the flower-extract. The fungus must therefore be regarded as a facultative parasite, which requires a decaying substratum and a certain degree of humidity, or an acid plant-extract, to assist it in the attack of living plants. The decay of the blossoms and the action of the mycelium in the leaf, the agglutination of the cell-content and its discoloration, stamp the fungus as an agent of humification in an advanced degree.

PAPE (H.). **Beobachtungen bei Erkrankungen durch *Botrytis*.** [Observations on the causation of disease by *Botrytis*.]—*Gartenflora*, lxx, 3–4, pp. 48–50, 4 figs., 1921.

The foregoing observations of Gleisberg on *Botrytis* have led the writer to describe a similar experience which occurred in 1920. After a rainy period at the beginning of September, the leaves of both *Nicotiana rustica* L. and *Nicotiana tabacum* L. exhibited dry, brown spots, which appeared as the result of contact with the withered petal tubes of the flower. These spots were either isolated and sharply defined, or merged into one another when several petals fell on the same leaf. As a rule, the petals were abundantly covered with the mycelium of *Botrytis cinerea*, and in some cases this was transmitted to the spots themselves, and appeared on the surface of the leaf. In cases where the fructifications were not visible at first, they appeared after one or two days in a humid atmosphere. The tissues of the spots, even of those on which the fungus was not apparent, were also found on microscopic examination to be completely penetrated by the mycelium.

The following are further examples of the capacity of *Botrytis* for proceeding from decaying vegetable tissues to the live parts of the organism:—

(1) A number of bean seedlings (*Phaseolus vulgaris* L.) in a greenhouse showed signs of withering. On examination they were found to be infected with *Botrytis cinerea*, which had first attacked the dying cotyledons, and thence spread to the young living tissues above them. The plants did not recover.

(2) In the late summer some fully-grown Soya bean plants began to wither. In this case, too, *Botrytis* had evidently first attacked the withering young pods on the upper part of the plant, and then proceeded to the main axis. In some cases it was noticed that the fungus was transmitted by direct contact from the tip of the pod to the stalk, without first passing through the entire pod.

THOMAS (H. E.). **The Relation of the Health of the Host and other Factors to Infection of *Apium graveolens* by *Septoria Apii*.**—*Bull. Torrey Bot. Club*, xlviii, pp. 1–29, 1921.

After a brief account of the late blight of celery and a description of the characters of the parasite, accompanied by bibliographical references, the problem of the relation of health, age, and other conditions to susceptibility, as determined by the results of the extensive inoculation experiments, is considered. The parasite was found to be very limited in its host range, perhaps entirely restricted to *Apium graveolens* and its variety *rapaceum*. Parsley (*Petroselinum sativum*), contrary to what might be expected from earlier statements, is not infected by the form here studied. On celery there is some difference in the susceptibility of different varieties, but none tested had any pronounced resistance. Golden Self-Blanching was especially susceptible both in the greenhouse and in the field.

The tests on plants variously treated with fertilizers and in other ways so as to modify the vigour and rate of growth of the plant are of the highest interest, and the conclusion is drawn that in a general way anything that favours the growth of the host increases susceptibility. This was specially marked when pot-bound plants were treated with nitrate of soda, which increased growth, but more than doubled the amount of infection as measured by the number of spots per leaf in atomizer inoculations. Calcium sulphate and hydrated lime slightly reduced susceptibility, the latter visibly reducing the vigour of the plant. In comparing lime with nitrate of soda in another series the latter averaged 284 spots per leaf as against 120 for the former, and what is perhaps even more significant, the difference in size of the spots was proportional, the spots of the nitrate plants averaging 2·64 mm. in diameter, while those of the lime plants averaged only 1·06. The ratios are 1 : 2·36 and 1 : 2·54 respectively. These data indicate that the degree of susceptibility is dependent upon the interchanges between the host cells and the fungus hyphae rather than upon the ability or lack of ability of the fungus to penetrate the host. Besides nitrate of soda, complete nutrient solution and top-dressing with sheep manure increase the susceptibility. Plants infected with nematodes (? *Heterodera radicicola*) have their susceptibility much reduced when the infestation is really severe, which is usually only the case in badly pot-bound plants. Where vigorously growing plants have nematode galls there is no reduction in susceptibility. In one case a very heavily infected plant was found to be highly resistant to the disease, and even when transferred to a larger pot with fresh soil, so that it was able to make considerable growth, it remained practically immune. After treatment with a nutrient solution, however, a large number of small spots developed. Etiolated plants, produced by keeping in a dark room for nine days before inoculation, had less than half as many spots on each leaf as the controls. The reduction in leaf area was plainly not commensurate with this difference. When plants were placed in the dark for three and a half days after inoculation no difference in degree of infection was noticed nor any delay in the first appearance of the spots. The average size of the spots was also less in plants etiolated before inoculation.

The young leaf is susceptible as soon as it comes into view. Leaves that are still growing have a much larger number of spots from inoculation than those that are mature. But the older the leaf the more rapidly the intervening tissue between the spots breaks down, and also the larger the individual spot, except in etiolated plants, where the spots on the young leaves developed in the dark are as large as those on the very old leaves. The older leaves were found to be markedly more acid than the younger in normally grown plants. Etiolation is, however, known to increase acidity, and there is therefore a suggestion that there is a relation between resistance and acidity, though this would appear to be other than the simple direct relationship claimed by Comes in his well-known researches on the subject.

The above results are considered to show that *Septoria Apii*, though it readily assumes the saprophytic habit, has become so adapted to its host that the development of infection is favoured by increased growth of the host such as is produced by feeding with nitrates, with a complete nutrient solution, or by top-dressing with sheep manure, while top-dressing with lime decreases the infection, and so does severe infestation by nematodes. The work of other investigators in this field is referred to, and attention called to the tendency shown by highly specialized parasites to become in some sense symbiotic rather than antagonistic for at least a part of their life in the host. In relation to age there appear to be two sets of conditions operating, one which governs the establishment of infection and another which determines the rate of subsequent spread of the mycelium. The number of spots on old leaves produced by inoculation is less, but their first appearance to the eye is earlier and their rate of growth greater than on younger leaves.

Adams (J. F.). **Observations on Wheat Scab in Pennsylvania and its Pathological Histology.**—*Phytopath.*, xi, pp. 115–124, pl. 2 & 3, 1921.

In 1917 the average infection of wheat heads with scab in

Pennsylvania was estimated at two per cent., the highest in observed fields being eight per cent. It is greatest when wheat follows maize. On the old maize stubble perithecia of *Gibberella saubinetii* are commonly found in spring, and these are no doubt partly responsible for infecting the wheat. On wheat these perithecia were not found, but cultural study of the organisms on the scabbed heads indicated that this fungus is the usual cause. This agrees with the work of Johnson, Dickson, and Johann (*Phytopath.*, x, p. 51, 1920), where less than one per cent. of the isolations gave other fungi (*Fusarium culmorum*, *F. avenaceum*, &c.) capable of causing scab.

The conditions found in infected kernels are fully described and figured from microtome sections. All parts are invaded, entry being apparently usually through the germinal end and the fungus having a special affinity for the embryo. The endosperm is also usually destroyed more or less completely. The glumes and rachis are more resistant. Infection appears to occur after the flowering stage as a rule.

Wheat seedlings were readily attacked by cultures isolated from scabbed wheat as well as from corn root rot. But it is probable that soil and temperature conditions with the autumn planting of wheat are not conducive to seedling infection under field conditions.

MARTIN (F. J.) & MASSEY (R. E.). **Experiments on Wheat Growing in the Sudan.**—*Wellcome Tropical Research Laboratories, Chemical Section*, Publication No. 19, Khartoum, 1921.

The indigenous Sudan wheat, chiefly grown in Dongola and Berber, is unsuitable on account of its comparatively long period of development, susceptibility to rust, and admixture of strains and varieties. Rust reduces the yield materially, and is favoured by late development, as black rust generally makes its appearance only towards the end of the season. Pure strains were isolated from the local wheats, and tested with imported varieties from Australia, India, Egypt, and elsewhere. Only those from the three mentioned sources appear promising. The only kinds that have yielded good results are the early varieties. None of the Australian kinds tested have rusted, though native wheats near by were attacked; most of the Indian wheats also escaped rust, while all the Egyptian were attacked. The best yielders were Federation, Firbank (both Australian), and Indian No. 40 (a selection from commercial Indian wheats). All these escaped rust, and gave a better quality grain than the indigenous. They have a short growing period and good milling qualities. All the Australian varieties were upstanding and strong, the most robust being Federation. The Indian wheats were slender, and in some cases weak in the straw (Indian No. 7 and Pusa 3 x).

THATCHER (L. E.). **A Fungus Disease suppressing Expression of Awns in a Wheat-Spelt Hybrid.**—*Journ. Agric. Res.*, xxi, 10, pp. 699–700, 1921.

Experiments carried out at the Ohio Agricultural Experiment Station with a number of F2 hybrids between *Triticum vulgare* Vill. and *Triticum spelta* L. demonstrate the possibility of isolating segregates resistant to *Tilletia foetans* (B. and C.) Trel., with the spores of which the seeds of the experimental plants had been treated. The result showed that, out of 124 F2 plants, (1) nineteen had all spikes diseased, (2) seventy-two had not all spikes diseased, (3) thirty-three had all spikes disease-free.

The interesting discovery was made that those plants which were awned segregates of Class 2 showed normal development of the awns in the disease-free spikes, and a suppression of awns in the diseased spikes. No spikes were found containing both diseased and disease-free kernels.

JENKIN (T. J.) & SAMPSON (Miss K.). **Rust Resistance Trials with Wheat.**—*Bull. of the Welsh Plant Breeding Stat.*, Series C, No. 1, pp. 41–49, 1921.

Experiments were conducted with wheat in 1920 in order to test the resistance of different species and varieties to Black (*P. graminis*) and Yellow Rust (*P. glumarum*) respectively. Tables were compiled showing the relative resistance of the different varieties to both diseases, their cropping power, earliness, and susceptibility to lodging. Generally speaking, the autumn varieties were more susceptible to Black Rust, and the spring (except those sown as early as February) to Yellow Rust. It is thought probable that this difference is more associated with the accident of the time of sowing than with the varieties. Comparatively few varieties are equally resistant to both diseases. Thus Swedish Iron, Dutch Million, and Red Stand Up show a high degree of resistance to Yellow Rust, but are severely attacked by Black Rust. There are, however, certain exceptions, such as Yeoman, which combines great powers of resistance to both Black and Yellow Rust, with early ripening and good cropping. Garton's Early Cone and Percival's Blue Cone are also to be recommended. Burgoyne's Fife and Red Fife are both subject to Yellow Rust, April Bearded somewhat less so. Benefactor, in spite of its high reputation as a cropper, can hardly be recommended on account of its susceptibility to both these rusts.

It is believed, as a result of observations made both with oats and wheat, that there is a connexion between the date of sowing and the severity of the attack. Where the same variety was sown on different dates, the severity of the attack was considerably greater on the later sown one in almost every case.

There would appear to be one or more periods during the maturity of the plant when it is most susceptible to rust. Hence the results obtained have to be interpreted in the light of the conditions under which the tests were made, and might not hold for a different set of conditions.

PUTTERILL (V. A.). **Plant Diseases in the Western Province.**—*Journ. Dept. of Agric. S. Africa*, ii, 6, pp. 525–532, 4 figs., 1921.

Two diseases of recent occurrence due to physiological causes are Chlorosis of Kelsey plums at Wellington, Cape Province, and Lithiasis of Bon Chrétien pear trees at Somerset West, in the same province. An analysis of the soil in which the plums were grown showed that it was deficient in plant food and in humus-forming organic substances, and low in water-retaining power. The proportion of iron was also low. Lithiasis, which produces wart-like excrescences on the fruit, probably arises from similar causes.

The two chief fungous diseases of the season were black mould, a storage rot of soft fruits caused by *Rhizopus nigricans* Ehr., and *Puccinia chrysanthemi* Roze, which attacks chrysanthemum leaves, forming small brown pustules on the under surface.

PUTTERILL (V. A.). **Plant Diseases in the Western Province II.**—*Journ. Dept. of Agric. S. Africa*, iii, 3, pp. 259–263, 4 figs., 1921.

Collar Rot in Orange Trees. The cause of this disease—also named gum disease, gummosis, mal di gomma, foot rot—is not conclusively established. It is particularly prevalent on seedling orange trees in South Africa. The following conditions favour its development: unfavourable soil, improper drainage and irrigation, and deep planting.

The common rough lemon, being very resistant to the rot, is widely employed as a stock on which the varieties of orange are budded. Good results were obtained at Porterville by exposing the main roots of the trees attacked, dusting the diseased areas and roots with lime (building lime) from time to time, and keeping the hole round the tree open. In other parts of the world Bordeaux paste or crude carbolic acid have also been used with success after cutting out the diseased parts. The important part of the process, however, seems to be the thorough aeration and drying out of the crown roots.

McLEAN (F. J.) & LEE (H. A.). **The Resistance to Citrus Canker of *Citrus nobilis*, and a Suggestion as to the Production of Resistant Varieties in other Citrus Species.**—*Phytopath.*, xi, pp. 109–114, 1921.

The horticultural varieties of the mandarin orange, *Citrus nobilis* var. *deliciosa*, are not seriously attacked by canker in the Philippines. Such infections as are seen are usually clearly associated with punctures or other wounds. Experiments showed that the uninjured leaves are not ordinarily capable of being inoculated, while wounds penetrating the epidermis readily permit artificial inoculation, and the degree of infection in these cases is equal to that found in highly susceptible species such as *C. maxima* or *C. aurantiifolia*. Apparently, then, the epidermis is the structure which renders *C. nobilis* resistant to canker.

The suggestion is made that it may be possible to obtain graft hybrids ('periclinal chimeras'), such as have been obtained in *Solanum* and *Pelargonium*, in which the epidermal characters of the mandarin may be combined with the internal tissue characters of the desirable varieties of *C. maxima*, so that the fruit would retain the qualities of the grape-fruit, while the tree would be resistant to canker.

McLEAN (F. T.). **A Study of the Structure of the Stomata of two Species of Citrus in relation to Citrus Canker.**—*Bull. Torrey Bot. Club*, xlviii, 4, pp. 101–106, 1 fig., 1921.

From personal investigation, as well as from a review of previous studies on the subject, the writer concludes that the varying degree of resistance to canker (*Pseudomonas Citri* Hasse) of two different species of citrus is attributable to divergence in the character of the stomatal structure. The species selected for comparison were the Szinkum mandarin, which is resistant, and the Florida grape-fruit, which is susceptible. Young leaves, two-thirds of their mature size, obtained from the Philippines, were used for examination.

The stomata of the two species were similar in size, general form, and mechanism of opening and closing. The main differences were found in the cuticular ridge of entrance to the stoma, i.e. the opening in the cuticle leading down to the pore. In the grape-fruit the opening is much larger (more than three times) than in the mandarin, and the ridge of entrance has its inner walls more nearly perpendicular to the leaf surface. The actual pore, in the closed stomata, is approximately equal in the two species. The bearing of these differences upon the resistance to citrus canker was then considered.

Canker is caused by a bacterium which is motile in water but entirely passive in air; hence it can only penetrate to the uncutinized cells of the air spaces inside the leaves through continuous films of water. In intact citrus leaves the latter can only form through the stomatal openings. It will naturally require less pressure to drive the water film inward through a wide aperture with nearly parallel walls, such as forms the outer portion of the outer chamber in the Florida grape-fruit, than for the same process to take place in the case of the Szinkum mandarin, with its narrow opening and receding walls. Once the bacteria have penetrated to the moist, uncutinized cell-walls, they are able to persist and develop in most varieties of citrus.

These differences account satisfactorily for the varying degree of resistance to canker observed in the two species. It is probable also that other resistant and partially resistant sorts have a similar structural character to the Szinkum mandarin, and a further study of the Rutaceae to establish this point will be desirable.

Elliott (J. A.). **A Mosaic of Sweet and Red Clovers.**—*Phytopath.*, xi, pp. 146–148, 1921.

A communicable mosaic of *Melilotus alba* in Arkansas is briefly described. This can be communicated to red clover (*Trifolium pratense*), horse bean (*Vicia faba*), and spotted burr clover (*Medicago arabica*), but attempts on white clover (*T. repens*) and alfalfa (*Medicago sativa*) failed. It is thought probable that the common mosaic of beans and cowpeas in Arkansas is identical with the disease in question.

Simmonds (H. W.). **Report on Coco-nut Districts of Vunilagi and Maguata.**—*Agric. Circular* (Dept. of Agric., Fiji), ii, 3, p. 42, 1921.

On the Vunilagi Estate, trees bearing good heads of nuts and flowers were seen to fall suddenly to the ground, without any apparent reason. Examination of the breaking-point showed the trunk half decayed away. There is first an outer area of dead wood heavily perforated with beetle borings; inside this there is a stained area generally free from the borings, and next comes the sound wood. The roots were found to be dry and unhealthy. The diseased wood did not generally reach to the base of the tree, but occurred from 6 in. to about 2 ft. 6 in. from the ground. The tree usually attempted to throw out fresh roots at the top of the diseased area, but these roots quickly died. Emergency measures included the cutting out of diseased portions and covering with tar, while the whole affected area was heavily limed and trees adjoining sprayed with lime-sulphur. The disease was reported from several other places on the coast. Its cause has not yet been determined.

SIMMONDS (H. W.). **Notes on *Levuana iridescens* Beth Baker.**—*Agric. Circular* (Dept. of Agric., Fiji), ii, 2, pp. 19–20, 1921.

Examination of dead larvae and pupae of *Levuana iridescens*, a moth attacking the coco-nut palm in Fiji, showed a fungus which may be parasitic. Parasitism has not yet been proved nor has the fungus been identified.

The Government Bacteriologist, Dr. Carment, whose report is appended, found the mycelium and spores of the fungus ramifying throughout the tissues of the dead larvae and pupae, and cultures made from them produced an abundant growth. The appearances suggested ante-mortem infection. Experiments to test its parasitism are proposed.

STAHEL (G.). **De Sclerotium-Ziekte van de Liberiakoffie in Suriname.** [The Sclerotium Disease of Liberian Coffee in Surinam.]—*Bull. Dept. van den Landbouw*, 42, 29 pp., 11 pl., 1921.

First described in 1913 by Kuyper under the name of 'Coremium' disease, the Sclerotium disease is at present known only in Surinam. The fungus is presumably a parasite of some local member of the Rubiaceae, as the genus *Coffea* is not indigenous in Surinam.

In 1917, and again in 1920, the disease caused much damage, and investigation was called for. The external symptoms consist of brown dead spots on the leaves and berries of Liberian, Excelsa, and Abeocuta coffee. A Canephora coffee-tree next to an Excelsa was also attacked. It was also possible to infect other varieties artificially, e.g. Robusta, Uganda, Mocca, and Surinam, but the fungus only thrives on varieties belonging to the Liberian group.

The spots of the fungus occur almost exclusively on fully grown leaves and ripe berries, and do not develop easily on growing portions of the plant. They clearly exhibit a number of concentric rings, narrow and light-brown, alternating with broad and dark brown. The former are as thick as the leaf, the latter sunken. In Excelsa coffee the spots often cover the whole breadth of the leaf, but they are not so extensive on the Liberian variety, 4 cm. being the maximum width. After a dewy night the under side of the leaf-spots is covered with white bristles, 1·5–4 mm. × 0·05–0·10 mm., which are easily detached and blown away by the wind. These are the chief organs of dissemination of the fungus, and in moist conditions develop on sound leaves, on which they alight, the characteristic brown spots. Infection results from appressoria-like organs up to 0·5 mm. in diameter which develop from the bristles in contact with the leaf. When the leaves fall to the ground, similar bristles also appear on their upper sides. On the fallen diseased leaves—or in continuously damp weather on leaves still attached to the tree—the mycelium grows centrifugally out of the diseased tissue, and spreads over the surface of the leaf in the form of rhizomorphs which also produce bristles.

The fungus cannot penetrate the berry until it has attained three-quarters of its definitive size. The spots are similar to those on the leaves, and also show concentric rings, the berries being quite covered with the white bristles. The berry forms a particularly favourable habitat for the fungus. The bristles are shorter and thicker (1–2 mm. × 0·08–0·20 mm.) than on the leaf, and in very damp weather the rhizomorphs spread from the dead berries and kill not only the young berries but also the buds and flower-cushions. They may even spread along the branches and kill the cortex. These rhizomorphs, too, are covered with bristles. The fungus does not, however, penetrate as far as the seed, the endocarp forming an insuperable barrier. The seeds therefore develop normally.

The sclerotia, already discovered by Kuyper, are of an orange or brown colour, somewhat flattened, and not exceeding 0·5 cm. in breadth. In some cases they do not develop on the surface, but within the leaf tissue. On the berry they are generally larger than on the leaf, and in wet weather they appear while the fruit is still on the tree. The attempts both of Kuyper and the writer to propagate fruit-bodies from these sclerotia were unsuccessful; they merely give rhizomorphs in a damp atmosphere.

Microscopic examination showed that the white bristles consist of a bundle of hyphae, 5–8 μ in diameter, and connected with one another by means of numerous anastomoses. In the ripe bristles the hyphae are encrusted with crystals of oxalate of lime. It is to this incrustation and the connexion of the hyphae by anastomoses that the bristles owe their rigidity. Neither Kuyper nor the writer discovered any trace of spore-formation in these bristles, but the former was told by a colleague named Drost that spores had been found some years previously. Kuyper therefore assumed that the fungus belonged to the Stilbaceae, and the bristles were coremia—hence his name for the disease. It is probable, however, that the fructifications in question were those of a *Penicillium*, which frequently occurs on the sclerotia and rhizomorphs. Such sterile bristle-like organs, resembling fruit-bodies, often occur in Clavariaceae, and are included in the genus *Anthina*. The contents of the hyphae of the bristles consist largely of glycogen, which is used up in the formation of appressoria.

The sclerotia are white inside, and covered with an orange or brown cortex, the outer layer of which consists of dead hyphae. This cortex, which is quite homogeneous in sclerotia formed in the open, exhibits in pure cultures dark spots, generally either convex or concave. The hyphae in the plant-tissues and in agar are 3–5 μ in diameter, and 5–8 μ in the rhizomorphs. They contain finely granulated plasma and vacuoles of a considerable size. The fungus grows intercellularly, and without forming haustoria. The appressoria have a diameter of 0·05–0·5 mm., being smaller on the under side of the leaf than on the upper. On the under side the fungus penetrates through the stomata, and on the upper side it traverses the epidermis. In the latter case the underlying epidermal cells are killed as soon as the cuticle is penetrated. The hyphae then enter the dead cells, and a layer farther in is killed in advance of penetration. The penetration of the stomata and cuticle constitutes the sole parasitic aspect of the Sclerotium fungus, which passes the rest of its life in a purely saprophytic manner in the dead tissues of the plant, killed in advance of its growth.

There is scarcely any doubt that the poison emanating from the fungus is oxalic acid, the rhizomorphs and the white bristles being covered with oxalate crystals.

Especially after heavy rain and dew, the spots are encircled by a watery green edge, 0·5–2 mm. in width, which forms the transition to the healthy part of the leaves. This watery zone quickly turns brown and dies. At the edge of the brown spots the leaf-tissue begins to react by the formation of callus, the stomata cease to function, and numerous parenchyma cells are converted into callus cells. In dry weather the fungus cannot develop, so that a few days' absence of rain may give the plant a chance to recover by means of the formation of a thick callus ring. Young plants react more quickly by the formation of callus than older ones, and are therefore better able to withstand the attacks of the fungus.

The fact that the Sclerotium fungus requires moisture throughout its development distinguishes it from other parasitic fungi, most of which need a humid atmosphere only at the stage of infection.

The only reference in previous literature to this fungus is the work of Kuyper mentioned above, and as his conclusions with regard to the identity of the fungus cannot be accepted, the name of *Sclerotium coffeicolum* n. sp. has been given to it by the author.

The fungus can easily be cultivated on nutrient agar, the bristles, provided they are not too old, readily developing into a mycelium. The centre of the mycelium is often occupied by colonies of bacteria, or the green *Penicillium* or *Aspergillus niger*, which appear in the site of the bristle. Owing to the surplus of oxalic acid, however, the mycelium is not injured by these extraneous growths. Alkaline media are not suitable, but in a weak acid solution a well-developed mycelium, consisting of ramified rhizomorphs, will appear after four to five days, and sclerotia after five to six days, ripening shortly afterwards. Cultures on a mass of finely cut sterilized leaves of Liberian coffee, weighing about 160 grammes, also developed satisfactorily, the fungus completely penetrating the material after twelve days. Numerous appressoria were formed. About the fourteenth day white sclerotia developed which turned brown as they ripened. By the twenty-second day the process was completed. The average weight of a single sclerotium was 0·05 gramme. A quantity of sclerotia crushed in a mortar gave out a smell resembling that of radishes, and this is also noticeable when the fungus develops on the berry.

The bristles may also be obtained in pure cultures on sterilized leaves. Just before the formation of sclerotia, a number of cultures should be taken from the flasks and exposed to the open air in small clusters. In two days they will be covered with bristles, which remain viable in the laboratory for several months. Sclerotia exposed to the air in a dish die in the course of a few weeks at most, and become covered with the green *Penicillium*, just as in the natural state. Only when the sclerotia remain lying isolated on the ground do they retain their viability for a considerable time. Thus in July 1918 the author strewed under a healthy Excelsa tree 50 grammes of sclerotia. In November 1919 some of these were still there, but three months later none could be found, though secondary sclerotia were numerous on the leaves, and the tree was infected.

Sclerotium coffeicolum is evidently closely related to *S. rolfsii*, which frequently occurs in Surinam on *Canavalia ensiformis*. Both form rhizomorphs and kill their hosts by the production of oxalic acid, and there are also many structural similarities, e.g. the clamp-connexions of the hyphae, which definitely refer the fungus to the family of Basidiomycetes. The sclerotia of the new fungus correspond most closely to those of *Typhula* and other Clavariaceae, which are also characterized by the formation of bristles. *S. coffeicolum*, however, is the only fungus known to the author which is propagated by these means.

The treatment recommended is an immediate application of Bordeaux mixture (2 per cent.), and in severe cases the burning of leaves and berries fallen from the trees, owing to the long duration of viability of the sclerotia described above.

The article is illustrated with eleven excellent plates.

Doidge (E. M.). **Crown-Gall: *Bacterium Tumefaciens* Sm. et Towns.** —*Journ. Dept. of Agric. S. Africa*, iii, 1, pp. 64–67, 1 fig., 1921.

Crown-gall was first recorded in South Africa by Lounsbury in an article in the *Cape Agricultural Journal* for April 1910, entitled Giant Twig Gall. The disease had then only been observed in the north-eastern districts of the Cape Province. It is now known to occur in all parts of the Union, being specially prevalent in districts liable to hailstorms. It frequently occurs on willows, and is probably widely disseminated by the planting of diseased cuttings.

The disease may manifest itself in two forms, known respectively as crown-gall and hairy-root. It is estimated that in the nursery 90 per cent. of the galls appear on the scion just above the point of union with the root. Young galls are comparatively small, greenish or nearly white, fairly smooth, and soft or spongy in texture. When mature they are usually hard, dark in colour, and from one to several inches in diameter. The disease spreads very rapidly, over 2,000 trees having been infected in 1912 from a single infection on a willow in 1907. Fruit-trees were included in the number of infections.

Hairy-root occurs on apple-trees, and is quite different from the form described above. There is an excessive production of small fibrous roots, growing out at right angles, singly or in tufts, from an older root or stem. There may be a broom-like formation, with extensive branching of the roots at the ends; or the disease may take the form of a woolly outgrowth originating from a smooth irregular swelling on the larger roots.

The author concludes with an account of the causes and directions for remedial measures, quoted from Hesler and Whetzel's *Manual of Fruit Diseases.*

SERGENT (E.) & BEGUET (M.). **Sur la nature mycosique d'une nouvelle maladie des Dattiers menaçant les Oasis marocaines.** [The mycotic character of a new disease of Date-palms threatening the Moroccan Oases.]—*Comptes rendus de l'Acad. des Sciences*, clxxii, pp. 1624–1627, 1921.

For the past twenty years date-palms in the oasis of Figuig, Morocco, have been attacked by a disease which threatens to destroy the plantations. Called by the natives 'baïoudh' or 'white', the disease is said to have originated in the south-west, reaching Figuig about 1898. It spreads slowly but continuously, the first case in a plantation being followed by others near by, and then there may be a sudden jump to another plantation. It has not spread farther east than Figuig, and is not known in the Algerian or Tunisian Sahara. The disease is peculiar to the date-palm, other fruit-trees in the vicinity being immune.

The external symptoms consist of a whitening and drying up of the leaflets, together with the appearance of dark reddish-brown veins on the petiole and a gummy degeneration of the fibrovascular bundles. These veins can be followed into the stalk. The leaves are not affected all at the same time, but in irregular sequence. The infection appears to ascend from the roots. Young palms may die in the course of a few weeks, while old ones can survive for three or four years.

Different varieties show varying degrees of susceptibility to the disease, but this is evident only in the length of time taken to kill the tree, the death of which is inevitable. The natives regard the disease as incurable.

Replanting in the same soil is followed by the death of the new palms. Soil conditions do not appear to be concerned, nor have insects been found responsible. Isolations from the reddish-brown lesions gave pure cultures of a fungus in 107 out of 110 cases taken from various localities, while cultures from healthy tissues remained sterile.

The fungus resembles the conidial stages of *Neocosmospora vasinfecta* E. F. Smith. Arrangements are being made to carry out inoculations with it at Algiers.

VAN HALL (C. J. J.). **Ziekten en Plagen der Cultuurgewassen in Nederlandsch-Indie in 1920.** [Diseases and Pests of Cultivated Plants in the Dutch East Indies in 1920.]—*Med. van het Inst. voor Plantenziekten*, 46, 50 pp., 1921.

The author devotes a separate section to each of the important economic plants, both of European and indigenous culture. Insect pests appear to have been more numerous than fungous diseases in 1920, though the heavy rains of the late summer and autumn gave the latter an opportunity to develop. The west monsoon was drier than usual, and the east monsoon much wetter. The principal damage caused by fungi may be summarized under the following headings:

POTATOES. *Macrosporium solani* was very prevalent on the east coast of Sumatra. The third month of growth appears to be the most critical time; the disease spreads with great rapidity, and a fortnight after the lower leaves are attacked the whole plant is dead. *Bacillus solanacearum* also did some damage. Leaf-curl, which was very widespread in 1919, was infrequent in 1920.

GROUNDNUT. *Bacillus solanacearum* occurred sporadically, and serious loss was caused by the 'curl' disease, which attacks young plants at the age of about two months. A curl disease occurred also in sweet potatoes, indigo, and *Vigna*.

CACAO. A peculiar disease has been observed which only attacks 'Criollo' trees. The first symptom is a withering of the extremities of the branches, followed in many cases by the death of the tree. The symptoms do not correspond with those of ordinary 'die-back'. The disease is probably due to a fungus.

RUBBER. Considerable damage was done by mouldy rot, due to *Sphaeronema* sp., in Salatiga. Brown bast was common but decreasing in severity, probably on account of improved and less severe tapping methods. Its treatment was chiefly by scraping, followed, when the surface is dry, by the application of paraffin. Stripping has been practically abandoned on the east coast of Sumatra. Stripe canker was prevalent during the wet period, but was less than usual. Where necessary, it is treated by daily applications of 5 per cent. Carbolineum or Izal. Patch canker was only sporadic. Root diseases continued to cause much trouble in young plantations in light soil in Sumatra. Besides the usual preventive methods of uprooting and burning dead wood, treatment by exposing the roots and the application of 20 per cent. Carbolineum or Izal is of the greatest utility. In West Java the commonest cause was *Poria*. At Malang the 'orange root fungus', mentioned in the last report, was prevalent in the same locality and killed a number of the older trees. Die-back was reported in several places. At Malang, under very damp conditions, the young leaves and twigs were rotted by *Phytophthora*; the condition improved when dry weather set in in November. Abnormal leaf-fall in Besoeki was only occasionally due to this fungus; *Gloeosporium* and *Diplodia* caused much die-back in this district. The mildew (*Oidium*) caused defoliation in some places; the disease seems to be worse in certain years than in others. Other diseases reported were *Corticium salmonicolor*, *Ustulina zonata*, *Sphaerostilbe repens*, *Fomes lignosus*, *Fomes lamaoensis* (*Hymenochaete*), *Fomes pseudoferreus*, and *Hypochnus*.

CINCHONA. *Corticum salmonicolor* was found extensively, especially on the 'Ledger' variety, after *Helopeltis*. Root disease, stem 'rust', and canker also occurred. In a few cases the 'Mopog' disease (*Moniliopsis aderholdi*) was found in the seed-beds.

COCO-NUT. A case was reported of deaths of young trees with the symptoms of bud rot. *Pestalozzia palmarum* also occurred.

COFFEE. According to some planters the Robusta variety shows increasing susceptibility to *Hemileia vastatrix*. *Corticium salmoni-*

color was very prevalent on account of the wet weather. Root disease was rare.

MAIZE. There have been serious outbreaks of 'yellow disease', due to *Sclerospora javanica*, the damage in some localities being estimated at 30 and 50 per cent. of the crop. An undetermined fungous disease, giving a rusty appearance to the leaves and spikes, considerably affected the yield.

OIL-PALM. A case resembling coco-nut bud rot was reported. The so-called 'Juvenile disease' was again found. The young leaves remain soft or even rot before they are fully opened, so that the crown shows a battered appearance. It does not appear to cause much damage. The cause is unknown.

RICE. Much damage was caused by the root rot ('Mentek') especially in the alluvial soil; even the young seedlings showed signs of the disease, probably because from the very beginning they were under water. *Ustilaginoidea virens* and *Helminthosporium oryzae* were also reported.

SUGAR-CANE. Mosaic disease ('Strepenziekte') and red rot were reported, and cases of *Leptosphaeria sacchari* and *Cercospora kopkei* occurred locally: root and sett diseases were prevalent in the young plantings. The most characteristic disease of the season, however, was the 'pineapple' disease (*Thielaviopsis ethaceticus*), which occurred during the last months of planting. Owing to delays in transport many diseased setts were imported from the hill gardens and spread the infection.

TOBACCO. Severe damage was caused by the 'lanas' disease (*Phytophthora nicotianae*) in the seedlings, but the attack in general did not develop greatly; while *Bacillus solanacearum*, *Oidium*, and *Sclerotium Rolfsii* did relatively little harm. Red rust, mostly due to an insufficiency of phosphorus in the soil, was prevalent. Mosaic disease occurred principally in the suckers of topped plants.

TEA. Red rust (*Cephaleuros virescens*) frequently succeeded the attacks of *Helopeltis*. Root diseases were also common.

SHAW (F. J. F.). **Studies in Diseases of the Jute Plant. (1) *Diplodia Corchori* Syd.**—*Mem. Dept. Agric. India*, Bot. Ser., xi, 2, pp. 37–58, 11 pl., 1921.

In 1917 a disease of a pure-line race of selected jute, characterized by the formation of a dense black discoloured band on the stem, was observed on the Pusa Farm. At harvest time 20 per cent. of the early sown crop was infected. A similar disease was found in other parts of North Bihar and in Assam. Later sown crops, which remained small, were, as a rule, free from the disease, as also were the suppressed plants of small size and thin stems that are commonly found in any dense stand as a result of delayed germination and the competition of more robust plants. Where the crop had been thinned for seed production, and the individual plants were larger and more branched, the disease was worse than in the ordinary fibre crop, which is crowded and little branched. Even in the late sown crop, disease appeared in an area where, probably from some local richness of the soil, a forced growth had occurred and the plants were larger than usual. Hence it would appear that only stems of a certain size and maturity are liable to successful infection. As a rule, the crop grown for fibre is cut before the disease has time to make much headway, and the chief damage is done to the relatively small portion which is grown for seed.

In 1918 and 1919 the disease was less severe in Bihar. It was found, however, to be widely distributed throughout the jute-growing districts of North-Eastern India, and the examination of herbarium material preserved at Pusa showed that it had been collected many years earlier in Bengal, but not recognized as a distinctive disease. Both the cultivated species of jute, *Corchorus capsularis* and *C. olitorius*, and both the red-stemmed and green-stemmed varieties were attacked, but in at least some cases *olitorius* was less liable, and the red-stemmed were less readily infected than the green.

The disease, to which the name 'black band' has been given, is caused by *Diplodia Corchori* Syd., described on jute stems from India in 1910, but not then known to cause disease. The attack takes place on the stem, usually 2 or 3 ft. above the ground level, and often commences at the base of one of the small lateral twigs that normally die back after reaching a length of a few inches. Sometimes it appears to start from a rotting leaf that has fallen over and adhered to the stem. A brown patch forms and gradually extends up, down, and around the stem, ultimately forming a brown ring which soon becomes dense black. The bark splits in longitudinal cracks, exposing the bast fibres. The part above the band withers, loses its leaves, and dries up completely. On the blackened surface of the band innumerable pycnidia appear as small, black, slightly prominent points, which develop below the epidermis and burst out to the surface, on which they discharge great quantities of spores, which remain as a dense coating of black dust on drying. The pycnidia are crowded, 200–300 μ in diameter, and with a prominent ostiole. The mature conidia are dark brown, oval, bicellular, and average 24×12 μ in diameter. The hyphae develop freely in the cortex, phloem, and cambium (especially the latter), and also penetrate the wood.

Inoculations with pure cultures showed that infection occurs through the unwounded stem as well as through wounds. In the former case it was not settled whether penetration through the unbroken cuticle could occur, as the only point through which entry was obvious was in the neighbourhood of a lenticel. Mature plants were killed in some cases in six to fourteen days after inoculation. The bark is extensively destroyed down to, and including, the cambium. The fungus produces a cellulose-dissolving enzyme, and can penetrate a cellulose diffusion cell and rot pure cellulose. Marked differences were found to occur in the results of the inoculation experiments carried out during three seasons. Some of these were connected with the variety and size of the host plant, and others appeared to depend on climatic factors at the time of and during the period following inoculation. A relatively high humidity is favourable to the disease and explains the severity of the attack in 1917. In conditions of lower humidity and higher temperature many inoculations failed.

As the disease was prevalent on the crop of selected pure-line jute intended for distribution, and as the seed from this was contaminated by spores, the whole of the seed (amounting to many tons) was treated by steeping for ten minutes in 2 per cent. solution of copper sulphate. The treatment was found to inhibit the germination of the *Diplodia* spores without in any way injuring the seed.

Further experiments in 1918 and 1919 showed that seed-borne infection is not common, little difference being found in the number of cases in plots sown with treated and with untreated seed. Experiments to test the possibility of the parasite remaining over from one season to the next in the soil gave inconclusive results, but the number of cases did not appear to be greater in plots which had been under jute for several seasons than in those not previously sown to jute.

COCKAYNE (A. H.). **Fireblight and its Control—The Hawthorn Question.**—*New Zealand Journ. of Agric.*, xxiii, 1, pp. 30–36, 1921.

Fireblight, caused by *Bacillus amylovorus* (Burr.) Trev., was first found in New Zealand in the latter part of 1919 and had certainly only been introduced shortly before. During the summer of 1919–20 a very careful survey was made of all New Zealand orchards, and the then distribution of the disease was ascertained to be scattered throughout the North Auckland and Auckland Land Districts, its southernmost and northern points being some 130 miles apart. The largest area generally affected in 1920 was the Waikato district, where it was very common on hawthorn (*Crataegus*) and pear and apple trees. The widely separated points of infection indicate that the disease had been distributed by means of diseased nursery stock, but definite information regarding this point has not been satisfactorily secured. During the 1920–21 season the disease has spread considerably.

At the time when the first outbreak was discovered it was found that the ordinary hawthorn, which is largely used in Auckland Province for hedges, became badly infected, and laboratory work carried out in the winter of 1920 showed that in New Zealand the disease winters over in the hawthorn. It has also been shown that the districts where hawthorn is abundant became more rapidly and more generally infected than where that plant is not prevalent, and the present position is that wherever hawthorn is present in an infected area no control of the disease in orchards can be satisfactorily carried out until the hawthorn is completely eliminated. This position is confirmed by the fact that during 1920 a great amount of work was done in infected districts in the cutting out of infected branches of fruit-trees, and also in the removal and burning of badly infected trees. In all areas, however, where hawthorn was abundant and infected, the value of such work was nil, owing to rapid reinfection of the orchards from diseased hawthorn in their vicinity. On the other hand, in districts where the hawthorn factor was absent, the disease seems to have been stamped out.

Fireblight affects only certain members of the rose family, and may be said to be confined to the genera *Pyrus* and *Crataegus* in New Zealand. In addition, another genus, *Amelanchier* (june-berry), is regularly infected in America. Very occasionally in America the genus *Prunus* is also infected, and there are records of apricot, cherry, and plum having been attacked, but this is quite unusual. In New Zealand the author has identified fireblight in his laboratory on apple, pear (which has suffered most), quince, hawthorn, and medlar. Cross-inoculations have been successful. So far in New Zealand it has not been found on mountain ash, nor on any but the ordinary species of hawthorn, nor on japonica (*Pyrus japonica*), but all these plants are likely to carry it.

The disease is carried through the winter in the tissues of host plants, mainly towards the edge of the wounds that were produced the previous season ('hold-over cankers'). In the spring the bacilli in these lesions multiply enormously, and drops of exudate containing myriads of the organism exude on the surface, and are carried by insects on to the flowers and blossom-infection takes place. It has been shown that the bacillus taken from dried ooze on the bark and kept dry in the laboratory remains alive for nine months. It has also been shown that a common Australian sucking insect, *Sephena cinerea*, is a very active carrier in the autumn. Once flowers are infected honey-bees may spread the disease to every flower in an orchard within a few days. After flower-infection has ceased, shoot-infection sets in, and may continue throughout the summer and autumn. Shoot-infection frequently rapidly spreads to the larger limbs, and entire branches may be quickly killed and the formation of large lesions occur, such lesions carrying over the disease for another season. In certain instances the bacilli were found in the tissues of the wood adjacent to the cambium at a distance of over 15 in. below any visibly diseased tissue. This fact well explains the failure that has often resulted in the cutting-back of twigs and branches, and emphasizes the urgent necessity of sterilizing the pruning-knife after every cut. Where the trees dealt with are young, vigorous growing ones, in which disease is spreading rapidly, the fact that the cut appears to have been made through apparently sound wood is no criterion that all the diseased wood has been removed.

As regards control measures, the position does not seem at all hopeful in the author's opinion. Spraying experiments have been found to be useless. The method of injections of different materials into the tree itself has been suggested by Dr. R. J. Tillyard, of the Cawthron Institute, who is carrying out certain work along this line, as is also the New Zealand Department of Agriculture, but the author is very doubtful of the efficacy of this treatment. In order to eliminate the 'hold-over cankers'—the first essential in control—the hawthorn will have to be destroyed in every important fruit-growing district in New Zealand, a task of very great magnitude.

Rivera (V.). **Osservazioni sopra la moria dei mandorli prodotta dal *Fomes fulvus*.** [Notes on the disease of Almonds caused by *Fomes fulvus*.]—*Boll. mensile della R. Staz. di Patologia vegetale*, ii, 1–4, pp. 28–29, 1921.

In the Northern Abruzzi the destruction of almond-trees by *Fomes fulvus* is frequent. The disease not only affects the trees already flowering, but apparently infects the surrounding soil, since young plants substituted for those killed by the fungus are suddenly attacked in full development. During the early stages the trees appear quite normal; later the branches wither. Fruit-bodies appear on the cortex only when decay has actually set in.

At the beginning of the disease the wood looks partially blackened; then the cells of the parenchyma, the vessels, fibres, and tissues of the medullary rays seem to be replaced by a yellowish-white substance; in more severe cases the weight of the timber is reduced, and it is rendered useless either for industrial purposes or for firewood.

The death of the young plants does not appear to be directly due to the action of the fungus, no mycelium being observed in the tissues. Most probably it is accounted for by the contact of the roots with substances secreted from the roots of trees previously attacked, or from the fungus which invaded them.

At first sight it might be supposed that contagion was transmitted from one tree to another by the roots, since when one is diseased the whole row dies. An examination of the roots, however, leads rather to the belief that the damage is done by the pruning-shears, which inoculate the tissues of the healthy trees with fragments of mycelium and diseased wood from the trees on which they have just operated. The sterilization of the shears with boiling water or phenol is recommended.

Losch (H.). **Eine Beobachtung über Apfelmehltaubefall und seine Beziehung zur örtlichen Lage.** [A Note on Apple-Mildew and its Relation to the Locality.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1–2, pp. 22–24, 1921.

In September 1919 the writer visited an orchard in Württemberg, situated on the south-eastern slope of a ravine. The upper part of this orchard was severely attacked by apple-mildew, which gradually decreased on the lower parts of the slope and was quite insignificant at the bottom. The soil consisted of a light variegated marl, which retained the heat. The rays of the sun struck full on the upper part of the orchard, but lower down they reached later in the day and naturally fell at a less acute angle, while the bottom was shaded by the high trees of an adjoining orchard during the forenoon. Thus the situation may be described as extremely hot and dry in the upper part, gradually descending to a cooler and moister atmosphere.

The decline of the apple-mildew ran strikingly parallel to that of the hot and dry section of the orchard. According to Rebholz, apples with light-green leaves covered with grey down, e.g. Landsberger Reinette, Bismarck, &c., are especially liable to mildew in hot situations. The case in point illustrates either a direct connexion between mildew and the situation, or an indirect relation, since the variety with which the orchard was planted (Beauty of Boskoop) requires moisture, and is therefore more susceptible in the heat. Oak-mildew presents similar features. It remains to be seen whether the foregoing observations apply to apple-mildew in general, or only to certain varieties.

PEYRONEL (B.). **Il marciume amaro o marciume del cuore delle mele e delle pere.** [Bitter or Core Rot of Apples and Pears.]—*Boll. mensile della R. Staz. di Patologia vegetale,* ii, 1–4, pp. 23–27, 3 figs., 1921.

Except in extreme cases the external appearance of the fruit is quite normal. A longitudinal section, however, reveals a zone of discoloured, soft, and bitter pulp round the ovary. In the early stages the interior of the cells and the surface of the seeds are covered with a cobweb-like growth, which is succeeded by a pulverulent efflorescence of a pale rose colour. Even the fibrous tissue bordering the tube connecting the ovary with the calyx is affected and the rot gradually spreads to the surrounding pulp, rendering it quite unfit for food. The entire fruit finally mummifies.

The mycelium consists of hyaline hyphae, cylindrical, ramified, septate, and containing an abundant plasma of oleose drops. These hyphae form the web in the ovary, the rose-coloured efflorescence of a later stage being produced by the conidial fructifications. The latter consist of erect conidiophores, sub-cylindrical, septate, hyaline, and terminating in a tuft of bicellular, obovate, pale pink conidia.

The fungus is a common mould, *Trichothecium roseum* Link (= *Cephalothecium roseum* Corda), ordinarily found as a saprophyte on dead vegetable matter. It is already known in America as the agent of pink rot in apples previously attacked by *Fusicladium dendriticum.* The mycelium of *T. roseum* is unable to penetrate the peel of sound fruit, and it is evident that the fungus enters the pear by way of the calyx. In the case of the apple it would be more accurate to describe the place of entry as the peduncular sinus, from which the fungus arrives at the ovaries by way of the fibrovascular bundles.

Probably the germination of the conidia and the entry of the mycelium are facilitated by the practice of placing fruits of the best varieties—which are the most subject to attack—on a level space with the calycine sinus inverted. This promotes humidity and allows any casual spores to germinate. The fruit should be kept in a dry place, and arranged in rows, not heaps.

HURD (ANNIE MAY). **Seed Coat Injury and Viability of Seeds of Wheat and Barley as Factors in Susceptibility to Molds and Fungicides.**—*Journ. Agric. Res.,* xxi, pp. 99–122, pl. 13–23, 1921.

A study of some of the factors, especially the physical condition of the seed-coat, which enable saprophytic fungi such as *Penicillium* sp. and *Rhizopus nigricans* to attack the seed, and of the relation of mechanical injuries sustained by the seed-coat to seed-treatment injury. These two fungi were used as they were the two causing most trouble in blotter germination in the laboratory. They were not usually found on healthy unbroken seeds, but if the seed-coats were broken over the endosperm, they were found invariably to be badly attacked under non-sterile conditions of blotter germination. An unbroken seed-coat was also found to protect against these fungi in damp storage and in the soil. But infection of uninjured seed was obtained by retarding germination by means of low temperatures, as, for instance, by keeping them for seven days at 10° C. and then removing them to a higher temperature. Even when there is no mechanical break, death or injury of the seed-coats from other causes, such as drying the seed after formalin treatment, renders the seed susceptible to attack. When the seeds are kept after treatment at a degree of humidity which prevents the formation of paraformaldehyde by evaporation of the formalin this injury ceases. Seed stored damp after treatment by 1 to 320 formaldehyde solution was uninjured, but if allowed to dry it suffered serious injury, especially from *Rhizopus*, under certain conditions. Washing with water after treatment removes the danger thus resulting from subsequent drying. Perfect seeds, killed by boiling or by prolonged exposure to a saturated solution of copper sulphate, were also attacked, except that *Rhizopus* did not attack those killed by the copper sulphate, *Penicillium* being the active agent in this case. Inoculated seeds germinated in the soil showed, when *Penicillium* was used, a normal germination with uninjured seed-coats and when the injury was confined to the region over the embryo, while when the coats were broken over the endosperm germination was reduced and those seeds that germinated gave weak seedlings with stunted roots and arrested growth. Seed kept throughout at 10° C. escaped this injury. In stored wheat injury from moulds depends on the same factors, but humidity is of great importance. *Penicillium* will only develop on wheat stored at a humidity of at least 80 per cent., *Aspergillus* requiring 70 per cent. These moulds develop more slowly on seed treated with copper sulphate or formaldehyde, *Penicillium* being especially sensitive to the latter. But the seed must not be allowed to dry after formaldehyde treatment or else the latter must be removed by washing.

The author holds that all seed injury from the recommended copper-sulphate treatment for smuts is due to broken seed-coats. The unbroken seed-coats are impenetrable (except after prolonged exposures) by salts. Hence machine-threshed seed is more injured, an examination showing that from 30 to 100 per cent. of such seed have the seed-coats broken. If the injury is over the embryo, even a five-minute dip in a 1 lb. to 40 gallons solution of copper sulphate causes damage, but if over the endosperm only, a longer exposure is required, damage being slight after an hour, or else a stronger solution, damage being extreme with a saturated solution after an hour. Seeds apparently unbroken are usually uninjured after six hours in a saturated solution. Liming does not prevent extreme injury when the seed-coats are badly broken, the copper sulphate entering too rapidly to be neutralized. In slight injury, dipping the seeds in lime is effective in neutralizing the copper sulphate before it has time to penetrate.

No matter how extreme the seed-coat injury is, a ten-minutes' dip in 1 to 320 formaldehyde solution (1 pint formaldehyde in 40 gallons water), followed by a ten-minutes' drain, causes no injury to the embryo, and even twice this strength is harmless, provided paraformaldehyde injury is avoided. 1 to 80 solution, however, causes extreme injury when the seed-coats are broken over the embryo, but this strength is never recommended. It is only when paraformaldehyde is allowed to form during the drying of the seed that the ordinary strengths used can cause injury. If the seed is not dried, but is sown moist in damp soil or kept in damp storage, paraformaldehyde does not form and there is no injury. A perfect seed-coat delays paraformaldehyde injury but does not prevent it.

The greater susceptibility of barley to seed fungicides, especially copper sulphate, than wheat appears to be due to the fact that the barley kernel, in certain varieties at least, unlike wheat, has a ragged hole where it has been broken from the rachis, and the coats are weakened or injured at this point. When treated without separating from the rachis little or no injury resulted. Varieties differ in this respect, and the results do not always tally, so that further work in this direction is required.

GRUBB (N. H.). **Tests of Fungicides on Apple Trees.**—*Journ. of Pomology*, ii, 2, pp. 93–114, 1 fig., 1921.

Experiments carried out at the East Malling Research Station to test the comparative values of different fungicides applied to apple trees showed that Bordeaux mixture (8–8–100) was more effective against scab (*Venturia inaequalis*) than lime-sulphur. A certain reduction in the value of the fruit is caused by 'Bordeaux injury' or 'russeting', but this is counterbalanced by the heavier crop of the sprayed trees. Ammonium polysulphide was slightly less effective than lime-sulphur as a scab fungicide, but greatly increased the yield. As regards 'spreaders', Saponin and Saponex failed to improve ordinary lime-sulphur in the case of scab, but increased its effectiveness against mildew (*Podosphaera leucotricha*). Lead arsenate proved of considerable value when added to lime-sulphur in the treatment of scab, but appeared to reduce its effects against mildew. The best fungicide against mildew of all those tested was ammonium polysulphide with soap, while Bordeaux was the least useful. The series of experiments on canker is not yet complete, besides which only two varieties, Worcester and Grieve, were sufficiently affected to necessitate a trial; but it is certain that spraying reduces to less than one-fifth the new bud infections caused by the presence of an old spore-producing infection. Summer spraying is likely to improve the keeping quality of the fruit by reducing the attacks of brown rot (*Sclerotinia fructigena*).

SCHAFFNIT (E.). **Eiweisserdalkaliverbindungen als Zusatzstoffe für Bekämpfungsmittel zur Erhöhung des Haftvermögens.** [Compounds of Albumen and Alkaline Earths for admixture in Fungicides and Insecticides, with a view to increasing the adhesion of the latter.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1–2, pp. 19–22, 1921.

The author is of opinion that the substances used hitherto for increasing the adhesion of spraying mixtures, such as resin-oil soap, molasses, &c., being soluble in water and consequently washed away by rain, are unsuitable. Soap solutions are known, besides, to impair the functions of the leaves and to delay or even prevent the development of flowers and fruits.

An ideal adhesive substance for spray fluids should satisfy the following desiderata: (1) the spray fluid should be fixed by the adhesive substance on the leaves so firmly as not to be washed away by rainfall, (2) the adhesive substance should possess the property of becoming insoluble after it has been sprayed on the surface of the leaves, (3) it should not interfere with the assimilatory functions and the development of the plants treated.

The property mentioned under (2) is to be looked for among colloidal substances, and more especially in the group of albumens, globulins, proteins, &c., when they are in certain chemical combinations. Trials made by Perraud with dried blood and albumen powder (probably dried white of egg) have shown that these substances remain soluble after drying on the leaves and are washed away by rain; they are therefore not used in general practice. On the other hand, certain albuminous substances have the property of forming with alkaline earths, such as lime for instance, compounds which are at first soluble in water, but which, after desiccation, become insoluble; compounds with barium salts are even less soluble than those with lime.

Trials were made in this direction with compounds of albuminous substances and alkaline earths, and it was found that casein and lime compounds were excellent as adhesive admixtures and satisfied all the above-mentioned requirements.

The casein is obtained either through natural souring or by artificial coagulation with hydrochloric acid, acetic acid, or rennet: the milk albumen is then washed in water, freed of fats, and dried. On being mixed with an alkaline earth and diluted with water it gives a slimy mass which is then added to the spraying liquid. The author gives the following formula as an example: 20 gm. of casein reduced to a dust-like powder is mixed in a mortar with about 5 gm. of strongly burnt quicklime; 150–200 c.c. of water are then slowly added, and the whole is allowed to stand for half an hour, when a thick slimy mass is obtained. This mass is diluted with more water to a liquid state and is then poured into 100 lit. of Schweinfurter green or Bordeaux mixture, and the whole is well stirred. The addition of this adhesive substance secures also a much finer distribution of Bordeaux and other mixtures over the leaves.

A series of experiments was undertaken to determine the quantities of copper and arsenic still adhering to the leaves of treated plants after the lapse of a certain time. They showed that the use of the adhesive substance added to liquid sprays in some cases more than doubled this quantity, while in a case where the adhesive substance was added in a powdered state to colloidal copper preparations, the quantity of the control found on the leaves, treated while wet with dew, was even trebled.

The present high prices of casein exclude the possibility of using it on a large scale in practice, and the author is now looking for a substance possessing the same properties as casein, but more economically practicable. If he succeeds, he believes that the cost of treatment can be reduced by using weaker preparations and by doing away with the necessity of frequently repeated treatments. Besides, by adding the adhesive substance in a powdered state to dusts, it will be possible to investigate more closely the value of the latter as compared with liquid spraying; the development of dusting has been checked so far by the fact that the fungicide is too easily washed off by rain to act efficiently.

THURSTON (H. W., Jr.). **A Note on the Corrosive Sublimate Treatment for the Control of *Rhizoctonia*.**—*Phytopath.*, xi, pp. 150–151, 1921.

A table is presented giving the percentage of sclerotia viable after various treatments with $HgCl_2$. A solution 1 : 1,000 was found to kill all sclerotia in five minutes, and a 1 : 2,500 solution killed all in two hours. Greater dilutions or shorter treatments than those mentioned usually allowed some growth of the sclerotia.

VOGT (E.). **Ein neuer Schwefelapparat.** [A new apparatus for applying sulphur.]—*Nachrichtenblatt für den deutschen Pflanzenschutzdienst,* 1–4, p. 29, 1921.

At present there are two methods of sulphur treatment. In the older widely spread method sublimed sulphur ('flowers of sulphur') is dusted on with bellows, while the more recent method is based on the use of the so-called colloidal sulphur ('Gel-sulphur'), the extremely fine particles of which remain in suspension in water long enough to allow of it being sprayed in a liquid mixture. Both methods are devised to cover the plants treated with the thinnest possible uniform coating of sulphur so as to obtain the best results with a minimum quantity of sulphur. From this point of view, the liquid spraying is unquestionably superior to the dusting, and will wholly supplant the latter if a method can be found of treating the plants both with sulphur and copper preparations in one and the same spraying.

Trials have recently been started with a third method of using sulphur, which deserves some attention owing to the great advantages it presents. It was demonstrated by its inventor, Dr. Rupprecht. in August 1921 in Munich and Dahlem, in the presence of the representatives of the Department for the Protection of Plants.

The very handy and light apparatus works, according to the inventor, as follows: 300 gm. of pure roll sulphur (stick sulphur) contained in a small iron pan is liquefied and brought to the boiling point (448° C.) on a spirit lamp, which heats at the same time a circular copper boiler containing 400 gm. of water; the strongly superheated steam of the latter is forced under high pressure through the boiling sulphur and vaporizes it into small mist-like drops. In consequence of the sudden cooling in the open air, the little drops of sulphur do not harden immediately, but preserve for several hours their liquid form (plastic sulphur); they possess in this state a high degree of adhesion, not otherwise common to sulphur. The use of the apparatus is simple and does not present any danger. No injurious gases are formed during the process, though it is possible to obtain any quantity of sulphur dioxide by lighting the stream of sulphur vapour. Seeing that the drops of the sulphur cloud are only a few thousandths of a millimeter in diameter, the quantity of sulphur used is exceedingly small. A few grammes of sulphur are quite enough to fill an average greenhouse with clouds of sulphur, which in a very short time cover all free surfaces, such as leaves, tables, window-panes, &c., with a very thin film-like coating of sulphur, which is so adhesive that a strong stream of water from a hose cannot remove it from the glass panes.

But along with its great advantages this method, as described above, has faults which must limit its use in vineyards and orchards. While the apparatus gives excellent results in closed spaces such as greenhouses, it can be successfully used in the open air in calm weather only. A weak current of air is sufficient to blow away the sulphur cloud and render its action at least very doubtful. The makers of the apparatus claim to have constructed meanwhile a new model which works better.

A practical introduction of the method would undoubtedly bring about a complete transformation of sulphur treatments as used in vineyards. While it is now necessary to treat each plant individually with the dusting machine or sprayer, it would be quite enough to place a few of the new machines in a vineyard, or to carry one slowly from spot to spot, in order to envelop the whole vineyard in a cloud of sulphur on a windless day. It would not cause a larger consumption of sulphur owing to its fine pulverization. Further trials on a large scale are needed to show whether this new method can be used in practice and what results are obtained.

STEVENS (F. L.). **The Relation of Plant Pathology to Human Welfare.**—*American Journ. of Botany*, viii, 6, pp. 315–322, 1921.

The losses due to plant diseases in the United States alone, for the year 1919, are given as follows in the Plant Disease Survey Reports:

For the five leading cereals	482,695,000 bushels.
For Potatoes	86,997,000 bushels.
For Tomatoes	307,168,000 bushels.
For Sweet Potatoes	58,841,000 bushels (more than half the crop).

Crops of world-wide interest are sometimes destroyed; e.g. the Coffee rust destroyed 272,000 acres in Ceylon in a short time. 20,000 acres of bananas planted in Panama had to be abandoned as a result of Banana wilt, thus rendering useless large railway connexions. The Chestnut bark disease caused a loss of $25,000,000 from 1904 to 1911, and will cause much more as it invades the Appalachians. Land values may be seriously depreciated, as when a farm in the Tobacco Belt becomes infected with Tobacco wilt. Even after harvest the destruction continues during transportation and storage; an annual loss of thirty million dollars is said to occur in the United States between the field and the consumer.

That diseases are more common now than formerly is due to the increased facility of transportation between countries and the greater congestion of crops within countries.

Plant pathology, which originated barely half a century ago, now absorbs large federal and state grants, and the question arises what return it makes. Its achievements fall under several general headings: protective applications; sprays and dusts; excision; seed steeps; general sanitation, leading to diminution of infective material; breeding for disease resistance; modification of agricultural practice; and quarantine restrictions.

With the exception of breeding, the great advances have all been made by strictly scientific investigation, and not by empirical methods, and the recent discoveries in Mendelism are of most value when the low acreage value of the crop precludes expensive methods.

To quote a few illustrations of utility: cereal steeps (costing three cents an acre) eliminate certain smuts; if universally practised, one state could save 7,000,000 bushels of oats. One spraying of Peach curl may be worth $400 an acre. By early extermination, Coffee rust, found in 1902, was eliminated from Porto Rico, and the coffee plantations of America saved from it. Rice smut was similarly cleared out of South Carolina in 1898. Florida expended $1,500,000, and has completely exterminated Citrus canker, after it was well started; the annual value of the crop is $50,000,000.

Greater benefits will be derived as the science advances. Many great problems still exist that will only yield to patient, scholarly attack. By their intricacy they demand more concentration, better equipment, and longer periods of research than of old, in a word, greater specialization, often necessarily accompanied by co-operation of workers in different branches. A division of labour is also developing, and rightly, between the many aspects of plant disease investigation and control: research, extension (propaganda), testing of fungicides, surveys of disease, seed certification, quarantine control, and the like.

Pathology should come into closer co-operation with the other branches of botany and, indeed, with the other sciences. Botany is less of a power than she should be because, unlike chemistry, she has not maintained her unity: each useful offspring has gone far from the maternal influence. Integration of the various phases of botany rather than further disintegration is to be desired. The ranks of fundamental botany are in danger of depletion with the numerous temptations in the applied field. The individual worker, such as is most likely to be found in academic surroundings, willing to devote a lifetime to the development of his field, requires to be encouraged. The workers in Government institutions are under certain obvious disadvantages. Sir A. D. Hall is quoted as saying that 'a government is unfitted by its very nature to conduct fundamental research', and the author emphasizes the danger of the pressure for immediate results and the limitations of the 'project system' under existing conditions. The foundations of pathology require to be added to, and its structure buttressed by the isolated worker fired with enthusiasm.

SALMON (E. S.) & WORMALD (H.). **Varietal Resistance to American Gooseberry Mildew in Red Currants.**—*Gardeners' Chron.*, lxx, p. 47, 1 fig., 1921.

Certain varieties of red currants in the fruit plantations of Wye College, Kent, were found to be attacked by this mildew after a very virulent epidemic on gooseberries. On June 26 the mildew was observed on young shoots of red currants, interplanted with Allington Pippin apples. The leaves were somewhat curled, showing large white powdery patches on the under surface. Further examination revealed the brown scurfy patches of the perithecial stage on the leaves, the young stem, and the green berries.

The border in which the attack occurred was mainly planted with Fay's Prolific, but the affected bushes did not belong to this variety, being 'rogues' of various types—probably Raby Castle was among them. In another part of the plantation a block of Raby Castle bushes adjoining Fay's Prolific was attacked, while the latter remained immune. These instances afford sufficient evidence of the resistance of Fay's Prolific to the disease in question.

The economic importance of the occurrence of Gooseberry Mildew on red currants lies in the hibernation of the ascospores on the leaves, whereas in the gooseberry it is usually confined to the stem. Early outbreaks of mildew on gooseberry bushes may therefore be due to the presence in the soil of spores carried there on red currant leaves. Affected shoots of red currant should be burnt before the leaves fall.

BROOKS (F. T.). **The Inheritance of Disease-Resistance in Plants.**—*Trans. Brit. Mycol. Soc.*, vii, pp. 71–78, 1921.

The writer gives a summary of the knowledge of the inheritance of disease-resistance in plants, quoting data from Biffen and from unpublished work by Armstrong, which indicate that resistance of wheat to *Puccinia glumarum* is a Mendelian recessive character. Resistance of wheat to *Erysiphe graminis*, on the other hand, is found by Armstrong to be a dominant character.

GAGET (J.). **La Dégénérescence de la Pomme de Terre.**—*Journal d'Agric. Pratique*, N.S., xxxv, 16, pp. 316–318, 1921.

The author attributes Mosaic and Leaf-curl principally to the punctures of insects. Bacteria may also gain admission to the plant in wounds caused by insect punctures.

FOËX (E.). **Dégénérescence de la Pomme de Terre.**—*Comptes Rendus de l'Acad. d'Agriculture de France*, vii, 18, pp. 432–434, 1921.

Tubers of potatoes submitted for examination by M. Gaget appear to be infected with a disease quite distinct from Mosaic or Leaf-curl. They show traces of the presence of insects, and it is probable that the unhealthy appearance of the eyes, which are black or brown in colour, is due to their innumerable punctures. The tubers which give rise to plants attacked by Mosaic or Leaf-curl are comparatively healthy in appearance, so much so that it is almost impossible to distinguish them in the early stages. Sections of the eyes of the tubers submitted for investigation reveal the existence of separate cellules, usually situated in the epidermic and cortical parenchyma, but sometimes also in the central cylinder. The bast is not more frequently attacked than the other tissues.

It will be evident that this disease does not correspond with Leptonecrosis, which, according to Quanjer, always accompanies Leaf-curl, and the investigation of its origin should be continued.

IMPERIAL BUREAU OF MYCOLOGY

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LINE (J.). **A Note on the Biology of the Crown-Gall Fungus of Lucerne.**—*Proc. Cambridge Phil. Soc.*, xx, 3, pp. 360–365, 7 figs., 1921.

The author's investigations have led to results substantially in agreement with those of Jones and Drechsler (*Journ. Agric. Res.*, xx, 4, p. 295, 1920). Masses of wart-like tissue are found on the diseased plants at about the level of the soil. They may be six inches in width, but rarely extend deeper than one inch below the surface of the ground.

When cut across, these masses show dark-brown areas, the spore cavities among the white tissue composing the gall giving a marbled appearance. The name 'marbled gall' has been suggested to distinguish this type from the true bacterial crown gall. The disease is said to be fairly common on lucerne in certain districts west of the Rocky Mountains; in England it has so far been reported only from three localities: Kent, Bedfordshire, and the vicinity of Cambridge. It is, however, probably often overlooked, as the galls are not easily observed until the plant is removed from the soil. In hot weather normal shoots developing close to the galls may turn yellow and wilt, and thus it is sometimes possible to detect infected plants.

The mature spores are globular, flattened at one pole, $30 \times 45\ \mu$, with a very brittle wall nearly $2\ \mu$ thick, of a rich golden-brown colour and lined with a thin hyaline membrane. Only a small percentage of spores could be induced to germinate, the process being effected most easily with spores obtained from galls which had rotted owing to the action of fungi (*Fusarium* sp.) or bacteria. The development of external sporangia as described by C. E. Scott (*Science*, N. S., 1340, pp. 225–226, 1920) was not observed.

Apparently the zoospores can only penetrate the host at points where the tissues are inadequately protected by cuticle or cork. The most common starting-points of natural galls are the adventitious buds arising in succession from the woody rootstock of the lucerne plant. These buds consist of a small axis and a number of leaf rudiments. The zoospores seem to penetrate between the outer scale leaves and to enter the cells of the young leaves and of the growing point. This penetration stimulates the host to increased local cell-division. An extensive branching vascular system develops with the gall in direct communication with that of the host stem; the galls are thus hypertrophied buds or parts of buds. They are first visible as minute, white, shining projections from the rootstock or a bud.

The fungus spreads radially into the host tissues from each point of infection. Active living hyphae are found only in the peripheral regions, the older portions of the gall being occupied by developing resting spores and degenerate mycelium.

A detailed description follows of the development of the fungus. No trace of the plasmodial stage described by Wilson (*Bot. Gaz.*, lxx, 1, pp. 51–68, 1920) was observed. In England the only host plant is *Medicago sativa*. Attempts to infect *M. falcata* and *M. lupulina* have failed. The most usual time of infection is from September to February.

MIÈGE (E) **Note préliminaire sur les principales maladies cryptogamiques observées au Maroc.** [Preliminary Note on the principal Cryptogamic diseases observed in Morocco.]—*Bull. Soc. de Path. Vég. de France*, viii, 1, pp. 37–40, 1921.

Generally speaking, there is not a very large number of fungous diseases, apart from rusts and smuts, at present on record in Morocco.

UREDINEAE. The rusts attack many plants, especially cereals, which are extensively cultivated. *Puccinia graminis* and *P. glumarum* are of frequent occurrence on all species and varieties of wheat. *Triticum durum* appears somewhat less susceptible than *T. sativum* or *vulgare*, but there is little difference between *Hordeum tetrastichum* and *H. distichum* as regards resistance. *Puccinia maydis* occurs on maize, while the species of *Oxalis*, especially *O. cernua*, are attacked by a rust which certain authorities regard as the aecidial stage of *P. maydis*. *P. malvacearum* is also of frequent occurrence. The Uromyces are often found: *U. pisi-sativi* on peas and vetch, *U. fabae* on beans, *U. appendiculatus* on haricots, *U. anthyllidis* on lupins, &c. Flax is attacked by *Melampsora lini*, and roses by *Phragmidium subcorticium*; but the damage caused by these parasites is not very extensive. Rusts occur also on *Ricinus* and *Euphorbia*.

USTILAGINEAE. Smuts, particularly on the coast, are widely diffused among cereals. In 1920 certain species of soft wheat were infected by *Ustilago tritici* to the extent of 25 per cent. Barley is attacked by *Ustilago nuda* and *U. hordei*, the first form being of more general occurrence. *U. maydis* is more rare, and occurs principally on the female inflorescences, though it is also found in the axils of leaves in the form of large tumours. Sorghum is relatively free. *U. cynodontis* has been observed on *Cynodon dactylon*. *Tilletia* is infrequent, though *T. tritici* (probably) has been observed on hard wheat.

PERONOSPORACEAE. The potato is attacked by *Phytopthora in-*

festans, but the ravages of this disease are much less than in France. It is more liable to a disease characterized by wide, brown, well-marked spots appearing on the terminal leaflets, and doubtless caused by a *Sporidesmium*.

CHYTRIDIACEAE. The only fungus belonging to this group actually observed is *Asterocystis radicis* on flax.

SPHAEROPSIDACEAE. Anthracnose (*Ascochyta pisi*) occurs on a certain number of Leguminosae.

MELANCONIACEAE. Anthracnose of clover (*Gloeosporium caulivorum*) was observed in 1920 on wild clover.

AGARICACEAE. *Armillaria mellea* occurs everywhere in abundantly irrigated or fertilized places.

BACTERIAL DISEASES occur chiefly on shrubs, especially olives and almonds, which develop tumours more or less severely. In 1920 wallflowers were attacked.

Mildew and oidium are found on the vine, but the indigenous varieties are remarkably resistant, and the damage to the young European species is not extensive.

UNDETERMINED DISEASES. Beans, peas, chick-peas, &c., have been attacked in various districts by a disease which is causing serious damage. It is specially apt to invade the collar and the base of the stems, but may descend to the tap-root and affect the aerial system. The latter exhibits wine-coloured or brown spots, and finally cracks and dries up, causing the death of the plant.

Another disease has been recently observed on potatoes, but not yet identified.

WHITEHEAD (T.). **On the Life-history and Morphology of Urocystis Cepulae**—*Trans. Brit. Mycol. Soc.*, vii, pp. 65-71, 1 pl., 1921.

The history of the disease, which has only recently been found in Great Britain, is given, together with a description of its characters and the microscopic details of the parasite. The author confirms Thaxter's observation that the sporidia are borne laterally along the promycelium. Under certain conditions they multiply by budding. Conjugation was not observed. Histological observations on the growth of the fungus in the host plant and of the development of chlamydospores are given. Infection is believed to take place at the region of the collar. A bibliography is appended.

THURSTON, Jr. (H. W.) & ORTON (C. R.). **A Phytophthora Parasitic on Peony.**—*Science*, N.S., liv, pp. 170–171, 1921.

Phytophthora has apparently not hitherto been met with on this host. The disease was manifest as a necrotic condition of the bud, involving the surrounding leaves and stem. The symptoms are similar to those caused by *Botrytis*, but the infected areas are darker. No evidence of external fruiting of the parasite was found, but pure cultures were readily made from diseased tissues. Inoculations were successful both with and without wounding the host. The characteristic symptoms appear in from three to six days. Zoosporangia are produced in abundance, and measure $16{\cdot}7–22{\cdot}3 \times 20{\cdot}4–29{\cdot}7\ \mu$. *P. thalictri* would appear to be its closest relative so far as hosts are concerned, but the sporangia are somewhat broader. Oospores were not observed.

ARTHUR (J. C.). **Origin of Potato Rust.**—*Science*, N. S., liii, pp. 228–229, 1921.

In an earlier note (*ibid.* li, p. 246, 1920) attention was called to the danger of the introduction of the rusts of potato (*Puccinia pittieriana*) and ground-nut (*Puccinia arachidis*) to the United States. The latter has since been reported in Florida, but all vestige of it was at once destroyed. In 1918 the potato rust was very severe in the Experiment Station at Ambato, Ecuador, and even worse on tomatoes. This is the first record in S. America, the previous known locality being only the highlands of Costa Rica on the potato alone. It was less severe at Ambato in 1919. The suggestion is made that it must have come from some wild host, native to both Ecuador and Costa Rica, there having been no importation of seed from Costa Rica to Ambato on which it can have come.

Abelardo Pachano (in *Bol. de Agric., Quinta Normal,* 'i pp. 7–12, 1920) described and figured the above rust as it occurred at Ambato.

BISBY (G. R.). **The Co-operative Potato Spraying Project. Progress Report for 1918, 1919, and 1920.**—*Phytopath.*, xi, 4, pp. 178–193, 1921.

Summary statements of the status of the application of fungicides to potatoes in each state and province of the United States and Canada. Certain workers provided new data. The use of Bordeaux mixture is necessary in the North-Eastern states and in Eastern Canada. Its use pays also in Pennsylvania, and evidently in the north central areas, including Ontario, Michigan, Wisconsin, and Minnesota.

Bordeaux mixture appeared to be of little value in Kansas and Arkansas. In certain regions it pays to spray late potatoes, or certain varieties, or to use combination insecticides and fungicides. Copper dusts as developed by Sanders in Canada appear promising. For many areas of North America the value of fungicides for potatoes is as yet uncertain.

WEIMER (J. L.) & HARTER (L. L.). **Glucose as a Source of Carbon for certain Sweet-Potato Storage-rot Fungi.**—*Journ. Agric. Res.*, xxi, 4, pp. 189–208, 1921.

The following is the author's summary :

Eight fungi—*Fusarium acuminatum*, *Diplodia tubericola*, *Rhizopus tritici*, *Mucor racemosus*, *Sclerotium bataticola*, *Penicillium* sp., *Botrytis cinerea*, and *Sphaeronema fimbriatum*—which cause decay of sweet-potatoes in storage, were grown at a constant temperature of 28° C. on a modification of Czapek's nutrient solution, with different amounts of glucose as a source of carbon. All these fungi, except *S. fimbriatum*, utilized glucose in considerable amounts.

The different fungi varied greatly in the amount of glucose they actually consumed at the same concentration. In general, the greatest consumption was in the weaker solution (10 per cent.), and decreased progressively with the increase of the concentration. With two exceptions all the organisms grew in solutions containing from 42 to 50 per cent. glucose. *Penicillium* sp. alone grew in a 58 per cent. solution.

A great variation was found among the different fungi in the amount of dry material that was produced at the same concentration. The concentration on which the greatest yield of fungous material was produced by a certain organism was not necessarily the optimum concentration for any of the other fungi.

The different organisms varied greatly in the amount of glucose required to produce 1 gm. of dry weight. Likewise the amount required to produce 1 gm. of dry weight of the same fungus differed with the concentration of the solution.

The 'economic coefficient' [the author, following Pfeffer, uses this term for the numerical relation between the sugar consumed and the dry weight of the substance formed] was found to be much higher in many cases than that given by Kunstmann and Ono; the maximum of 28·88 and the minimum of 1·44 being reached by *Mucor racemosus* on a 30 and 50 per cent. solution respectively. The highest 'economic coefficient' for some fungi was on the weaker solutions. For other organisms, however, the order was reversed.

Some of the organisms—namely, *Fusarium acuminatum*, *Sclerotium bataticola*, and *Sphaeronema fimbriatum*—had little or no influence on the hydrogen-ion concentration. *Rhizopus tritici*, *Diplodia tubericola*, *Mucor racemosus*, *Penicillium* sp., and *Botrytis cinerea*, on the other hand, increased perceptibly the acidity of the solution.

All of the fungi studied grew in solutions with a maximum osmotic pressure varying from 81·33 to 101·46 atmospheres. *Fusarium acuminatum* and *Mucor racemosus* increased the concentration, whereas the other fungi in general decreased it. In a few cases where a considerable amount of sugar was consumed the concentration was actually increased. In general, the decrease in the osmotic concentration was not in proportion to the sugar consumed, so that it is possible that compounds such as organic acids, alcohol, &c. were formed from the sugar which would themselves influence the osmotic concentration.

WEIMER (J. L.) & HARTER (L. L.). **Respiration and Carbohydrate Changes produced in Sweet-Potatoes by Rhizopus tritici.**—*Journ. Agric. Res.*, xxi, 9, pp. 627–635, 1921.

Experiments were carried out to determine the relative amount of CO_2 given off from the two halves of the same sweet-potato, one of which was rotted by *Rhizopus tritici*, and also the final differences in starch, cane-sugar, and reducing sugar content in the two halves.

It was found that the decayed half gave off 6·3 to 7·8 times as much CO_2 as the healthy, decay being usually completed in three days.

There was less starch, total sugars, and cane-sugar in the decayed portion at the end of the experiment than in the healthy. Reducing sugars were decreased in two experiments and increased in two.

Other investigations have shown that glucose is readily utilized by the fungus, and cane-sugar, by itself, sparingly or not at all. Even boiled starch is a better source of carbon than cane-sugar. Raw starch can be hydrolysed to some extent by the fungus. The latter seems capable of maintaining a fairly constant supply of reducing sugars obtained from cane-sugar and starch; but glucose must be present before cane-sugar can be absorbed, as when the latter alone is present the growth of the fungus is slight, and it is probable that it does not produce sufficient acid to invert the cane-sugar.

It is thought probable that the increased acidity caused by the growth of the fungus in the sweet-potato causes the inversion of some of the cane-sugar and permits the use of the resulting reducing sugars by the fungus. It will then depend on the amount of growth and activity of the latter whether an excess or a deficiency of reducing sugar is found at the end. The total quantity of carbohydrates lost was greater than that accounted for in the CO_2 produced, and some was therefore apparently used in the building up of the fungus and in the formation of acids, alcohol, &c.

WEIMER (J. L.) & HARTER (L. L.). **Wound Cork Formation in the Sweet-Potato.**—*Journ. Agric. Res.*, xxi, 9, pp. 637–648, 1921.

Sweet-potatoes develop a cork layer over wounded areas under moist conditions, and a hard surface layer under dry conditions. The healed surface in either of these cases forms a fairly good barrier against infection by micro-organisms.

In potatoes that have been in storage for about two months periderm formation was most rapid at a temperature of 33° C., a cork layer being evident in four days, whereas at 31° C. it was first visible in eight days, and at 19·5° C. in eleven days. The relative humidity in these experiments was 95 to 96. Exposure to dry air checks cork formation, but the hard dry surface covering which develops under these conditions was sufficient to prevent artificial infection by *Rhizopus tritici*. The latter is the usual method of healing under storage-house conditions, as the air is kept dry.

PALM (B.). **Slijmziekte in een Rubberplant.** [Slime Disease in a Rubber Plant].—*Teysmannia*, xxxii, 1, pp. 31–33, 1 fig., 1921.

Bacterial diseases have long been known to attack various plants belonging to the Euphorbiaceae, e. g. *Ricinus communis*, *Acalypha*, *Phyllanthus*, and *Codiaeum*, but until lately had not been observed on any plant actually producing rubber. The Botanical Garden of Buitenzorg (Java) contains a certain number of *Manihot* plants of various species, one of which, *M. glaziovii* (Ceara rubber), produces an abundance of seeds. These are scattered broadcast by birds, and it has recently been discovered that most of the seedlings thus propagated show symptoms of bacterial disease. The affected leaves have a limp appearance during the day, though in the early stages they recover towards evening. Gradually, however, the leaves dry up, beginning at the tips, and this causes a greyish discoloration of the lobes, which finally spreads over the entire surface. It is noteworthy that the stem of the plant remains firm and healthy. Examination showed that the wood vessels were seriously affected both in the stem and root, even in a comparatively early stage of the disease, bacteria being present in masses.

There appears to be no doubt that the disease is due to *Bacillus solanacearum* E. F. Smith. Cultures of the bacteria from the diseased *Manihot* plants were obtained on sterile potato, the colonies assuming the grey to jet-black colour characteristic of *B. solanacearum*. Tomatoes artificially inoculated with the bacteria from the *Manihot* plants exhibited the typical symptoms of bacterial disease. Considering the close relationship between *Manihot* and *Hevea*, the latter is likely to be attacked by the same disease.

SIMMONDS (H. W.). **A Bacterial Disease of Para Rubber.**—*Agric. Circular* (Dept. of Agric., Fiji), ii, 3, p. 45, 1921.

In a plantation of *Hevea* rubber in the Navua district two trees not far from one another were found in a very diseased condition.

The renewed bark was rough and discoloured, shot-hole borers had attacked this diseased area, and latex was flowing freely from their borings, about half a pound having collected at the foot of one tree. In the other, a big mass of latex, forming between the cortex and the cambium, had forced them apart. The bark in both cases showed a reddish-brown stain, which in one tree had also affected the cambium, whilst a slightly sour smell seemed to be present.

No mycelium was found, but the Government bacteriologist, Dr. Carment, whose report is attached, found bacteria present which were cultured. The organism was a short rod, motile, and with no evidence of spore-formation.

The disease, which has been present in Fiji for many years, does not appear to be highly infective, but is probably carried from one tree to another by the tapping tools of the coolies. If observed early, and tapping be suspended, and the bark scraped and painted with a strong disinfectant, there should be a fair prospect of saving the tree.

HOERNER (G. R.). **Germination of Aeciospores, Urediniospores, and Teliospores of Puccinia Coronata.**—*Botan. Gaz.*, lxxii, 3, pp. 172–177, 1921.

The author summarizes as follows the results of a series of experiments connected with the spore germination of Crown Rust of oats:

Aeciospores from herbarium specimens of *Rhamnus* were not viable after a period of 167 days from date of collection. Urediniospores from herbarium specimens of *Avena sativa* proved to be viable as long as 87 days after date of collection. Unprotected urediniospores lost their viability within 22 days, with a minimum temperature during this period of 27° F., and a maximum of 42° F. When afforded protection with a temperature range similar to the unprotected, these spores remained viable as long as 44 days. Exposed to light, viability of urediniospores was lost within 23 days, during which period the maximum temperature was 86° F., and the minimum 29° F. Kept in the dark, urediniospores at similar temperatures to those exposed to light remained viable as long as 79 days. Urediniospores germinated at a temperature as low as 7° C., with an optimum of 18° C., and a maximum of 32° C. Teliospores developed on oat seedlings in the greenhouse and not afforded a period of overwintering did not germinate. Previous to overwintering, and as late in the spring as May 2, teliospores developed in the field were incapable of germination.

Baudys (E.). **Die Sporen der Getreidebrandpilze sind nicht giftig.** [The spores of Grain Smuts are not poisonous.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1–2, pp. 24–27, 1921.

The writer conducted a number of experiments both on animals and on himself with a view to ascertaining whether the spores of *Tilletia tritici* had any injurious effects.

Poultry fed on smutted grain throve and gained in weight, while mice and rabbits also flourished on the same diet.

No ill effects were experienced by the writer, who therefore concludes that the reports of harm caused by the consumption of infected bread are much exaggerated. The fatal effects consequent on the consumption by animals of grass attacked by *Ustilago longissima* are due, not to the spores themselves, but to the glucosides contained in the grass.

Lee (H. A.) & Medalla (M. G.). **Leaf Stripe Disease of Sugar-Cane in the Philippines.**—*Science*, N. S., liv, pp. 274–275, 1921.

Early in 1920 the writers' attention was drawn to the presence in the Philippines of diseased varieties of sugar-cane imported from Formosa. Periodical inspections were made, and in April, after ratooning, numerous cases of etiolation were observed. The light-coloured plants were very conspicuous and could be seen from a considerable distance.

On the lower surface of affected leaves a species of *Sclerospora*, which was not present in the surrounding fields of native cane, was abundant. According to Dr. W. H. Weston (Philippine Downy Mildew of Maize. *Journ. Agric. Res.*, xiv, 3, p. 97), the morphology of *Sclerospora philippinensis* Weston is almost identical with that of *S. sacchari* Miyake. He observed no case, however, of native varieties of sugar-cane becoming infected with the maize mildew, even when growing in close proximity to the diseased maize plants. He was, moreover, unable to cross-inoculate *S. philippinensis* from maize to sugar-cane. Thus the evidence clearly points to the importation of sugar-cane downy mildew, *S. sacchari* T. Miyake, from Formosa.

Measures have been taken to plough up the affected field, burn the stubble, and fallow the land. Steps to trace seed-cane which originated in the affected field are also in progress, and the eradication of the disease may be possible. The present note is intended to emphasize the necessity of a rigid enforcement of the plant quarantine regulations.

Bovell (J. R.). **Report on the Dept. of Agric., Barbados, 1918–19. Fungus Diseases.** Pp. 26–27, 1921.

The sugar-cane was the principal crop to suffer from fungous diseases, of which the following occurred: *Marasmius sacchari* (Root Fungus), probably due to the adhesion of the fungus to cuttings used for planting purposes, or to excessive ratooning. *Himantia stellifera* (Stellate Crystal Root Fungus)—this was much in evidence in a field of second ratoons in the red soil district. The treatment recommended was the application of lime and the planting of a leguminous crop as a green dressing. *Colletotrichum falcatum* (Red Rot) occurred as usual on Bourbon canes at Dodds. *Thielaviopsis paradoxa* (Pine-Apple Fungus)—a large percentage of the sugar-cane cuttings which failed to germinate were attacked by this fungus. Only healthy cuttings treated with Bordeaux mixture should be used for planting. *Cercospora vaginae* (Fungus of the leaf-sheath)—this was greatly in evidence, and the disease was aggravated by the use of infected cuttings.

Sugar-Cane Industry of British Guiana.—*Agric. News* (Barbados), xx, p. 279, 1921.

In a summary of a Report on the Agricultural Conditions of the Sugar Industry in British Guiana, Mr. J. Crabtree, Superintendent of the British Guiana Sugar Planters' Experiment Stations, is quoted as stating that conditions with respect to fungous diseases are at present satisfactory, the only one of any seriousness being root disease in a few localities. An inquiry into the causes underlying root disease is urgently required.

VINCENS (F.). **Parasitisme du Schizophyllum commune Fries sur la Canne à Sucre.** [Parasitism of *Schizophyllum commune* Fries on the Sugar-cane.]—*Bull. Agric. de l'Inst. Scient. de Saigon*, iii, 3, pp. 65–68, 2 figs., 1921.

The writer draws attention to several authenticated cases in which the fungus in question, usually regarded as almost exclusively saprophytic, has developed parasitic tendencies on various trees, e.g. the orange, mulberry, Indian chestnut, rubber, &c. Instances are described of its parasitism on sugar-cane in Indo-China, successful inoculations having been obtained on healthy cuttings of an indigenous variety. The setts were infected either by means of fragments of ripe fructifications of the fungus, or by a suspension of spores in cane-juice. At the end of five months the shoots of the infected cuttings did not exceed 50 cm. in height, and were scarcely more vigorous than those actually taken from the base of diseased plants. The mycelium of the fungus, hyaline and very slender, was found in the tissues of the cuttings, which were still succulent, though reddened.

The appearance of the canes on which the fructifications of *Schizophyllum* occurred suggested the 'Sereh' disease. The diseased portions were dry and marked internally with red streaks.

EDGERTON (C. W.) & MORELAND (C. C.). **Fungi and Cane Germination.**—*Sugar*, xxiii, 1, pp. 16–17, 1 fig. 1921.

The most important fungi attacking cane in Louisiana are:—*Colletotrichum falcatum*, *Melanconium sacchari*, *Gnomonia iliau*, *Marasmius plicatus*, *Thielaviopsis paradoxa*, *Fusarium* sp., and *Scopularia* sp. A large number of other forms have also been noticed, including *Sclerotium Rolfsii*, *Pythium artotrogus*, and species of the following genera: *Agaricus*, *Rhinotrichum*, *Alter-*

naria, *Penicillium*, *Aspergillus*, *Meliola*, *Rhizopus*, *Cladosporium*, *Mucor*, *Saccharomyces*, *Acremonium*, *Catenularia*, and *Nectria*.

Colletotrichum falcatum is the cause of the red rot disease of sugar-cane, and is one of the chief organisms responsible for seed deterioration. It usually enters by way of borer holes. The rind tissue is not attacked unless it is very young and tender, the disease usually being confined to the interior of the stalk. In the red tissues of the stalk are elongated white areas at right angles to the main axis of the stalk. The presence of these spots is conclusive evidence of the disease, but detection is not always easy on account of the absence of external symptoms. Almost the only sign of *C. falcatum* on the rind is the blackened rootlet buds in the nodal region. There are small thin places in the rind of each node where the young roots emerge, and a number of experiments in Louisiana go to prove that the penetration of these thin places by the fungus is responsible for much of the infection. This disease is very serious, the germination percentage of the eyes of stalks inoculated by puncture with this fungus at planting time being reduced about 50 per cent.

Melanconium sacchari, the cause of the so-called rind disease, occurs abundantly on deteriorating cane, but does not seem to reduce the percentage of germination.

Marasmius plicatus causes a disease of the growing cane. It grows in and between the lower leaf-sheaths of the stalk, and the abundant mycelium cements these together so that they remain on the stalk all through the growing season. Stalks affected with the root-rot caused by this fungus are easily recognizable by the presence of the clinging leaf-sheaths and white mycelium. The fungus forms its fruiting-bodies in the fields from July to September.

Gnomonia iliau causes the Iliau or stem rot disease of cane, and is known only in Hawaii and Louisiana. It principally attacks growing canes, and in some respects is similar to the root-rot caused by *Marasmius plicatus*. The lower leaf-sheaths are bound together and also to the stalk itself. Unlike *M. plicatus*, this fungus grows into the stalks from the sheaths. As soon as it begins to fruit it can be readily distinguished on the outside by the numerous black perithecia, with long, hard and sharp-pointed beaks. There is no evidence that these last two fungi reduce the germination percentage.

Thielaviopsis paradoxa is the cause of the so-called pine-apple disease of the sugar-cane. It enters wounds in the rind tissue or at the cut ends and rapidly grows through the whole stalk. The affected region turns darker in colour and frequently there is a central black pipe running lengthwise in the stalk. The intensity of this dark colour can be increased if the stalk is cut open and laid in a moist place for twelve to twenty-four hours. The dark spores of the fungus develop abundantly in such conditions. *T. paradoxa* has not hitherto caused appreciable seed deterioration in Louisiana.

Fungi of the genus *Fusarium* are very common, the two distinct types which occur on cane being known as the purple and white respectively. The former is a very large-spored form, producing deep purple fruiting pustules on the cane and on culture media.

The white *Fusarium* is present in almost every stalk of discoloured seed cane, but it can only be detected by means of cultures. This latter species somewhat reduces germination.

A species of *Scopularia* frequently occurs on the outside of stalks of seed cane, forming patches of greyish mycelium. If the stalks are in a damp place, the conidiophores of the fungus, carrying little heads of spores, develop abundantly. This fungus may also occur on the inside of the stalk in split places, borer holes, &c. It is of little economic importance.

On the whole, sugar-cane does not germinate as well in Louisiana as in the tropics, the average germination being about 20 per cent. The buds or eyes on cane-tops do not germinate as well as those on the bottom halves, presumably on account of the more rapid deterioration of the soft tissues of the cane-tops. The optimum temperature for the growth of several fungi studied in the course of the experiments is approximately 27° C. Seed cane has been treated at planting time with formaldehyde and corrosive sublimate, with encouraging results. In one case a 50 per cent. increase in tonnage was obtained from a plot treated with corrosive sublimate.

MASON (F. A.). **Micro-Organisms in the Leather Industries. I. A Systematic Arrangement of the Fungi mentioned in the Literature of Leather Technology.**—*Bull. of the Bureau of Bio-Technology* (Murphy & Son, Ltd., Sheen Lane, London), 3, pp. 67–78, 1921.

The uncertainty which exists with regard to the names of the species that occur on leather and leather-making materials, and the lack of definite knowledge of the relationships of the fungi to the substances on which they are found have induced the author to attempt the compilation of a systematic list of the species hitherto recorded.

The ZYGOMYCETES include: *Mucor racemosus, M. mucedo, M. piriformis, Circinella simplex, Rhizopus stolonifer, Pilaira dimidiata, Pilobolus crystallinus.* Amongst ASCOMYCETES are: *Saccharomyces ellipsoideus, S. pastorianus, S. acidi lactici, Hansenia apiculata*; whilst FUNGI IMPERFECTI furnish: *Monilia fructigena, Aspergillus glaucus, A. niger, Penicillium* (no recognizable species), *Botrytis cinerea, Verticillium glaucum, Cephalothecium roseum, Cladosporium herbarum, Macrosporium cladosporioides, Alternaria tenuis, Fusarium roseum, F. putrefaciens.* MYCODERMAE, represented by *M. tannica*, have been placed at the end though usually considered along with the yeasts, as their true relationships are uncertain.

It is pointed out that some of the names recorded in the literature, e.g. *Penicillium glaucum*, cannot be recognized, as recent investigations have resulted in the recognition of the fact that this and others of the older 'species' of moulds are an aggregation of several distinct species. A striking instance of dissimilarity in behaviour towards leather by moulds of similar habit of growth, colour, and size is furnished by the unicellular *Mycodermae*, some species of which are quite inert, whereas others, microscopically indistinguishable from them, produce unsightly stains by affecting the gelatinous fibres composing the corium. Hence the necessity for extreme care in the checking of the purity of cultures of organisms during the stages of an investigation.

A rose-coloured and an orange-yellow *Torula*, as well as a *Mycoderma* mentioned by Andreasch, cannot now be recognized, and are therefore not included. Several species of fungi not previously recorded on leather, skins, or tanning materials have been isolated by the author in the course of his work on the microbiology of these substances, while others that are mentioned in the literature have not been encountered.

MASON (F. A.). **Micro-Organisms in the Leather Industries. II. Species of the Genus Penicillium and their Identification.** —*Bull. of the Bureau of Bio-Technology* (Murphy & Son, Ltd., Sheen Lane, London), 4, pp. 87–90, 1 fig., 1921.

In the tabular arrangement of the fungi of leather technology published in Bull. No. 3 (see last abstract), no species of the blue and green moulds belonging to the genus *Penicillium* were included. In this and a later paper several organisms will be discussed which were probably referred previously to *Penicillium glaucum*. Thanks to the work of Thom and Westling, these can now be differentiated into separate species. They are amongst the commonest species found in the tannery.

As a result of the author's examination of leather and raw materials used in its manufacture, the following species can now be recorded: *Penicillium decumbens* Thom, *P. expansum* (Link) Thom, *P. viridicatum* Westling, and *P. lanosum* Westling, together with minute white species so far unidentified, which will be discussed later.

An English translation is appended of Westling's Key to the Green Species of *Penicillium* (Ueber die grünen Spezies der Gattung *Penicillium, Arkiv för Botanik, Stockholm*, 1911), which the author has found of the greatest possible value in the routine work of the laboratory. The key is based primarily on the separation of species into the two groups *Eupenicillium* and *Aspergilloides*; the latter group embraces species originally placed by Wehmer in the genus *Citromyces*, but which both Thom and Westling regard as belonging to *Penicillium*.

THILLARD (R.). **La Culture du Tabac de Sumatra au Cameroun.** [Cultivation of Sumatra Tobacco in the Cameroons.]—*L'Agronomie Coloniale*, vi, 40–42, pp. 185–194, 22 figs., 1921.

Tobacco plantations in the Cameroons are subject to several diseases of parasitic and non-parasitic origin, a prominent place among which is occupied by that due to *Phytophthora nicotianae*. This fungus attacks chiefly the collar, covered with earth at the moment of transplantation of the young plants, or roots, and penetrates into the tissues of the plants through any wound, either in the stem or in the roots, caused by unskilled manipulation when transplanting the seedlings. From the wound the parasite destroys the rind, and penetrates into the inner tissues of the stem, attacking the pith, which becomes semi-liquid in wet weather or else, in drier conditions, is broken up into characteristic compartments. The leaf, or rather its chief vein, early shows signs of the infection; the leaf folds up, withers, and is slowly discoloured. The lower leaves are the first to be altered, the infection spreading gradually on to the upper parts of the plant. The roots of the diseased plant seem weak, and are of a dark-brown colour; when crushed with the fingers they resolve themselves into a blackish pulpy mass. When attacked in wet weather, the leaves present concentric dark-green patches, passing into dark brown. In dry weather such patches on the leaves spread very slowly, and the disease of the stem seems also to be stopped in its progress.

As a means of prevention seedlings should be carefully examined and selected, and only the quite healthy ones, without any stains on the leaves or wounds in the stem and roots, should be planted. When a plant is attacked in the plantation, it must be removed immediately, and in the hole thus formed in the ground some unslaked lime is put, after which the spot is watered with a 20 per cent. solution of ammonia. Surrounding plants must be sprayed for two days with Bordeaux mixture. A new method consists in mixing the earth on the spot from which the plant was removed with 50 gm. of pure permanganate of potassium, and abundantly watering the spot for two days in the morning and evening, when a new plant can be set in. In spite of all these precautions, neighbouring plants can be attacked, and then all the leaves showing spots of *Phytophthora* must be removed and burnt. In order to prevent a recurrence of the disease, all remnants of tobacco plants in the fields must be gathered carefully and incinerated, and this operation is to be the more recommended as it yields ashes of a high fertilizing quality. At Nyombé there was no sign of *Phytophthora* in 1916 and 1917; this was explained by the fact that during the two foregoing years no tobacco had been grown there, and because the new plantations were started in dry weather. In the spring plantations in 1917 and 1918, however, the disease recurred. In the Cameroons, chiefly at Esosung, *Phytophthora* is said to have been present for more than twenty years, the climate being very favourable to its propagation owing to its humidity.

The following diseases are also described as occurring in the Cameroons:

(*a*) Parasitic Rust [parasite not mentioned].

(*b*) Non-parasitic Rust.

(*c*) White spots on the leaves.

(*d*) Mosaic (very frequent).

(*e*) Leaf-curl. This very grave disease first appeared in Nyombé plains, in the Cameroons, in April 1917. In the autumn plantations of 1916 a few curled top leaves had been already noticed, but they were ascribed to attacks of some insect or caterpillar on the terminal bud. Leaves immediately below the point attacked presented small swellings, but there seemed to be no contagion from plant to plant. In April 1917, the weather being abnormally hot, the disease greatly extended in a few days, and this led to the opinion that very dry weather is favourable to the spread of the affection, though it was observed in 1917 that a too great moisture and heavy continuous rainfall also bring about the curling of the leaves. In 1918, however, the weather conditions were very fine, and the disease recurred again, entailing the same considerable loss in the crop (about 60 per cent.) as in 1917, showing that climatic conditions, although they have an undoubted bearing on the appearance and spread of the disease, cannot alone be responsible for it. Experiments over three years and microscopical investigation gave no clue to the presence of any infective or toxic agents, either in the soil or in the plants, and inoculation of healthy plants with sap taken from diseased ones gave negative results; neither had the use of mineral fertilizers, such as sulphate of potash, superphosphates, &c., any appreciable effect on reducing the spread and gravity of the affection.

The symptoms of the disease are irregular swellings on the leaves, there being an excrescence of tissue between secondary veins on the whole surface of the leaf, the latter curling in a characteristic manner; the diseased plant is atrophied, and does not attain its usual size; a few flower-buds can be produced, but they seldom bloom.

It was observed that the disease appeared on plants grown from seeds gathered in the fields at Nyombé-Penja (altitude about 300 ft. above sea-level) even when the mother-plants were in excellent condition, whereas seeds gathered at Nkongomba at an altitude of about 2,550 ft. gave normal plants, even after several generations. Seeds coming directly from Sumatra also gave excellent results. It is noteworthy that seeds gathered on degenerate and diseased plants and transported elsewhere may give more or less healthy and well-conditioned plants.

HERRMANN (F.). **Züchtung einer gegen die Blattrollkrankheit widerstandsfahigen Tomatensorte durch Auslese.** [Selection of a variety of Tomato resistant to Leaf-curl.]—*Ber. der Höheren staatl. Lehranst. für Obst- und Gartenbau zu Proskau*, 1918–19, p. 111, 1921.

Not only do special varieties of tomato differ in their degree of susceptibility to leaf-curl, but individual plants of the same variety show divergent qualities in this respect. Thus in 1913 one plant out of twenty-five 'Paragons' showed no signs of leaf-curl by the late autumn, whereas the others had begun to curl at the beginning of July. Self-pollinated seed from the immune plant was sown next to the old variety, with the result that only two out of ten plants showed a slight tendency to curl. Four plants with entirely smooth leaves were selected for further propagation, and their forty descendants planted the next year close to a susceptible variety (Schöne Lothringerin). They proved to be practically immune against leaf-curl, and gave a good yield. Resistance to the disease in question appears therefore to be an inherited characteristic, and attention to this fact may greatly improve the individual varieties.

HEINSEN (E.). **Das Auftreten und die Verbreitung des Tomatenkrebses bei Hamburg.** [The Occurrence and Spread of Tomato Canker near Hamburg.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1–2, pp. 16–18, 1921.

Tomato plants examined by the writer in September 1919 were severely attacked by a fungus, from 50 to 70 per cent. of the plants being diseased in some cases. The soil in which the tomatoes were grown was everywhere identical in composition, and equal quantities of lime and animal manure were applied in every instance. In spite of this, however, certain plants were attacked, while others immediately adjoining them remained immune. Several different varieties, e.g. Dutch Grape, Sunrise, Lucullus, Alice Roosevelt, and Danish Export, were equally affected. The owners stated that the disease was most prevalent in damp and cold weather, and also that the spots of the fungus were more numerous on the sunny than on the shady side. The latter statement could not be verified by the author. A marked feature of the disease is the suddenness and violence with which it occurs. All attempts to check the disease by the removal of the affected plants were useless. Thorough ventilation may possibly contribute to the resistance of the plants, but the writer is unable to explain why isolated plants should remain healthy while their immediate neighbours are attacked. In some cases rows of diseased plants alternated with healthy ones.

The small spots on the stalks rapidly spread into large black patches, measuring 6 cm. or more. Sometimes the spots extend round the stalk, at others they are restricted to one side. The attack usually takes place immediately above the level of the soil, but the spots occur also higher up on the stalk. The writer did not observe any traces of the fungus on the lateral branches, the leaves, or the fruit. The spots produce a depression in the cortex, which quickly shrivels. There is a sharp line of demarcation between the sound and the diseased tissues, and the fungus penetrates the interior as rapidly as it spreads over the surface. Microscopic examination has shown the mycelium extending as far as the centre of the stalk.

Treatment has hitherto proved of little use, but an early application of Bordeaux mixture may be recommended.

The disease dealt with in this paper is, according to Klebahn (see next abstract), the canker caused by *Didymella lycopersici* Kleb.

KLEBAHN (H.). **Der Pilz der Tomatenstengelkrankheit und seine Schlauchfruchtform.** [The Fungus of the Tomato-stem Disease and its Perithecial Stage.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1–2, pp. 1–16, 10 figs. in the text, 1921.

In the autumn of 1919 a previously unobserved disease of tomatoes appeared around Hamburg. It attacks chiefly the stems, and within a short time kills the portions of the plant above the point of attack. Younger stems are often attacked at their base and break down.

The disease was first mentioned by G. Massee, who called it Canker, and who states that it can also be observed on cucumber, and that it can pass over from the latter to tomatoes, and from tomatoes to vegetable marrow; according to him the fungus—an *Ascochyta*—is the conidial stage of *Mycosphaerella citrullina* described by Grossenbacher. Other workers in England and Holland accept this determination. Perithecia were not hitherto found on tomatoes.

The author had no difficulty in obtaining pure cultures of the fungus on artificial media (Salep agar), the resulting mycelium being quite similar to that found in natural cases; the somewhat twisted hyphae consist of short cylindrical cells, three to four times longer than thick, a little thinner in the middle than at the ends, which are rounded and a little swollen. From a central point, which assumes a brown colour, spreads a concentric mycelium, at first quite colourless, and later brown, which progressively invades the whole of the substratum; on the surface appear wavy threads, over which grows an aerial mycelium in flakes of a white colour. Cultivated on sterile fragments of tomato-stems the fungus produced perfect pycnidia in about eight days.

Infected tomato-stems kept during the winter either in a dry room or in the open were covered in the spring with a mass of pycnidia which yielded conidia with quite a similar germinating power to those used in the autumn; on keeping such stems damp for some time, large numbers of perithecia were also found among the pycnidia. Pure cultures were obtained from the ascospores and experiments established that both pycnidia and perithecia belong to the development process of one and the same fungus. By further experiments it was also established that the fungus is not strictly limited to the stem of tomato plants, but that it can also attack and grow on the leaves.

The author's experiments point to the fungus being a true parasite. Inoculations with conidia on the fruit gave decided results only when they were injured, the uninjured epidermis, at least on ripe fruit, being resistant to attack. On the stem, especially in experiments with ascospores, it was clearly established that penetration can occur through the unbroken epidermis, as germ tubes were observed in all stages of penetration into the uninjured cells.

The author objects to Schoevers' classification of the fungus as an *Ascochyta*; the structure of the pycnidia and perithecia is described in detail and compared with the characters of the several genera to which they may be assigned. He concludes that the fungus should be known as *Didymella lycopersici* n. sp., and that other *Mycosphaerellas* with *Ascochyta* stages require re-examination as they may also prove to be *Didymellas*.

Attempts to infect some Cucurbitaceae with this fungus gave negative results, except in the case of *Citrullus vulgaris*, of which two plants showed on a very few leaves a couple of infection foci on which pycnidia with bicellular conidia were found. Hence it is doubtful whether the fungus is the same as Grossenbacher's *Mycosphaerella citrullina*.

WILSON (M.). **A Newly-recorded Disease on Japanese Larch.**—*Trans. Royal Scottish Arbor. Soc.*, xxxv, 1, pp. 73–74, 1921.

A section of the trunk of a Japanese larch (*Larix leptolepis*), 6 ft. long and 2 to 2½ in. in diameter, and showing twelve annual rings at the lower end, was found to be attacked by a fungus apparently identical with *Phomopsis pseudotsugae*.

Two depressed areas appeared on the bark, one near the base and the other towards the upper end. These were darker in colour than the normal bark, elliptical in form, and measured 10 to 11 by 5 in. Considerable quantities of resin were exuded from the boundaries of these areas. A number of small black fructifications were found on the diseased parts, emerging through small elongated slits in the bark placed at right angles to the longitudinal axis of the stem. The fructifications were of the usual *Phomopsis* type, consisting of pycnidia partially divided up by incomplete septa. The pcynidia had a short, rather wide neck with a terminal opening. The spores were borne on distinct sporophores, and measured $7–8 \times 3–4\ \mu$.

The depressions were due to the non-development of the xylem in the infected areas, in which the cambial cells were discoloured and partially disintegrated. The phloem and cortex were still alive, but devoid of starch and permeated by hyphae. The diseased tissue was bounded by a layer of periderm, beyond which the cambium was normal, and developed a zone of secondary xylem. In the healthy tissue the phloem and cortex were normal, the cells of the latter being full of starch.

This is the first recorded instance of *Phomopsis pseudotsugae* on this host. Another new host has also recently been found, viz. *Tsuga albertiana*, on dead leading shoots of which the fungus was seen in Fifeshire in May 1921. On both these new hosts the spores agree exactly with those of the fungus on the Douglas fir, thus differing greatly from *P. abietina*.

SCHMITZ (H.). **Enzyme Action in Polyporus volvatus Peck and Fomes igniarius (L.) Gillet.**—*Journ. Gen. Physiol.*, iii, 6, pp. 795–800, 1921.

The present paper is the third of a series dealing with enzyme production in the wood-destroying fungi, the preceding ones having appeared respectively in (1) *Ann. Missouri Botan. Garden*, vi, pp. 193–200, 1919, and (2) *Journ. Gen. Physiol.*, ii, p. 613, 1919–20. The fungi dealt with were:—*Armillaria mellea* Vahl., *Daedalea confragosa* (Bolt.) Fr., and *Polyporus lucidus* (Leys.) Fr. in (1) and *Echinodontium tinctorium* Ell. et Ev. in (2).

Cultures of *Polyporus volvatus* and *Fomes igniarius* may be obtained from the young sporophores by the tissue method. In both fungi the presence of the following enzymes was demonstrated:—esterase, maltase, lactase, sucrase, raffinase, diastase, inulase, cellulase, hemicellulase, glucosidase, rennet, and catalase. In *Fomes igniarius* urease occurred in addition to the rest.

AVERNA-SACCA (R.). **Molestias da Videira.** [Diseases of the Vine.]—*Bol. de Agric. São Paulo*, Ser. 22, 1 and 2, pp. 6–15, 4 figs., 1921.

Observations on diseases of the vine in the State of São Paulo, associated with *Capnodium salicinum* Mont. and *Pestalozzia uvicola* Speg., are given. The latter fungus was found in a very active state on leaves and clusters of grapes affected by the *Capnodium*. It produces small, irregular, ash-coloured spots on the leaves and fruits, either scattered or close together, covered by small, projecting, black, shiny dots caused by the fructification of the fungus.

Both fungi are described at length, and preventive treatment with Bordeaux mixture is recommended for the latter.

Felicioni (C.). **Il Roncet nelle viti della Tripolitania.** [Rachitis of the Vine in Tripoli.]—*L'Agricoltura Coloniale*, xv, 10, pp. 507–508, 1 pl., 1921.

Vine-growers in Tripoli are threatened with serious losses from a disease which greatly resembles the typical rachitis attacking *Vitis rupestris*. The disease does not appear to be indigenous, no record of its occurrence being contained in any of the District Commissioners' Reports, which date back to the earliest days of the Italian occupation, or earlier. It has probably been introduced with the grafts imported from Tunis, which are extensively used in the local plantations.

The disease, which is not confined to grafts, is characterized by the abundant production of small, finely indented leaves, sometimes accompanied by the shortening and swelling of the internodes, and by pale spots on the leaves. These symptoms occur, in vineyards of the first year, towards July, i.e. in the second period of vegetation. Scars and necrotic patches also occur on the leaves, especially along the edges, and at the points where the dew collects. The roots show no particular external alteration, and do not appear to be rotted. Some brush-like malformations, however, have been observed, together with a discoloration of the cortical tissue. It has not yet been possible to make a structural examination of the affected organs.

The character of the soil exercises a great influence on the intensity of the disease; thus the vines growing in the alluvial regions of the Wudiâm are more severely attacked than those cultivated in sandy soil, possibly on account of the muddy bed of mixed clay and sand, the compactness of which prevents the drainage of water and aeration of the soil in which the deeper roots are situated.

Dowson (W. J.). **Some Problems of Economic Biology in East Africa (Kenya Colony).**—*Annals of Appl. Biol.*, viii, 2, pp. 83–100, 1921.

The author gives a sketch of the more important diseases of the chief plants of economic importance dealt with, bringing out where possible the conditions (meteorological and other) which influence the severity of the disease.

Coco-nuts are grown chiefly in the coastal belt with a rainfall of 60 to 70 in., distributed between a short rainy season in November, and a longer one from April to June. The most important disease is the bud-rot, but whether this is bacterial or fungal has not been determined. It attacks palms at the bearirg age (seven years) and causes considerable losses. In one case 60 per cent. of young Ceylon palms were killed, and the rest were taken out and replaced by sisal hemp. African varieties seem to be much more resistant than those from Ceylon, which suggests that the disease is probably indigenous. The state of cultivation of the plantation has a considerable influence on the disease. Thus in one case the palms growing amongst the labourers' huts, where the ground was kept clean, showed no sign of bud-rot, while those outside, where weeds flourished around the base of the trees, became diseased.

Sisal hemp (*Agave rigida*, var. *sisalana*) is also grown in the coastal belt. It has few enemies. Ring-spot disease, caused by *Colletotrichum agaves* Cav., has been recorded in a very wet rainy season. The spores of this fungus can be disseminated by air currents. In similar conditions a sun-scorch nearly always takes place, causing large, irregular, reddened patches which render decortication difficult or impossible. In the season when the ring-spot disease occurred a yellow bacterial blotch was found near Nairobi, and by the amount of gum produced on the tissues decortication was rendered impossible. Sunken yellow areas were produced on the upper half of the leaves, varying in size from a small speck to a patch several inches in length. Spread ceased at the end of rains. The organism—a bacillus—was isolated and produced the disease by inoculation. It enters through the stomata. It has not been studied in detail.

Coffee-growing has steadily increased since *C. arabica* was first planted by missionaries a quarter of a century ago. A native species, *C. nandiensis*, is found over 7,000 ft. on steep river banks, under shade. Both species are subject to a number of diseases, meteorological conditions playing a most important part in their severity, especially in regard to the leaf disease *Hemileia vastatrix* B. and Br. Below 4,000 ft. coffee-growing is rendered unprofitable through leaf disease; the high temperature and considerable rainfall are favourable to the growth of the coffee plant, but still more so to *Hemileia*. Near Nairobi, on the other hand, with an altitude of 5,000 to 6,000 ft. and a rainfall of about 30 in., the general balance of conditions is less favourable to the fungus. In the Limuru district the altitude is from 6,000 to 7,000 ft. and the rainfall from 60 to 70 in. The atmosphere is saturated in the mornings and a 'Scotch mist' is the normal experience. In this colder region coffee grows slowly but is hardy, and though *Hemileia* is present it is scarce and does little damage in well-kept estates.

The first attack is in general the most severe, and nearly all the trees may be badly infected. In well-kept plantations only a small percentage of the leaves fall, though the life of the others is shortened. Subsequent attacks cause infection on fewer leaves, and there are not so many rust pustules per leaf. This is not due to any lessening in the virulence of the parasite, as is shown by the severity of the attack on a plantation that has hitherto escaped when others in the vicinity are affected. It is due to an increased resistance of the host after the first attack.

The general health of the tree has much to do with the effects of the disease, the initial preparation of the ground, proper planting of the seedlings, pruning and thinning the crop, being all factors which influence resistance. Spraying has proved successful at altitudes of 5,000 to 7,000 ft. Any dilute fungicide will not only control the disease, but will completely eradicate it if applied at the right time. Spraying is not necessary in the Limuru district, and is useless below 4,000 ft. The most popular fungicide, known locally as 'carbide', is prepared by adding 12 oz. of calcium carbide to 40 gals. of a solution containing 2 lb. copper sulphate in water. Between 4,000 and 5,000 ft. a stronger mixture, containing 4 lb. copper sulphate and 24 oz. calcium carbide to 40 gals. water, has given encouraging results on well-cultivated estates. At such altitudes, it is essential to spray regularly to keep *Hemileia* in check.

Other diseases of coffee mentioned are the leaf and berry spot due to *Cercospora coffeicola* B. and Cke., which has caused considerable damage on neglected plantations, and is favoured by heavy and prolonged rains. It is easily controlled by spraying with carbide or weak Bordeaux mixture. Another berry spot, due to infection by a species of *Septoria*, which in its effects on the fruit is similar to that produced by *Cercospora coffeicola* and which may be identical with *S. maculosa* (Berk.) Cke. recorded on coffee berries from Venezuela, is more often met with on low-lying heavy soil, and does considerable damage unless checked by spraying when the berries are still green.

Rot of the roots occurs only on badly prepared ground and wherever old stumps and roots—which are always sources of infection by root-destroying fungi—have been left in the soil.

Die-back of the branches is particularly troublesome in districts where the rainfall exceeds 45 in. and the soil is heavy. Among the various contributory causes rendering the trees liable to this disease, which up to the present is not fully understood, are unhealthy conditions of cultivation, water-logged soil, attacks of *Hemileia*, over-bearing, insufficient pruning, and the presence of *Colletotrichum coffeanum* Noack. General conditions are less favourable in Uganda, where die-back is of frequent occurrence. So far, all attempts to elucidate the true cause of a very singular die-back of the stem, which has been reported more than once from nearly every coffee district, have met with failure. In nearly every case the disease was reported shortly after a heavy thunderstorm had passed over the plantations, and was at first ascribed to lightning. Circular patches of trees from twenty to fifty in number were discovered with shrivelled and blackened foliage; the least affected were on the outside, while there was always one tree in the centre more stricken than the rest, intermediate stages occurring between. The shoots bearing the blackened leaves were dead towards the tips; and for some distance down each shoot, including the main stem, the cortex was discoloured and the cambium disorganized. Unless the affected parts were cut off well below the discoloration in the cortex, the trees invariably died slowly back to the roots. It was found by examining old dead specimens that the cambium had been replaced by a brown mycelium, and very often the fructifications of a *Diplodia* were found on the bark, while the pycnidia of a *Phoma* and a *Phomopsis* were always present. Inoculation experiments have disproved the theory put forward that the disease was due in the first place to the *Phoma* or the *Phomopsis*, and the problem, which is of economic importance, calls for a more thorough investigation.

Amongst the forest trees of the Highlands *Juniperus procera* is subject to the attacks of the bracket fungus *Fomes juniperinus* (Schrenk) Sacc. and Syd., which causes great damage by producing a heart-rot. About 70 per cent. of the trees are affected. The fungus is probably a wound parasite.

An important *Sclerotinia* disease affecting young seedlings of *Brachylaena hutchinsi* has been recorded and partially investigated in the nurseries of the Forestry Department near Nairobi. Young trees were found to wither and die when from 3 to 4 feet high, and the roots showed numerous small black sclerotia, irregular in shape, clinging to the base of the stem just below ground level. Their size varied from a rounded mass 1 mm. in diameter to a flat irregularly-shaped mass 1 cm. across. Apothecia were produced on long ($\frac{1}{2}$ in.) stalks after a few months on sclerotia kept under conditions as natural as possible, but they never succeeded in reaching maturity and when nearly ripe withered and died, through being infested by eel-worms, which may thus keep the spread of the fungus in check.

In Citrus trees the most serious disease, if not the most common, is the foot-rot or mal-di-gomma, usually ascribed to *Fusarium limonis* Briozi, but which the author thinks is more likely due to bacteria in the first place. The *Fusarium* is probably secondary, and gains entrance through cracks in the bark due to the activity of the bacteria. Various bacterial leaf-spots, in which the Citrus Canker of the Gulf States and South Africa is not included, are common in the dry season and cause great damage by defoliation, especially in neglected groves or on stiff soil which is apt to become water-logged in the rains. The most common form of these appears as large concentric rings of small blisters, hard in texture and brown in colour.

Wheat grown in East Africa is subject to attacks by the following rusts:—Black stem-rust (*Puccinia graminis* Pers.), yellow rust (*Puccinia glumarum* Eriks. and Henn.), and brown or leaf rust (*Puccinia triticina* Eriks.). While in England *P. glumarum* is the commonest and most destructive, and in Australia *P. triticina* causes most damage, in East Africa the greatest destruction is due to *P. graminis, P. glumarum* being, in addition, very common on certain wheats of Egyptian origin. These two rusts usually, and *P. triticina* nearly always, appear late in the season, generally after the wheat has come into flower. Climatic conditions are important factors in the spread of the rust, and by choosing early maturing varieties of wheat it is possible to avoid the disease altogether. This has been demonstrated at Nairobi, where there are two rainy seasons, during both of which early maturing wheats, such as the Australian 'Florence' which matures in four months, were successfully grown. Though not a rust-resistant variety, 'Florence' escapes the rust attack if sown early enough, while 'Bobs', another Australian wheat that takes six to seven months to ripen, always falls a victim to *P. triticina* and *P. graminis*. It has been shown by experiment that excess of nitrogen in the soil renders wheat more susceptible to attacks of rust, and that flax, being an exhaustive crop, is the most useful one to precede it, since it removes the excess of nitrogen. The following rotation of crops has been found to give excellent results: (1) flax, (2) wheat, (3) beans, (4) flax or maize. A rust-resisting hybrid (Cross No. 13) has been successfully evolved by crossing 'Egyptian No. 3' and 'Nut Cut', while Cross No. 11, a selection from the hybrid 'Early Rieti' and 'Red Fife', is highly resistant to *P. graminis*.

The chief fungous enemy of flax is the wilt due to *Fusarium lini* Boll., the conidia of which have probably been borne on imported seed. Experiments designed to find out what effect the action of formalin vapour (liquids being unsuitable for flax seed-disinfection owing to the mucilaginous seed-coat) would have on the germinating power of the seed brought out the unexpected fact that germination was more rapid with a higher concentration of the gas than with a lower. The effect on the *Fusarium* has not yet been tried.

Second Rapport de la Station Agronomique de la Guadeloupe, 1919–1920, pp. 21, 22, 35–42, 1921.

The two most important pests which attack sugar-cane plantations in the island are said to be *Diatraea saccharalis* (Moth-borer) and the fungous root disease *Marasmius sacchari.* Extensive local statistics are given of the degree of susceptibility of each variety of cane cultivated in the island to these troubles, and growers are recommended to exercise the strictest care in the choice of plants and to concentrate on the resistant varieties.

Administration Report of the Department of Agriculture in Mesopotamia for the Year 1920, pp. 5, 6, 29, 30, and 42, 1921.

The most important fungous diseases identified were:

WHEAT. Black rust (*Puccinia graminis*); brown rust (*Puccinia glumarum*); orange rust (*Puccinia triticina*); loose smut (*Ustilago tritici*); stinking smut (*Tilletia tritici*). BARLEY. Rust and smuts (both loose and covered smut) do considerable damage, and late blight (*Helminthosporum teres*) is a very serious disease in this country. SORGHUM. Short and long smut are both very common on local as well as imported varieties. COTTON. Black mould (*Aspergillus* sp.), white mould (*Rhizopus* sp.), and brown mould (*Alternaria* sp.) were observed on the bolls. The sore-shin fungus was found particularly on seedlings sown deep or with bad tilth. RICE. Burnt ear disease, prevalent in 1919, has not been reported in 1920. GROUND NUT. Tikka leaf-spot (*Cercospora personata*). DATES. Leaf-spot and smut. CITRUS. Die-back, said to be caused by a *Phoma*, is the most serious disease; gummosis and canker have also been observed. GRAPE. Leaf-spot (*Cercospora viticola*). PEACH AND NECTARINE. Leaf-curl, due to *Exoascus deformans*, is spreading rapidly in the districts round Baghdad. APPLE. Scab is very common.

LEVINE (M.). **Studies on Plant Cancers. II. The Behaviour of Crown Gall on the Rubber Plant (Ficus elastica)** —*Mycologia*, xiii, pp. 1–11, 2 pl., 1921.

The rubber plant was used in inoculation experiments with *Bact. tumefaciens* in order to determine the effect of the organism on mature evergreen perennials under uniform greenhouse conditions. When inoculations were made in the stem or leaves benign or malignant neoplasms were formed, one kind in which growth was uniform and another type indicating a peripheral growth of isolated nodules. The early stages of development of the stem galls did not interfere with the growth of the plant. Finally the gall becomes hard and dies, and although the entire conducting system of the stem is not destroyed, the stem above the gall nevertheless dies, as well as a part below.

An organism was isolated from old galls and the stem above, which appeared to be *Bact. tumefaciens* in too depauperate a condition to bring about the production of a new growth in the affected plant.

EISLER (M.) & PORTHEIM (L.). **Über die Biologie des Bacillus carotovorus Jones.** [The Biology of *Bacillus carotovorus* Jones.] —*Centralblatt für Bakt.*, liii, 1–3, pp. 7–33, 1921.

The writers were unable to obtain inoculations on the raw roots of *Daucus carota* with a strain of *Bacillus carotovorus* cultivated for years on agar. The bacteria developed in some cases on slices of cooked carrots, but failed to grow on others on account of their higher acidity. When the acidity was neutralized with soda solution all the slices were attacked. Bacteria taken from successful cultures on cooked carrots flourished and became more virulent when transferred to roots previously heated to 56° C., and were then able to infect some of the raw carrot roots. Subsequent transfers from the latter gave a strain that was constantly infective. This strain also grew in the sap of the cooked carrots in which the non-virulent strain failed to grow. Against these virulent bacteria the natural acidity of the roots is of no avail, and infection can only be counteracted by mechanical processes, such as the formation of periderm and wound-tissues. Any decrease in the capacity to form such protective tissues brought about by external influences helps the entry of the bacteria. So also the non-susceptible raw roots can be rendered susceptible by neutralizing with soda solution. The strains thus obtained on hosts artificially made susceptible are then capable of attacking normally resistant roots.

The soft root-rot of *Daucus carota* was thus obtained by the writers from their pure culture strain only after the bacteria had been cultivated on carrots, the resistance of which was artificially lessened. A successful infection results on the one hand from increasing the virulence of the parasite and on the other from diminishing the resistance of the host.

MANNS (T. F.) & ADAMS (J. F.). **Prevalence and Distribution of Fungi Internal of Seed Corn.**—*Science*, N. S., liv, pp. 385–387, 1921.

The fungi occurring within kernels of *Zea Mays* are determined by means of the following technique:—Fifteen or more kernels are disinfected in a test-tube 150 × 20 mm. for one minute in a solution of 50 per cent. alcohol containing 1 gm. $HgCl_2$ per litre. The kernels are then washed in the same tube with two successive washings with 20 c.c. each of sterile water, and ten kernels are immediately removed with sterile forceps and placed with the germ side down on 20 c.c. of nutrient glucose agar in a culture dish. Five of the remaining kernels are placed each in a sterile culture dish and the point of the kernel (which contains most of the internal infection) is cut off one-sixth to one-fifth inch from the end; each of these points is then taken with a strong sterile scalpel and placed in the mouth of a heavy-walled tube containing 10 c.c. of sterile agar at 40° C., and crushed and shaken down into the medium, mixed, and poured into the dish containing the remaining part of the kernel. Germination tests of the corn were also made. The following fungi were obtained from within seeds:—*Cephalosporium sacchari*, in 39·54 per cent. of the 3,285 kernels cultured from Delaware, and also, in percentages varying from 2 to 46, from sixteen of the twenty other states from which tests were made; this is said to be the first report of this fungus in the United States.

Gibberella saubinetii was obtained commonly (fourteen states), the percentage varying from 1·33 to 25·83, and *Fusarium moniliforme* even more frequently than the *Gibberella*. *Diplodia zeae* was obtained from thirteen of the twenty-one states, and although it occurred in only 0·8 to 14 per cent. of the kernels, it was found when present to be the most important of these fungi in inhibiting germination of the seed.

DICKSON (J. G.), JOHANN (HELEN), & WINELAND (GRACE). **Second Progress Report on the Fusarium Blight (Scab) of Wheat.**—Abs. in *Phytopath.*, xi, p. 35, 1921.

From two hundred specimens of wheat scab from sixteen eastern and central states in 1920 *Gibberella saubinetii* was obtained in all but four cases, in which *Fusarium avenaceum* was found. Only 15 per cent. of the specimens produced perithecia in 1920, as contrasted with 51 per cent. in 1919. Infection occurs principally when the wheat is in flower, initial infection usually occurring through extruded anthers. Rapid development of the disease ensues if there are three or four days of warm humid weather.

FRASER (W. P.) & BAILEY (D. L.). **Biologic Forms of Wheat Stem Rust in Western Canada.**—Abs. in *Phytopath.*, xi, p. 202, 1921.

One form of wheat stem rust was found to be more common and widely distributed than the others, of which there were at least three. All were similar to biologic strains found in the United States.

NEWTON (MARGARET). **Biologic Forms of Wheat Rust in Western Canada.**—Abs. in *Phytopath.*, xi, p. 202, 1921.

At least five forms of wheat stem rust occur in Western Canada. These are identical with forms isolated in the United States by Stakman. A rather virulent strain is quite widely distributed.

DOYER (L.). **Fusarium-Befall des Getreides.** [*Fusarium* attack on Cereals.]—*Angew. Botanik*, iii, 3–4, pp. 75–83, 1921.

During 1920 the writer investigated a number of cases of *Fusarium* infection of wheat at Wageningen, Holland, and made the following observations. In the dry state grains infected with *Fusarium* are scarcely distinguishable from healthy ones; occasionally, however, they show a reddish discoloration near the germ, or may even be shrivelled. When kept moist the hyphae soon become visible on the surface. The variety of wheat principally studied was the Japhet summer wheat, which was severely attacked

(30 to 40 per cent. of diseased grains) by *Gibberella saubinetii* (Mont.) Sacc. The grains are covered with a violet and brown mycelium, interspersed with clusters of indigo-coloured perithecia. The conidial stage is a *Fusarium* with 5-septate spores, $50 \times 5\ \mu$ in diameter, often diffused in the mycelium.

In other, less frequent, cases the attack was due to *Fusarium culmorum* (W. G. Sm.) Sacc. (= *F. rubiginosum* App. et Wr.), which produces masses of brown spores, $35 \times 6\ \mu$, and a sparse violet mycelium. Occasionally also deep pink to orange sporodochia and a thin white mycelium occur on the grains. The spores, which are long and narrow, measure $65 \times 3\ \mu$. These belong to *F. avenaceum* (Fr.) Sacc. (= *F. subulatum* App. et Wr.). Similar sporodochia may be produced by *F. herbarum* (Cda.) Fr. (= *F. metachroum* App. et Wr.).

There were only a few instances of attack by *F. minimum* Fuck. (= *F. nivale* Fr.).

With a view to ascertaining the effects of seed infection on the resulting crop in *G. saubinetii*, infected samples of Japhet wheat were sown in the spring of 1920, and harvested at the beginning of September. Many of the ears were attacked, masses of pink spores and numerous perithecia occuring on the glumes, and also on the base of the stalk. The internodes showed no external signs of attack, but the nodes were covered with perithecia and *Fusarium* spores. Transverse sections through the stalks showed the hyphae of the fungus situated in the parenchyma cells, which have large lumina and relatively thin walls. The mycelium spreads rapidly from one cell to another, and may be found so high up in the stalk as to make it very possible that the ears are infected in this way. Furthermore, typical *Fusarium* cultures can be obtained from the infected internodes after surface sterilization. All this points to the probability of internal infection, a theory which has hitherto received little attention.

In the case of *F. nivale*, Schaffnit distinguishes between primary and secondary infection of the grain, the former taking place in the immature stage and checking development, and the latter occurring at the fully ripe period. Only in the last case is treatment with various fungicides useful before sowing, since the earlier attacked grains are not capable of germination even after disinfection. The author believes that the same occurs with *G. saubinetii*.

Infection is probably also disseminated by means of the perithecia on the stalk, which remain with the stubble in the soil and can affect the crop the following year, or even later.

The seedlings resulting from sowing infected grain are not always sufficiently damaged to prevent their subsequent development. Symptoms of the attack may be observed on the coleoptile and first leaves, but the subsequent growth may appear sound. Further research will no doubt show that such cases carry internal infection.

Thus the three types of disease which Schaffnit has described in *F. nivale*—seedling disease in which the young seedling is attacked and either checked in its development or destroyed, foot-rot in which the base of the stem is chiefly attacked, and ear or grain infection—occur also with *G. saubinetii* and are connected directly with one another. Starting with grain infection, diseased seedlings are obtained which may fail to develop or may give an infected plant on which, at a later stage, the symptoms of the stem-base attack (foot-rot) develop. On this infected plant the ear is attacked by internal spread of the mycelium from below and the newly-formed grain becomes infected from within.

HAMBLIN (C. O.). **Flag Smut and its Control.**—*Agric. Gaz. of New South Wales*, xxxii, 1, p. 23, 1921.

Wheat can be infected by this fungus (*Urocytis tritici*) both through the soil and through the grain to which the spores adhere. The best methods of control appear to be rotation of crops, fallow, early preparation of the seed-bed, conservation of soil moisture, and pickling, while the burning of diseased stubble is also very important.

The pickling process, employed as a preventive of stinking smut, has a cleansing value for flag smut only if the paddocks have not previously been badly infected by it. If a rotation of crops is impossible, the land should be ploughed and worked as soon after the harvest as possible, the moisture thus conserved most likely resulting in the germination of the flag smut prior to the sowing. A late variety would in this case be of advantage. It is of importance to note that spores of the fungus survive the digestive processes and are still capable of germinating, hence the disease may be spread from paddock to paddock by horses and cattle.

POLE EVANS (I. B.), THOMSON (MARY R. H.), PUTTERILL (V. A.), & HOBSON (G.). **Further Investigations into the Cause of Wastage in Export Citrus Fruits from South Africa.**—*Dept. of Agric. S. Africa, Bull.* No. 1, 48 pp., 20 pl., 1921.

This publication contains reports on micro-organisms affecting citrus fruits in S. Africa, by Mary R. H. Thomson and V. A. Putterill, and on the state of the fruit when received in England, by Geo. Hobson, together with an introduction by I. B. Pole Evans.

Brown rot (*Pythiacystis citrophthora*) and cottony mould (*Sclerotinia libertiana*), which cause serious losses in California, are unknown in S. African orchards and packing-sheds, where the wastage is due in the first place to *Penicillium digitatum* (Fr.) Sacc.; *P. italicum* Wehm. and *Colletotrichum gloeosporioides* Penz. are minor causes of loss. These fungi apparently gain entrance to the fruit only through a bruise or injury to the skin caused by handling or by insects, so that, with reasonable care, losses from this cause should be largely avoidable. The wastage appears to be directly proportional to the amount of injury sustained by the fruit.

Tests, spread over a considerable period, were carried out in the orchards, packing-sheds, and railway trucks to determine the number of species of spores contained in the atmosphere. Tables are given enumerating the fungi found on agar plates exposed (*a*) during five seconds, (*b*) during fifteen seconds; the resulting colonies included, besides *P. digitatum* and *P. italicum*, other species of *Penicillium*, *Hormodendron*, *Phoma*, *Alternaria*, *Isaria*, *Mucor*, *Epicoccum*, one *Aspergillus*, one *Helminthosporium*, *Capnodium* (?), and numerous yeasts. Old packing-cases left in packing-sheds, when moved, released innumerable spores of citrus-rotting fungi, and this was also the case with affected fruit lying about. The general conclusions drawn are, that it is of prime importance to handle the fruit with great care so as to avoid bruising or otherwise injuring the skin; that affected fruit must be destroyed by burning, and that packing-sheds require frequent disinfection and scrupulous cleanliness at all times; that the fruit truck should be clean and well ventilated and the packs so stacked as to allow free circulation of air amongst them; that the boxes should be made of smooth, well-seasoned, clean and strong wood, leaving sufficient space for good ventilation between the boards; and that the fruit should be cured for three days before being packed.

A case of South African oranges, on arrival in London, was found to contain a great number of rotten fruits, and embedded in a mass of these could be seen oranges in a perfectly sound condition, their skins having suffered no injury. Hence the most important point to keep in mind is that rotting organisms can only attack citrus fruits through a skin injury.

CARMENT (DR.). **Coco-nut Bud-rot Disease (Taviuni).**—*Agric. Circ.* (Dept. of Agric., Fiji), ii, 4, pp. 94–95, 1921.

Samples taken from diseased coco-nut buds at Taviuni (Fiji) were culturally examined and found to contain the characteristic bacillus of the *coli* group, side by side with fungi. The latter must be regarded as saprophytic and not disease-producing. The bacillus in question was inoculated on glucose peptone water and found to be negative in regard to indol production and positive to the Voges and Preskauer reactions. It can therefore be definitely stated that the *Bacillus coli* of bud-rot does not belong to the classical type of *coli communis* organisms, of human origin.

ELLIOTT (J. A.). **A New Phoma Disease of Cotton.**—Abs. in *Phytopath.*, xi, p. 48, 1921.

A hitherto unreported disease of cotton in Arkansas appeared in 1920 and made very rapid progress during a period of cool, wet weather. All plants were killed in small patches in severe cases; in others the stand was greatly reduced. A change in weather conditions abruptly checked the progress of the disease and many plants recovered. Scars of the lesions caused by the disease were found throughout the summer. The parasite, a species of *Phoma*, was isolated and successful inoculations obtained both in wounded and unwounded tissues. All parts of the plant above ground can be attacked, and extension in the tissues is very rapid, but a high degree of humidity is essential for the activity of the fungus.

BROOKS (F. T.) & KIDD (M. N.). **The 'Black Spot' of Chilled and Frozen Meat.**—*Dept. of Sc. and Ind. Res., Food Invest. Board*, Special Rep. No. 6, 6 pp., 1 pl., 1921.

Consignments of beef and mutton brought from the Argentine, New Zealand, and other countries to England are sometimes found to be disfigured by the presence of black spots on the surface. The result of detailed investigations of the occurrence and nature of this condition, which may cause the meat to be condemned at the port of entry, is described by the authors. Towards the end of the war and afterwards it was fairly common on account of the long periods of storage that were necessary.

'Black Spot' is caused by *Cladosporium herbarum* and affects all kinds of frozen meat. It has been found that the fungus develops at temperatures down to 18° F. (−7·7° C.) to 22° F. (−5·5° C.), and its spores are then of the same character as those produced at ordinary temperatures, namely, oval spores, 8 to 16 $\mu \times$ 4 to 5 μ, which may be once septate, and roughly spherical spores 3·5 to 5 μ in diameter, budded off in chains from the former. But conidiophores arising under cold-store conditions are sometimes entirely unbranched, thus differing from those produced at normal temperatures. 'Black Spots' were produced artificially in cold storage, the time taken being about six months. This, however, was shortened by keeping the tubes and pieces of meat at ordinary temperature for 24 to 48 hours after inoculation, before placing in cold storage. The lower the temperature, the slower the growth, but, since at temperatures above freezing-point competing bacteria may prevent the development of the fungus, the optimum temperature for 'Black Spot' must be placed at, and just below, freezing-point.

On meat, *C. herbarum* develops particularly upon the subcutaneous connective tissue, whether overlying muscle or fat, the brownish-black fungal threads sometimes penetrating the underlying tissues, especially muscle, to a maximum observed depth of about 4 mm. Material in which the meat is packed also carries the fungus.

Whilst meat affected by 'Black Spot' is unsightly, the presence of *C. herbarum* alone does not render it dangerous or unfit for human consumption, as no toxic substances are produced during growth, whether upon meat or other substrata. Large quantities of the fungus consumed by one of the authors mixed with other food have failed to produce deleterious results. During the latter part of the war much meat spotted in this manner was legitimately saved by trimming away the most conspicuously damaged parts. 'Black Spot' on meat may, however, be accompanied by putrefactive bacteria, and should then be condemned; the presence of the latter can easily be ascertained by the characteristic odour produced. Other fungi which may or may not accompany *C. herbarum* are white moulds (species of *Sporotrichum* and *Oospora*), bluish-green moulds (*Penicillium* spp.), pink yeasts, together with the profuse growths known in the trade as 'whiskers' (*Mucor* spp. and *Thamnidium* spp.). White moulds are known to develop at temperatures below freezing-point, but this is not established as yet in the case of the others.

Van der Bijl (P. A.). **A Paw-paw Leaf-spot caused by Phyllosticta sp.**—*South African Journ. of Science*, xvii, 3–4, pp. 288–290, 1921.

A leaf-spot disease, which does not seem to have been previously reported as occurring on paw-paw (*Carica papaya*) in South Africa, though it is not uncommon in Natal, is caused by a *Phyllosticta*.

The attacked leaves show white spots of an average breadth from 2 to 5 mm., circular, or angular, or more or less elongated in one direction, and frequently coalescing. These are often bounded by a yellow or brownish margin, which gradually merges into the normal green of the leaf. The tissues of the spots ultimately become brittle, and fall out, giving a shot-hole appearance. Black dots, consisting of pycnidia, may be observed about six days after infection in the spots on the upper surface of the leaves.

The mycelium appears to be primarily intercellular, and the author thinks it excretes an enzyme which kills the cells of the host, as these are much shrivelled up and collapsed in the affected area; in section the latter appear thinner than the rest of the leaf. The pycnidia are at first sub-epidermal, but later become erumpent; they are globose, from 80 to 106 μ in diameter, and with thin walls. The spores are hyaline, straight to slightly curved, rounded at both ends, and measure 4·4 to 5·8 $\mu \times 1{\cdot}5$ to 1·8 μ.

The fungus grows well in culture, though pycnidia do not appear to be readily formed. They were obtained on beerwort agar plates, and were up to 133 μ in diameter.

Inoculations with pure cultures gave positive results both on unwounded leaves and wounded fruits. This suggests that the fungus may possibly cause a fruit-rot in nature.

Of the three fungi, *Phoma microsporella* Karst. and Har., *Phyllosticta papayae* Sacc., and *Ph. caricae-papayae* Allesch., recorded as causing leaf-spots of the paw-paw, the author thinks that his species should be referred to the last-named.

CAYLEY (DOROTHY M.). **Some Observations on the Life-history of Nectria galligena Bres.**—*Ann. of Botany*, xxxv, 137, pp. 79–92, 2 pl., 1921.

The author describes a series of observations, both on bark and in pure cultures, on the life-cycle of the fungus isolated from canker on apple trees in England, which agrees in morphological and biological characteristics, except for the somewhat larger dimensions of the ascopores, with *Nectria galligena* Bres., not with *N. ditissima* Tul.

The only media found on which the fungus completed all the stages of its life-history, including the development of perithecia, were those containing starch or some derivative of starch, with one per cent. glycerine. Potato slopes in glycerine gave the best results.

The cultural characters of the fungus are fully described, together with the cytological details of the development of the perithecium and ascogenous hyphae. The further development of the asci was not followed. No definitely recognizable pycnidia were obtained in culture, though pycnidia occur on the bark in close proximity to the perithecia.

In addition to the micro- and macro-conidia described by former observers, the author observed a two-celled multinucleate conidium with eight or more nuclei in each cell when mature. Unstained, they cannot be distinguished from two-celled macrospores.

Inoculations with macrospores from pure culture produced typical sunken cankered areas on one-year-old apple twigs in spring.

STONE (R. E.). **Leaf Scorch or Mollisiose of Strawberry.**—Abs. in *Phytopath.*, xi, p. 44, 1921.

A disease of strawberry leaves prevalent in Ontario, and characterized by purple spots and later by a dried scorched appearance, is caused by the imperfect fungus *Marssonia potentillae* (Desm.) Fisch. This fungus was found to have as its ascigerous stage *Mollisia earliana* (E. and E.) Sacc., the connexion between the two forms being established by culture and typical infections obtained with ascospores.

ZELLER (S. M.). **Heart-rot of Prune and Peach in Oregon.**—Abs. in *Phytopath.*, xi, p. 105, 1921.

In Western Oregon the chief cause of heart-rot of these stone fruits is *Trametes carnea* (Nees) Cke., which causes more wood decay in the trees than all other fungi. Large pruning wounds are the most common place of infection. Two other fungi, *Lenzites saepiaria* Fr. and *Fomes pinicola* (Sw.) Cke., which are also usually found on coniferous hosts, very frequently cause heart-rot of peach and prune.

MARCHAL (El. et Em.). **Contribution à l'étude des champignons fructicoles de Belgique.** [Contribution to the study of fruit fungi in Belgium.]—*Bull. de la Soc. Royale de Bot. de Belg.*, liv (N. S. iv), 31 pp., 2 pl., 1921.

Owing to war conditions the authors' investigations of the fungi occurring on fruits, extending over six years, were restricted to the region round Gembloux in the province of Namur, but even so several thousand specimens were collected, of which 815 formed the subject of study. In the majority of cases pure cultures were obtained. The following list includes twenty-four new species or varieties, of which the Latin diagnosis is given, and in some cases figures:

PHYCOMYCETES: *Mucor mucedo, M. racemosus, M. fragilis, Chaetocladium Jonesi, Phytophthora infestans, P. omnivora, Pythium de Baryanum, P. intermedium.* ASCOMYCETES: *Eurotium Aspergillus glaucus, Sclerotinia Fuckeliana, S. cinerea, S. fructigena, Nectria galligena, Venturia cerasi, V. inaequalis, V. pirina, Pleospora lycopersici* n. sp., *Diaporthe perniciosa,* n. sp.; also various Saccharomycetes. FUNGI IMPERFECTI: *Phoma destructiva, Dothiorella vinosa* n. sp., *D. mali* var. *globuligera* n. var., *Fuckelia conspicua* n. sp., *Fusicoccum malorum* var. *macrosporum* n. var., *F. rimosum* n. sp., *Cytosporella fructorum* n. sp., *Cytospora personata, Septoria piricola, Sphaeropsis pseudodiplodia, Hendersonia vagans* var. *fructicola* n. var., *Gloeosporium album, Coryneum longistipitatum, Oospora umbrina* n. sp., *O. perpusilla, Geotrichum candidum, Monilia cinerea, M. fructigena, Hyalopus pruinosus* n. sp., *Botryosporium diffusum, Eidamia acremonoides, Aspergillus fuliginosus, A. glaucus, Penicillium brevicaule, P. glaucum, P. flavum* n. sp., *P. olivaceum, P. olivaceum* var. *discoideum* n. var., *P. roseum, Gliocladium cinereum* n. sp., *Acrostalagmus cinnabarinus, Cephalothecium roseum, Ramularia candida, R. magnusiana, R. macrospora, R. cerasorum* n. sp., *Echinobotryum atrum, Torula lamelligera* n. sp., *T. pulveracea, Stachybotrys alternans, Fusicladium* *cerasi*, *F. dendriticum*, *F. pirinum*, *Cladosporium herbarum*, *Macrosporium sarcinaeforme*, *M. solani*, *Alternaria tenuis* var. *mali* n. var., *Tilachlidium nigrescens* n. sp., *T. malorum* n. sp., *Isaria felina* var. *pirina* n. var., *Graphium fructicolum* n. sp., *Stysanus stemonites*, *Tubercularia piricola* n. sp., *Dendrodochium pulchrum* n. sp., *D. versicolor* n. sp., *Fusarium solani*, *F. coeruleum*, *F. subulatum*, *F. oxysporum*, *F. Willkommii*.

The conidial form of *Pleospora lycopersici* n. sp. is stated to be *Macrosporium sarcinaeforme* Cav., thus confirming the existence of a relationship between certain members of the genus *Pleospora* and conidial forms of the *Macrosporium* type.

Cultures of *Diaporthe perniciosa* n. sp. on different media have established with certainty the connexion between the ascigerous stage of the fungus and *Fusicoccum malorum* Oud. Cultures of the latter on branches of pear and apple trees produced, after several weeks, the perithecia of the *Diaporthe*, and from the ascopores of this pycnidial stromata and, later, fresh perithecia were obtained. These cultures showed considerable variations in the character of the fungus, as regards the dimensions of the perithecial necks and the grouping of the perithecia. The pycnidial stage is still more variable in culture, so much so, that it seems possible that several other previously described forms may be merely variations of *Fusicoccum malorum* Oud. *Aposphaeria pomi* Sacc. and Schulze, and *Myxosporium mali* Bres., are amongst these. *D. perniciosa* is—at least in the Namur district—one of the most frequent causes of rot in late varieties of apple and pear, especially in dry surroundings, causing a brown-black, slowly spreading spot usually at the stalk end. Pycnidial fructifications cover the spots very late in the rotting process, while perithecia are observed very exceptionally in the spring on completely mummified fruits. Plums and peaches are also attacked before ripening, becoming covered with stromata, cracking, drying up, and falling. *D. perniciosa* hibernates on the branches, especially on pear and apple, less frequently on plum and cherry, producing a canker in the outer layers of the bark; it rarely attacks the cambium and is not so serious as *Nectria galligena*. The bark infections give rise to numerous pycnidial stromata in the autumn which remain hidden in the external layers, thus simulating certain species of *Myxosporium*. Perithecia are formed later and rather capriciously. Inoculations with *Fusicoccum* spores on wounded young apple twigs in August showed the cortex invaded and pycnidial stromata forming in November.

Dothiorella vinosa n. sp. seems to be a ubiquitous species, having been found as a parasite on the leaves of plum trees and on the bark of pear and apple trees and red currant bushes. It is a frequent cause of rotting of certain varieties of apples and pears, producing a large, dark brown spot with a progressive dissolution of the tissues. The mycelium long remains sterile, pycnidia only appearing on completely rotted fruits.

Fuckelia conspicua n. sp. has been found on fallen pears of the varieties Bésy de Chaumontel and Josephine de Malines, and once on apple. The affected fruits are entirely covered with dark olive-coloured pycnidia, growing close together, below which the fleshy pulp is completely invaded by the mycelium. Spermatia, either mixed with the normal spores, or in special spermagonia, occur both in culture and on the fruit. They have resisted all efforts at germination.

Fusicoccum rimosum n. sp. differs from *F. malorum* Oud. in the character of the disk and in the position of the opening; it has been found on tomatoes gathered before complete maturity.

Notes are given on the other species mentioned in the list above, especially regarding their parasitism, frequency, and the hosts on which they occur. Besides the new forms, twenty-one are new for the Belgian flora.

HARTER (L. L.) & WEIMER (J. L.). **Studies in the Physiology of Parasitism with Special Reference to the Secretion of Pectinase by Rhizopus tritici.**—*Journ. Agric. Res.*, xxi, 9, pp. 609–624, 1921.

The following is the authors' summary:

Rhizopus tritici produces a powerful intracellular and extracellular pectinase when grown in sweet-potato decoction. The enzyme is able to effect the complete maceration of raw sweet-potato disks so that coherence of the cells is entirely lost. The optimum temperature for maceration is between 45° and 55° C. At 60° deactivation of the enzyme is nearly instantaneous; below 45° the activity of the enzyme decreases simultaneously with the decrease in temperature.

The maximum enzyme content of the hyphae and the solution is attained in about 24- and 48-hour-old cultures, respectively. The volume of the enzyme solution of a given strength does not influence the rate of maceration; the concentration of the enzyme in the solution does. Exposure of the hyphae for two hours to direct sunlight does not affect the macerating power. Centrifuging to remove the sand and fungous débris slightly deactivates the enzyme. Filtering the solution in which the powdered hyphae and sand are suspended through filter-paper weakens the enzyme; filtering the solution after the removal of the fungous felt does not reduce its strength. Extraction of the powdered hyphae for eighteen hours in water does not increase the rate of maceration when compared with hyphae not extracted. Toluol may safely be employed as an antiseptic without impairing the action of the enzyme. The quantity of sand used for grinding the hyphae does not influence the action of the enzyme. The treatment of the hyphae with acetone for twelve minutes and ether for three minutes has no influence on the macerating action of the hyphae. Washing the hyphae in running water for fifteen minutes has no influence on the action of the enzyme. The results of these investigations indicate that work of this type, involving a study of the relationship existing between a host and its parasite, may throw some light on the important question of parasitism.

Rhizopus tritici belongs to a large group of organisms, incapable of themselves of penetrating the unbroken cells of the epidermis mechanically or of dissolving them with enzymes. However, after it has once reached the tissues beneath the epidermis, it progresses with great rapidity. It, like certain other organisms, is characterized by its ability 'to act in advance' of its growth.

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IMPERIAL BUREAU OF MYCOLOGY

REVIEW

OF

APPLIED MYCOLOGY

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It is with deep regret we have to announce the death of Viscount Harcourt from heart failure on February 24th. Lord Harcourt had been Chairman of the Honorary Committee of Management of the Bureau of Mycology since its inception, and had taken keen interest in the organization and working of the Bureau. His loss will be deeply felt.

Speare (A. T.). **Massospora cicadina Peck, a Fungus Parasite of the Periodical Cicada.**—*Mycologia,* xiii, pp. 72–82, 2 pl., 1921.

The periodical cicada, *Tibicina septemdecim,* passes sixteen years and nine months of its existence subterraneously. It nevertheless bears a parasite not known to occur upon any other host. The fungus is largely confined to male insects. Conidia were found on cicadas early in the season, and are oval, 10–14 × 14–17 μ, papillate, and verrucose. They germinate by germ tubes, but the writer was unsuccessful in culturing the fungus artificially. Later in the season resting spores were found on 50 to 90 per cent. of the males. These azygospores are spherical, brownish, reticulated bodies, 38–48 μ in diameter. Attempts to germinate them failed. The fungus belongs to the Entomophthorales, and may possibly develop on biennial cicadas, although it has not been found on these so far, nor upon the larvae of *T. septemdecim.* It is not known how it is perpetuated.

Raybaud (L.). **Sur un Fusarium parasite de quelques Mucorinées.** [On a *Fusarium* parasitic on some Mucorineae.]—*Comptes rendus de la Soc. de Biol.,* lxxxiv, 4, pp. 213–215, 1921.

The writer describes the parasitism of a *Fusarium* on cultures of *Phycomyces nitens, Mucor mucedo,* and *Rhizopus nigricans.*

The fungus originated on potato-peel, and is probably a variety of *F. solani.* It will not germinate on acid media, e. g. orange-juice, and prefers the young parts of the hosts where the protoplasm is dense.

TRAVERSO (G. B.). **Cenni su l'industria degli anticrittogamici e degli insetticidi in Italia.** [Notes on the fungicide and insecticide industry in Italy.]—*Boll. mensile della R. Staz. di Patologia vegetale,* ii, 5–6, pp. 51–63, 1921.

In a general summary of the position of the fungicide and insecticide industry in Italy, the author states that the use of CAFFARO PASTE and CAFFARO POWDER has, since 1912, replaced in part that of Bordeaux mixture in Italy. The paste is prepared with oxychloride of copper, which salt was formerly used as a fungicide in Switzerland and France under the name of 'Cuprose'. From a practical point of view Caffaro paste offers over Bordeaux mixture the advantage of containing the exact proportion of lime, so that it needs only to be dissolved in the prescribed volume of water in order to have the mixture ready for use. It is true that Caffaro paste contains only 16 per cent. of metallic copper, instead of the 25 per cent. contained in the copper sulphate of Bordeaux mixture, but it has been proved by ten years' use that its efficiency as a fungicide is more or less equal to that of the ordinary mixture.

In 1919 further progress was effected by the appearance in the market of Caffaro powder, which is nothing more than Caffaro paste reduced to an extremely fine powder. It can be used either for liquid treatment by dissolving it in water in the proportions needed, or for dry pulverizations, which are recommended especially in regions where lack of water renders the use of liquid mixtures expensive. The great advantages presented by Caffaro powder from the point of view of facility of manipulation, packing, and forwarding, should cause it gradually to supplant completely the paste.

BORDEAUX POWDER ('Polvere bordolese') is still under trial and its practical value has not yet been established. [See next abstract.]

Italy is the country producing the largest quantity of sulphur after the United States, and, in addition to its use in the form of sublimed sulphur and the like, various other preparations are extensively employed, viz.:

CUPRIC SULPHUR ('Zolfo ramato').—Sulphur to which from 3 to 10 per cent. of sulphate of copper, reduced to a fine powder, has been added; it is used either pure or with the addition of inert powders such as talc, gypsum, lime, steatite, &c., to reduce the cost of treatment especially in slighter attacks of fungi.

'VITTORIA' POWDER.—A cupric sulphur powder of a patented formula, containing 3, 5, 8, or 10 per cent. of sulphate of copper and 40 per cent. of some inert impalpable powder not commonly used, which increases the adhesiveness of the preparation, so that in many cases it can be usefully employed instead of liquid treatments. It has found favour with the Italian vine-cultivators and its use is spreading.

CALCIUM-POLYSULPHIDES (or lime-sulphur mixture).—Prepared, in Savastano's method, by boiling a mixture of 10 kg. of lime and 20 kg. of sulphur in 25–30 litres of water for about one hour. The mixture thus obtained is diluted to 5 per cent. for summer and 8 or 10 per cent. for winter treatments. Its use gives good results. Various [illegible] manufactured on an industrial scale in Italy [illegible] them to be extensively used.

SUPER-SULPHUR ('Supersolfo') is a [illegible] polysulphide which appeared under this name on the market in 1920; it is a liquid super-concentrated mixture, at 35° to [illegible]° Beaumé, of polysulphides. It is diluted to 2 per cent. for summer and 4 per cent. for winter treatments, and has a strengthening action on the plants, as it contains a certain quantity of soluble iron. It is prepared from by-products of gas-manufacture and has [illegible] with success.

Professor Bruttini has lately produced a cupric super-sulphur which has given satisfactory results at the first test, and experiments are now being carried on with it

CERASOLI (E.). **Il problema nazionale degli anticrittogamici a base di rame.** [The national problem of copper fungicide preparations.]—*Boll. mensile della R. Staz. di Patologia vegetale*, ii, 5–6, pp. 64–71, 1921.

Bordeaux powder, as prepared by the author, is made by adding to a milk of lime (containing 10–15 per cent. of calcium hydrate) about 4 per cent. of chloride of calcium. Into this mixture is allowed to fall little by little and uninterruptedly, while stirring, a solution of sulphate of copper at 20° to 22° Beaumé until neutralization as indicated by phenolphthaleine. This gives a precipitate which filters without washing and is then dried in a current of air at 90° to 100° C. The preparation is claimed to have all the properties of Bordeaux mixture.

The preparation of Bordeaux powder does not entail appreciable waste of material, seeing that the reaction between the sulphate of copper and milk of lime produces the slightly soluble sulphate of calcium which has the property, amongst others, of prolonging the life of the leaf.

In order to increase the suspension of the powder, 10 per cent. of a paste made from infusorial earth and sugar-factory residues is added. Like Caffaro powder (details of the manufacture of which are given) Bordeaux powder contains 16 per cent. of copper, but its cost is lower because of simplicity of manufacture and less waste. Both these powders are cheaper than Bordeaux mixture.

DALMASSO (G.) & SUTTO (S.). **Prove di rimedi contro le crittogame della vite.** [Tests of fungicides for vine diseases.]—*Il Coltivatore*, lxvii, 12–13, pp. 364–368 and 395–399, 1921. Abs. in *Boll. mensile della R. Staz. di Patologia vegetale*, ii, 5–6, pp. 77–78, 1921.

The authors, of the Royal School of Viticulture, Conegliano, state that the treatment of the vine with dry powders only, in regions with frequent rainfall, is not sufficient against *Peronospora*, but that they can be very useful as a complementary means of checking the fungus, if alternated with liquid treatments. Bordeaux mixture remains the chief remedy, and the one per cent. formula gives sufficiently good results to justify its use rather than the stronger and more costly mixtures. Caffaro powder in solution of one per cent. gives results but little inferior to Bordeaux mixture.

The preparation known as 'Supersolfo' has not given satisfactory results against *Oidium*, but further tests are required as to the best method of applying it.

THOMPSON (N. F.). **The Effect of certain Chemicals, especially Copper Sulphate and Sodium Chloride, on the Germination of Bunt Spores.**—Abs. in *Phytopath.*, xi, 1, p. 37, 1921.

Copper sulphate, one lb. to five gallons of water, for one minute to one hour did not prevent germination of spores of *Tilletia laevis* and *T. tritici*, but only retarded it. But copper sulphate and sodium chloride inhibited germination of the spores at a strength of only one lb. of each to 100 gallons water.

MACKIE (W. W.) & BRIGGS (F. N.). **Chemical Dusts for the Control of Bunt.**—Abs. in *Phytopath.*, xi, 1, p. 38, 1921.

Copper carbonate dust, and equal parts of copper sulphate and calcium carbonate applied as a dust, each gave perfect control of *Tilletia tritici* when applied to the wheat seed at the rate of two ounces per bushel.

WERTH (E.). **Phänologie und Pflanzenschutz.** (Phenology and Plant Protection.)—*Zeitschr. für Pflanzenkrankh.*, xxxi, 3–4, pp. 81–89, 1921.

When the organization of a Plant Protection Service was started in Germany endeavours were made to gain some knowledge of the relationship, undoubtedly existing in many cases, between the occurrence of plant diseases, especially of widespread epidemics, and meteorological conditions. No general conclusions can, however, be drawn from this work, as no uniform plan was followed, and a direct proof of such a connexion is still wanting. The attempt to develop international observations made in 1913 by the International Institute of Agriculture in Rome was shattered by the Great War.

With the foundation of a laboratory for Meteorology and Phenology at the Biologische Reichsanstalt, Berlin, the investigation of the connexion between plant diseases and weather conditions has entered a new stage. A centre has been created where will be registered (through a system of report cards) the incidence of diseases and pests throughout Germany, with the phenological data required to trace their relation to weather factors; this will undoubtedly lead to new and more secure methods of handling their control.

Phenology (i. e. the observation of the annual development phases of plants or animals) can help towards attaining this end by studying the pathogenic organisms themselves from a phenological point of view, and drawing a parallel between their behaviour in the course of a particular year, or on an average of a number of consecutive years, and meteorological data such as the isothermic lines.

Examples of the correlation between diseases and weather conditions are given. Thus *Monilia* attacks primarily the ovaries of the dead blossoms of fruit-trees, and such blossoms are killed chiefly by late spring frosts; *Fusicladium* is less discriminating, and its preference for immature parts of fruit-trees indicates the danger of a cold spring; a long-delayed spring causes a delay in the sowing and favours the attacks of hoppers on young cereals;

the same may occur when the sowing is made in its right time, by a delayed growth due to drought.

Phenology can also be of considerable practical interest to plant-growers, as it can help towards the immediate selection of resistant and sufficiently productive varieties to be cultivated in a given locality under known climatic and soil conditions, without losing years in unsuccessful trials.

As it would take many years to organize regular observations of all known pests, it is necessary at first to select only a few of the most widespread and best-known vegetable and animal forms which are easy to observe and may be considered as typical representatives. Thus a standard will be obtained which will allow of conclusions being drawn regarding the behaviour of other ecologically similar forms.

General plant and animal phenology can be very helpful to the Plant Protection Service and may lead to the discovery of further cases of 'indicators', that is of associations between some easily observed phenological phenomenon and the severity of a disease-outbreak. Thus according to Hiltner: 'There seems to be a striking interdependence between the dates at which snowdrops bloom and the seriousness of the plague of field-mice which occurs from time to time in Bavaria.'

Furthermore, phenological observations will undoubtedly render more clear the combined action of climate and soil on plants. There is already convincing evidence that, under similar climatic conditions, the general type and annual developmental course of vegetation is closely dependent on the quality of the soil, but still there is much to be learned, especially regarding the influence of soil on disease. Thus it is stated that the plum-pocket disease (*Taphrina pruni* Tul.) and the red spot of plum leaves (*Polystigma pruni* Tul.) hardly ever occur on lime-rich soils, while in lime-poor soils or where no lime at all is present they can occasion heavy damage. A rainy and warm summer will favour the development of the *Phytophthora* stem and tuber-rot of potato to such an extent that, in heavy soils, up to 50 per cent. of the tubers can easily be rotted, but in a light soil the formation of tubers is stimulated by such weather, so that the damage done by *Phytophthora* can be counterbalanced and a good crop obtained.

The author therefore advocates the creation of a National Phenological Service over the whole of Germany, which in time will be able to determine the laws of the interdependence between climatic variations during a number of years, and the increase or decrease in the intensity of diseases and pests of cultivated plants; this service will ultimately aim at giving warning of a threatening plague or epidemic, and preventive and control measures can be taken in good time.

There exists already in Germany a network of official and private institutions which might be called upon to help in the organization of a regular and uniformly planned phenological service. In Bavaria there has been, since 1912, a phenological observation service with the Chief Station for Plant Protection in Munich as centre; in Württemberg also phenology has long been a part of the activity of the Meteorological Central Station (Provincial Bureau of Statistics), while in Saxony phenological observations are collected and published by the Central Meteorological Office. In Mecklenburg the State Bureau of Statistics also collects phenological notes, which are published periodically.

The author suggests the following bases for the observations:

1. Observations on a small selection of characteristic plants, the selection being made on the ground of already available experience, so as to permit of determining with certainty all the phenological phases in the course of the plant year.

2. A short list of observations on the animal kingdom, comprising five points only.

3. Observations on a series of animal and vegetable parasites.

Reports should be made at the end of spring and summer, with a general report at the end of the year, and should be sent in as early as possible to the co-ordinating centres.

Brocq-Rousseu (M.). **Les recherches mycologiques en médecine vétérinaire.** [Mycological Research in Veterinary Medicine.] —*Bull. Soc. Myc. de France*, xxxvii, 2, pp. 99–103, 1921.

The War Minister installed in 1920, at 8 Avenue de Ségur, Paris, a laboratory for veterinary research for the Army, which has for its particular object the study of contagious and parasitic diseases of the horse, their prevention and cure. The author calls attention to several diseases of fungous origin as being deserving of further study. Some of them are common to man and the horse, and are thus important from the point of view of comparative pathology. From the purely mycological standpoint their full life-history and relations are in need of further investigation. The skin diseases, of which ringworm is a type, due to *Achorion gypseum*, *Microsporon lanosum*, *M. equinum*, *Trichophyton gypseum*, *T. equinum*, *T. gypseum granulatum*, and others, are of interest to mycologists as their perfect stages, usually believed to be probably of the Gymnoascaceous type, are not known, nor under what conditions they can occur in nature as saprophytes. Sporotrichosis, due to *Sporotrichum Beurmani*, is perhaps transmissible from the horse to man by contact. Epizootic Lymphangitis, the causal organism of which is a *Cryptococcus* which in culture has given indications of a mycelial development, is worthy of much more detailed mycological study. Then there is the group of forms variously known as *Streptothrix*, *Actinomyces*, *Discomyces*, *Nocardia*, *Oospora*, *Cladothrix*, &c., which are in a most regrettable state of confusion as regards their nomenclature. Here again some are common to animals and man.

It would also be of great practical value to determine the identity of the numerous fungi affecting fodder and causing alterations which may lead to intoxication. The chemical changes they bring about should be of particular interest.

Keilin (D.). **On a New Type of Fungus: Coelomomyces stegomyiae n. g., n. sp., parasitic in the Body-cavity of the Larva of Stegomyia scutellaris Walker (Diptera, Nematocera, Culicidae).**—*Parasitology*, xiii, 3, pp. 225–234, 7 figs., 1921.

Among six parasitized larvae of *Stegomyia scutellaris*, collected by Dr. Lamborn in the Federated Malay States, one harboured a new parasite which was very similar in appearance to a new ciliate

Lambornella described in the same journal (pp. 216–224). A detailed study of the structure of this parasite, however, showed that the organism was a fungus, which the author proposes to name *Coelomyces stegomyiae* n. g., n. sp. The examination of sections showed that the larva was heavily infected and lacked one gill, while the fat-body had completely disappeared. The other internal organs were apparently healthy.

The infected portions of the parasitized larva contained oval bodies, 37·5 to 57 μ long by 20 to 30 μ in breadth, surrounded by a more or less thick yellowish wall. Fragments of a true mycelium were also seen, forming two or three concentric layers so closely attached to the host tissues that there was difficulty in separating them. The mycelium was also well developed beneath the hypoderm of the host, where it was covered with the pigmented remains of the peripheral cells of the fat-body. The numerous branches varied from 2 μ to 6 μ in thickness, the main ones being often connected by short transverse branches which showed a small diverticulum or spherical thickening in places. The mycelium was unicellular, the nuclei being crowded or scattered.

The majority of the branches show terminal multinucleate thickenings of various sizes, sometimes as much as 30 to 35 μ by 20 to 22 μ. Later these become separated from the mycelium and are found within the body-cavity of the insect, their length varying from 32 to 65 μ. At a still more advanced stage these bodies become more regularly oval, the peripheral layer of protoplasm grows denser, the external wall thickens, the nuclei increase in number, and the protoplasm becomes more basophile. Finally they become sporangia which measure 37·5 to 57 μ by 20 to 30 μ, and are flattened on one side and convex on the other. The wall of the sporangium, highly magnified, shows a very fine granular structure and many small clear lenticular spots. This wall consists of two distinct layers: (1) an internal, thin, structureless layer, 0·7 μ thick, and (2) an external layer, 1·7 to 2 μ thick, of a yellowish colour and showing numerous apertures, from which oily drops are extruded.

The young sporangium is filled with very dense basophile protoplasm containing a number of small nuclei. As it develops, the protoplasm divides into many portions, each surrounding a nucleus, and gives rise to as many small spherical cells as there were nuclei. These cells, 3 μ in diameter, become elongated, and ultimately the sporangia are filled with lozenge-shaped spores, 5 μ long by 1 μ in diameter. The escape of the spores probably results from the rupture of the sporangium along the clearly-marked line of cleavage visible on its convex surface. Thin- and thick-walled sporangia were found, both these forms being independent of the stage and content of the sporangia. Possibly the former serve for immediate reproduction, while the latter represent a resistant or resting form of the parasite.

The systematic position of this organism is somewhat obscure. The mycelium of *Coelomyces* being devoid of transverse walls, it would appear to belong to the Phycomycetes, and undoubtedly resembles the Chytridineae in some respects. Its systematic position cannot be exactly defined, however, until more abundant and living material is available for study. It is still necessary to determine

(1) the structural character of the mycelium during the early stages of infection, before its more or less complete transformation into sporangia; (2) whether conjugation occurs, and if so, at what stage of development; (3) the structure of the spores; (4) the mode of their liberation from the body of the host; and, finally, (5) the mode of infection of a new host and the formation of the first mycelium.

POLITIS (J.). **Du rôle du chondriome dans la défense des organismes végétaux contre l'invasion du parasitisme.** [Part played by the Chondriom in the Self-defence of Plant Organisms against Parasitic Invasion.]—*Comptes rendus de l'Acad. des Sciences*, clxxiii, 8, pp. 421–423, 1921.

The presence of a parasite in the interior of tissues very frequently provokes an irritation which manifests itself by a reaction in the part attacked. The author believes that the chondriom plays a considerable part in these reactions.

The leaves of *Euonymus* bear, when they are attacked by *Oidium euonymi-japonici* in the spring, large red blotches on both sides, caused by the action of the mycelium, which sends haustoria into the interior of the epidermal cells. The excitation provoked by the mycelium can be transmitted to some distance, for the red discoloration, due to an anthocyanic pigment dissolved in the liquid contained in the vacuoles, is also observed in cells quite free from haustoria. In order to explain this action at a distance, one is naturally led to admit the diffusion of an irritating principle exosmosed by the parasite. In other cases the reaction which takes place seems to be the more or less direct result of an irritation of the mitochondria, and, as a matter of fact, mitochondria are present in the cytoplasm of the cells in which the trouble starts. Most of these elements participate in the formation of the anthocyan, and of the colourless tannic compounds which are found in the diseased parts of various plants. In several parasites which produce a set of symptoms closely resembling the well-known 'brunissure', such as the *Oidium* disease of the vine, one can ascertain that the brown spots are always due to the action of the mitochondria, which produce a brown tannic compound.

In another set of cases the chlorophyll persists longer in the diseased areas of organs where it disappears normally at a given time, than in the sound ones. So, for instance, leaves of apple and arbutus, which normally are yellow when they fall, often show green patches in the areas attacked by *Fusicladium dendriticum* or *Septoria unedonis*. The same occurs also under scale insects; small green spots can thus be observed on oranges attacked by *Chrysomphalus minor*. The long persistence on the trees of leaves attacked by a parasite must also be ascribed to a parasitic excitation, as is, for instance, the case with lilac bushes on which the leaves attacked by *Aspidiotus hederae* remain during the whole winter (Trabut). In all these cases it can be proved that the parasitic invasion has an exciting action on the chloroplasts, which, according to recent views, are nothing more than highly differentiated mitochondria. The examination of a transverse section shows that the cells in these green areas contain chloroplasts which increase in size, multiply by division, and actively produce chlorophyll and starch, while the cells in the sound areas either contain degenerating chloroplasts or are wholly without them.

When the action of the parasite results in the formation of true galls, the irritability of the mitochondria is very acute; a good example of this is given by certain bluish galls on the leaves of *Lycium europeum* L. In the epidermal tissue of the galls the cytoplasm of the youngest cells contains a bright corpuscle of an oleaginous aspect. These represent the cyanoplasts described by the author in the epidermal cells of various flowers, and are derived from mitochondria (Guillermond). At first they are colourless and very small, but they gradually increase in size until they equal or even outgrow the size of the nuclei, and then become impregnated with a bluish-purple colouring matter. In this case it is therefore quite evidently proved that parasitic invasion causes an excitation resulting in the growth in size of mitochondria which produce an anthocyanic pigment. The formation of large quantities of tannin in galls must also be attributed to a similar excitation.

Thus the excitation in plants caused by a parasite can give rise to a state of reaction in the mitochondria, which become active centres for the elaboration of most of the substances secreted by the cell; some of these substances, e. g. tannin compounds, can be produced in large quantities, and probably contribute to the self-defence of plant organisms against parasitic invasion. The reaction in the mitochondria varies in different plants or even in the same plant in accordance with its stage of development and the nature of the parasite.

ALCOCK (Mrs. N. L.). **Protection against Fungi from Abroad.**—*Journ. of the Ministry of Agric.*, xxviii, 7, pp. 455–459, 4 pl., 1921.

The new Destructive Insects and Pests Order of 1921 has been framed to prevent the entrance of certain dangerous parasites into England. Two of these—wart disease of potatoes and onion smut—are already in this country, but their distribution is known and their control is dependent on this knowledge being reliable, so that new introductions are undesirable. The other scheduled diseases have so far not made their appearance, and it is hoped that the new Order will prevent their introduction. They are four in number. Chestnut blight (*Endothia parasitica*) is a bark disease which has caused losses in the United States reaching many million pounds sterling, and all efforts to control it have proved fruitless. Downy mildew of hops (*Peronoplasmopora humuli*) was imported from Japan into the United States and is there spreading. Fire blight, a bacterial disease due to *Bacillus amylovorus*, has been stated to be the most universally destructive of all pomaceous fruit diseases, and in the United States the growing of susceptible pears has been rendered unprofitable by it in some localities. Black knot of plum and cherry (*Plowrightia morbosa*) abounds on the wild plums and cherries in the United States, and is as destructive as it is common. Other diseases occur in various parts of the world that may become extremely destructive to cultivated plants if introduced into England, but these four are of outstanding importance.

UPHOF (J. C. T.). **Eine neue Krankheit von Cephalanthus occidentalis.** [A new disease of *Cephalanthus occidentalis.*]—*Zeitschr. für Pflanzenkr.*, xxxi, 3–4, pp. 100–108, 1 fig., 1921.

A disease of the shrub *Cephalanthus occidentalis* (Rubiaceae) is described, which the writer found in 1918 near Poplar Bluff, Missouri, U.S.A. It is believed to be a form of mosaic disease. No similar affection, so far as the writer knows, has been hitherto observed on the Rubiaceae.

The soil was a fertile clay, very liable to flooding, and in some parts practically a swamp. There were entire rows composed of these shrubs with the characteristic mottling of the leaves, while others again were quite green and normal. To all appearance the disease radiated out from a given point, and was presumably connected in some way with the early summer floods.

The young leaves, 3 to 10 cm. in length, were of a normal pale green colour, but dotted with small light spots. The latter gradually increase in size with the growth of the leaf, and finally merge into one another, thus forming large irregular patches from 3 to 30 mm. in diameter. All parts of the leaf—base, centre, veins, and tip—are liable to attack, as are also the pedicels, young branches, and roots.

The disease appears to result in an elimination of the chlorophyll grains. Neither insect nor fungous parasites could be detected, while bacteria were also absent.

The structural differences found between healthy and mosaic tobacco-plants, one of the foremost of which is the feeble development of the palisade parenchyma in affected leaves, appear to be absent in the case of *Cephalanthus*. Transverse sections of a *Cephalanthus* leaf in a fairly advanced stage of the disease show that some of the chloroplasts are normal in colour, while others are much lighter. All, however, are of the same size. The virus appears to be diffused from the centre of the spots, and to be conveyed by means of the protoplasm to the chloroplasts. Gradually, as the disease advances, the chloroplasts divide irregularly, and the last stage of infection is characterized by the total degeneration of the chlorophyll grains and the presence of large grains of starch. The corresponding parts of the leaves are very transparent.

Inoculation experiments were successfully carried out, the average duration of the incubation period being 12 to 14 days. Healthy parts of the plant could be infected by the virus, which was filtered through cotton or paper. A temperature of 100° C. kills the virus, which survives 60° C. The actual thermal death-point has not been ascertained. All attempts to inoculate other plants of various families were unsuccessful.

BLAKESLEE (A. F.). **A Graft-infectious Disease of Datura resembling a Vegetative Mutation.**—*Journ. of Genetics*, xi, 1, pp. 17–36, 5 pl., 1921.

Plants of the Jimson Weed (*Datura stramonium*) have been found to develop spontaneously a peculiarity which can be transmitted by grafting to normal stocks. Such plants are called *Quercina* on account of structural characteristics of the leaves. The first *Q.* plant was found in the cultures at the Connecticut Agricultural College in the autumn of 1915, and was then believed to be a spineless mutant of the purple-stemmed form. Seed was obtained for experimental purposes by means of artificial pollination.

The *Q.* plants do not breed true, but throw a small proportion of normal plants along with *Q.* seedlings. The latter are usually recognizable at an early stage, the leaves being narrower than the normal, somewhat twisted, and indented at the margins. The stature of *Q.* plants is below the normal, the branches are more slender, and the root system not so well developed. The flowers are also easily distinguishable from the normal. The corolla is split between the lobes as far down as the insertion of the filaments, the segments being incurved and twisted around the base of the flower. In the expansion of the bud they are frequently unable to free themselves from the calyx. The colour of the flower is darker than the normal, while the stem colour is also more intense. The stamens in the bud are shrivelled, and produce only a few small grains which do not function. The stigmatic surface is chiefly on the inside of the lobe, and runs part of the way down two sides of the style.

The most conspicuous peculiarity of *Q.* plants, however, is the suppression of spines on the capsules. This may be complete, giving capsules as smooth as those of the *inermis* variety. The form of the capsule, however, is that characteristic of the variety or mutant affected, the globe mutant plants, if also *Q.*, having flattened globose fruits. Seeds from *Q.* capsules are distinctly smaller than those from normals, and their percentage of germination is less. Older seedlings also appear less vigorous than the average.

The foregoing descriptions apply to *Q.* plants raised from seed, but the condition has been known to break out spontaneously in the field, generally late in the season, on plants which have been produced by normal parents. The first symptoms are changes in the form of leaves and flowers. Purple flowers turn darker and are often mottled. As the season advances, more plants show *Q.* branches, and when normal plants have flowered and formed capsules, *Q.* plants are still flowering. Breeding experiments have been carried out, the *Q.* plants being combined with all available types of the Jimson Weed. No varietal immunity has been discovered within the species. The evidence from these experiments shows that the *Q.* infection is ordinarily carried by the female gametes and affects at least 79 per cent. of the seed produced by *Q.* parents. It can also be carried by the male gametes, but this is less common since *Q.* plants only occasionally produce pollen.

It was thought that the *Q.* complex might be due to a mosaic type of disease, such as that affecting tobacco, another member of the Solanaceae. Attempts were therefore made to transmit the infection to healthy plants by rubbing their leaves with those of *Q.* plants, but without success.

The grafting of *Q.* branches on normal stock or vice versa has invariably given infection, which is usually manifest as soon as new leaves are formed. A number of Solanaceous species were tested by grafting with *Q.* Jimson Weeds, but none was so susceptible as the Jimson Weed itself. *Datura meteloides* was infected by grafting, but the disease was slow in making its appearance. Most of the species tested seem immune against the infection and unable to transmit the virus. The petunia is a typical example, being unable to transmit the virus through as much as 16 cm. of its stem. Experiments with tomatoes were also unsuccessful, the virus failing to pass through 3·5 cm. of the tomato stem and infect a normal Jimson graft. Both the scions of Jerusalem cherry grafted on *Q.* stock produced normal flowers with pollen and fruit, but their leaves, though normal in shape, were more or less marked with yellow blotches. Of two grafts from these infected scions on to Jimsons, one transmitted the disease. The egg-plant gave some slight evidence of susceptibility to infection, one of the two scions grafted on to *Q.* Jimsons having puckered leaves resembling those of *Datura meteloides* in the earlier stages of infection. The only other instance of susceptibility to *Q.* infection through grafting was that of *D. ceratocaula.* Of two scions grafted on to *Q.* Jimson stock, one produced a flower without pollen and two slightly abnormal buds which fell off before opening. The corollas of the latter were more or less slit. Later flowers from this plant, however, were normal.

At least one other mosaic-like disease has been found to affect *Datura stramonium.* This has been called '*Z*', and was first noticed in two adjacent plants in the field cultures of 1917. Infected plants are obviously diseased. The leaves are light in colour, mottled, somewhat eroded, and very much puckered, resembling the badly diseased leaves of beans attacked by mosaic. The leaves may be reduced to merely the midribs. The capsules are deformed, with spines reduced or absent. The buds are usually elongated, the flowers 'confused', with corollas split or malformed and numerous accessory carpels. Infection develops rapidly, and is evidently transmitted by means of contact. Attempts to communicate the disease to normal plants by rubbing them with infected leaves were mostly successful, but no extensive experiments have been carried out to discover susceptibility in other Solanaceae. It has not yet been found possible to transmit the disease to tobacco (*Nicotiana tabacum*) either by rubbing the leaves together or by grafting.

From smooth capsules of a '*Z*' plant 89 seeds were sown, giving 77 seedlings which remained normal. Experiments thus indicate that the '*Z*' disease is infectious by contact of leaves but is not carried by seed.

A number of mosaic diseases have been described in the Solanaceae. The *Q.* disease of *Datura stramonium* differs from these in being carried both by seed and pollen, and appears not to be transmitted artificially by mere contact or inoculation. The communication of infection to normal plants by grafting relates the disease to the infectious chlorosis of *Abutilon thompsoni* and other forms investigated by Baur. It differs, however, from such in that no vegetative function of the plant is obviously impaired, and also in being carried by seed.

The far-reaching morphological changes in the flowers, fruit, and leaves of *Q.* individuals would entitle them to specific, if not generic, separation if 100 per cent. instead of only 79 per cent. of the seedlings bred true to the *Q.* complex. As the facts stand, however, there is much in the behaviour of *Q.* plants which suggests genetic phenomena. Instances in the literature are cited where the same disease appears to have been met with, but mistakenly attributed to blending or to so-called 'mosaic' inheritance.

DICKSON (B. T.). **Studies on Mosaic.**—Abs. in *Phytopath.*, xi, 4, p. 202, 1921.

The writer states that mosaic is now known in thirty genera of ten families, and mosaic-like diseases in eight genera of five families. Hyperplasia of palisade parenchyma and less chlorophyll and carbohydrate in the light areas, and generally an increase in trichomes and glandular hairs, are reported as histological symptoms of true mosaic.

GARD (M.). **Sur le dépérissement des Noyers dans quelques régions de la France.** [On the dying of Walnut-trees in some regions of France.]—*Bull. Soc. de Path. Vég. de France*, viii, 1, pp. 41–44, 1921.

One of the most serious diseases attacking walnuts is the rot described by Prillieux and Delacroix in 1878. The large roots exhibit laminated rhizomorphs, which spread into fan-shaped plates in the cortex, phloem, and cambium. As a rule the wood is destroyed only to a slight depth, though in the smaller roots all parts are attacked and decayed. The plant reacts by producing tyloses and wound-gum. One of the surest indications of the parasite is the peeling of the dead cortex at the base of the trunk, accompanied by the exudation of a blackish liquid, which solidifies when exposed to the air. At this stage, however, the tree is nearly dead.

Microscopic examination reveals the rhizomorphs embedded in the tissues, and sending feeding branches into the adjacent parts. Most authorities are agreed, with Prillieux and Delacroix, that the disease is caused by *Armillaria mellea* Vahl, and the presence of this fungus at the base of dead or dying walnuts supports this view, as also does the spread of the epidemic in rows or circles in walnut groves. Experimental inoculation from the spore or rhizomorphs has not, however, to the author's knowledge, been attempted. Experimental cultures in different media are in progress.

A second serious disease of the walnut attacks not only the roots but the branches, and is characterized by the appearance of a zone, first brown and then black, and of considerable extent, in the pericambial region. The cell-walls turn yellow, while deposits of small black granules collect along their inner surface. Certain cells rich in starch, especially in the cortex, contain a brown substance in the shape of small, variable, irregular bodies, which unite to form one or several masses, while the starch grains gradually disappear. The starch grains evidently play a part in this process, as is shown by a progressive change in their coloration and the loss of their property of being tinted by iodized water. Sometimes they seem to swell and then amalgamate to form more voluminous masses. The cortex turns black in patches which are isolated by layers of cork, while the wood, though less affected, reveals the same discoloration in places. Tyloses and pectic gum are also formed, as in the case of rot.

The root system suffers more than the branches, at any rate at the beginning. In the older organs of both the wood undergoes less change than in the young ones. In the woody tissue there is also a transformation of the membrane of various elements, which is incompletely detached from the middle lamella. Possibly the walls take part in the process described above. Here and there are groups of bacteria, especially in the gum of the vessels. The colloidal substance engendered is insoluble in ordinary solvents, such as alcohol, ether, chloroform, benzine, and carbon bisulphide. On the contrary, hypochlorite of soda discolours and almost destroys it.

It is possible that this disease belongs to the group of the gummy degenerations ('mal nero', 'gummosis', &c.), the exact cause of which is still debated. In any case, further researches will be necessary to reveal its source. There are indications that it develops much more slowly than the disease first mentioned. Both these diseases usually occur together, sometimes one being predominant and sometimes the other. They are causing enormous damage in several districts of France.

De Wildeman (E.). **Les maladies et ennemis du palmier à huile.** [Diseases and Pests of the Oil-Palm.]—*Matières grasses* (Institut Colonial de Marseille), xiii, 153, pp. 5737–5738, 1921.

Notwithstanding the recognized fact that the African oil-palm growing in its native state in the forests of tropical Africa is less subject to attack by parasites than the highly-cultivated varieties, certain diseases do occur, and these have been largely overlooked. In May–June, 1920, an article by Maublanc and Navel appeared in *L'Agronomie coloniale* (No. 30, p. 187) describing a disease of *Elaeis* at San Thomé, which was certainly due to a Polypore (*Ganoderma applanatum* Pers.).

Miss Wakefield (*Kew Bull.*, 1920, No. 9) states that *Ganoderma lucidum* (Leys.) Pat. was reported by Farquharson in Nigeria and Swainson-Hall in the Portuguese Congo. In addition to these the following have also been found on the oil-palm in the Congo: *Ganoderma pectinatum* Kl., *pectinatum* var. *congoanum* Bres., *tumidum* Bres., *versicolor* Bres., *connatum* Pers., *fornicatum* Fr., *fulvellum* Bres., *pediforme* (Fr.) Pat., *australe* (Fr.) Pat.

Thus it is evident that even in Africa considerable damage may result from fungous diseases, and it is extremely important that all diseased material should be submitted to a competent systematic mycologist, with a view to determining the nature and extent of the danger. The greatest care should be taken to remove all decaying logs, &c., from the plantations, and to excise the diseased tissues from trees which it is possible to save (Maublanc and Navel, *loc. cit.*). The wounds should be dressed with sulphate of iron and tar, and the cavities filled with cement to increase the solidity of the trunk. If any doubt exists as to the possibility of a radical cure by those means, the trees should be destroyed, since they will otherwise only harbour the germs and disseminate them.

The method of planting in squares (suggested by Dr. Cramer of Buitenzorg) is recommended, as it facilitates the removal of worthless trees.

Insufficient attention has been paid to the ravages caused by the Oryctes, which are undoubtedly instrumental in carrying fungus-spores from diseased to healthy trees (cf. L. R. Jones, 'Problems and Progress in Plant Pathology', *Smithsonian Report*, 1914, pp. 407–419). It must be remembered also that, according to a report of Farquharson, the bud-rot of coco-nuts can be transmitted to oil-palms. The practice of 'bleeding' the latter should therefore be prohibited in all regions where bud-rot of coco-nuts is prevalent. According to Swainson-Hall, a disease very similar to bud-rot exists among oil-palms in the Portuguese Congo. Although not yet reported from the Belgian Congo or Gaboon, the disease probably exists there too, and is no doubt in part responsible for the mortality supposed to be due to excessive 'bleeding'.

KOBEL (F.). **Das Problem der Wirtswahl bei den parasitischen Pilzen.** [The Problem of Host selection by parasitic Fungi.]—*Naturw. Wochenschr.*, xxxvi, 8, pp. 113–118, 1921.

A discussion of the choice of hosts by obligate parasites. Allied fungi on allied hosts may show marked differences in specialization. Thus, *Cystopus candidus* on *Capsella* attacks various other Cruciferae, while *Peronospora parasitica* is highly specialized and seldom occurs in the same biologic form on more than one Crucifer.

Cronartium asclepiadeum has its aecidiospores on the pine, and its uredo-teleuto stage usually on *Vincetoxicum officinale*. But the latter may also be found on some fourteen other species belonging to seven Natural Orders, while several other species of the same genera are immune. It will attack, for instance, only two of nine species of *Verbena* tried, and only one of four *Impatiens*.

Uromyces trifolii has two morphologically indistinguishable forms, one of which attacks primarily *Trifolium pratense*, and in a lesser degree other *T.* species, with the exception of *T. ochroleucum*, while the other is found on *T. ochroleucum* and some other species, but never on *T. pratense*. *T. alpinum*, *arvense*, *pannonicum*, and *squarrosum* are attacked by both forms.

In considering the cause of this, several factors must be distinguished. One of the most important is the ecological one. In some cases a fungus appears to be dependent on those plants which occur naturally close to its original habitat. In 1905 Stäger found a form of ergot which attacked only *Brachypodium silvaticum* and *Milium effusum* growing in woods, and not the allied meadow species. Fischer found that *Uromyces caryophyllinus*, which forms its aecidia on *Euphorbia seguieriana* (= *E. gerardiana*), had teleutospores in Wallis (Switzerland) on both *Saponaria ocymoides* and *Tunica prolifera*, but when he brought material for inoculation from Baden he found only the latter host was readily attacked, the former responding very slightly, presumably because it does not grow in Baden. But such a connexion between specialization and natural surroundings is often absent, e. g. in *Cronartium asclepiadeum*, which attacks a number of plants quite foreign to the natural habitat of the pine.

Morphological peculiarities of plants have not, in a general sense, any close bearing on this question, though there are some exceptions. Systematic relationships also do not throw much light on it, since within even susceptible species or varieties there may be immune strains. But sometimes the systematic relationships are marked, e.g. in *Puccinia hieracii* and *Bremia Lactucae*, both of which follow closely the systematic relations of their hosts.

Chemical affinity affords a sounder clue to specialization, though there is as yet little definite work on this aspect. It is known from the work of Thöm and Thaysen (1915) that the same plant may possess different proteins, and it may be that the different hosts of a parasitic fungus have certain proteins in common. This line of work deserves to be followed up. A bibliography is appended.

KASAI (MIKIO). **On the Morphology and some cultural results of Fusarium solani (Mart.) Appel et Wollenweber, an organism which causes Dry-rot in the Irish Potato tubers.**—*Berichte des Ohara-Inst. für landwirtschaftliche Forschungen* (*Japan*), i, 5, pp. 519–542, 3 pl., 1920. (Recd. Nov. 1, 1921.)

A *Fusarium* which was identified as *F. solani* was isolated from rotted tubers of *Solanum tuberosum* from the Okayama district of Japan. The *Fusarium* was found to be able to rot tubers, although slowly, when the tubers were artificially wounded and inoculated. The results of a number of cultural and morphological studies are given, together with very full spore details. The author considers that the organism very closely resembles *F. coeruleum* (Lib.) Sacc., but on the basis of shape of conidia and coloration of glucose agar assigns it to *F. solani* (Mart.) App. and Wollenw.

CURTIS (Miss K. M.). **The Life-history and Cytology of Synchytrium endobioticum (Schilb.) Perc., the cause of Wart Disease in Potato.**—*Phil. Trans. Royal Soc. London*, Ser. B, ccx, pp. 409–478, 5 pl., 1921.

This is a very complete account of the life-history and cytology of the cause of wart disease, and forms the most important contribution to the subject as yet furnished.

The life-history of *Synchytrium endobioticum* is as follows: Zoospores are liberated from resting sporangia in the spring. After a short period of activity these spores come to rest on the surface of the host. The entire spore passes into the host cell through a small pore in the cell wall. More than one spore may enter a host cell, but these are usually separated into different daughter host cells by the cell multiplication of the host. The spore of the fungus rounds off within its host cell, and from this stage until segmentation to form sporangia begins the term prosorus is applied to the structure. The prosorus grows, as does also the host cell. The former develops a thick orange outer and a thin hyaline inner membrane. Its contents, surrounded with a delicate membrane, pass through a pore in the outer wall into the host cell. Several mitoses of the nuclei of the fungus then take place, whereupon the protoplasm segments into about five thin-walled sporangia which constitute the sorus. Further nuclear divisions (mitotic) occur, until finally small zoospores are formed. Meanwhile the host cells have divided repeatedly, forming a tumour, and the epidermal cells in contact with an infected cell grow up to form a rosette arching over the sorus. The mature sporangia absorb water and enlarge, rupturing the host tissue, and so come to lie exposed on the surface. The motile cells escape from the sporangia. They may act either as zoospores and cause infection and the production of another sorus, or they may act as gametes and fuse in pairs. The zygote resulting from this fusion enters a host cell in much the same way that zoospores enter, but instead of forming a sorus forms a resting sporangium. This sporangium comes to lie rather deeply in the tumour because of repeated host-cell divisions above the cell containing the fungus. The resting sporangium produces a thick wall about itself, the epispore being deposited from the dead contents of the host cell. Its zoospores do not function as gametes.

The zoospores have a single long posterior cilium, attached to a blepharoplast. They may swim about for thirty to forty minutes after liberation, after which they come to rest. If not then on a host cell, they disintegrate. They seem, however, to be attracted by host tissue, and especially towards the host cells in which nuclear division is proceeding. The cilium becomes contracted, eventually forming a heavily staining globule on the zoospore. This globule is apparently thrown off. A projection meanwhile appears on the side of the nucleus towards the epidermal surface; this elongates, and reaches the surface of the zoospore next to the cell wall, and then consists of a chromatic granule connected to the nucleus by a thread of nuclear material. This projection, doubtless covered by a layer of cytoplasm, which, however, is too thin to be visible, then pierces the cell wall and enters the host cell, and the cytoplasm and nucleus of the zoospore follow through the pore. The nucleus is much drawn out in the process of entering, but once within, the nucleus and prosorus round up. The pore through which the zoospore entered is not evident after penetration has occurred. Zoospores derived from the same sporangium apparently will not act as gametes and fuse, but those from different sporangia (even of the same sorus) seem to be mutually attracted and fuse. No cell wall appears to be formed around the zoospore after it comes to rest, only plasmatic membranes being present from the beginning until the prosorus or resting sporangium has reached a fairly advanced stage of development.

The author presents many cytological details in addition to those mentioned above. While the nuclear divisions are mitotic in the developing sorus and non-resting sporangium (although accompanied by nucleolar discharges of globules, the production of strands, &c.), the nuclei after fusion, i. e. in the formation of zoospores in the resting sporangia, divide amitotically. Reduction is considered to come about by extrusion into the cytoplasm of granules of chromatin.

Persistence of the organism in the soil may be explained perhaps either by resting sporangia remaining ungerminated, by the infection of other host plants, or by a saprophytic mode of life.

The fact that sori are developed in the spring and resting sporangia in late summer or autumn is considered to be dependent not upon temperature, but upon moisture supply. Only matured zoospores, developed while the sporangia remained comparatively dry, were found to fuse, and from zygotes only are resting sporangia produced.

The author discards the generic name *Chrysophlyctis* for this fungus, and does not consider that *Pycnochytrium* is a genus sufficiently distinct from *Synchytrium*.

A bibliography is appended, and the paper is fully illustrated.

JENNISON (H. M.). **Bacillus atrosepticus van Hall, the Cause of the Blackleg Disease of Irish Potatoes.**—Abs. in *Phytopath.*, xi, 2, p. 104, 1921.

The writer concludes from an exhaustive study of the comparative morphology and physiology of the parasites that *Bacillus atrosepticus* van Hall (1902), *B. phytophthorus* Appel (1903), *B. solanisaprus* Harrison (1906), and *B. melanogenus* Peth. and Murphy (1910) are identical, and agrees with Morse that *B. atrosepticus* should stand. The group number is given as 221·1113033.

HEALD (F. D.). **The Skin Spot (Oospora pustulans) of the Irish Potato.**—Abs. in *Phytopath.*, xi, 2, p. 104, 1921.

This disease was found on 95 per cent. of the tubers in several car-loads of Gold Coin potatoes shipped to Spokane, Washington, from British Columbia. Affected tubers showed very poor keeping qualities.

YOUNG (H. C.) & BENNETT (C. W.). **Studies in Parasitism in the Fusarium Group.**—Abs. in *Phytopath.*, xi, 1, p. 56, 1921.

Wilting of potato plants may be produced by a water solution of an alcoholic precipitate derived from a 28-day culture of *Fusarium oxysporum* in Richard's solution. Hence the fungus acts not by plugging the vessels but by the production of substances, the exact nature of which is being investigated.

MARTIN (W. H.). **A Comparison of Inoculated and Uninoculated Sulfur for the Control of Potato Scab.**—*Soil Science*, xi, 1, pp. 75–84, 1 pl., 3 figs., 1921.

A number of experiments conducted by the author and here described in considerable detail led to the following conclusions:

The addition of sulphur to soil usually leads to an increase in soil acidity due largely to the oxidation of the sulphur by sulphofying micro-organisms. Where these organisms are absent it is necessary to supply them.

On the soils used for these experiments the use of sulphur inoculated with sulphofying organisms gave better control of scab than similar amounts of uninoculated sulphur. In addition to the difference in control, smaller quantities of inoculated sulphur produce the required results.

Hydrogen-ion exponent values of soil samples taken from plots treated with inoculated and uninoculated sulphur respectively were considerably lower than corresponding exponent values of soil samples taken from check plots. In most instances this increase in acidity was accompanied by a corresponding decrease in the number of scabby tubers.

McKay (M. B.). **Transmission of some Wilt Diseases in Seed Potatoes.**—*Journ. Agric. Res.*, xxi, 11, pp. 821–848, 8 figs., 3 pl., 1921.

Verticillium albo-atrum is more important than *Fusarium oxysporum* as a cause of wilt of potato plants in western Oregon. Isolations made from 12,136 tubers yielded *V. albo-atrum* in 17·3 per cent. of the cases, and 30·7 per cent. of the tubers showing browned vascular tissue at the stem end gave this fungus. It may be present in tubers not showing discoloration, an average of 6·6 per cent. of the tubers that yielded *V. albo-atrum* being free from discoloration. *Fusarium oxysporum* (which also causes wilt) was present in 2·4 per cent. of all the tubers cultured. *F. radicicola*, which is not known to cause wilt but discolours the tubers, was isolated from 4·2 per cent. In general, *Fusarium oxysporum* produced the heaviest discoloration, *F. radicicola* next heaviest, and *Verticillium* the least heavy discoloration of the three fungi; but identification of the pathogen cannot be made with certainty from an examination of the vascular discoloration. In many cases no organisms were obtained from tubers showing discoloration. Other Fusaria and miscellaneous fungi may also occur in the stem ends of tubers. The longer the potatoes are kept in storage, the greater the number of tubers giving organisms in culture. *V. albo-atrum* occurred somewhat more extensively in small potatoes than in those of medium size. The presence of *F. oxysporum* and *F. radicicola* shows no particular correlation with the size of the tubers. Sometimes more than one organism is present in the discoloured tubers.

From 30 to 50 per cent. of the tubers grown from seed potatoes infected with *Verticillium* were invaded by the same organism. *Fusarium radicicola* and *Fusarium oxysporum* were transmitted to only a slight extent from seed potatoes to yields, and are probably present in the soils.

It was found that little reliance could be placed upon the practice of discarding the stem end portions of potatoes which showed vascular discoloration, since practically the same amount of disease was obtained from planting eye ends as from planting stem ends of the infected tubers.

Potato plants affected with *Verticillium albo-atrum* yield 30 to 50 per cent. less than unaffected plants, and the disease causes appreciable losses each year in western Oregon. Fusaria producing wilt cause little loss in this region.

Tisdale (W. H.) & Jenkins (I. M.). **Straighthead of Rice and its Control.**—*U.S. Dept. of Agric. Farmers' Bulletin*, 1212, 16 pp., 7 figs., 1921.

Straighthead, a name commonly given to rice heads (panicles) which are so nearly sterile that they remain erect when mature, is one of the most destructive diseases of irrigated rice in the Southern States. A number of other forms of sterility may be confused with it, namely:

1. Alkali Injury, due to an abundance of alkali in the soil which weakens the plants and gives them a stunted and rusty

appearance. Some of them fail to produce seed after heading, but these do not remain green as do plants with typical straighthead.

2. Drought Injury, developed when the plants are heading; their rapid dying and blasted appearance distinguish this trouble.

3. Nitre Spots, a local (Californian) condition causing green plants to be seen at harvest time. They are sterile and straight, but none of the typical straighthead symptoms could be detected. Experimental dosing with nitrogen in sufficient quantities to kill most of the plants failed to produce sterility in those that headed.

4. Dry, hot winds are said to cause considerable sterility of rice in California. The heads have a blasted appearance as if they had been scorched by fire.

5. Poor, grassy land causes sterility, especially when there is not sufficient water to kill the weeds and grass. The glumes in these cases are likely to be stained by invading fungi. The other typical straighthead symptoms are absent and this form of injury is not common.

6. Rotten Neck (*Piricularia*), a fungous disease which may kill rice heads sufficiently early to prevent their filling normally. The frequent breaking of the heads and the brown discoloration caused by the fungus prevent their being mistaken for straighthead.

Investigations have shown that straighthead is caused by certain unfavourable soil conditions and not by a parasitic organism, which all attempts have failed to find. The disorder is chiefly found either on virgin soil or on land on which non-irrigated crops (notably corn and cow-peas) have been grown for a number of years preceding the rice crop. Decaying organic matter aids the disease, and it has been found that where corn is grown on ridges—as is the case in the Southern States—rice plants in the corn rows are normal while those in the furrows (where the old corn and pea plants are generally thrown) suffer from straighthead. Want of aeration in the soil, partly due to excessive and premature irrigation, appears to be an important contributory cause. Loose soil, which when irrigated becomes soft clinging mud, is not favourable to the growth of the plants as the air is pressed out by the water.

The symptoms are not easily detected until the plants have headed, but even before this stage of the development is reached there are certain characteristic peculiarities: (*a*) the leaves of the diseased plants appear darker green and stand more erect than the leaves of normal plants; (*b*) the sheaths adhere closely to the stem and are hard to remove even when the plants are dry; (*c*) the heads emerge slowly and do not extend as far above the top sheaths as do normal heads: plants affected severely may even fail to head; (*d*) when the glumes start to develop, aborted glumes are the most noticeable symptom; (*e*) most of the flowers in diseased plants never open, and no indication of seed development can be seen, while others open normally but fail to produce kernels; (*f*) straighthead plants remain green (the heads noticeably so) after normal plants of the same age are mature; (*g*) diseased plants show strikingly abnormal root systems: they will be found to have a large number of coarse, or water, roots, and these only sparingly branched, while the normal plant possesses only a few of these coarse roots and will be branched abundantly, with a large number of secondary roots and root-hairs. These root characteristics of diseased plants are useful in detecting the disease in its early stages and thus making it possible to aerate the soil in time to prevent a severe outbreak of straighthead.

According to the authors, it has been proved conclusively that aeration of the soil, if properly carried out, will prevent straighthead. It is recommended to irrigate for about six weeks, commencing about ten days after the plants emerge, or when they are six to eight inches high. If symptoms of the disease are seen then, drain the land and leave from two to three weeks. When the plants begin to turn yellow and show signs of withering, apply water again and retain it for the remainder of the season.

B(OBILIOFF ?) (W.). **Over het uitdunnen en het optreden van bruine binnenbast-ziekte bij Hevea.** [Thinning-out and the occurrence of brown bast disease in *Hevea.*]—*Teysmannia*, xxxii, 3, pp. 141–142, 1921.

The writer discusses the results obtained by Harmsen ('Uitdunnen volgens productie-gegevens en het optreden van bruine binnenbastziekte', *Nederl. Ind. Rubbertijdschr.*, v, p. 745, 1921), which tend to show that the more productive trees of *Hevea brasiliensis* are most subject to brown bast. Harmsen found that if he divided the trees into five classes according to the daily yield of latex (Class I, 1–20 grammes; Class II, 20–30 gm.; Class III, 30–40 gm.; Class IV, 40–50 gm.; Class V, more than 50 gm.), the amount of brown bast developed in these trees was as follows: Class I, 13·9 per cent.; Class II, 17·8 per cent.; Class III, 23 per cent.; Class IV, 25·7 per cent.; Class V, 31 per cent. From this it is evident that in selecting trees for thinning, other circumstances than mere yield must be taken into account, and especially liability to brown bast. The writer thinks that in thinning-out, the number of rows of latex vessels in the bast should be taken into consideration. The trees would then be removed in which the structure bears no relation to production, i.e. those *presumably* susceptible to brown bast. Further investigations are necessary to confirm the reliability of this theory.

LA RUE (C. D.). **Lightning Injury to Hevea brasiliensis.**—*Mycologia*, xiii, 2, p. 125, 1921.

Lightning injury to the Pará rubber tree is seldom shown in the sudden tearing or breaking of the branches. As a rule, a single small branch at the top of the tree dies first, the trunk gradually becoming affected and dying back until the root is reached. This progressive death of the tissues suggests the invasion of the tree by a destructive organism. The injury has been attributed to *Diplodia*, and the organism in question was named *Diplodia rapax* Massee. The author's cultures showed that *Diplodia* was the only organism constantly present, but it can only be regarded as secondary, and not the cause of the death of the tree. The injury is most marked in the cambium region, the tissues of which turn deep purple and decay rapidly. This discoloration is considered by the author to be a distinguishing characteristic of this type of injury. Trees surrounding the affected tree often exhibit the injury in a lesser degree and at a later stage, thus suggesting the spread of an organism from one tree to another.

WURTH (TH.). **Verslag omtrent de Werkzaamheden van het Proefstat. Malang over 1920.** [Report of the Work of the Malang Experiment Station during 1920.]—*Meded. van het Proefstat. Malang*, 34, 17 pp., 1921.

The following diseases of rubber were prevalent:

Leaf-fall due to attack by *Phytophthora*, which occurred at the period of leaf-change (ordinarily dry but characterized on this occasion by heavy rain) and led in some cases to the death of the new leaves; stripe-canker; *Oidium* (general, but not a serious danger); and Djamoer oepas (*Corticium salmonicolor*), which was worse than usual.

Pure cultures of the *Phytophthora* causing leaf-fall were obtained, and inoculation experiments showed that the parasite in question has more in common with *Phytophthora faberi*, the agent of patch-canker and cacao-canker, than with *P. meadii*, which causes stripe-canker and fruit-rot.

BLOMMENDAAL (N.). **Het optreden van witte vlekken op crepe.** [The occurrence of white spots on crepe rubber.]—*Meded. van het Algemeen Proefstat. der A. V. R. O. S.*, Rubberserie 33, 6 pp., 1 fig., 1921.

Crepe rubber has been found to be attacked by a bacterium which produces white spots, sometimes of considerable extent. The organism, one of the slime-forming Micrococcaceae, is described. It requires oxygen and moisture for its development, and therefore grows best on material exposed to the air (damp crepe, lumps, and scrap). It has also been isolated from latex and from the coagulum before rolling. The white slimy lumps found frequently on the cement floors of rubber factories contain large numbers of the bacterium in question, which is also present in the Shanghai jars used for storing the material, and these are probably the usual source of infection. Latex exposed to the air overnight developed two distinct colonies, white and yellow, of which cultures were taken. After further exposure to the air the yellow colonies (which the author thinks may possibly be the cause of 'rustiness' in sheet rubber) became predominant. The white colonies appeared to be identical with those already isolated from the spots and the floor-slime, and were found to be capable, when inoculated in pure culture on crepe, of reproducing the spots. To avoid infection the coagulum should be kept entirely under water until ready for use. Damp crepe should be dried as quickly as possible, and the factory, Shanghai jars, &c., must be kept scrupulously clean.

KNIEP (H.). **Urocystis anemones (Pers.) Winter.**—*Zeitschr. für Botanik*, xiii, 5, pp. 289–311, 1 pl., 1921.

Urocystis anemones produces on germination a short promycelium tube which throws out at its tip three or four branches forming a whorl. The diploid nucleus of the smut spore divides into four, very probably with reduction of the number of chromosomes. These four nuclei pass one into each of the whorl branches, or, in the case where only three whorl branches exist (the more frequent case), a nucleus passes into each of them, and the fourth remains in the whorl stem. The branches are then separated from the original promycelium tube by septa, and form separate cells. Then appear the first signs of conjugation; conjugation canals, having the shape of a horseshoe, are formed joining the bases of each pair of whorl-branches, or, in the case of three branches only, between one pair of branches, and between the third branch and the whorl stem. Through these canals one of the nuclei migrates over to its partner, forming thus two pairs of nuclei; it is noteworthy that the nucleus from the stem passes always into its conjugated branch, the reverse never having been observed. The branches in which the paired nuclei occur begin then to elongate considerably, while the cells from which the nuclei have migrated are emptied and cut off by a septum; the former grow rapidly, the plasma pushing continually forwards and being from time to time separated at its base by a septum from the empty part, and form two long, articulated and mostly empty threads, each carrying a double-nucleus cell at its tip.

In water culture development soon ceases owing to lack of food. In adequate dilute nutrient solutions it progresses farther, and after some weeks thick flakes consisting of richly branched and entangled hyphae can be distinguished. In these also most of the cells are devoid of protoplasm. Spores taken from ripe infection-boils ready to burst were sown in test-tubes with about 5 c.c. nutrient solution, and also streaked on gelatine plates (3 per cent. malt extract, 10 per cent. gelatine). The latter was unsatisfactory owing to too high concentration. In a 0·1 per cent. malt extract solution germination was far better, though it was still several weeks before the mycelium was visible macroscopically in test-tubes sown with a few spores. Then small, light-brown flakes were seen which increased to about the size of a lentil. A culture started on October 22, 1917, and kept in a warm room, showed on December 5 the presence of smut spores, to whose formation the brown colour was chiefly due though the vegetative hyphae were also partly coloured brown. With the cells containing protoplasm, many others that were empty were found. The masses are formed by the copious branching and entanglement of the hyphae. Many of the cells containing protoplasm are swollen and often joined in rows like a string of pearls. Such swollen cells are mostly divided by several septa and give rise to a complex of primary and companion spores. As under natural conditions on the host primary spores are at times found alone without companion cells, so also in the cultures isolated primary spores were observed. Groups of empty companion cells were also sometimes seen without primary spores. The ripe spores produced in culture were completely identical with those from the host. It has thus been proved that it is possible without difficulty to grow *Urocystis anemones* from smut spore to smut spore outside the host under conditions of saprophytic nutrition, a step not hitherto completely accomplished for any other smut fungus. Tests with 0·1 per cent. malt extract on *Ustilago tritici* failed to give true smut spores, so the medium is not of universal application. Further examination of the best concentration to use with *Urocystis anemones* indicated that 0·5 per cent. malt extract gave the optimum conditions of culture.

The phenomena observed during the development of *Urocystis anemones* make it probable that the four nuclei which issue from the diploid smut-spore nucleus and distribute themselves among the branches of the promycelium differ the one from the other in each pair; that there exists a physiological sexual differentiation caused by the reduction division, as has been experimentally proved to be the case in the anther-smuts and with *Ustilago scabiosae* (Kniep, 1919), though with *Urocystis anemones* a similar experimental proof cannot be made, because the whorl-branches do not fall off and are not capable of yeast-like budding. Such a complicated conjugation mechanism would evidently be quite unnecessary if it were indifferent which of the four nuclei unite together in pairs. The isolation of the four nuclei in four closed cells and the ensuing formation of conjugation canals have apparently the purpose of preventing the meeting of sexually alike nuclei, as might happen if the nuclei were allowed to group together without this mechanism. It is suggested that each nucleus bestows on the cell to which it belongs the corresponding sexual character, and that, owing to this, the cells of different sexes are stimulated to put out towards each other the short processes which later fuse into the horseshoe-shaped conjugation canals.

The author considers *Urocystis anemones* to be an aggregate species, and to this is to be traced the differences in germination observed by other workers. A remarkable fact is that forms originating from different host plants differ in that the spores of some of them require a period of rest before germinating, and others do not. This recalls the behaviour of some seasonally dimorphous Phanerogams, and may be partially explained by the ecologic habits of the hosts.

Dastur (J. F.). **Cytology of Tilletia tritici (Bjerk.) Wint.**—*Ann. of Botany*, xxxv, 139, pp. 399–407, 1 pl., 1921.

The results of investigations carried out by the author are summarized as follows:

The spore, on germination, produces a single-celled promycelium, into which the undivided spore-nucleus passes. The divisions of this nucleus do not take place at any fixed stage in the development of the promycelium, and the number of daughter nuclei, as also of sporidia, is variable, but generally eight. Each sporidium usually receives a single nucleus from the promycelium, and the sporidia conjugate in pairs, either while still fixed or after they fall off. As a result the nucleus and part or the whole of the cytoplasm of one sporidium pass into the other, which then germinates and produces a secondary sporidium. The latter is shorter, broader, and more sickle-shaped than the primary one. It is usually uninucleate, but at times binucleate. In a few cases fusion of the conjugate nuclei has been observed in the secondary sporidium. More often a division of a single non-conjugate nucleus has been seen to be the cause of the two nuclei at times found in the secondary sporidium. Tertiary sporidia, when found, are uninucleate, while the infective hyphae and also the hyphae of the later-formed mycelium in wheat seedlings are uninucleate or multinucleate, never regularly binucleate.

Seedlings a day old were inoculated with cultures from germinated spores, incubated at 50° C. and fixed in Fleming's weak solution from time to time. From sections of these the penetration process was followed.

The infecting hypha, as a rule, enters the first or outermost leaf-sheath between the epidermal cells, by pushing aside their adjoining walls, these being sometimes ruptured in the process. Direct entry of the germ-tube into the lumen of the epidermal cells takes place very rarely.

DEERR (NOEL). **Cane Sugar.** *Second (revised and enlarged) Edition,* viii + 644 pp., 30 pl., of which 12 are coloured, and numerous illustrations in text. London, Norman Rodger, 1921.

The new edition of this well-known text-book has been completely rewritten. The first four chapters contain a description of the macro- and microscopic characters of the sugar-cane plant, its chemical composition, range of distribution, and varieties. These are followed by an account of the agriculture of the cane. The remaining chapters, comprising more than two-thirds of the whole, deal with the manufacturing processes and sugar-house chemistry.

Chapter ix contains an account of the pests and diseases of the cane. The diseases due to fungi and bacteria are fully described and for the most part illustrated. In each case there is a Latin diagnosis of the parasite with a description of the symptoms, distribution, and severity of the disease.

Of diseases, the cause of which is not definitely known, the chief are sereh, mosaic or yellow stripe, chlorosis, top rot, and the leaf-splitting disease. There is, the author points out, still much confusion regarding what is called 'rind-disease', especially as to whether *Melanconium sacchari* is to be looked upon as parasitic or strictly saprophytic. The author quotes several apparently contradictory observations, concluding that the mass of evidence points to the non-parasitic nature of the fungus, though it may perhaps under certain conditions become an active parasite. The chapter terminates with a discussion on the practical control of cane diseases.

EASTERBY (H. T.). **Twentieth Annual Report of the Bureau of Sugar Experiment Stations, Queensland, to the end of October, 1920.** 1921.

Of interest is the following from the report of work at the Northern Experiment Station at South Johnstone (Innisfail):

In 1913, when it was thought that some varieties, including the valuable *Badila*, were showing signs of deteriorating, a number of them were sent up to the Kairi State Experiment Station to see if a change to a higher altitude would bring about a rejuvenescence. After six years, during which none of them showed a trace of disease, they were brought down again during the current year and planted at Innisfail. All of them showed a markedly better growth than canes that had not been sent to the hills.

THOM (C.) & CHURCH (MARGARET B.). **Aspergillus flavus, A. oryzae, and associated species.**—*Amer. Journ. of Bot.*, viii, 2, pp. 103–126, 1921.

Some types of *Aspergillus* are so closely identified with the fermented food products of the Orient that a comparative study to determine their significance in the fermentation processes is called for. These organisms are not only found in the oriental fermentation industries but have a world-wide extension, and their numerous strains align themselves into groups of closely related forms which the authors, for convenience, have classified under three series names: *Aspergillus flavus-oryzae*, *A. wentii*, and *A. tamari*.

Between *A. oryzae* (Ahlb.) Cohn, the diastatic power of which has brought into being the saké industry of Japan, and *A. flavus*, there exists a whole series of forms, which, morphologically, bridge the gap. In fermenting samples obtained from China the dominant organism possesses characteristics that are to be referred to *A. flavus* in the sense of Brefeld and Wehmer rather than to *A. oryzae* (Ahlb.) Cohn, and the same obtains in cultures from certain of the koji products distributed under the patents of Takamine. All these forms have, however, one chief characteristic feature in common, and that is the structure of the walls of the conidiophore stalks and conidia, which are pitted. The pits on the ripe conidia are elliptical instead of circular, thus giving the appearance of being areolate. It is to be noted that the cell walls, when examined with a low magnification, are often recorded as rough or spinulose.

Colonies grow best in starch- and sugar-containing media. Some strains fruit at temperatures up to 50° C. Spores survive heating to 57·2° C. for thirty minutes and dry heat at 110° C. for thirty minutes. All forms show mixtures of yellow and green colour when grown in Czapek's solution agar, but some strains lose this more or less rapidly, and a tendency towards floccosity is at times observed.

Amongst the intermediate strains linking up *A. flavus* and *A. oryzae* the following are named and described: *A. oryzae* var. *basidiferens* Costantin and Lucet; *A. pseudoflavus* Saito; *A. microvirido-citrinus* Cost. and Luc.; *A. gymnosardae* Yukawa; *A. parasiticus* Speare; *A. effusus* Tiraboschi.

The stalk throughout the genus *Aspergillus* originates as a mycelial cell transformed into a spore-producing organ. The cell broadens, its walls thicken, and from it, and approximately perpendicular to its course, arises the stalk, the original cell remaining in the hypha as a kind of foot. Usually the stalk in its growth becomes many times the size of its foot, both in breadth and length, and in *A. effusus* the foot-cell, which is often very long and branching, connects with other foot-cells and forms a trailing, fertile hypha from which the stalks arise as short branches. This strain of *Aspergillus* was isolated from spoiled corn products.

In the chapter devoted to the nomenclature of subsidiary types of the series, a short historical analysis of some of the more prominent forms is given. The authors suggest that one or other of the *A. herbariorum-repens-amstelodami* series in the sense of Mangin was the basis of Link's description of his *A. flavus*, though it is not now possible to be sure what Link had.

Certain strains of this group have resulted in lesions and death when injected into animals, and they have also been found in connexion with infection in the human ear, but active pathogenicity has not been proved.

After careful and prolonged study of the subject the authors arrive at the conclusion that the species described by Brefeld and Wehmer and believed by them to be *A. flavus* Link is the type of a cosmopolitan organism, of which *A. oryzae, A. parasiticus*, and *A. effusus* are closely related, but morphologically recognizable, varieties or species.

Going on to *Aspergillus wentii* Wehmer and related forms, the authors found the species to differ from Wehmer's characterization in the quite general presence of both primary and secondary sterigmata. Perithecia were not found and sclerotia were limited to more or less undefined masses of thick-walled cells, occurring occasionally, not uniformly. All strains tested find their cultural optimum below 37° C.; they liquefy gelatine, both with and without sugar.

In the series *A. wentii* typical test-tube cultures produce a mass of sterile mycelium above the colony, which overgrowth becomes more prominent on potato plugs. There are, however, strains that possess this characteristic only partially or not at all, and the authors justify their inclusion in the series by reference to other common structural characters. The forms of this series have a wide range of substrata, including organic materials and soil.

A. tamari Kita and its allies, which form the third series under discussion, are distinguished from the other brown species by the absence of true green in colour; by stalks prominently pitted, especially towards the apex; and by conidia tuberculate at the distal end in the chain, rough, showing firm, fairly thick, and not pitted inner walls, and thin vesicular outer walls fitting rather loosely over masses of branching, more or less irregularly arranged bars of yellow-brown substance. In size of colony, habit, and appearance apart from colour, which is similar to *A. wentii*, these forms resemble *A. flavus*, while the markings of their conidia suggest *A. niger*. Their distribution is world-wide in forage and feeding stuffs, oriental soy fermentations, and in soil.

To illustrate the fallacy of overstressing the significance of measurements in miscellaneous cultures, instances are given of the difference in size of vesicles, primary sterigmata, and conidia obtained from cultures grown on different media. A strain of *A. tamari* when grown upon Czapek's solution agar showed vesicles about 35 μ in diameter, primary sterigmata 8 to 14 by 3 to 5 μ, and conidia 5 to 6 μ in long axis, while the respective measurements for the same strain grown on unsterilized, clean corn for two weeks were 100 μ, 25 to 35 by 5 to 9 μ, and 8 to 9 μ. Transferred back to Czapek's solution agar, the original measurements were once more obtained. The variations in environment seemed to affect the secondary sterigmata much less than the primary ones. These experiments emphasize the necessity of using a standard medium as the basis of comparative studies of saprophytic organisms, for even in the most carefully standardized culture work a certain elasticity in the measurements is required.

Variations in colour help to separate different strains of the *A. tamari* series, but the same culture will exhibit different colours according to age or on exposure to acid or alkali. Whilst these are less marked than in members of the *A. flavus* group, it is clearly established that the differences in colour are due to variation in the reaction induced by the metabolic activity of the organism. These differences vary with the composition of the medium, and with the characters of the race or strain studied, but clearly indicate close relationship among the forms. Amongst the special forms studied is *A. citrisporus* v. Höhnel, which was got from caterpillar excrement, while another form, found in redland soil in Georgia, is described under the name of *A. terricola* var. *americana* Marchal n. var. These forms are readily separable in culture.

A key to the species described from culture, and a bibliography with critical notes, are appended. The latter covers many species that may belong to the groups here described, but of which material was not available.

GROVE (W. B.). **Mycological Notes. V.**—*Journ. of Bot.*, lix, 697, pp. 13–17, 2 figs., 1921.

Describes *Boydia insculpta* (Oud.) Grove comb. nov., a parasite of holly (*Ilex aquifolium* var. *hendersonii*) with very remarkable and unusual spores, and gives the previous history and synonyms of this fungus. Records the very rare British rust, *Puccinia peucedani-parisiensis* (D.C.) Lindr., on *Peucedanum officinale*. Determines as *Phomopsis abietina* (Hartig) Grove (*Phomopsis pithya* Lind) a parasite of *Pseudotsuga douglasii*, which also occurs on dead *Pinus sylvestris*, from Scotland. It is suggested that the last fungus may be the same as *Fusicoccum abietinium* Pril. and Del., *Dothiorella pithya* Pril. and Del., and possibly even *Sclerophoma pithya*, these being merely forms of the one species.

PETCH (T.). **Red Rust on Tea.**—*Tropical Agriculturist*, lvii, 3, pp. 188–192, 1921.

In describing the symptoms of this well-known disease the author points out that it is necessary to distinguish between leaf variegation due to non-parasitic chlorosis and that due to red rust. In the variegated leaves of bushes attacked by red rust, the white areas usually shade off into the green, whilst in the case of chlorosis the demarcation is generally fairly well defined. The attack on pruned branches of diseased plants is also described. As a rule, these affected branches do not produce new shoots but die back.

It has usually been supposed that there is only one species of *Cephaleuros* on tea, appearing sometimes in an epiphytic (superficial and harmless) form, sometimes in a parasitic form, but the author's studies seem to point to the fact that each form is due to a distinct species, namely, *C. mycoidea* and *C. parasitica* respectively. It is the last named which is so destructive, particularly when it attacks the stems. The effect on the young green stems may be, as in the case of the leaves, to cause watery green areas to appear, which subsequently blacken and produce clusters of red hairs; generally speaking, however, the first evident sign is a premature hardening of the twigs with the dead epidermis showing in grey patches. Whether the latter has been killed by penetration or by simple contact, is not certain, but it is probable that in the second eventuality the algal filaments enter the tissues later. On the older bark the spores lodge in the minute cracks, where they germinate and penetrate to the living tissues. The effect extends beyond the limits of penetration, a layer of dead cells existing between the algal and the living host tissues.

Red rust is a weak parasite, and vigorous plants have been found to be highly resistant. Usually, the cause of weakness in the plants resides in the soil, and improvement in the soil conditions is followed by a diminution in the disease. The recent increase in its severity in Ceylon is attributed by the author to the shortage of manures which occurred during the war, especially of potash fertilizers. This chemical favours the development of strong wood, which is an important point as red rust is only really serious when it attacks the stems.

With regard to spraying, this offers some difficulties, as it is scarcely practicable on unpruned tea, and also as the velvety patches are hard to wet. Hence it is best to use Bordeaux mixture on pruned bushes before the red hairs develop. Severely attacked bushes should always be sprayed after pruning.

FROMME (F. D.). **Wildfire and Angular Spot.**—*Rhodesia Agric. Journ.*, xviii, 4, pp. 411–414, 1921.

A verbatim report of a circular issued by the Plant Pathologist of the Virginia Agricultural and Mechanical College and Polytechnic Institute and the U.S.A. Department of Agriculture, co-operating. In a foreword the Tobacco Expert of the Board of Agriculture, H. W. Taylor, states that both the diseases in question now occur in Rhodesia, and that they have no doubt been imported with tobacco-seed from the U.S.A.

Angular spot has been very prevalent during the past two seasons and has caused severe loss. The Rhodesian Department of Agriculture is prepared to treat tobacco-seed free for farmers in Southern Rhodesia, and it is hoped by this means, and by the precautions advised in the American work, that the loss will be greatly reduced next season.

JOHNSON (J.). **Inheritance of disease resistance to Thielavia basicola.**—Abs. in *Phytopath.*, xi, 1, p. 49, 1921.

When varieties of tobacco, such as Little Dutch, which are resistant to root-rot are crossed with susceptible varieties, such as White Burley, the first generation is intermediate as regards resistance. The second generation gives individuals of all grades of resistance, from those even more resistant than the resistant parent to those as susceptible as the susceptible parent. Selected individuals in the third generation may continue to vary, while others appear to breed true for the resistant character. Susceptibility is apparently a recessive character. No simple Mendelian [illegible] pot.—Abs[illegible] [illegible]21.

[illegible] ne s[illegible] from [illegible]

[illegible]) & BU[illegible] (C[illegible]) [illegible] Flora of [illegible] **and water supplies in rel[illegible] [illegible] Plant Diseases.**—*App[illegible]* viii, [illegible] pp. [illegible]–1[illegible] [illegible]92.

[illegible] attention [illegible] before been given [illegible] danger of intro[illegible] disease organisms with the water supplied to plants. The writer's attention was [illegible] to this danger by finding *Phytophthora cryptogea* Peth[illegible] and *P. parasitica* Dastur in the water supplied to tomato plants.

Samples of water were obtained by means of a filter made of two layers of wire netting, cupped in the centre, and containing cotton-wool between the two pieces of netting. The filter was sterilized and a considerable quantity of the water was allowed to pass through it. The cotton-wool was then removed and shaken in physiological salt solution, and cultures made on various agars.

From water from various sources (wells, tanks, brooks, ponds) the following organisms were obtained. The number after each fungus indicates the number of samples which contained the organism in question out of forty-one samples tested:

Botrytis cinerea, 17	*Phytophthora cryptogea*, 6
Cladosporium cucumerinum, 1	*P. parasitica*, 6
C. fulvum, 9	*Phoma* sp., 28
C. herbarum, 34	*Rhizoctonia solani*, 11
Fusarium sp., 25	*Rhizopus nigricans*, 23
Macrosporium solani, 13	*Verticillium albo-atrum*, 13

Bacillus lathyri was also found in three samples.

The Water Company's supply and deep artesian wells gave the purest water; brooks and ponds the most contaminated. Certain of the waters were found to be moderately good culture media for the fungi.

Mercuric chloride was found to be the best of the chemicals tried for the purification of the water, varying amounts from one part of $HgCl_2$ to 200,000 parts water to 1 to 5,000 being sufficient to kill the spores and mycelium of the fungi tested. Fifty to seventy degrees C. for one minute was the temperature required to kill the mycelium and 'summer' spores of these fungi.

HAMBLIN (C. O.). **Spotted Wilt of Tomatoes.**—*Agric. Gaz. of New South Wales*, xxxii, 1, p. 50, 1921.

The causal organism of this disease has so far not been discovered, in spite of prolonged research. Inoculations of healthy plants with bacteria isolated from diseased tissues had negative results; in fact, though the field indications point to the infectious nature of the disease, all attempts at its transmission from diseased to healthy plants have so far met with failure, even actual contact not bringing about infection.

Two insects (*Nezara viridula* and the common green aphis) were suspected transmitters, but tests have totally disproved their connexion with the disease. The possibility of transmission by seed seems to have been discounted by examining carefully data collected from the fields.

Not one of the various specifics recommended seems to have been successful in checking the disease.

HAMBLIN (C. O.). **Overwintering of Spotted Wilt of Tomatoes.**—*Agric. Gaz. of New South Wales*, xxxii, 8, p. 547, 1921.

According to observations carried out in a suburban garden, the disease winters in the old plants. The exact method of its transmission from plant to plant is unknown; growers would do well, however, to incinerate all old vines before commencing to raise early seedlings.

SOUTH (F. W.). **An important Root Disease on Borneo Camphor.**—*Agric. Bull. Fed. Malay States*, ix, 1, pp. 34–36, 1921.

In December, 1920, two-year-old seedlings of Borneo camphor (*Dryobalanops aromatica* Gaertn.) were found killed by a root disease due to *Rosellinia bunodes* (B. and Br.) Sacc. The tree is being extended and encouraged by the Forest Department, F.M.S., on account of its valuable timber.

This fungus has been reported from India and the West Indies as an important parasite attacking a number of plants belonging to widely different families. It has been recorded on coffee in Southern India and causes stump-rot of pepper in Mysore, where it attacks also *Litsea angustifolia*, *L. Wightiana*, *Schleichera trijuga*, *Holigarna longifolia*, and *Grevillea robusta*. In the West Indies it attacks cacao, limes, Castilloa rubber, camphor (probably *Cinnamomum camphora*), arrowroot, and a number of forest trees. In Porto Rico it probably occurs also on coffee. The species named *Rosellinia echinata* Massee, which attacks the roots of *Ficus dubia*, Dracaenas, rattans, Dieffenbachias, and of various shrubs and even herbs growing together under the *Ficus*, in the Singapore Botanic Garden, is now generally held to be identical with *Rosellinia bunodes*.

The fungus is probably indigenous in the Malay Peninsula, since the seedlings on which it was found came from a Forest Reserve devoted to the cultivation of an indigenous tree by methods which do not involve the introduction of planting material from outside. But it seems to be of limited distribution, and has not been found on Pará rubber, although the very wide range of its various hosts admits of the possibility of its attacking *Hevea* and other cultivated plants in Malaya.

The attack starts from a decaying jungle stump, but there are indications that the fungus can also germinate on, and spread from, heaps of damp leaves and twigs, and the writer has seen this occur in Dominica. It may also run in the surface layer of the soil from one small root or dead twig to another. When it reaches the lateral root of a suitable living host, it grows up this and spreads around the collar, finally killing the plant. Often death is very sudden on trees such as limes; an apparently healthy tree may die within two or three days, retaining its withered leaves and presenting a scorched appearance.

The attacked roots and collar are covered with a dark felt of external mycelium which, in damp and shady spots, may extend up the stem of dead trees for a distance of from 6 in. to 2 ft. The advancing edge of the external mycelium is smoky grey, and the hyphae are light and cobweb-like in appearance; behind this the mycelium is denser and becomes dark olive green in colour, passing into a purplish black in the old parts. In damp places the older mycelium develops a mass of closely packed, black, hairy conidiophores projecting at a right angle to the stem. When ripe, the tips of the conidiophores are branched, and bear small white hyaline conidia, which give a grey or whitish appearance to the surface. Later, in damp sandy places, perithecia develop on the base of the stem above ground, sometimes to a height of 1 ft. or more above the soil; they are spherical, warty, black bodies, about 1·6 mm. in diameter, closely packed together and often partly buried in the mycelium. In the centre of each is a small smooth papilla, from the mouth of which ascospores are extruded in a black tendril. The spores, which are black, hard, boat-shaped, and have a long, fine, black appendage at each end, number eight in each ascus.

The mycelium penetrates, at a short distance from its advancing edge, through the bark of the root or stem of the host plant, and ultimately also traverses the wood, which becomes dry and light, the bark being almost completely rotted. The fungus penetrates in the form of black mycelial cylinders about 0·5 mm. in diameter, running transversely through bark and wood. In radial sections of the diseased plants the penetrating mycelium appears as black lines running inwards in the bark and wood; in tangential section, however, it appears as black dots; this appearance in section is somewhat characteristic.

The treatment of this disease is the same as that for root diseases in general. The infected area, including a 2 or 3 ft. wide margin of apparently unaffected soil, should be carefully isolated by a trench 2 ft. deep and 1 ft. wide, all the earth from the trench being thrown inside the infected patch. All the plants within the patch should then be dug out and burnt, with as much as possible of the surface cover of leaves and twigs. The patch should be limed at the rate of about two tons per acre, and should be well forked over, removing and burning all bits of wood and roots in the soil. The isolating trench must be kept as free as possible from leaves and twigs. It would probably be safe to replant land thus treated after an interval of twelve months.

IMPERIAL BUREAU OF MYCOLOGY

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BEHRENS (J.). **Die Perithecien des Eichenmehltaus in Deutschland.** [Perithecia of Oak Mildew in Germany.]—*Zeitschr. für Pflanzenkr.*, xxxi, 3–4, pp. 108–110, 1921.

In October, 1920, the writer discovered the perithecial stage of the oak mildew near Hildesheim (Hanover). This is the first time the perithecia have been observed in Germany. They were restricted to one single leaf.

They were compared with those found by Arnaud and Foëx in France in 1911 and considered to be identical by Neger. The fungus is identified as *Microsphaera extensa* Cooke and Peck (*M. quercina* (Schw.) Burr.), which has been united by Salmon with *M. alni* (Wallr.) as *M. alni extensa* (Cooke and Peck) Salm.

TRAVERSO (G. B.). **La forma ascofora dell' oidio della Quercia a Roma.** [Ascus stage of Oak Oidium in Rome.]—*Boll. mensile della R. Staz. di Patologia vegetale*, ii, 1–4, p. 35, 1921.

The author reports that Peyronel has discovered numerous perithecia of the oak mildew, which first appeared in Europe in 1907, near Rome, and has, in agreement with Peglion, Arnaud, and Foëx, identified it as *Microsphaera quercina* (Schw.) Burr. Peyronel considers that the conidial form occasionally met with on the oak in Italy, Portugal, and Switzerland prior to 1907, belonged not to this fungus, but to *M. alni*. He maintains that cold is only a contributory factor in the formation of the perithecia, the chief cause being dryness or, rather, the excessive transpiration of the fungus in relation to a scarcity of nutrient juices obtainable from the host.

KRISTOFFERSEN (K. B.). **On the Relation between Sugar Content and Winter Rot in the Garden Carrots.**—*Botaniska Notiser*, iv, pp. 149–163, 1921. (English.)

Samples of commonly cultivated carrot-roots were taken by boring average roots, and the sugar content determined polarimetrically. The results showed that different cultivated kinds varied considerably in their sugar content, the variety known as

'St. Valery' having the greatest excess of cane sugar, 'Guérande' being next, and 'Nantes' still lower, while in 'Parisian' invert sugar was in excess.

During the winter the bored roots were kept in a cellar, and when examined in the spring all the roots of Parisian carrot and Nantes were found to be rotten, as was also the case with most of the Guérande, but most of the St. Valery variety had wintered well, only a few being rotted. Thus St. Valery, which had the greatest excess of cane sugar, was the most resistant sort, Guérande was intermediate, while Nantes and Parisian carrot, with a slight excess of cane sugar and of invert sugar respectively, showed poor resistance. This pointed to a certain relation between the cane sugar content and the resistance to winter rot, but gave no information in regard to the percentage of total sugars.

In the winter of 1920–1 further investigations were made with the same varieties, there being two stocks, (A) and (B), of each of the varieties St. Valery and Nantes. A number of typical roots of each of these sorts was placed in sand in the cellar, and an average sample was prepared from each sort for more detailed analysis, the rest being left to test resistance to rot. The methods of analysis employed are described in detail, special attention being directed to avoiding possible sources of error in the determination of the quantity of reducing sugar present.

Summarizing the results of the sugar analysis and of the rot resistance, the difference between the percentages of total sugar in the individual varieties was found to be relatively insignificant. Thus the percentage of total sugar in Parisian carrot was 6·90 and in St. Valery 8·13, the other varieties being intermediate. The variation in the invert sugar was proportionally greater; in Parisian carrot the percentage was 4·53 and in St. Valery 2·43. The resistance to rot varied greatly, the poor resistance of Guérande (84·6 per cent. of rotten roots) being remarkable. This variety is generally superior to Nantes in the matter of resistance, but in the case in point Nantes (A) had only 33·3 per cent. of rotten roots, while (B) (an improved race) had but 7·1 per cent. St. Valery (A) had 26·9 per cent. and (B) 5 per cent. of rotten roots.

No correlation could be established between total sugar present and rot resistance. On the other hand, there was a decided connexion between the amount of invert sugar and resistance: the lower the percentage of invert sugar the greater the resistance. The correlation became more marked if, instead of considering the total percentage of invert sugar, its relative percentage in regard to the total sugar was taken.

The critical point in rot resistance appears to be located at a relative percentage of invert sugar to total sugar of about 45 to 50 per cent.: that is to say, the roots will probably rot during the winter if they have more than half the cane sugar inverted at the beginning of storage. Among 39 individual roots analysed by taking a boring and then, after covering the bore-hole with sulphur, placing them in sand to test their rot resistance, only three form exceptions to this rule, all belonging to the variety Guérande. More than half the cane sugar was inverted in these three, but they wintered well. Possibly the anatomical structure of the roots of this variety, which differs from the others, may be responsible for these departures from the rule.

It is evident from these data that carrots contain both cane sugar and a reducing sugar, here termed invert sugar. The writer has made no attempt to determine the exact nature of the latter, and states that there are very few references to it in the available literature. Dextrose has been reported to be contained in carrots by König, while Hellweg, like the writer, calculated the reducing sugar as invert sugar.

It has been stated by other workers that cane sugar is inverted considerably during the winter in *Beta*, and that a correlation exists between the percentage of cane sugar and invert sugar in the beet, which is not apparent in carrots.

The investigations made give no information as to the physiological connexion between greater or lesser ease of the inversion of cane sugar, and greater or poorer rot resistance. Probably the invert sugar is a better nutrient for the bacteria involved in rotting than cane sugar.

The practical application of the results of these experiments should lie in the determination of the proportion of invert sugar in carrots, in order to select varieties likely to prove resistant.

DUCOMET (V.). **La Résinose du Topinambour.** [Resinosis of Jerusalem Artichoke.]—*Bull. Soc. de Path. Vég. de France*, viii, 2, pp. 64–65, 1921.

A disease, apparently not previously described, was found in specimens from the Aude Department, France. Sections of the tubercles showed rusty yellow areas of variable size, from a pin's head to 2 to 3 mm., or rarely 7 to 8 mm. in diameter. These spots form a regular network, affecting the greater part of the tubercle, from the phloem to the medulla. The coloured matter is friable, having the aspect and consistency of powdered resin. Even when cooked the tubercle has a bitter taste, and cattle feed on it with repugnance.

The disease seems to have affected plants grown from local tubers only; those grown from tubers imported from other departments appear to have escaped, except when mixed with local kinds. When, however, the introduced kinds were planted in the immediate vicinity of home-grown varieties, and in the direction of predominating winds, they became attacked, thus suggesting a contagious disease.

A preliminary study of the data has led the author to the conclusion that this disorder is an excessive secretion of oleo-resin—normal in the case of the Jerusalem artichoke and allied plants—and a subsequent modification of the secreted product (oxidation most likely). Heating dry, or in water or lactic acid, reduces the resinous, coloured concretions to small, ultimately colourless globules, that fix Sudan with energy. As soon as these excretions disappear, irregular lacunae are seen, surrounded by large, more or less dislocated cells, having very large nuclei, and quite distinct from the normal parenchyma. These lacunae form knots, as it were, in the normal secretory network found in healthy tubercles, especially in the fibro-vascular ring. Only very slight and rare traces of this disease have been found in the Grignon and Lot-et-Garonne districts, but severely attainted tubercles were met with by the author twenty-five years ago in the sandy soil of the Landes. Both then and now the fact has been noted that affected plants show no symptoms whatever above ground.

The condition is of biological as well as practical interest, since it will perhaps swell the list of 'degeneration diseases', the nature of which is problematical.

MURPHY (P. A.). **The Presence of Perennial Mycelium in Peronospora schleideni Unger.**—*Nature*, cviii, p. 304, 1921.

The assumption that, because the onion mildew fungus—*Peronospora schleideni* Unger—produces its sexual organs in the leaves of the host plant, it is dependent on its oospores for perpetuation from year to year, is shown by the author to be erroneous, as the non-septate mycelium is capable of a perennial existence in the bulbs, and the shoots produced therefrom carry infection *ab initio*. It was found impossible to induce the fungus to fruit on the bulb scales of infected bulbs examined, to infect other onions, or to grow on artificial media. The whole structure of the mycelium is plainly visible without staining, the hyphae being stout and well differentiated from the cells of the host plant, into some of which large convoluted haustoria extend. Where green leaves were present, the mycelium could be traced from the bulb to the apical portion of the leaf on which conidiophores of *P. schleideni* were being produced. In one particular plot, badly mildewed in 1920, almost 66 per cent. of the smaller-sized onions contained non-septate mycelium, and such infected bulbs sprouted prematurely, but the fruiting stage of the fungus was not reached in the greenhouse under winter conditions, though the mycelium grew up with some of the shoots.

Further proof of the relationship of this fungus to *P. schleideni* was obtained in an experiment in which bulbs of *Allium cepa* and of *A. ascalonicum* containing non-septate mycelium were grown (in the early spring) under conditions excluding external infection. In contrast to numerous control plants, which were originally free from mycelium and remained free from mildew in spite of lengthy exposure to conditions favourable to infection, the diseased plants, placed under a bell-jar for one night, were found almost totally covered with mildew the next day. Occasionally shoots, replacing the originally infected leaves which had been cut away before mildew became apparent, were found to be permeated with the mycelium and again developed mildew under favourable conditions. Non-septate mycelium has been observed in the bulbs of the common onion, the shallot, and the potato (or underground) onion, its connexion with the mildew fungus being definitely established in the case of the first two varieties. It survives in infected bulbs left in the soil during the winter, and there is a time, generally in April, when the mildew is found only on plants whose bulbs and leaves are pervaded by it. These plants appear to act as important centres of infection.

A nice balance is preserved between host and parasite, both flourishing side by side for a considerable period, until at a certain stage in the maturity of the leaves the conidiophores are developed, and even then the host tissue is not destroyed for a long time. When the tips of the leaves turn yellow and droop, mildew breaks out, under favourable weather conditions, at first just below the withered portions of the older leaves, and then spreads to all the other leaves except the youngest.

Other points in this phase in the life-history of *P. schleideni*, including the effect on the keeping qualities of infected bulbs, are still awaiting investigation.

LEHMAN (S. G.). **Soft rot of Pepper fruits.**—*Phytopath.*, xi, 2, pp. 85–87, 1921.

A disease of sweet peppers (*Capsicum annuum* var. *grossum*), in which the fruit rapidly rots, was found in North Carolina. It is attributed to *Pythium de Baryanum* Hesse. Artificial infection was found to be difficult to produce. The natural attack always begins at the blossom end of fruits, not more than 6 or 8 in. above the ground, and is believed to result from zoospores, splashed from the ground by rain, which infect through wounds caused by insects.

COONS (G. H.) & NELSON (R.). **Celery Yellows.**—Abs. in *Phytopath.*, xi, 1, p. 54, 1921.

The disease, characterized by stunting, yellowing, and thickening of the foliage, is found to be due to an undescribed species of *Fusarium*. It was first discovered at Kalamazoo, Michigan, in 1914, and has increased until practically all soil in the vicinity of that city can no longer grow the susceptible variety Golden Self-blanching. It occurs in other parts of the United States. The so-called green varieties do not suffer much from yellows.

POOLE (R. F.). **Recent studies on Bacteriosis of Celery.**—Abs. in *Phytopath.*, xi, 1, p. 55, 1921.

The organism causing the bacterial celery rot in New Jersey was found to be *Bacillus carotovorus* Jones or *B. apivorus* Wormald, which are probably strains of the same organism. The green varieties are only slightly susceptible. Sowing before May 15 reduces loss, the temperature at this time not being favourable to the bacillus.

NISHIKADO (Y.). **On a Disease of the Grape-cluster caused by Physalospora baccae Cavara.** (In Japanese: Author's summary in English.)—*Annals Phytopath. Soc. Japan*, i, 4, pp. 20–41, 1 pl., 1921.

Studies of the causal organism of the disease of the grape-cluster here described (chiefly on the morphological characters of its pycnidium, pycnospore, perithecium, ascus, and ascospore) were carried out during 1914–16.

In the Okayama prefecture and other places where *Vitis vinifera* is cultivated, the disease has been prevalent for about ten years. It affects the peduncle, pedicel, and berry, but not the leaf or stem. The pycnidial stage of the fungus is identical with *Macrophoma reniformis* (Viala & Ravaz) Cavara, known as the cause of black rot in the Caucasus. Its perithecial stage agrees with *Guignardia* *baccae* (Cav.) Jaczewski (the perithecial stage of *Macrophoma reniformis*), except for the existence of paraphyses among the asci in the Japanese fungus. The name *Physalospora baccae* Cavara, changed by Jaczewski to *Guignardia baccae*, has been adopted by the writer because of the existence of these paraphyses in the perithecia.

The fungus flourishes on cultural media such as boiled potato or rice, developing copious black aerial mycelia, and occasionally producing pycnidia. The latter do not resemble externally the pycnidia found on the host, though the pycnospores are very similar.

The author's inoculation experiments have so far been inconclusive, but the parasitism of the fungus has been fully demonstrated by previous workers.

BEACH (W. S.). **A Phytophthora crown rot of Rhubarb.**—Abs. in *Phytopath.*, xi, 1, p. 55, 1921.

An undescribed *Phytophthora* producing conidia and oospores abundantly in culture was found to cause the rot. Inoculations were successful. Secondary fungi may complete the decay. The disease becomes severe in wet weather in late summer, and has caused the sudden death of considerable areas in rhubarb fields in Pennsylvania, usually in those recently set, having poor drainage, or receiving heavy manuring. With the return of dry weather many plants recover in part.

BOURNE (B. A.). **Fungoid Attacks reported or observed.**—*Rept. of the Dept. of Agric. Barbados*, 1920–21, pp. 10–11, 1921.

SUGAR-CANE. Root-disease still continues to cause heavy losses. The exact cause of the disease has not yet been definitely ascertained, especially since recent work indicates that it is doubtful if *Marasmius sacchari* Wakker has any parasitic connexion with the root-system of the sugar-cane. The writer has several times isolated a species of *Rhizoctonia* from cane-roots showing typical symptoms of disease, and is of opinion that the latter fungus is largely responsible for the condition. Proper tillage and drainage are essential, and only healthy cuttings should be planted. Other fungi observed were: *Colletotrichum falcatum* and *Cephalosporium sacchari*, associated with red rot; *Thielaviopsis paradoxa*, causing pineapple disease; *Cercospora vaginae*, responsible for a red spot of the leaf-sheath; and *Leptosphaeria sacchari*, the agent of ring spot of the leaves.

SUDAN GRASS (*Holcus sorghum sudanensis*). A typical leaf-disease was caused by *Colletotrichum lineola*, which produces reddish blotches and gives a scorched appearance to the leaves.

CASSAVA (*Manihot* sp.). Specimens of tubers stated to be affected by a rotting disease were submitted for examination, and found to be attacked by a *Gloeosporium*. The conidia extruding from the acervuli formed globular pustules. Spores in mass are greyish white, or with a roseate tinge, sometimes spherical or cylindrical but mostly elliptical, hyaline, 1–2 guttulate, 4–12 by 3–4·5 μ. The tubers showed signs of punctures, and the fungus is evidently a wound parasite causing rot. All diseased portions should be burnt.

Carrot (*Daucus carota*). A softening of the external part of the root was presumed to be caused by *Bacillus carotovorus*.

Mango (*Mangifera indica*), Elder (*Sambucus canadensis*), and Gardenia (*Tabernaemontana*), were attacked by *Diplodia cacaoicola*.

Date palm (*Phoenix dactylifera*) was severely attacked by *Graphiola phoenicis*, which destroyed the lower leaves.

Trost (J. F.) & Hoffer (G. N.). **Kernel starchiness as an index of susceptibility to root, stalk, and ear rots of Corn.**—Abs. in *Phytopath.*, xi, 1, p. 33, 1921.

Starchy ears of certain dent varieties of maize were found to produce plants more susceptible to *Fusarium* injury than are plants from ears more horny in composition.

Melchers (L. E.). **Ecologic and Physiologic notes on Corn smut (Ustilago zeae).**—Abs. in *Phytopath.*, xi, 1, p. 32, 1921.

The writer reports evidence that there are physiologic differences in culture of *Ustilago zeae* from different isolations. They vary in virulence, and this may possibly account for the varying resistance of selected strains of corn to smut in different localities.

Mitra (M.). **Morphology and parasitism of Acrothecium penniseti n. sp. (A new disease of Pennisetum typhoideum.)**—*Memoirs Dept. Agric. India*, Bot. Ser., xi, 3, pp. 57–74, 4 pl., 1 fig., 1921.

A parasitic species of *Acrothecium* is found commonly on *Pennisetum typhoideum* (vern. bajra) over a large area in North and Western India. It affects the growth of the plants and the production of sound grains, but as yet there is no definite information as to the actual amount of damage caused, though this seems to be considerable. It attacks the leaves, leaf-sheaths, and ears; as it is most common on the leaves the author suggests that the disease caused by it be called leaf-spot or leaf-blight of bajra.

Infected leaves show small, yellowish-brown spots, which gradually increase in length and become oval or oblong. Soon the centre of the spots assumes a dirty brown colour with a yellow margin around it. They are most frequent towards the edge of the leaf, and when situated near each other they soon unite, causing large patches, killing the tissues along the margin of the leaf, and gradually extending towards the midrib. Frequently both margins are affected, and the whole leaf is gradually killed. The spots occur on the midrib also, especially in young leaves, and, in severe cases, even on the leaf-sheaths. The infected portion becomes brittle with age. The disease begins from the lower drooping leaves, starting from the tips which either touch the soil or are very near to it, and then spreads and attacks the upper leaves. The spread of the disease is facilitated by the moisture which the tip and margin of the leaves retain on account of their being slightly upturned. At Pusa, in 1919, the disease made its appearance in June, starting on the lower half-dead leaves of young plants.

The ears can also be attacked. The infection begins from the tip of the floret and spreads gradually to the whole of the spikelet, and thence to those in the neighbourhood. In a badly-infected ear very few normal grains are formed. An infected flower shows a tuft of black mould at its tip, and mycelium in the ovary, glumes, and paleae.

The mycelium is both intra- and inter-cellular, and is found in all parts of the diseased tissues, even in the cells of the endodermis, sclerenchyma, and vessels. It consists of septate hyaline hyphae, which turn brown at the points where conidiophores are produced. Haustoria are not present. Conidiophores are most numerous in the central dead portion of the spot, issuing from the stomata, and gradually decrease in number towards the margin. They are amphigenous, solitary, fasciculate, rigid, erect, and straight or slightly nodulose or bent. Usually they are simple but occasionally forked near the tip. In colour they are olive brown to dirty brown with paler tips which are either swollen or flexuous. The base sometimes is also swollen. They are 68·4 to 154 μ long and 5·8 to 8·7 μ broad, and have three to five septa. The conidia are clavate, pear-shaped, or elongated, straight or slightly bent, thick-walled, 2–3 septate, and light olive brown to dirty brown in colour. The middle cell is broader and darker than the end cells. They are constricted at the septa, and are borne at the tip of the conidiophore in groups of two to five. Very rarely conidia are noticed on the sides of the conidiophore below the tip. They measure 25 to 41·8 μ by 12·5 to 20 μ.

The fungus was grown on a large number of media in pure culture, and numerous experiments have shown that in such cultures germination is usually rapid and the mycelial growth copious. In some media the spore production is free, and in others scanty, the conidia produced being slightly smaller than those found on the host plant. Chlamydospores are formed in most of the cultures; the cells of a hypha swell up singly or sometimes in a long line, become spherical or oval in shape, develop a thick wall, and, as the culture grows old, turn brown or greyish-brown in colour. These chlamydospores either remain united in a chain or separate, and germinate readily, giving rise to new hyphae. The results of a series of experiments show that the fungus prefers a reaction ranging between +5 and +10 Fuller's scale, but can withstand a considerable range either way.

Formal proof that *Acrothecium penniseti* was the cause of the disease was obtained. The fungus is constantly associated with the disease and was isolated from typical diseased tissues of the host; healthy plants inoculated with pure cultures gave characteristic signs of the disease. Altogether 106 inoculations on leaves (both sides) and leaf-sheaths, together with forty on ears, were made by the author, and all were successful. The fungus was re-isolated from inoculated diseased spots and re-inoculated on healthy plants, and the disease was produced as before. The re-isolated fungus was compared in culture with the fungus used for inoculation and was identical with the latter.

The fungus infects its host through the stomata and also by piercing the epidermis. The host-cells are killed in advance of the mycelial growth, and penetration of the dead cells is evidently easier than of the living, since in the central dead portion of the spot hyphae are found abundantly, while they are almost absent in the cells towards the margin.

Cross-inoculations failed with *Andropogon sorghum*; they succeeded on the male inflorescence, but failed on the leaves, of *Zea Mays*.

KESSLER (B.). **Zum Auftreten der Federbuschsporenkrankheit in der Rheinprovinz.** [Appearance of the 'Plumed Spore' disease in the Rhine Province.]—*Nachrichtenblatt für den deutschen Pflanzenschutzdienst*, i, 4, p. 28, 1921.

This disease, the appearance of which has been reported in the district of Rheinbach near Bonn, in Rheinhessen, and Baden, is supposed by the author to have been introduced with straw from France, either at the retreat of the German armies or during the present occupation of the territory by the French. Its spread indicates that it has been present for one or two years.

In the Rheinbach district the parasite (*Dilophospora graminis*) attacks both wheat and rye, and neither the composition of the soil nor the nature of the fertilizers employed seems to have any influence on its appearance. The extraordinary drought of 1921 does not appear to have stopped the development and spread of the fungus, and Schaffnit has observed it in Rheinhessen, which suffered particularly from the drought.

In judging the extent of the damage done by the disease, it should be borne in mind that generally only about 5 per cent. of the diseased spikes grow out of the leaf-sheaths and reach the normal height. By far the greater proportion of affected plants are therefore not noticed at all on a cursory inspection, and the estimate of the damage is likely to be too low.

The peculiarly plumed spores of the fungus are pycnospores. The pycnidia lie in rows, completely buried under the epidermis, in a thick, felted, white bedding of mycelium. Their walls are of a dark olive-green colour, and the interior is filled with a mass of spores, almost horny when dry, but becoming gelatinous when moistened, and protruding out of the mouth of the pycnidium in a worm-like mass.

The germination of the spores is peculiar. A septum is formed in the middle, and both halves of the spores swell up until, when they have reached a certain size, they break apart at the septum. Each half, or sometimes only one of them, then puts out a germ-tube in the direction of the axis of the spore. The two halves may remain in contact or separate during germination.

According to Fuckel, perithecia are developed on plants attacked in autumn and during the winter, but whether this perithecial form, described by Fuckel under the name of *Dilophia graminis*, is the perfect stage of *Dilophospora graminis* has not yet been conclusively proved. The point is of importance in checking the disease, for while it is easy to free the grain from pycnospores by disinfection, it will be much more difficult to control the disease if it is caused by ascospores, as these can winter over on fragments of straw or stubble which remain in the field.

VAN DER BIJL (P. A.). **On a Fungus—*Ovulariopsis papayae* n. sp.—which causes Powdery Mildew on the leaves of the Pawpaw plant (*Carica papaya* Linn.).**—*Trans. Roy. Soc. S. Africa*, ix, 2, pp. 187–189, 1 pl., 1 fig., 1921.

The under surface of the leaves of pawpaw along the coast of Natal is often found to be covered with blotches of a powdery mildew, which sometimes spreads over the greater portion of the surface. No previous records of a powdery mildew on the leaves of the pawpaw seem to exist, and it is held to be a new species for which the name *Ovulariopsis papayae* is suggested. The writer gives the morphological description of the genus *Ovulariopsis* as founded by Patouillard and Hariot, and points out the close relationship between this genus and *Phyllactinia* in their conidial fructifications and habit. Thus far only the conidial stage has been observed in the pawpaw fungus, but the possibility that it belongs to *Phyllactinia* is not excluded. It has not been observed to spread to the leaves of the mulberry, a known host of *Phyllactinia corylea*, growing near by.

The following is the description given by the author: *Ovulariopsis papayae* n. sp. Sterile hyphae hyaline, epiphytic, penetrating interior of leaf through the stomata and ramifying in the intercellular spaces of the spongy parenchyma; conidiophores arising from the sterile hyphae, erect, cylindrical, pluriseptate, up to 200 μ long, 7 μ diameter; conidia large, borne singly at apex of conidiophores, subclavate, 60 to 90 by 14 to 23 μ, majority 72 by 14 μ; conidiophores and conidia usually smooth, rarely beset with fine projections.

WILTSHIRE (S. P.). **Studies on the Apple canker fungus. I. Leaf scar infection.**—*Annals of Appl. Biol.*, viii, 3–4, pp. 182–192, 1 pl., 1921.

The general view that the apple canker fungus is a 'wound parasite', and that as long as the host remains intact no infection is possible, would appear to be in need of revision, as the author's investigations at Long Ashton, near Bristol, spread over some years, have established the fact that infection in a large number of cases takes place through the scars left by the fallen leaves in the autumn, and also through these scars in the following spring. It is evident that it is only if such natural ruptures of external tissues as those occurring during the normal growth of the tree are regarded as 'wounds' that *Nectria ditissima* (the author expresses no opinion regarding the name *N. galligena* Bres. recently suggested for this fungus) may be termed a wound parasite. It is worthy of note that inoculations of scars from freshly removed leaves, attempted in June 1919, were a complete failure, although wounds treated with the same inoculant produced the typical canker. This is probably due to the more active and vigorous growth displayed by the host in June, as compared with the autumn, when the normal leaf-fall occurs.

In microscopic examinations the dead tissues of the leaf scar were invariably found to be infected by fungi, and amongst these occurred a very interesting, not yet identified, pycnidium-forming fungus that appeared to be universally present, but whether it contributes in any way to the infection is not known. With the pycnidia, which are either immersed in the leaf scar or may occur outside based on a small mass of hyphae, dark-coloured conidiophores are generally found with spores that resemble *Fumago vagans*, but whether these belong to the pycnidial fungus is uncertain.

The entry of the canker fungus into the tissues is accomplished by means of small cracks in the leaf scar caused by the contraction of the tissue on contact with the atmosphere. These cracks are specially noticeable in the region of the soft tissue adjacent to the leaf traces, and they afford ready access to the fungus before the host is able to form a protective phellogen. Small quantities of water, collecting in slight depressions between the leaf scars and the main stem, no doubt aid the germination of the spores of the fungus. The latter grows very freely in the intercellular spaces of the leaf base, the looser texture of which—as compared with the normal cortex—favours rapid development.

Very similar in its symptoms to the autumn infection is that which occurs in the spring when the enormously increased rate of growth of the buds gives rise to fissures in the leaf scar through which the fungus gains direct and unimpeded access to the deeper tissues of the leaf base, where it develops rapidly, in many instances surrounding the stem and killing the shoot above it. But the infections do not always develop into cankers, the infected tissue being sometimes isolated by the formation of a phellogen, which acts in exactly the same way as when shallow cuts are inoculated artificially. Whilst in some cases the development of the canker may be so rapid as to kill the shoot above it almost immediately, the contrary has been known to occur on other occasions when the canker has taken three or more years to complete the encircling of the stem.

The material used by the author for the study of the canker consisted of seedlings of the cross Kingston Black × Médaille d'Or, two cider varieties, and one of the first points noted was that the shoots became infected during the year following their formation. The ratio of increase from year to year was generally found to be high, counts undertaken in a specific instance giving the following results: On the 1915 wood, one canker; on the 1916, four; on the 1917, twenty-nine; and on the 1918, 434. For 1919 the number was certainly over 600, though exact figures were not obtained. A feature observed in connexion with the disease was the extraordinary large number of infections that occurred in a comparatively restricted area, a single branch of one of the trees, having a diameter of 1½ in. at its base and not more than five years old, showing sixty-five cankers, almost every bud being infected. Trees severely attacked present a partially defoliated appearance.

The loss through canker, especially in the case of young trees, is considerable, and methods of control have therefore received close attention. Winter pruning of bush trees, in which process most of the infected wood is cut out, has given good results, although infection may still occur after the pruning has been done; but with orchard trees, where pruning is not practised to any extent, a different procedure has to be adopted. Spraying of the leaf scars before the bursting of the buds would appear to be successful in the control of spring infection, and the reduction of the number of cankers obtained in the course of the preliminary experiments at Long Ashton amounted to about 80 per cent.

The spraying of the leaf scars in the autumn, immediately after defoliation, is not devoid of danger as the liquid may spot the fruit still remaining on the trees, and while the employment of a copper fungicide in the case of ripe fruit is obviously objectionable, the alternative of a sulphur spray does not appear to be effective. A further difficulty which presents itself is the rapidity of infection, this very often taking place before defoliation is complete. Provided suitable spraying fluids can be found, at least two sprayings during the autumn would therefore seem to be required to check the disease. Other more promising treatments may yet be discovered, but, meantime, a fact worth noting is that vigorous trees usually hold their leaves longer than weakly ones, and anything that tends to invigorate growth may thus reduce the risk of infection.

BRYCE (G.). **The 'bunchy top' plantain disease.**—*Dept. of Agric. Ceylon Leaflet*, No. 18, 2 pp., 1 pl., 1921.

This disease, which is also known in Fiji, Australia, and Egypt, and has recently been reported from the Bonin Islands, first appeared in the Colombo district of Ceylon in 1913, and has gradually spread to other parts of the island up to an elevation of 3,000 ft. In 1918 a plot of Manila hemp (*Musa textilis*) at the Peradeniya Experiment Station was practically destroyed by it.

The symptoms of bunchy top are easily recognizable. The young suckers of a diseased plantain have their leaves bunched together at the top, growth being arrested at the same time. Diseased suckers never mature or produce fruit, development ceasing when a height of two to five feet is reached. The bunching of the leaves is caused by the stunting of the leaf-stalk which prevents their separation from one another, and causes them to remain closely packed in a rosette, giving the sucker somewhat the appearance of a shaving brush. The leaves are smaller than the normal, lighter in colour (the margins sometimes quite white) and very brittle. As they grow older they become thicker in transverse section and develop a strongly ridged or corrugated surface.

The bulbs of the plants affected by bunchy top show small flecks and lines of a yellow or brown colour. These are scattered throughout the interior of the bulb, and vary considerably both in size and number. The banana root-borer (*Cosmopolites sordidus*) tunnels the bulbs, causing considerable damage, but it is also found in suckers which are free from bunchy top. The roots of affected plants are mostly dead; the larger ones are apparently killed back from the root tip for a considerable distance, but the portions adjoining the bulb remain still living, while the finer roots are generally all dead.

The cause of this disease has not yet been definitely ascertained. Nematodes sometimes occur in the living portions of the roots, but they are not invariably associated with the dis[illegible] improbable that they produce it. *Rhizoctonia* is prevalent on both the finer and larger roots, but the evidence is insufficient to connect the disease definitely with the presence of this fungus. A preliminary experiment to determine whether bunchy top could be due to a filterable virus gave negative results.

The disease has probably been spread from one district to another by exchange of plantain suckers for planting up purposes. The banana root-boring weevil is very likely also concerned in its local spread.

Bunchy top is much more prevalent in plantain fields which have been allowed to run on for several years from the date of planting up. The bulbs of the old stools in such fields are also riddled by the root-boring weevil. It is therefore advisable to dig up old bulbs and replace them by carefully-selected and healthy suckers at about three-year intervals. The spot from which diseased suckers are removed should be heavily limed, and at least one year should elapse before replanting.

In India, where *Rhizoctonia* frequently occurs on jute, the application of potash has been found to reduce the incidence of disease, besides greatly increasing the yield. This is also the case with bunchy top in the Bonin Islands, where the disease is definitely ascribed to a deficiency of potash in the soil. The addition of a nitrogenous manure to the potash is recommended in both cases. The author advocates a combination of nitrogen, potash, and lime. In small gardens, where an application of expensive fertilisers is impossible, a liberal dressing of wood ash and a mulch of leguminous plants may be substituted.

It has not yet been ascertained whether any Ceylon plantain varieties are immune against bunchy top. In Fiji the *Gros Michel* banana is immune, and the plantain industry, which was practically destroyed by the disease between 1890 and 1900, is again profitable there owing to improved methods of control and better cultivation.

McFarland (F.). **Infection Experiments with Claviceps.**—Abs. in *Phytopath.*, xi, 1, p. 41, 1921.

Successful cross-inoculations are reported of *Claviceps* conidia from *Bromus inermis*, *Agropyron repens*, *Poa pratensis*, and *Arrhenatherum elatius* to rye (*Secale cereale*). Wheat was also infected in certain cases by using conidia from rye, *Arrhenatherum elatius*, *Poa pratensis*, and *Agropyron repens*.

Shear (C. L.) & Dodge (B. O.). **The life-history and identity of 'Patellina fragariae', 'Leptothyrium macrothecium', and 'Peziza oenotherae'.**—*Mycologia*, xiii, 3, pp. 135–170, 3 pl., 5 figs., 1921.

A fungus found growing on strawberries, raspberries, and various other plants was found to have sporodochia, pycnidia, and apothecia in its life cycle. Some twenty-seven names, or combinations, have been applied to these stages. The correct name for the fungus is given as *Pezizella lythri* (Desm.) Shear & Dodge. The conidial (sporodochial) stage is stated to be *Hainesia lythri* (Desm.) v. Höh., and the pycnidial stage is *Sclerotiopsis concava* (Desm.) Shear & Dodge.

The conidial stage has been found upon the genera *Acer, Ampelopsis, Castanea, Cercis, Cornus, Duchesnia, Epilobium, Eucalyptus, Fragaria, Gaultheria, Gaura, Hicoria, Jambosa, Lythrum, Nyssa, Oenothera, Vaccinium, Pelargonium, Populus, Potentilla, Prunus, Quercus, Rhus, Ribes, Rosa, Rubus, Salix, Smilax, Ulmus.* and *Vitis.* The pycnidia have been found on most of the above, and the ascus stage on six genera, including *Prunus* and *Rubus.* The above hosts were found attacked in North America, but as the fungus is also known in Europe and South America the list can doubtless be extended.

The fungus is a weak parasite, and was shown by cross inoculations to pass readily from one host to another. The ascigerous stage appears to have been described but once, as *Peziza (Mollisia) oenotherae* Cke & Ellis. The pycnidial stage has received at least four generic names, *Ceuthospora, Leptothyrium, Sporonema,* and *Sclerotiopsis,* and twelve specific, one of the best known being *Leptothyrium macrothecium* Fckl. The conidial stage has been referred to the genera *Dacryomyces, Sphaeronema, Gloeosporium?, Tubercularia, Hainesia, Hymenula,* and *Patellina,* the most recent of the ten specific names traced being *Patellina fragariae* Stev. & Pet.

The chaos which at present prevails in the taxonomy and morphology of the Ascomycetes is considered by the authors to be in imperative need of serious attention from mycologists and pathologists. The most practicable and effective plan for establishing generic names is believed to be the fixing of a type species for each genus which shall furnish a basis for a definite application and interpretation of the genus. The importance of life-history studies is also emphasized.

PAILLOT (A.). **Les traitements simultanés contre les Maladies cryptogamiques et les Insectes parasites des Arbres Fruitiers par les Bouillies mixtes.** [Simultaneous treatment with mixtures for Cryptogamic diseases and parasitic Insects of Fruit-trees.]—*Ann. des Epiphyties,* vii, pp. 169–194, 1921.

Considerable progress has been made in the United States and Nova Scotia of recent years in the simultaneous treatment, by mixed preparations, of insect and fungus diseases. Experiments were undertaken during 1919 and 1920 by the French South Eastern Entomological Station in the Drôme and Rhone Departments with the following objects: (1) The comparative study of the efficacy of different formulas of mixed compounds adapted to practical use. (2) The selection of those most suitable for recommendation on account of their low retail price or easy preparation. (3) The determination of the most favourable periods for the application of the different treatments. (4) The formulation of general principles of application.

The experiments comprised cupro-arsenical and lime-sulphur-arsenical mixtures, and were carried out on apple and pear trees. In cupro-arsenical mixtures the copper salts may be the sulphate or acetate (verdet), while the arsenic may be given as lead arsenate or lime arsenate. In the experiments described the following combinations were used:—(1) Neutral verdet (of 32 per cent. copper) 0·750 kg., commercial lead arsenate ('Bouillie Billault à poudre unique') 1 kg., and water 100 litres. This is very easy to prepare, and applied to William pears doubled the yield, and reduced scabbed fruit from 75 per cent. to 5·1 per cent. in one case. It is, however, liable to cause damage by scorching the young leaves and fruit unless applied at the right moment. (2) Lead arsenate-Bordeaux mixture (Bouillie Billault 1 kg., Bordeaux mixture (of 1 per cent. copper sulphate) 100 litres). This caused severe scorching in the one experiment made. (3) Lime arsenate-Bordeaux mixture (copper sulphate 1 kg., freshly slaked lime 3 kg., dry lime arsenate 300 gm., water 100 litres). This is more troublesome to prepare. The commercial lime arsenate used was in two forms, as powder and paste, which appeared to be of equal value, but the paste requires to be used in double the dose given in the above formula (600 instead of 300 gm.). This mixture should not be applied during the flowering period, but should be replaced at that period either by a simple lead arsenate spraying (without copper) or by the following: liver of sulphur, 300 gm., dry lime arsenate 300 gm., freshly slaked lime 3 kg., water 100 litres. In some cases the yield was more than doubled, and the percentage of scab on the fruits reduced from 90 to 4 with this mixture.

In general the results obtained with these different types of cupro-arsenical mixtures were almost equally satisfactory. *Fusicladium* scab on the fruit rarely exceeded 5 per cent. in the treated trees, whereas the untreated had often over 50 per cent., while the control of the fruit worms (chiefly *Carpocapsa*) was almost equally good.

Arsenical lime sulphur mixtures, widely employed in the U.S.A., Canada, and Italy, are as yet little known in France. They are made up with polysulphides of calcium which vary considerably according to the quality of the lime, the respective weight of the ingredients, the physical conditions of preparation, and the chemical composition and constitution. The commercial concentrated liquids, of which there are several satisfactory types, are chiefly used. Dry lime sulphur, which is much employed in America, has all the properties of the liquid mixtures and is more easily transportable. The arsenical lime sulphur mixtures used were as follows: (1) Lead arsenate-lime sulphur (concentrated commercial liquid lime sulphur (32° Baumé) 4 litres, lead arsenate (Swift) 600 gm., water 100 litres). This gave good control of scab and caterpillars on pears, the improvement with apples being less marked. (2) Lime arsenate-lime sulphur (concentrated lime sulphur as above 4 litres, lime arsenate paste 600 gm., water 100 litres). This caused burning, probably owing to inferior lime sulphur. It gave a good control of scab and *Carpocapsa* on pear and mildew of apple. The lime arsenate paste can be replaced by half the quantity of dry lime arsenate and the liquid lime sulphur by dry lime sulphur (500 gm.) without apparent difference.

All sprayers are not equally suitable for use with lime sulphur mixtures, brass or leaded steel being superior to copper. Most of the American apparatus for work on a large scale is made of bronze.

From the point of view of efficacy against diseases and pests of apple and pear there is little to choose between the copper and lime sulphur mixtures. The latter are, however, less expensive. Unfortunately it will not be easy to secure their extended use in France, where copper sprays are traditional.

In the writer's opinion three treatments with any of the above-mentioned preparations are sufficient to protect the trees against their chief parasites in the spring. The first should take place when the buds are bursting into flowers. If *Cheimatobia* are not numerous the first spraying may be without arsenate and may be advanced so as to coincide with the treatment of peach trees for leaf curl, or may even be, in the case of apple trees, omitted altogether.

The second treatment should be given at the end of the flowering period, when the petals begin to fall. The practice of spraying in the middle of the flowering season is not to be recommended.

The third treatment should take place ten to fifteen days after the foregoing, when the fruits are well formed.

The following measures are absolutely necessary to ensure successful treatment:—The first spraying being directed principally against the *Fusicladium* scab and the young larvae of *Cheimatobia* and *Hybernia*, all parts of the tree, including the wood, should be well covered. The second application aims chiefly at the extermination of *Carpocapsa*, the entire larval existence of which is passed in the interior of the fruit, so that it is vulnerable only at the moment of penetration. In the majority of cases this penetration takes place through the calyx, and the aim should therefore be adequately to protect the fruit by filling the depression of the calyx with insecticide. This is not easily effected with the ordinary apparatus, unless the nozzle is placed as near as possible to the flowering clusters. It is necessary to insist on these details since their non-fulfilment may annul the efficacy of the treatment. The same conditions apply to the third application.

The American spray pumps, which discharge the spray at a high pressure, are best suited for the treatment of orchards on a large scale and are more useful than the ordinary knapsack sprayers used in France. Owing to the high pressure, the drops are forcibly ejected, rapidly and effectively covering all parts of the tree. The writer considers that the problem of treating fruit-trees is more mechanical than chemical. Good mixtures are not scarce, but the machines available in France require to be improved.

FEYTAUD (J.). **Essais de Bouillies mixtes pour le traitement des Arbres Fruitiers.** [Experiments in the treatment of Fruit-trees by combined mixtures.]—*Ann. des Épiphyties*, vii, pp. 195–236, 1921.

Experiments were carried out in 1918 and 1919, near Bordeaux and in the province of Dordogne, on apple and pear trees, with the following mixed formulas:—Lime arsenate or lead arsenate combined with Bordeaux mixture or lime sulphur or di-basic copper acetate (verdet gris). The treatment was directed both against insects and fungi, especially *Carpocapsa pomonella* L., *Venturia pirina*, and *V. inaequalis*. As in the experiments reported by

Paillot [see last abstract] lead arsenate with lime sulphur caused little damage to apple foliage, but when lime arsenate or copper acetate was used the leaves were sometimes scorched. Bordeaux mixture caused no damage in the combinations tried on apples, but on pears some scorching was produced when it was mixed with lime arsenate.

In general there appears to be no great advantage in replacing lead arsenate by lime arsenate. The combined mixtures (Bordeaux or lime sulphur mixture with lead arsenate) are to be recommended in place of simple lead arsenate, as simultaneous treatments against *Carpocapsa* and *Venturia*. The Canadian formula of Bordeaux mixture (five times as much slaked lime as sulphate of copper, the latter not to exceed 1 per cent.) is to be recommended. The addition of resin soap was not found to be advantageous.

On the whole the combination of lead arsenate with basic Bordeaux mixture was more effective than with lime sulphur, though the latter produced very good results. The advantages of the Bordeaux combination are due largely to the excess of lime, which gives greater adhesiveness, increased insecticidal efficiency, and is effective in killing the eggs of *Carpocapsa*.

The addition of arsenical salts increased the efficacy of the fungicides against *Venturia*. Even the simple lead arsenate mixture (Bouillie Billault) gave marked results in controlling this disease. The best time for the application of the first spraying to apple trees is during the ten days following the end of the flowering period; pear trees that are liable to scab should be sprayed also within ten days of the fall of the petals, but the main treatment should come later, about the same time as the first spraying of apple (first half of May near Bordeaux). Supplementary sprayings are often advantageous or even necessary in severe attacks, and may have to be given both before and after those mentioned.

THIELE (R.). **Kolloidaler (flüssiger) Schwefel zur Bekämpfung des Mehltaues.** [Colloidal (liquid) sulphur for the control of Mildew.]—*Deutsche Obstbauzeit.*, lxvii, p. 113, 1921.

Hitherto the powdery mildews of vines, hops, fruit-trees, and other economic plants have been treated mainly with sulphur in the form of a powder, but the scattering of minute particles by the wind is a great drawback to this method. Hollrung ('Mittel zur Bekämpfung der Pflanzenkrankheiten', p. 8) recommends, as a general principle, the use of liquid sprays in preference to powders wherever possible.

A proposal, based on practical experience, has now been made to use sulphur in the form of a colloidal watery paste. This method has many advantages. Colloidal sulphur is far more effective than the most finely-ground sulphur powder. The mixture adheres firmly to the plant, and is not blown away by the wind like the powder. The sulphur is better distributed by spraying than by dusting. The dissemination of the colloid expedites the oxidation of the sulphur in the air. It can be applied in any weather, and the same apparatus can be used for spraying with Bordeaux mixture and with colloidal sulphur, so that these two treatments can be applied simultaneously. The economic advantages are considerable. If this method were generally adopted, the quantity of sulphur imported into Germany for agricultural purposes should be reduced to one-tenth of the present figure.

SMITH (J. H.). **The killing of Botrytis spores by Phenol.**—*Annals of Appl. Biol.*, viii, pp. 27–50, 1921.

The writer, using *Botrytis cinerea* spores from a single-spore isolation grown on Czapek's medium, tested the effect of phenol in killing the spores under various conditions. All the spores do not die simultaneously. In 0·4 per cent. phenol at 25° C. some 7 per cent. are killed in 50 minutes, and 3 per cent. are still alive after 160 minutes. With 0·6 per cent. phenol, only 0·39 per cent. are alive after 30 minutes. When the temperature is lowered, more time is necessary to kill the spores. The use of larger numbers of spores also causes a slowing in the rate of killing in a given phenol solution. Younger spores are more susceptible to phenol than are older spores.

The curves, plotted to indicate the number of survivors after successive intervals of time, are discussed in some detail. They are usually of the sigmoid type with a stage of increasing steepness, a maximum, and finally a stage of decreasing steepness, flattening out more and more as time goes on. This result is at variance with the curve generally accepted as the typical mortality curve for bacteria exposed to disinfectant agents, which is usually regarded as a logarithmic one: but the sigmoid curve has been obtained in many other biological investigations of the kind. With an increase in the strength of phenol used, the curve obtained approaches more nearly to the logarithmic type. Both curves are considered to be explicable on the assumption that the individual spores differ in their resistance to phenol and that if the number showing each grade of resistance be plotted, the resulting curve approaches a normal frequency curve.

MORSTATT (H.). **Zur Ausbildung für den Pflanzenschutzdienst.** [Training for the Plant Protection Service.]—*Zeitschr. für Pflanzenkr.*, xxxi, 3–4, pp. 89–94, 1921.

The author considers that plant pathology should be regarded as a specialized and independent branch of applied biology, and that the present controversy whether plant protection should enter within the scope of applied botany or of applied zoology, alone, is fruitless, since both these sciences are but subsidiary branches in the training of men for the plant protection service.

The word 'phytopathology' has lost much of its original meaning (pathological anatomy and physiology of plants); in Germany, for instance, it is understood as the study of plant diseases in the widest sense, while in America it covers chiefly the study of plant diseases caused by vegetable organisms, especially fungi and bacteria.

Plant pathology has undergone three marked phases of development in recent times. It started with the investigation of plant pests—fungi, bacteria, and insects; the next step consisted in endeavours to check such pests, chiefly by means of chemical preparations; and lastly arose the question of plant hygiene in contrast with purely therapeutical methods. From this followed a number of new points of view and tendencies, such as, for instance, the study of the influence of weather, soil, and other environmental factors on the spread of epidemics; transportation and importation of pathogenic agents and of their carriers; the question of susceptibility and resistance of varieties, which led in practice to the cultivation of immune varieties; the problem of virulence in pathogenic organisms; lastly, the so-called biological control of disease. Such preventive measures as improved cultivation, pruning, manuring, rotation of crops, as well as quarantine and the disinfection of seeds, are to be regarded as falling within the scope of pure hygiene.

These considerations lead to the conclusion that a 'phytopathologist' must be also a hygienist, that is, he must be fully conversant with all sides of the question (including cultivation methods) in order to be able, when investigating diseases and pests, to grasp the combined action of the various causative factors and to judge their individual bearing on the disease. His specialization in the aetiology of diseases due to fungi, bacteria, insects, &c., or in questions appertaining to cultivation, use of chemicals, and the like, should come only in the second place. It is a fact well known to all persons dealing in practice with plant protection problems that one-sided control measures against plant pests are not sufficient, and that it is necessary to investigate the whole ecology of the cultivated plant in order to find the most appropriate point from which the disease can be controlled. It must be remembered, too, that there are non-parasitic diseases, as well as diseases for which the pathogenic agent is still unknown, or in which the part played by the latter is but small in comparison with other circumstances which prepare the ground for it; and this is true not only of fungi and bacteria, but also of a whole series of insects.

There is a close parallel between the practical plant pathologist and the general practitioner in medicine. The former must be in a position to diagnose on the spot the symptoms of a disease or attack of a pest and to give prompt advice. This does not exclude in the least, any more than in human medicine, the necessity for having trained specialists for dealing with particular cases. In this respect the author points out a defect in the available literature intended to give practical help to cultivators, namely its division into zoological and botanical publications; and he asks what use to a horticulturalist is a book dealing, for instance, with the cabbage root weevil and not with clubroot. There is a great difference between writing a handbook for the pathologist and compiling practical advice for farmers; in the former case specialization is quite correct, but in the latter it is hardly admissible.

The fact should therefore be recognized that it is not sufficient to be a specialist (mycologist, entomologist, or other) in order to be fit for the plant protection service. The training for this service, if it is to give the practical results which are aimed at, must be of a general nature, so that the subject may be viewed in all its bearings from a central standpoint and not from the outside point of view of the botanist or zoologist or other specialist.

BOYLE (C.). **Infection by Sclerotinia libertiana.**—*Ann. of Botany*, xxxv, pp. 337–347, 1 pl., 1921.

The conclusions arrived at by the author may be summarized as follows:

Investigations into the early stages of infection of bean leaves (*Phaseolus coccineus* and *Vicia faba*) have shown that the hyphae of the ordinary mycelium and also the appressoria growing in turnip-juice are surrounded by a mucilaginous sheath, which can be easily demonstrated by mounting a piece of actively growing mycelium in Indian ink or by a short staining in dilute aqueous gentian-violet and mounting in water. This sheath cannot always be demonstrated in the case of aerial hyphae. When a hyphal tip is brought into contact with any resistant material, e.g. a cover-slip or the surface of the host, there is a modification in the staining reaction of the wall of the tip. This modification extends a short distance behind the point of contact, and in the case of appressoria it is very pronounced. An 'infection hypha' arises from the tip of each hypha in contact with the host plant or a glass surface, and in the former case this penetrates the host under suitable conditions. The point of origin of this infection hypha is early visible as a thinning of the hyphal wall, simulating a germ-pore. The infection hypha is very narrow, and has a normal unmodified wall. At the point of contact with this hypha the cuticle may be much indented as a result of pressure.

The invading hyphae appear to be fixed to the cuticle by means of the mucilaginous sheath. At this stage there is no evidence of the softening or solution of the cuticle or sub-cuticular layers of the host, and the rupture of the cuticle by the infection hypha seems to be due to mechanical action only. As soon as this process has taken place, the subcuticular tissue is rapidly disorganized, but even at a late stage the cuticle undergoes no chemical change. Under similar conditions the penetration of the host may occur with or without the formation of appressoria. Thus the method of hyphal 'mass infection' adopted by *Sclerotinia libertiana* is physiologically similar to infection by *Botrytis cinerea* and *Colletotrichum lindemuthianum* as described in the earlier 'Studies'.

DUFRÉNOY (J.). **La transmission des maladies des plantes par voie biologique.** [The transmission of plant diseases through biological channels.]—*Rev. gén. des Sciences*, xxxii, 13, p. 389, 1921.

There are few more important problems in phytopathology than that of the transmission of disease by animals. Recent researches have facilitated the classification of the means of transmission, which may be enumerated as follows: (1) Insects, by wounding the host, prepare the way for parasites which are incapable of penetrating the sound epidermis. (2) Insects transport the parasite on their teguments and deposit it on lesions, or on the natural channels of penetration. (3) The pathogenic germs, ingested by animals, are deposited on the host after passing through the alimentary canal; thus birds are responsible for the rapid dissemination of *Microsphaera mors-uvae* on gooseberries in France and of *Endothia parasitica* in the chestnut-forests of America, while squirrels have been proved to communicate *Peridermium* to the pines which they gnaw; in the soil nematodes, mites, and cockchafer larvae disseminate spores and bacteria. (4) Parasitic forms, accumulating in the alimentary canal, multiply, and remain there during a part of their life-cycle. Thus the Coleoptera, *Diabrotica vittata* and *D. duodecimpunctata*, harbour in their alimentary canal during the winter *Bact. tracheiphilus*; these 'germ-carriers' inoculate with wilt the Cucurbitaceae which they attack in the spring. Still more intimate is the connexion between *Bact. Savastanoi* and the olive-fly (Petri, 1909).

The transmission by insects of infectious mottling diseases (chlorosis, mosaic, leaf-curl) of potatoes, and probably of wild plants such as peppermint, renders the preservation of uninfected varieties extremely difficult. The wild plants or the insects themselves act as a receptable for the virus, and ensure its hibernation.

Sometimes insects become the prey of the fungi which they have transported: thus, *Beauveria* soil-saprophytes become entomophytes, following Bostrichid beetles into their galleries, while Laboulbeniales of the genus *Rickia* appear to be disseminated on Coleoptera and ants by symbiotic or parasitic Acarians.

Sometimes also the carrying insect lives in association with the transported parasite: Mangin and Viala have shown how a cochineal (*Dactylopius vitis*) associates on the roots of the vine with a fungus (*Bornetina vitis*), in order to be able to survive in very dry countries, such as Palestine. Very often, however, the insect carries fungi and bacteria merely accidentally, but with disastrous effects on cultivation.

Marchal has succeeded in curing epidemics of *Exobasidium azaleae* on greenhouse azaleas by the suppression, with tobacco fumigations, of the white fly (*Aleurodes vaporarius*), which transported the spores to the buds. This example should prove useful in stimulating efforts to destroy germ-carriers, which the author considers to be one of the principal methods of combating plant-diseases.

HOTTES (C. F.). **A Constant Humidity Case.**—Abs. in *Phytopath.*, xi, 1, p. 51, 1921.

The apparatus to maintain a constant humidity within a variation ± 1 per cent. consists of a plant chamber $20 \times 20 \times 20$ in. constructed of wood with the top and sides of three thicknesses of glass to give two dead air spaces for insulation. The case is furnished with the Johnson Service Co. humidostat and thermostat. The case sits on an accurately fitted base three inches in height, through which the supply pipes for the moist and dry air, respectively, pass into the case. The heating elements for the maintenance of a uniform temperature are attached to this base. Between this shallow base and another, ten inches in height, is a perforated 'transite' plate through which the shoots are passed into the plant chamber. The roots, in soil or nutrient solution, may be placed under conditions like or unlike those of the shoot, through independent regulation of the temperature, &c., of this lower base. The humidity is controlled by the humidostat making contact, now with one, then with the other terminal of an electro-magnetic valve (Johnson Service Co., old style) that will shift the flow of compressed air (20 lb.)

through the humidifying or the drying apparatus respectively. The humidifier consists of a ten-litre aspirator bottle furnished with an inlet tube tipped with De Vilbiss atomizer No. 28, and partly immersed in distilled water. The air from the valve, passing through the atomizer, forms a fine spray, and thus becomes rapidly charged with moisture, especially if the water is slightly heated. The air leaves the aspirator bottle through a condenser head, and is delivered to the plant chamber by a connecting tube. The drying apparatus consists of a series of calcium chloride towers or a sulphuric acid atomizer (glass) for drying. The regulation is very simple, and the range of the instrument is from 20 to 95 per cent. relative humidity. When adjusted for medium humidity and without plants in the chamber, the change from moist to dry air and the reverse occurs at intervals of about three minutes. With plants in the chamber the interval on the dry air is lengthened.

PANTANELLI (E.). **Sui rapporti fra nutrizione e recettività per la ruggine.** [The relation between nutrition and susceptibility to rust.]—*Riv. di Patol. Veg.*, xi, 3–4, pp. 36–64, 1921.

After a summary of the work of previous investigators on the relation between nutrition and the attack of rust fungi, the author describes three years' experiments (pot and water-cultures) directed to ascertain the factors favouring susceptibility to rust in wheat, oats, maize, and beans inoculated with *Puccinia glumarum tritici*, *P. coronata*, *P. sorghi*, and *Uromyces fabae* respectively. In the main experiments ten series of cultures were undertaken, the nutrient solutions being given as follows:—(1) Tap-water. (2) Sodium nitrate. 3. Ammonium carbonate. 4. Potassium bicarbonate. 5. Potassium nitrate. 6. Monopotassium phosphate. 7. Magnesium sulphate. 8. Sodium sulphate. 9. Sodium nitrate with monopotassium phosphate. 10. Sodium nitrate with monopotassium phosphate and magnesium sulphate. There were also several subsidiary series of water-cultures.

In the first series, lack of nutrition reduced susceptibility in the cereals, ultimately rendering them immune. With beans, on the other hand, it allowed a severe attack in the water-cultures, though not in the pots with sand. In the series with sulphate of magnesium and of sodium respectively, although in these the primary nutrient elements were absent, severe infection also occurred.

Sodium nitrate augmented susceptibility strongly in the cereals; in maize the cultures with only this salt were always the worst attacked. This cannot be attributed merely to the excess of nitrogen, as the series with ammonium carbonate in equivalent doses of nitrogen remained practically immune. Beans maintained immunity both with sodium nitrate and ammonium carbonate given alone. A subsidiary experiment showed that when ammonium salts were added to sodium nitrate the attack was severe, this being true even with beans. The addition of nitric acid to other nutrient salts from which nitrogen was eliminated increased susceptibility in the cereals, but not with beans. The observations suggested that a rapid absorption of nitrogen increased susceptibility.

Potassium bicarbonate increased resistance in the cereals but diminished it in the beans. Potassium nitrate increased susceptibility in cereals and beans.

Phosphoric acid given alone slightly increased susceptibility. Combined with potassium the action was contradictory, oats and beans remaining immune, while wheat was lightly attacked and maize was attacked in the same degree as the control. Added to sodium nitrate, the phosphate did not limit the favourable action of the former to rusts, and with ammonium there was a great increase in susceptibility, even in the case of beans.

Magnesium sulphate given alone increased susceptibility, but the effect was not cumulative when nitrate was added in series 10. The high concentration of the substratum, however, must be taken into account in the latter case.

Sodium sulphate also slightly augmented susceptibility, which suggests that the high degree of susceptibility observed in the sodium nitrate series was partly due to the action of the sodium.

Judging by these results, it appears probable that a plentiful supply of nitrogen increases susceptibility, that potassium exerts contradictory effects, that phosphoric acid is slightly favourable to rust, and that poor nutrition increases resistance. In the water-cultures tests were made which showed that the absolute elimination of particular elements such as nitrogen, phosphorus, potassium, or magnesium, while supplying in each case a normal quantity of the others, increased resistance. But the elimination of chlorine and sulphur from an otherwise complete nutrient solution results in a degree of susceptibility similar to that induced by a good nitrogen-phosphatic nutrition.

A fact regularly observed was that the rusts preferred the plants with the most rapid growth. Rapidity of growth must, however, be distinguished from increase in dry weight, for while nitrate of soda induces rapid growth, it gives ultimately, in cultures such as these, a less prosperous development than ammonium carbonate in the young plants. In the former case the attack was severe, in the latter the plants remained almost immune.

The root-system did not develop in proportion to the aerial parts; the more luxuriant the growth of the stems, the less was (comparatively) the weight of the roots. Whereas in maize and wheat no correlation was apparent between susceptibility and the ratio of the roots to the stems, in oats and beans the connexion was evident. In the case of the two latter crops, the greater the development of the roots in respect to that of the stem the more severe was the infection. The observations suggested that this depends more on the activity of the absorption than on the size of the absorptive system. It was also observed that infection was very severe in cases where much water was absorbed by the plant in proportion to the weight of its absorptive system during the period immediately preceding inoculation. This indicates that a diminution of the absorptive activity of the roots tends to lessen the susceptibility of the leaves, quite independently of their respective development. The behaviour of the series with double or triple formulas, in which the concentration of the nutrient solution was higher than when the salts were given alone, supports this view. In these series the higher concentration induced a relatively lesser absorption of water, and the susceptibility was not so great as might be expected when sodium nitrate and magnesium sulphate were combined,

The effect of the varying degrees of acidity and alkalinity in the nutrient solutions was examined. The relative absorption of water in regard to the extent of the absorptive system was promoted by a neutral or slightly acid reaction, and decreased by an alkaline or strongly acid one. Susceptibility to rust did not fluctuate in the same way, though a marked acidity of the nutrient solution, sufficient to impede the absorption of water, always promoted immunity. Slight acidity increased immunity when the acids were of such a nature as to favour synthetic processes in the plant (phosphoric and sulphuric acids), but induced susceptibility when the acids interfered with the synthesis of the albumins and more complex carbohydrates (nitric and hydrochloric acids).

Alkalinity of the nutrient solution, if not too marked, increased susceptibility because the synthetic processes were impeded (sodium nitrate, sodium sulphate, potassium and sodium carbonates), but when sufficiently pronounced to produce injurious effects on the plant, immunity was induced (higher concentration of sodium and potassium carbonates, ammonium carbonate).

While an indirect relation must be recognized between susceptibility to rust and reaction of the nutrient solution, the results are not entirely due to the effects of this reaction on the activity of the roots. Modifications in the internal metabolism, as discussed below, are evidently involved.

Analyses were made at the moment of inoculation of some of the plants in each series. No correlation was established between the water-content of the leaves and susceptibility. So also it was not possible to find any relation between the density of the aqueous extract of the leaves and susceptibility. The molecular concentration of the extract, determined by the cryoscopic method, appeared to have no regular bearing on the rust attack. But by comparing the mineral components (ash) with the density and the molecular concentration of the extract an important relation was found, namely, that the richer the sap in organic substances and mineral salts, the greater was the susceptibility to rust. The reaction of the nutrient solution surrounding the roots affects this relation; weak external acidity promotes the absorption of water as compared with salts, while alkalinity or high acidity decreases the absorption of water and allows of the relatively greater penetration of salts. In the former case, the cellular sap being deficient in salts, the plant shows less susceptibility.

The work of Comes has revived the discussion as to the rôle of acids and sugar in the determination of resistance and susceptibility respectively. In the foregoing experiments it was found that in the cultures with potassium phosphate the sap contained slightly more free acids. No definite relation was established in regard to free acids in the other cultures, although their degree of susceptibility varied. It is pointed out, however, that the greater part of the vegetable acids of the sap are present in a combined form, and when these were determined it was found that the more susceptible plants (e.g. those grown in solutions of sodium or potassium nitrate) were the most deficient in free and combined acids, so that, in a very general sense, a connexion may be established between the total acid-content and resistance. Two points, however, must be borne in mind: 1. That the 'stronger' organic acids, such as oxalic and tartaric, may disguise an eventual relation due to 'weaker' acids, such as malic, or those of a higher molecular weight, such as citric. 2. That if the sap is rich in organic nitrogenous bases combined with acids, there is a loss during heating, not only of the base but also of the acid and the derived carbonic acid. For this reason the combined acidity, simply calculated by the alkalinity of the ash, may appear less than it actually is.

Sugar was more plentiful in the susceptible plants (sodium and potassium nitrate, magnesium sulphate, &c.), decidedly scarce in the resistant cultures (controls, potassium carbonate), except that it was abundant in the ammonium carbonate series, which was the most resistant. Resistance was greater in plants in which the synthesis of the more complex carbohydrates was best effected.

No relation was found between susceptibility and the percentage of total nitrogen and soluble nitrogen in proportion to the dry substance, whereas it was noted that susceptibility increased with the preponderance of soluble over insoluble nitrogen. The same connexion was observed in the case of phosphorus. These facts show that susceptibility is greater when the synthesis of albumins and other phosphoric compounds insoluble in water is impeded.

Thus the most salient characteristics of the constitution of the sap of leaves susceptible to rust are a preponderance of sugar over the more complex carbohydrates, and of soluble nitrogenous and phosphoric substances over insoluble.

In further experiments it was found that the sulphates of iron, zinc, and aluminium, and chloride of barium conferred immunity or reduced susceptibility. On the other hand, manganese sulphate and copper sulphate did not prevent a severe attack of rust, while the former actually increased susceptibility. In this last case, development was very luxuriant, but the same was also true with iron. Both iron and manganese were found to be absorbed by the plant. Sulphate of copper stimulated growth, but zinc, aluminium, and barium retarded it.

It will be evident from the foregoing investigations that malnutrition does not predispose the plant to attack by rust, the contrary being rather the case. The augmentation of resistance observed in practice to result from an excess of phosphate relatively to nitrogen is due merely to the retardation of growth. When the phosphate nutrition is balanced in regard to nitrogen there is no such influence. An increased concentration of the nutrient solution diminishes susceptibility in so far as it reduces the absorptive activity of the roots, but not by increasing the osmotic pressure of the sap in the leaves, since no relation between the latter and susceptibility appeared to be present. Of more importance is the concentration of organic substances in the sap. Resistance is apparently increased by the augmentation of free acids of low molecules, while the more susceptible organs are richer in sugar, in acids of large molecules, and in soluble compounds of phosphorus and nitrogen.

DOOLITTLE (S. P.). **The relation of wild host plants to the over-wintering of Cucurbit Mosaic.**—Abs. in *Phytopath.*, xi, 1, p. 47, 1921.

Mosaic was transmitted from cucumber to *Asclepias syrica, Capsicum annuum,* and *Martynia louisiania,* and from these plants to cucumber. The wild cucumber (*Micrampelis lobata*) is, however, most important in the over-wintering of cucumber mosaic. The disease is transmitted through the seed of the wild cucumber. Eradication of this plant and the milkweed may be of value in controlling mosaic.

DOOLITTLE (S. P.). **Influence of temperature on the development of Mosaic diseases.**—Abs. in *Phytopath.*, xi, 1, p. 46, 1921.

Higher soil and air temperatures were found to favour the development of cucumber mosaic. Inoculations at a soil temperature of 18° C., when the air temperature was about 20° C., gave a few cases, but none when the air temperature was below 20° C. Between 22° and 27° C. soil temperature the percentage of infection did not vary, but the incubation period was longer at an air temperature of 18° than at 30° C. With soil temperatures from 27° to 30° C., regardless of air temperature (from 18° to 30° C.), incubation was shortened and the percentage of infection increased. Field observations on aster yellows strengthen these conclusions.

CRAWFORD (R. F.). **Over-wintering of Mosaic on species of Physalis.**—Abs. in *Phytopath.*, xi, 1, p. 47, 1921.

Tomato mosaic was transferred to *Solanum dulcamara, S. nigrum, Physalis longifolia, Nicandra physaloides,* and *Datura stramonium. Physalis longifolia* is a perennial weed which may carry the mosaic of cultivated Solanaceae over winter.

MELIN (E.). **Über die Mykorrhizenpilze von Pinus silvestris L. und Picea abies (L.) Karst. (Vorläufige Mitteilung).** [The Mycorrhiza Fungi of *Pinus silvestris* L. and *Picea abies* (L.) Karst. (Preliminary Note).]—*Svensk Botan. Tidskr.*, xv, 2–4, pp. 192–203, 9 figs., 1921.

For some years the author has been occupied with the study of the ectotropic mycorrhiza of Swedish forest trees, the first results of his investigations having been published in *Akad. Avh.* (Uppsala) in 1917. After having satisfied himself of the vital importance in certain types of soil of mycorrhiza formation, his next object was to isolate the fungi concerned. So far three distinct, genuine mycorrhizal fungi have been isolated from the pine, and one from the fir. The occurrence of clamp-connexions on the hyphae in all cases refers these fungi to the Hymenomycetes. No fructifications were formed, but in certain conditions the hyphae develop terminal or intercalary swellings, as is also the case with the fungi of the *Calluna* mycorrhiza. Growth in pure cultures is usually very slow. For the present, the fungi isolated in these experiments are termed *Mycelium radicis silvestris* (from *Pinus sylvestris*) and *M. r. abietis* (from *Picea abies*).

Mycelium radicis silvestris. The three forms isolated (α, β, γ) exhibit such striking morphological and physiological differences that they must probably be regarded as distinct species. It is uncertain, even, whether they all belong to the same genus. *M. r. silvestris* (α) was isolated from mycorrhiza of the nodule type. On nutrient gelatine the aerial mycelium is usually thick, resembling cotton-wool, white, or with a faint tinge of yellow or pink. The hyphae frequently branch at the same height on either side, giving a characteristic appearance recalling a branched candlestick. The aerial hyphae are very thickly covered with elongated nodules of an excreted substance, which give them a papillose appearance. Clamp-connexions only occur occasionally in very old cultures. A brownish colouring matter is usually excreted. *M. r. silvestris* (β) was isolated from mycorrhiza of the forked type. On nutrient gelatine the aerial mycelium is usually white and fleecy, and consists of very slender hyphae (about 2 to 2·5 μ in diameter). Clamp-connexions are very frequent. Mycelial strands composed of intertwined hyphae are absent. A yellowish-brown colouring matter is excreted. *M. r. silvestris* (γ) was isolated from mycorrhiza of the same type as the last. Growth takes place chiefly on and under the surface of the substratum, only a sparse light-grey to grey-brown aerial mycelium being formed. In many cases even this is absent. A dark brown or olive-green colouring matter is generally formed, sometimes in such a way that the dark-brown colonies are surrounded by an olive-green areola. On the whole, the hyphae are thicker than in the last (about 3 to 3·5 μ). The clamp-connexions are well developed. Mycelial strands composed of 2 to 10 intertwined hyphae are frequent.

M. r. abietis. So far only one mycorrhizal fungus of *Picea abies* has been isolated. Growth is mainly on and under the surface of the substratum, with rather sparse, greyish, aerial hyphae, which are sometimes altogether absent. The colouring matter and hyphae resemble those of *M. r. silvestris* (γ), and possibly these two forms belong to the same species.

Another fungus has been almost constantly isolated by the author from older mycorrhiza, as also from the young tap-roots of pines and firs. This fungus does not belong to the genuine mycorrhizal fungi, being morphologically and physiologically distinct from them. It has been provisionally named *Mycelium radicis atrovirens*, and may be described as follows: Compact, generally greyish mycelium composed of slender hyphae without clamp-connexions. Strands of 2 to 10 intertwined hyphae frequent. Growth much more rapid than that of the genuine mycorrhizal fungi. A dark olive-green colouring matter is formed. Conidia were not developed.

Inoculations were carried out on sterile seedling plants with the above-mentioned fungi, non-inoculated plants being grown simultaneously in pure cultures. The results were as follows:—(1) *M. r. silvestris* (α, β, and γ) and *M. r. abietis*, which develop very slowly on plates in pure culture, exhibit a more active rate of growth in association with the seedlings, and all form ectotropic mycorrhiza. Infection takes place more rapidly in sand than in humus cultures, probably because the hyphae are better developed in the former. At first the hyphae grow intracellularly in the outer cortical cells, where they form pseudoparenchymatous aggregations. The

'Hartig's braidwork' and hyphal coating are not developed till later. External infection occurs through the root-hairs, or, in their absence, through the epidermal cells. The roots of uninoculated plants resemble those of non-mycotropic plants; there is no marked difference between short and long roots, and the root-hairs are well developed. The seeds of *Pinus silvestris* and *Picea abies* can germinate without the co-operation of the fungi. They also develop very well in pure culture, given a supply of nitrogen in an assimilable form. *M. r. atrovirens* forms no ectotropic mycorrhiza. The plants are attacked parasitically, the fungus penetrating the lateral roots and living exclusively within the cells. Root-hairs are not formed. Starting from the lateral roots, the fungus permeates the entire root-system and also penetrates the aerial portions of the stem as far as the needles. The inoculated plants die after a few months. The shortened lateral roots strikingly resemble the pseudomycorrhiza described by the author in 1917, and there is no doubt that this fungus also produces pseudomycorrhiza in nature.

Several writers have expressed the opinion that the mycorrhiza fungi are disseminated by means of the seed, but the author's investigations do not confirm this view. The seeds of old cones are frequently infected by various other fungi, which flourish on the surface of the testa after penetrating the dead scale-cells. The endosperm, like the embryo, is always sterile, so that the seeds can easily be disinfected without producing any ill-effects on germination.

Thus the mycorrhizal fungi must grow in the soil, whence they attack the roots. It is obvious that such fungi must be very widespread in soils with a high admixture of humus, since it is here that the mycorrhiza of conifers constantly occur. Probably the number of species capable of forming mycorrhiza is very limited, and the fungi involved are most likely biologically related. This view is supported by the fact that *M. r. silvestris* (α) and (β) have been isolated by the author both in Holland and Sweden. They develop very slowly on plates, the greatest activity being shown by *M. r. silvestris* (α), and appear to have adapted themselves in a remarkable degree to symbiotic conditions. In all probability they also develop very slowly in the soil when not in association with conifer roots.

On the whole, organic compounds appear to be superior to inorganic as a source of nitrogen. Thus *M. r. silvestris* (α) develops best on nucleic acid, *M. r. silvestris* (γ) and *M. r. abietis* on ammonium citrate. Assimilation of atmospheric nitrogen does not occur in pure culture. The fact that nucleic acid constitutes a suitable source of nitrogen for *M. r. silvestris* (α) is of great interest, as it has been isolated from humus by Schreiner and Skinner. This suggests that at any rate certain mycorrhizal fungi are able to assimilate complicated organic nitrogenous compounds from the soil, and to supply the trees with nitrogen in some form. Further experiments on these lines will be undertaken. There is also a possibility that some of the fungi in question can fix the atmospheric nitrogen, for though assimilation of free nitrogen has not been observed in pure culture, it may take place in the symbiotic condition.

In any case, the probable significance of the mycorrhizal fungi lies in their transmission of nitrogen to the trees. Pine seedlings flourish in pure cultures when supplied with nitrogen in an assimilable form, e. g. sal ammoniac or nitrate.

These fungi do not seem to thrive equally on all natural types of humus. Culture experiments show that mould extracts tend to arrest considerably their development. This would explain the poor development of the mycorrhiza of conifers in mould soils ('Mullboden'). In acid types of humus their development is sometimes good, sometimes poor, and the author proposes to follow up this line of investigation.

Law of May 6, 1921, concerning the export and import of Potatoes from and to Denmark with orders and regulations of September 13 and October 20, 1921, and regulations of October 18, 1921, concerning a Plant Inspection Service. Abbreviated Translation authorized by the Danish Minister of Agriculture, 12 pp., Danish Legation, London, 1921.

The orders concerning the export and import of potatoes of September 13, 1921, came into force on October 1 last. All consignments of potatoes for export must be accompanied by a certificate issued by the 'Committee for examining the commercial quality of potatoes for export', stating that inspection has taken place according to the regulations, and that the consignment has been found fit for export. At least ten days before the inspection, the exporter must notify the committee stating his name and address, name and address of the consignee, name of country of destination, time and place of inspection. number and marks of bags (or number of tons and railway trucks if not bagged), and name of variety.

If the country of destination requires the potatoes to be certified as to freedom from certain diseases, the consignment must also be accompanied by a certificate issued by the 'Committee on contagious diseases of plants' stating that inspection has taken place according to the regulations, no case of wart disease (*Synchytrium endobioticum*) has been found in the part of the country where the potatoes in question were grown, the potatoes are free from wart disease, other injurious diseases of potatoes, or destructive insects, and the consignment is packed in new bags, boxes, barrels, or other receptacles. This committee must be notified in the same way as the committee on quality and receive the following additional details: quantity of potatoes from each grower, with name and address of growers, and the number of permits to import if such permit be required in the country of destination. Notice to the health inspection committee is counted to serve also as notice to the committee on quality.

By an additional order of October 20, the export of potatoes not for food but for industrial purposes may take place without an examination of their commercial quality, but the consignment must be accompanied by a certificate from the above-mentioned committee to that effect.

In the health inspection of the potatoes only those grown in Denmark are to be inspected. At least 5 per cent. of the bags must be examined, the potatoes being turned out and examined one by one. The inspectors are required to see that the consignment is derived from districts where no wart disease has been found, that certain diseases (at present wart disease) do not exist in the slightest degree, that the potatoes show a satisfactory state of health, that damage by cutting, frost, potato blight (*Phytophthora infestans*) and other decay (*Fusaria, Bacillus phytophthorus* or other bacteria), and scurf is not present in more than 4 per cent. of the potatoes examined (provided that the Chairman may prescribe certain limits for special diseases), that the potatoes have been packed in new bags, boxes, barrels, or other receptacles, and that the exporters have fulfilled in every respect the requirements of the present regulations.

In the inspection for commercial quality the inspectors are required to see that the consignment does not contain more than 2 per cent. of potatoes damaged by frost or rot (*Phytophthora infestans, Fusaria, Bacillus phytophthorus* or other bacteria), that it does not contain more than 5 per cent. of tubers suffering from scurf or damaged by cuts from implements or by larvae or birds, that it does not contain more than 4 per cent. of potatoes with shoots of more than 2 cm. in length, nor more than 4 per cent. of soil, straw, &c., that the potatoes are not covered by soil or dirt, or damp to such an extent that disease and damage to the tubers cannot be seen, that the consignment does not contain more than 5 per cent. of potatoes of a variety differing in shape and colour from that notified to the committee on commercial quality, and that the potatoes are carefully sorted. Excessively large and irregularly-shaped tubers must not be present. Unless otherwise stipulated, potatoes sold to Great Britain and the United States must have a diameter of at least 4·5 cm., and to other countries a diameter of at least 3·5 cm., measured where the diameter of the tuber is shortest. (This does not apply to new potatoes exported before the end of August.) Potatoes for export to Great Britain and the United States must be packed in bags of 51 and 75 kg. respectively, unless otherwise stipulated. The total of the above-named detractions from the quality must not exceed 6 per cent. In the export of potatoes for industrial purposes without an examination, the exporter must prove before the committee that the potatoes are sold for such purposes, by means of a declaration and a statement from the purchasers abroad that they have bought the consignment to be industrially treated in a factory. A permit for import must be produced, if required by the country of destination.

As regards the import of potatoes the regulations provide that potatoes may only be imported into Denmark on condition that the consignment is accompanied by a certificate issued by a recognized service of plant inspection in the country of origin, that the potatoes are packed in new bags, boxes, barrels, or other receptacles, sealed by the said service of plant inspection, and that the consignment on arrival in Denmark is examined by the committee on contagious diseases of plants, a certificate from which must be handed to the customs, stating that the committee is of opinion that the consignment is free from wart disease (*Synchytrium endobioticum*), and fulfils in all respects the conditions for the import of potatoes into Denmark specified in the regulations.

The certificate from abroad must be attached to the invoice, and must be issued within a month before the shipment of potatoes from the country of origin by a recognized service of plant inspection, and contain the names and addresses of consignor and consignee, and the name of the country and district of origin. The certificate must state that the potatoes in the consignment have been grown in a district free from wart disease, and are free from wart disease, other injurious diseases and destructive insects, and that the consignment is packed in new bags, boxes, barrels, or other receptacles, sealed by the service of plant inspection. At least ten days before the inspection in Denmark, the importer must notify the above-named committee, stating the quantity of potatoes, probable date of shipment, name and address of exporter, name of country of origin, port of shipment, port or place of entry (Customs), and name and address of receiver.

All expenses connected with the inspection must be paid to the committee by the importer.

In inspecting the consignment the inspectors will be required to see that the certificate from abroad is as prescribed; particularly that certain injurious diseases (at present wart disease) are not present even in the slightest degree. The potatoes generally must show a satisfactory state of health; damage by cutting, frost, potato blight (*Phytophthora infestans*) or other decay (*Fusaria*, *Bacillus phytophthorus* or other bacteria), and scurf not being present in more than 4 per cent. of the potatoes examined (provided that the Chairman may prescribe certain limits for special diseases). The potatoes must have been packed in new bags, boxes, barrels, or other receptacles, closed with the seal of the service of plant inspection abroad. In general, inspectors must satisfy themselves that the importers have fulfilled in every way the requirements of the present regulations.

By regulations of October 18, 1921, a Plant Inspection Service to control the health of live plants and parts of plants to be exported from Denmark has been established under the control of the committee on contagious diseases of plants appointed by the Minister of Agriculture. These regulations extend the inspection of plants, intended for export to countries requiring health certificates, to other plants than potatoes.

The regulations with regard to notice of intention to export and particulars to be furnished to the committee are similar to those laid down in the previous orders (which dealt only with potatoes). It will be noticed that whereas the inspection of potatoes for export and import is compulsory, that of other plants for export is voluntary.

Only such live plants and parts of plants shall be inspected as, according to a declaration in writing, have been produced in Denmark or grown in Danish soil for not less than twelve months.

Inspection of consignments of plants shall take place only if they are derived from plantations which, by an investigation during the time of growth, have been found free from such destructive insects and injurious diseases of plants as can be conveyed by means of the plants. Notice of such investigation must be given to the committee before July 1, and an inspection of consignments must be carried out immediately prior to export, the exporters arranging to transport the consignments to the place of inspection. When both the consignment and the plantations from which it is derived have been found free from destructive insects and injurious diseases of plants, the committee shall issue a certificate in the form prescribed by the country of destination, and shall seal the packages with lead seals.

Einfuhrkontrolle der Kartoffeln in Schweden und Dänemark (Kartoffelkrebs). [Control of Potato-imports in Sweden and Denmark (Wart disease).]—*Nachrichtenblatt für den deutschen Pflanzenschutzdienst*, i, 6, pp. 55–56, 1921.

A Royal Decree issued on September 12, 1921, concerning the import of potatoes into Sweden, came into force on October 1, 1921. It is thereby enacted that the import of potatoes by land or sea shall take place only under the following conditions:

1. That the potatoes are accompanied by a certificate of health, issued by an official expert of the exporting country not longer than thirty days before the date of export. The *bona fides* of this expert must be attested by the Swedish Legation or a Swedish consulate in the exporting country.

2. That the potatoes are dispatched in sacks, barrels, cases, or other packing material.

The certificate of health shall contain the following particulars:

(*a*) Names and addresses of the sender and the addressee.

(*b*) Place of origin of the potatoes.

(*c*) A statement to the effect that the potatoes are free from canker (wart disease).

(*d*) A statement to the effect that potato canker or wart disease (*Synchytrium endobioticum*) is not known to occur in the country of origin, or that it has not been known for the last six years before the issue of the certificate.

(*e*) A statement that the packing material has not been used before.

(*f*) The seal of the official issuing the certificate to be affixed to the packing cases.

(*g*) A statement of the official position of the person issuing the certificate.

[For the Danish regulations see the last abstract.]

DRECHSLER (C.). **Occurrence of Rhyncosporium on Dactylis glomerata and Bromus inermis.**—Abs. in *Phytopath.*, xi, 1, p. 42, 1921.

Rhyncosporium secalis (Oud.) Davis was found to be as abundant on *Bromus inermis* as on rye and barley at Madison, Wisconsin, in 1920. It was also found on *Dactylis glomerata*, but less commonly.

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CHRISTOPH (H.). **Untersuchungen über die mykotrophen Verhältnisse der Ericales und die Keimung von Pirolaceen.** [Researches on the mycotrophic relations of the Ericales and the germination of the Pirolaceae.]—*Beihefte Bot. Centralbl.*, xxxviii, 2, pp. 115–157, 1 pl., 1921.

The mycorrhiza of *Erica carnea* and *Calluna vulgaris* are stated to be produced by soil fungi. Experiments with cuttings planted out in flower-pots showed that in soil sterilized by heat the roots remained perfectly sterile, while in ordinary heath-soil rich in humus the entire root-system was affected. Both sterilized and unsterilized seeds of both genera gave plants whose roots remained entirely free from mycorrhizal fungi when grown in thoroughly sterilized soil. Plants from unsterilized seeds grown in ordinary soil rapidly exhibited the characteristic formation of mycorrhiza. Permanently sterile plants of both *Erica* and *Calluna* can easily be cultivated, and grow as vigorously as those provided with mycorrhiza, but when the fungus is present it does not appear to exercise any harmful effect. It is entirely absent from plants grown in dry soil without humus. The fungus was isolated and grown on a medium consisting of peat with an admixture of 10 per cent. of gelatine. It forms a sterile mycelium, which is capable of producing the typical fungous growth in the roots. Mycorrhiza are also found in many other members of the Ericaceae when grown in humus-rich soils.

In the case of the Pirolaceae the fungus also comes from the soil. Infection does not, however, occur by means of the penetration of the external epidermal cell-walls, as in *Erica* and *Calluna*, but the hyphae enter between the epidermal cells and form an intercellular mycelium. The cells of the epidermis are only subsequently penetrated from within. The mycorrhiza of all the species of *Pirola* examined are thought by the author to be produced by the same fungus, the hyphae of which possess clamp-connexions.

An examination of the root-system of the Monotropoideae (a subdivision of the Pirolaceae), showed that their subterranean vegetative organs are less extensive than those of *Pirola*. The fungus, which is clearly a distinct species, without clamp-connexions, forms a rather loose fungous sheath from which numerous hyphae extend into the substratum, and presumably act as organs for the conveyance of nutriment. This is the only case in which there appears to be any evident exchange of nutrition between the fungus and the root. In the other cases the fungus is not considered to have any part in supplying nutriment to the roots. It is a 'harmless parasite'.

Ectotropic fungous development occurs only in those species of *Pirola* whose subterranean system is divided into rhizomes and roots, and then exclusively in soil with a rich humus content which leads to an extensive ramification of the roots. The external fungous growth arises from the intercellular mycelium only after the epidermal cells are filled with hyphae, and it has no direct connexion with the substratum. When the youngest lateral, or feeding, roots are completely enveloped they cease to function and die. The plant does not suffer, since it is able to substitute one of the embryo roots situated on the rhizome. In the Ericaceae also the ectotropic growth only develops in species which form a coralloid root-system in rich soil, and the fungus lives at the expense of the epidermal cells in a similar fashion.

The seed of *Pirola rotundifolia*, the root-system of which shows the most pronounced association with the fungus in certain localities, germinates independently of the fungus, and the same is presumably true of other allied species, since otherwise they could not develop at all in dry soil where the fungi concerned are absent. Further germination studies are in progress.

DUFRÉNOY (J.). **Bactéries anaérobies et Gommose du Noyer.** [Anaerobic Bacteria and gummosis of the Walnut.]—*Comptes rendus de la Soc. de Biol.*, lxxxiv, 3, p. 132, 1921.

For some years walnut-trees of all ages in the Pyrenees and vicinity have been attacked by a disease resulting in the destruction of entire groves. The first symptoms are a cracking and desiccation of the cortex of the collar, and the decay of the roots, beginning at the extremity, which is of a deep black colour. The cortex is easily detachable. At the other end of the root-system, not yet blackened, mycelial hyphae penetrate the fibres, stopping up the cells of the medullary rays and producing brown or greyish swellings (? arthrospores or conidia).

Sections through the collar or roots show numerous cells (dispersed in the cambium, the wood, or especially the pericycle, and sometimes grouped at the brown edges of the radical cankers), filled with yellowish-brown gum. They are detached at the angles by the solution of the middle lamella, while the membrane turns brown. Fragments of gummy, unblackened roots, externally sterilized and then split, were placed on the surface of agar with peptonized glucose, or immersed in it. No cultures were obtained from the parts exposed to the air, but colonies of grey bacteria developed in the depths of the agar, extending as far as the bottom of the tubes. It is impossible to tell as yet whether these bacteria are responsible for the death of the walnuts, or whether they are secondary parasites penetrating by means of lesions such as frost cankers.

HENNING (E.) & LINDFORS (T.). **De viktigare Potatissjukdomarna.** [The principal diseases of the Potato.]—Reprinted from *Landtmannen*, 34 pp., 11 figs., 1921.

A popular account of the chief potato-diseases of Sweden due to fungi, bacteria, and physiological causes, with directions for their treatment. The diseases enumerated include 'felt-disease' (*Hypochnus* or *Rhizoctonia solani*), fusariose, verticilliose, blight (*Phytophthora infestans*), wart disease (*Synchytrium endobioticum*), corky scab (*Spongospora subterranea*), true scab (*Actinomyces scabies*), stem bacteriosis (*Bacillus phytophthorus*), ring bacteriosis, bacterial soft rot, leaf roll, and curly dwarf.

WEISS (F.) & ORTON (C. R.). **Second report on the reaction of American Potato varieties to the Wart disease.**—Abs. in *Phytopath.*, xi, 1, p. 57, 1921.

Seventy-eight varieties of potato have been tested and twenty-seven found to be immune. Foreign immune varieties also remain immune in the United States. American immune varieties include several very widely grown commercial varieties such as Irish Cobbler, Early Petoskey, Spaulding Rose, Burbank, and Green Mountain.

WEISS (F.) & HARVEY (R. B.). **Catalase, hydrogen-ion concentration, and growth in the Potato Wart disease.**—*Journ. Agric. Res.*, xxi, 8, pp. 589–592, 1921.

The H+ concentration of wart tissue is greater than that of healthy tissue (P_H 6·00 and P_H 6·49 respectively). Catalase activity is much greater in wart tissue than in healthy (17·9 as against 7·8 c.c. of O_2 evolved respectively). Differences in acidity of the varieties are not associated with immunity to the disease.

COLLINS (E. J.). **The problem of the inheritance of immunity to Wart disease in the Potato.**—*Gardeners' Chron.*, lxx, pp. 260, 271, 290, 314, and 326, 2 figs., 1921.

The author, writing from the John Innes Horticultural Institution, outlines the experiments being carried out by him there, and in the Ormskirk potato trials, relative to the inheritance of wart disease.

Although potatoes are commonly listed only in the groups 'immune' and 'susceptible' to wart, there should be an intermediate group if the inheritance follows Mendel's laws. The immune group includes those forms which would produce only immune plants if seeds from self-fertilized flowers were planted. To such plants could be assigned the constitution RR. It was found impossible on account of absence of pollen or early dropping of the flowers to obtain selfed seed of the following immune varieties:—Golden Wonder, Langworthy, Dargill Early, Favourite, Conquest, Arran Comrade, Sutton's A 1, Witch Hill, and others. Selfed seedlings of Leinster Wonder, Shamrock, and Majestic were discarded because of lack of vigour and yield.

Susceptible varieties may be designated SS. Selfing tests cannot be made for the same reasons as in the last group with Up-to-date, British Queen, Arran Chief, King Edward, Macpherson, Sharpe's Express, Eclipse, Harbinger, Ninety-fold, and Midlothian Early, but could be made with President, Edgecote Purple, and Myatt's Ashleaf. The author has done so with the last two, but the seedlings were poor and were discarded.

Intermediates, SR or RS, should occur when crosses of resistant and susceptible varieties are made. Crosses are impossible between certain potato varieties because of lack of viable pollen, failure to flower, &c., but special treatment of the plants may sometimes in part overcome these difficulties.

A discussion of expectations in case of dominance or of recessiveness of immunity is given, and some results published by Wilson (*Trans. Highland Agr. Soc., Scotland*, 1916) are analysed. The results are then given of some crosses made in 1916, the progeny being grown at Ormskirk in 1919. Defiance (R) × Edgecote Purple (S) gave three susceptible and one resistant seedlings; Macpherson (S) × Defiance gave six seedlings all S; Defiance × Leinster Wonder (R) gave five R seedlings; Macpherson × Leinster Wonder gave two R and one S seedlings. *Solanum edinense* was found to be immune. The evidence is considered to indicate the dominance of susceptibility.

MELHUS (I. E.) & GILMAN (J. C.). **Measuring certain variable factors in Potato seed treatment experiments.**—*Phytopath.*, xi, 1, pp. 6–17, 1921.

Formaldehyde or mercuric chloride solutions, as ordinarily used, do not kill all the scab (*Actinomyces scabies*) or black scurf (*Rhizoctonia solani*) organisms on potato tubers. Cultures in the laboratory may be made to forecast the effect of treatment in the field. Mercuric chloride may exert only an antiseptic, but not a completely disinfecting action on sclerotia of *Rhizoctonia*, in that penetration of the poison is not sufficient to kill the hyphae in the centre of the sclerotia. As a rule, when the laboratory data showed a large percentage of viable sclerotia after treatment, the field counts gave a high percentage of infected tubers from seed treated in the same manner.

Since both these organisms may exist in the soil, a considerable number of checks must be run in order to obviate so far as possible misinterpretations from this variable factor.

KUWATSUKA (K.). **Some studies on the Pseudomonas Pruni E. F. Smith.**—*Annals Phytopath. Soc. Japan*, i, 4, pp. 12–19, 1921.

The author carried out a series of inoculation experiments with this organism on sixteen genera of Rosaceae, including the plum and peach. Strains were isolated from various sources, including the leaf, branch, and fruit of diseased peach and plum trees. These strains were proved to cause not only shot-hole disease of the leaf but also black spot of plum fruit. Infection occurred with strains isolated from hibernated diseased branches in early spring, as well as from branches in the autumn and fruits in the summer. This suggests that the viability of the organism in the infected tissue of a twig is not destroyed during the winter under field conditions, and such branches may serve as a source of infection in the spring.

The plants previously recorded as hosts of *Ps. pruni* are the apricot, nectarine, peach, plum, and Wragg cherry (*Prunus cerasus* L.). All varieties of these plants are not, however, equally attacked, the susceptibility and resistance to natural infection varying according to the variety. From the results of his inoculation experiments the author states that almost all species of *Prunus*, wild and cultivated, are liable to attack. He obtained successful infection on apricot, plum, peach, nectarine, *Prunus avium* (stem only), *P. buergeriana* (stem only), *P. crassipes*, *P. donarium* subsp. *elegans* var. *glabra* (stem only), *P. japonica*, *P. mume*, *P. mume* var. *microcarpa*, *P. mume* var. *bungo*, and *P. triflora*. *Sorbus japonica* was the only host outside the genus *Prunus* that was successfully inoculated. Excessive soil moisture seems to be an important factor in increasing liability to infection, having much more effect than high atmospheric humidity. The author suggests that as leaf infection occurs through the stomata, soil moisture may act by influencing the degree to which these are opened. Attention to drainage is probably an important point in the treatment of the disease.

TISDALE (W. H.). **Two Sclerotium diseases of Rice.**—*Journ. Agric. Res.*, xxi, 9, pp. 649–657, 5 pl., 1921.

SCLEROTIUM ROLFSII SACC. Forms of this disease occur in Louisiana on soy-bean, wheat, and tall oat grass (*Arrhenatherum elatius* L. (Beauv.)), as well as on rice, but although in culture the organisms appear slightly different morphologically, this difference does not warrant their being classed as distinct species. An apparently identical sclerotial disease of rice occurs in the Philippines.

On rice it is not a vigorous parasite. It attacks germinating seed and the roots of young seedlings in various stages of growth, many having been found destroyed before emergence from the soil. The fungus requires a free supply of air for its growth, and consequently does more damage to seedlings when the soil is rather dry. Its distribution is not known, but considerable losses may result in localities where it occurs. Investigations carried out at Crowley, La., showed that early sown rice seems more subject to attack than that sown later, as the latter germinates more readily and the plants grow more vigorously, thus giving the fungus less chance to overcome them before the irrigation period. It has been established that water checks the development of the fungus, and unless plants attacked by it are too far gone they will usually readily recover under irrigation. But the fungus is only checked, not killed, by this treatment.

The decayed roots showed small, brown, spherical sclerotia, while the typical, rather coarse, white mycelium was present on these parts, and in the soil immediately surrounding them. The fungus remains in the sclerotial stage during seasons that are unfavourable to growth. Sclerotia, even under adverse conditions, retain their vitality for considerable periods, and kept dry they germinate readily after nine months when placed in congenial surroundings.

The mycelium will live for a long time in the infected plant tissues, and also in the soil where there is sufficient organic matter to furnish food.

Dissemination may be effected by the sclerotia, which float on the surface of water like cork, and can easily be carried by the irrigation flow. The fungus also grows vigorously as a saprophyte, and may be carried on old straw or other plant material.

If the disease begins to develop, the field should be irrigated as soon as possible. If the soil is known to be infected, it should be irrigated sufficiently to wet it thoroughly at the time the seed is germinating.

While the forms from soy-bean and tall oat grass did but little damage to rice, it is suggested that adaptation accomplished through more or less prolonged contact with the rice plant may render them more parasitic.

Stem rot caused by Sclerotium oryzae Catt. This disease was observed at Crowley, La., in 1919 and 1920, and has also been met with in various other localities in the United States, while in Italy it has been known for years, and several districts in India and Japan have reported damage from it.

There are indications that the sclerotia float on the water, and thus come in contact with the leaf-sheath—which is the first part of the plant to be attacked—where they germinate and penetrate the tissues, causing dark-brown areas. These lower sheaths die when submerged in the irrigation water, the fungus living more or less as a saprophyte at first in the dead tissues, and finally attacking the stems after the plants are older. Two or three nodes from the base the stem appears darker, and the internode where the irrigation water stands is almost completely destroyed, only the thin epidermal layer remaining intact; the stem at this point is often completely collapsed so that the plants lodge readily. In the cavity of the diseased portion of the stem and in the diseased tissues a weft of fine white mycelium and numerous small, black, and rather uniformly spherical, smooth-surfaced sclerotia are found. The hyphae are 3 to 5 μ in diameter, septate, and profusely branched. When the sclerotia are dry and mature they range in size from 220 to 270 μ in diameter, averaging about 250 μ.

The most severe damage is caused at the time the vitality of the stem is declining and the panicles are filling. The latter are poorly filled and light. According to Shaw and Butler, in India the diseased plants produce tillers, a condition which is not observed to any great extent in Louisiana, but may be due to earlier attacks by the fungus in India.

The means of dissemination are the same as for *Sclerotium rolfsii*, and survival takes place during the winter and other periods unfavourable to growth in the sclerotial stage.

Petch (T.). **The Diseases and Pests of the Rubber Tree.** x + 278 pp., 6 col. pl. and 38 text-figs., London, Macmillan & Co., 1921.

The present work is a revised and greatly enlarged version of the section devoted to pathological problems in the author's well-known book, *The Physiology and Diseases of Hevea brasiliensis*, which appeared in 1911. Attention is drawn in the preface to the fact that the future of plantation rubber is largely dependent on the effective control of disease, and that the importance of this factor both in its effects on cultivation and in its research aspect can hardly be exaggerated.

The opening chapter deals with general sanitation, and emphasizes the necessity for a thorough clearance in new plantations of jungle stumps and fallen timber, which are such a fruitful cause of root disease. Thinning out in Ceylon is now taking place on a scale which leaves about eighty to one hundred rubber trees to the acre, and it is probable that ultimately the number will not exceed sixty. Alternative methods of planting are considered at some length, the author's conclusions being that the trees should be planted at the distances at which they are intended to stand. This would obviate the disadvantages of close planting, which leads to poor bark renewal, diminished yield as the tree grows older, and greater prevalence of disease, as well as the labour and expense of subsequent thinning out, with the inevitable risk of root diseases developing from the *Hevea* stumps and logs.

Great interest attaches to the question of intercrops and cover plants, and the comparative merits are discussed of cacao, coffee, and tea for the former, and *Crotalaria striata*, *Tephrosia candida*, *Albizzia moluccana*, and the thorny dadap for the latter. From the mycological standpoint, cacao is the worst possible intercrop for rubber, of which it shares many of the diseases. Directions for pruning, scraping, forking, tree surgery, and the protection of wounds are included in this section.

Referring next to the six root diseases hitherto recorded (*Fomes lignosus*, *F. lamaoensis* (*Hymenochaete noxia*), *F. pseudo-ferreus*, *Poria hypobrunnea*, *Ustulina zonata*, and *Sphaerostilbe repens*), the author gives a detailed account of their causes and symptoms, together with methods of treatment. He thinks that there is, generally speaking, little hope of saving a tree attacked by a root disease, and such operations as trenching are undertaken mainly to prevent the spread of infection.

Writing in 1911, the author remarked that rubber was not subject to any serious leaf disease. This would now, as he points out, be a grave misstatement, two diseases having made their appearance which threaten the entire future of the rubber industry. One of these, *Fusicladium macrosporum* (*Melanopsammopsis ulei*), is at present confined to South America. The abnormal leaf-fall caused by *Phytophthora* and associated with excessively heavy rainfall occurs in India and Ceylon, and probably in Java also, and is the most serious leaf disease of rubber as yet known in the East. A less severe type of leaf-fall is caused in Ceylon by *Gloeosporium alborubrum*. Both these last diseases are associated more or less closely with a fruit rot. The symptoms of other *Phytophthora* diseases are described, and suggestions made for treatment. Pink disease (*Corticium salmonicolor*) and die-back (*Botryodiplodia theobromae*) are also treated at length. *Kretzschmaria micropus* Berk., a fungus that does not seem to have been recorded previously on *Hevea*, is described as a wound parasite of stems which produces similar effects to the stem attacks of *Ustulina zonata*.

A chapter is devoted to diseases of a physiological character and other abnormalities, such as globular shoots, fasciations, cork warts, nodules, &c. Chief among the non-parasitic diseases is brown bast, due to some interference with the normal physiological functions of the tree, or occurring in response to some condition induced by tapping. It has not yet been found possible definitely to correlate the incidence of brown bast with the frequency of tapping, or the yield of the tree, or prolonged tapping on one section. The percentage of disease, however, appears to be lower in Ceylon, where the alternate-day system of tapping is practised, than in countries where daily tapping is in vogue.

In the section on prepared rubber, the causes and effects of spotting and flushing are discussed. With the introduction of improved methods of drying, the occurrence of these discolorations has been greatly reduced. The various types of spots and flushes are described and their prevention discussed. The development of 'rust', surface moulds, and tackiness is also dealt with, and it is held that the question of the effect of spraying with Bordeaux mixture on the rubber prepared from treated trees requires further investigation.

Insect pests are described, and the author concludes with a chapter on miscellaneous preservatives and disinfectants, with directions for their preparation. In discussing izal, a 20 per cent. solution is mentioned for bark treatment, and considered to be unsafe, but this is much above the strength ordinarily used and recommended by the makers, who state that 5 per cent. need never be exceeded.

The book is illustrated with fine coloured plates and excellent photographs, and a good bibliography and index are appended.

HOHNGAARD (J.). **Undersøgelser vedrørende saasæds sortsægthed og frihed for brand og stribesyge. 1917–20. Beretning fra Statsfrøkontrollen.** [Investigations on the purity of strain and freedom from smut and stripe disease of seed-grain. Report of the Danish State Seed Testing Station.]—*Tidsskrift for Planteavl*, xxvii, 4, pp. 553–599, 8 figs., 1921. (English summary.)

During the period under review the following samples were tested: 482 of two-rowed barley, 71 of six-rowed barley, 317 of oats, 17 of wheat, 2 of rye. In addition to laboratory tests for purity, content of foreign seed, and rate and power of germination, field tests (15,000 plants as indicator, 30,000 plants as guarantee, sown at two experiment stations at two different seasons) were carried out to determine the germinating power and the presence of *Pleospora graminea* and various smuts, namely, *Ustilago nuda, U. hordei, U. avenae, U. levis, U. tritici, Tilletia caries,* and *Urocystis occulta*. With the exception of Tystofte cross barley, most of the barley samples were attacked by *Pleospora graminea* (0·1 to 480 per thousand), the Prentice strains and Karls barley being the worst, while 122 of 499 samples (25·6 per cent.) showed a figure per thousand in excess of that for which compensation is paid for guaranteed seed samples. Svalöf Gold and Abed Binder barley were more affected with *Ustilago nuda* than Prentice, which, however, had more *U. hordei.* Both these smuts were much less prevalent than the stripe disease fungus. *U. avenae* was most severe on Yellow Naesgaard, Svalöf Victory, and Lyngby Heath oats: Svalöf Crown being the freest. The incidence of this disease varied between 0·1 and 61 per thousand. Wheat samples treated with copper sulphate or hot water were practically free from *Tilletia caries.*

Rands (R. D.). **Brown Bast disease of plantation Rubber, its cause and prevention.**—*Meded. Inst. voor Plantenziekten,* 47, 57 pp., 5 pl., 1921.

Brown bast, which has only been recently recognized as a separate and distinct disease of *Hevea brasiliensis* though probably present since the tree was introduced in the East, is an affection of the bark of tapped trees, involving the discoloration of the inner bark and the stoppage of the latex flow. The bark is not killed, however, the diseased trees often being characterized by irregular overgrowths known as 'burrs'. The severity of the disease in the East Indies and Federated Malay States has led to much investigation, certain aspects of which have already been published by the writer (Progress report on brown bast (read before the Rubber Growers' Association), *Nederl.-Ind. Rubber-tijdschrift,* iv, pp. 157–158, 1919; Bruine binnenbast en tapproeven, *Alg. Landb. Weekblad Nederl.-Indië,* iii, pp. 1592–3, 1919; De bruine binnenbastziekte van *Hevea brasiliensis, Arch. voor de Rubbercult.*, iii, pp. 156–159, 1919). Further histological and microchemical studies will shortly be published [see next abstract].

Brown bast disease is generally easily recognized by a partial or complete dryness of the tapping cut (i. e. stoppage of the latex flow), accompanied by a greyish to greenish-brown discoloration in the middle and inner bark. In severe cases the discoloration may at first be confined to narrow parallel lines following the rows of latex vessels. Successive inspections at intervals of five to ten days are necessary to detect the disease in the incipient stage, since the symptoms may otherwise be confused with a normal unevenness of flow which occurs during the dry season or at a period of leaf change. The dryness of the cut is sometimes preceded by an unusually large yield of thin latex with a low rubber content, or there may be unevenness of scrap on the cut resulting from unequal duration of flow. This latter symptom may be regarded as a reliable warning of the presence of the disease. Care must be taken not to mistake a superficial brown or blue discoloration of the tapping cut occurring in very wet weather for a symptom of brown bast, since it is nothing more than a case of local wound response.

There may be no outward manifestation of the disease, even in advanced cases, the bark remaining smooth and development proceeding normally. A deep cut, however, will reveal lack of latex, dryness, and discoloration. Mere pricking the bark is not a satisfactory criterion, since there is normally a flow of latex from the few healthy rows next to the cambium.

Other severe cases, however, pursue quite a different course, a longitudinal cracking of the outer bark and exudation of latex taking place after a few weeks or months. This condition is due to the formation of woody nodules (the 'burrs' referred to above) in the diseased bark, which finally becomes too irregular to be of any further use for tapping.

No cases of brown bast on untapped trees are known to the writer, though similar discoloration is reported on trees injured by fire.

From the planter's point of view, brown bast is certainly the most serious disease affecting the Pará rubber tree. Loss through decreased production is the chief item, though the expenditure on inspection, treatment, and thinning out is also heavy. The highest producing trees are generally claimed to be the most susceptible. In some plantations as many as 50 to 85 per cent. of the trees are affected, and the writer has seen 15,000 trees out of tapping on account of brown bast in a Java estate. This represented an average monthly loss in yield of 2,000 kg. of dry rubber, and it is probably safe to estimate a financial loss of several million guilders per annum from the 750,000 acres or more under rubber in the Dutch East Indies.

The writer has found a proportion ranging from 0·3 to 85 per cent. of brown bast in the forty odd plantations inspected by him in Java and Sumatra. These variations are probably due to differences in the tapping system, the amount and methods of thinning, elevation, climate, and soil conditions. The Ceylon method of tapping, i. e. one cut on one half the circumference every other day, appears to be the most satisfactory as regards brown bast disease, less than 3 per cent. of affected trees being usually found on estates where it was in use. The disease appears to be particularly severe in the Federated Malay States, where daily tapping has long been the rule. A general adoption of less drastic methods is following upon the recognition of a connexion between tapping and disease, and a corresponding improvement in the condition of the trees may therefore be expected.

Diseased areas of bark in all stages were microscopically examined for a possible causal organism. The yellowish gummy substance described later was found in every case, occupying many of the latex vessels and intercellular spaces. This suggested a bacterial agency, but neither constancy of occurrence nor the results of inoculations suggest that the organisms found can be the cause. The protoplast of the latex vessel is apparently the only element in ordinary diseased bark which actually dies. Endeavours were made to transmit the infection from diseased to healthy trees, freshly diseased bark being brought into contact with healthy plants. The outcome of all these experiments under different conditions was negative. These results lead to the conclusion that brown bast is not caused by a parasite and is not a transmissible disease. Similar negative results are reported by several earlier investigators.

The diseased tissues contain a deposit of a yellowish gum-like substance, which impregnates the membranes, fills intercellular spaces, and clogs the latex vessels. It is this substance which causes the discoloration and cessation of latex flow referred to above. It is apparently a positive secretion and not the result of tissue disorganization. The latex itself is usually coagulated in the affected vessels, and the death of the vessel protoplast may cause the formation of an enclosing cambium and a woody burr in the bark. A striking similarity was observed between brown bast and the local discoloration occurring at the margin of ordinary wounds in *Hevea*. They are closely related phenomena, and the former appears to represent merely an accentuated type of wound gum secretion. The chief factor in the causation of the disease seems to be repeated withdrawal of the latex from the same tissues. The disturbance thus set up causes a reaction of the drained tissues by the secretion of gum which prevents further loss of latex. There is a considerable depletion of starch in the diseased cortex, but not complete exhaustion.

Experiments undertaken with a view to determining the relation between severe tapping and brown bast showed that a distinct connexion existed. Three groups of fifty trees each, growing under similar conditions, were selected for comparative trials. Group A was tapped six times per diem, beginning at 6 a.m. and using two cuts on one-third of the circumference at a height of one-half and one metre. In less than a fortnight 40 per cent. of the trees showed typical symptoms of brown bast; after one month there were 58 per cent., and after two months 60 per cent. The trees of Group B were tapped once a day at 6.30 a.m., also with two cuts. After one month 2 per cent. of the trees were diseased, after six weeks 4 per cent., and after two months 10 per cent. Group C, which was only tapped for one month six times per diem, and with one cut on one quarter of the circumference at a height of half a metre, developed 2 per cent. of brown bast. In another series daily tapping on an isolated area of the bark caused a high percentage of brown bast. Further experiments to test the effect of disinfecting the cut showed that when the tapping was sufficiently severe, disinfection did not prevent a very high percentage of brown bast developing. Both tapping experiments and histological examination suggest that the response of the tissues is the result of an irritation or stimulation connected with the loss of latex, rather than of actual depletion or exhaustion of the reserve food, though there may be a temporary depletion of some constituents of the latex, e. g. the proteids.

Generally speaking, it appears that the same conditions which promote rapidity of growth and vigour of the tree also increase the tendency to brown bast. Trees growing on poor soil or exposed dry ridges are believed to be less liable to the disease than those in the adjacent rich and well-drained flats. In one case where *Hevea* was planted at an altitude of 2,200 to 2,800 ft., there was a progressive decrease in the amount of disease from 2,300 ft. upwards, probably because of the unfavourable conditions for growth.

Figures are also available showing that the disease develops more abundantly during the rainy season, which is also the time of the highest yield.

The length of the tapping cut does not appear to exercise any definite influence on the incidence of the disease, nor could any correlation be discovered between the size of the tree and its degree of liability to attack. No favourable influence from thinning on the development of brown bast could be detected. On the other hand, in so far as thinning contributes to greater vigour and a higher latex yield, it may actually increase the proportion of the disease. Close planting and later removal of the most susceptible trees should help, however, to reduce the number of subsequent cases.

As regards preventive measures, a moderate system of tapping on alternate days on a single cut over half the circumference is advocated.

Extensive comparative experiments have now been started to ascertain which system will give the highest latex yield with a minimum of brown bast. In the meantime the alternate-day system has been favourably reported upon by several estate-owners, and should be generally used.

For new plantings the vegetative offspring of high-yielding trees which are also resistant to brown bast should be used. The selection of resistant individuals for propagation necessitates a test, which consists of tapping the proposed mother-trees five or six times per diem for two months, with two cuts on one-third of the circumference. This severe tapping will soon produce disease in the susceptible trees, and the remainder will serve as a source for vegetative planting.

Diseased trees must be treated if the same surface is to be tapped again within several years. Cures have been effected by each of the three common methods, i. e. scraping, stripping, and light scraping followed by the application of hot tar, but it has not yet been determined which of these methods is the best. For protection of the exposed tissues after scraping or stripping, the A.V.R.O.S. Experiment Station recommends coating with ordinary paraffin, but the writer found the following mixture gave the best results at Buitenzorg: Lamp wax (melting-point 40° C.), 50 per cent.; vaseline (dark commercial, melting-point 38° C.), 25 per cent.; soft paraffin (melting-point 55° C.), 25 per cent.; solidifying point of the mixture, 43 to 44° C. The mixture can be applied with a wide thin-hair brush at a temperature of 50 to 70° C., or warmer with a garden sprayer. For lower elevations the proportion of paraffin should be increased by 10 per cent. at least. The application of hot tar (Harmsen's method) is said to effect a throwing off of the diseased tissues, through stimulation of cambial activity. In this method the bark is simply scraped away superficially and warm tar painted on. Further experiments are necessary to test it fully, the results hitherto having varied so much as to be inconclusive.

RANDS (R. D.). **Histological studies on the Brown Bast disease of Plantation Rubber.**—*Meded. Inst. voor Plantenziekten*, 49, 27 pp., 9 pl., 1921.

Studies conducted by the writer during the last two years indicate that this is a non-parasitic trouble caused by certain methods of tapping. This conclusion is based on the results of work already published [see last abstract].

A striking feature which is constantly noted in sections of diseased bark is the yellow, plastic, gum-like secretion present in the latex vessels, and also filling and enlarging many of the intercellular spaces of the soft cortical tissues. The discoloration of the tapping cut caused by this substance, in combination with the absence of latex, offers the best and most certain means of identifying the disease. The quantity and the extent of the gumming vary greatly with the individuality of the tree and are also dependent on environmental conditions, which, indirectly, affect the vigour and the physiological processes of the tree. Gum secretion is at its maximum during the rainy season in the most vigorous trees, the diseased bark colouring an intense brown, and showing a marked tendency to develop burrs. New cases are less frequent during dry weather or on defoliated trees, and the gumming, which in these cases is mostly confined to the latex vessels, may not be sufficiently abundant to cause appreciable browning of the cut even after latex flow has ceased, but the subsequent developments of the disorder may be equally serious.

The stoppage of the latex flow is due in the first place to the gumming of the latex vessels for some distance below the cut. An additional contributory factor is the coagulation of the latex itself, which in normal bark only occurs in old vessels of the outer layers that are much interrupted by stone tissue. Whether this coagulation precedes, occurs simultaneously with, or follows the gum secretion is difficult to determine, but in certain cases where the gum has been observed to flow into the latex, frequently surrounding the nuclei and sometimes even forming a crude reticulum, gumming appears to occur first. Lack of turgor in the diseased bark does not explain the stoppage of the latex flow, as some rows or parts of rows of normally acting vessels continue to flow for a considerable time after the remainder have ceased to function.

The gum-like substance in brown bast, which is first evident in the form of clear yellow microscopic droplets on the inner walls of the latex vessels and soon invades the latex, where it forms irregular masses, is secreted into the latex vessels from most of the adjoining parenchymatous cells. Simultaneously or at a later stage intercellular spaces filled with gum develop in the inner bark, usually in the parenchyma next the latex rows. When gumming is severe the resulting disturbance causes the death of the protoplast of the latex vessels, and humification changes are probably responsible for the dark cells in the centre of burrs, already referred to by earlier workers. The necrotic latex vessels contained in these burrs probably form the original stimulus which induces a cambium to develop in the adjacent cells and leads to the development of the burr. Burrs do not, however, necessarily occur under plantation conditions; in a specific case, only 14 per cent. of the diseased trees left untreated were found to show them. The majority of the burrs appear to take their rise from near the cambium, where the greater activity of the tissues favours their growth. If allowed to remain, they quickly connect up with the central woody cylinder of the tree; hence their practical importance in spoiling the bark for tapping.

The author has found that ordinary wounds reaching the inner bark give rise to changes which are surprisingly similar to the symptoms of brown bast, not only in the resulting discoloration, but even, in one case, in causing burr formation to commence. Microscopic examination shows the typical yellowish intercellular secretion, which occasionally is also found in the latex vessels. Even the margins of tapping cuts on thoroughly healthy trees are sometimes similarly affected. Evidently in these cases there is a wound response, characterized by the secretion of wound gum of the type known to occur in a very wide range of plants. In *Hevea* a temporary covering is first formed by the coagulation of the exuded latex, followed rapidly by the closing of the wound through the formation of wound gum. A week or so later a cork layer is generally found to have developed just behind the gummed surface region, and is followed by stone tissue formation; the gummed layer is finally shed as a result of further bark growth. In the case of tapping cuts the formation of cork and stone tissues is prevented by frequent reopening, and here it is generally the coagulated latex which forms the protective covering. The conditions responsible for this wound reaction on the tapping cut are usually temporary, and the locally discoloured area disappears gradually after a week or more of continuous tapping; should, however, the discoloration persist and the areas showing absence of latex flow enlarge, without apparent cause, a case of brown bast may be suspected and the extent of the discoloration below the cut should be determined. Wood wounds show the same reactions and the locally engendered gum secretion agrees in every respect with that produced in bark wounds and in brown bast. The gum produced was examined in considerable detail, and was found to agree in its characters fairly closely with the wound gum already described in other plants.

The general conclusion arrived at by the author is that the disease known as brown bast is very probably only an abnormal and extreme type of wound response, and that this abnormality occurs apparently because of the nature of the wounding to which *Hevea* is subjected in the process of tapping. As a tentative explanation of the facts the author suggests that the repeated opening of the same wound in susceptible trees, and the frequent losses of latex from the same tissues over a considerable area below the cut, stimulate gum secretion not only in the tissues immediately surrounding the wound, as is normal, but also in cells situated at a distance, though the stimulus would, of course, act more feebly as the distance increased. This is confirmed by the observation that the secretion, which appears first at the wound, spreads very rapidly downwards and affects a fairly large area below the cut. The possible rôle of enzymes in this spread has not been determined.

Sanderson (A. R.) & Sutcliffe (H.). **Brown Bast. An Investigation into its causes and methods of treatment.**—71 pp., 4 diag., 26 pl., London, The Rubber Growers' Assoc., 1921.

The book gives a full description of the characters of the bark in *Hevea* when affected with the brown bast disease.

The authors consider that the most characteristic feature of the cortex in cases of brown bast is the presence of meristematic tissue almost invariably in the vicinity of latex vessels, the latex in the vessels enclosed in the meristem being usually coagulated. The remaining characteristics of affected cortex, the deposition of tannins and calcium oxalate, the excessive formation of sclereids (stone cells), often very deep seated, the depletion of starch, &c., they consider to be secondary symptoms, though these give rise to the diagnostic features of the disease.

In a large number of cases the beginning of meristematic activity can be definitely traced to a point or points immediately below the cut. In its earliest appearance it precedes the coagulation of the latex in the vessels bounded by the meristem, and it may be that this coagulation is due to by-products of metabolism from the active meristem, and is also assisted by the withdrawal of water from the latex by the new tissues formed. The formation of new tissues results in the displacement or even rupture of latex vessels in the neighbourhood. Burrs may then result from the development of a new secondary cambium arising in the place of the original simple meristem and cutting off woody cells on its inside. Functional sieve-tubes are present in normal bark within the limits in which the new meristem may develop, and in such cases they share in the displacement, &c., of the latex vessels. The meristem does not usually arise quite near the cambium, its depth being related to the depth of tapping. Spread towards the cambium takes place later on. Outward spread also occurs in some cases. Extension downwards below the cut (the authors believe the disease almost invariably begins immediately below the tapping cut) is in the form of a cone, the outer side of which early becomes flattened as the margin of the laticiferous tissue is reached, while the inner side may reach to the newest-formed latex vessels. The outer side may become flattened before it reaches the outer functional vessels, which may then continue to yield. In shallow tapping the inner vessels may also escape, at least for a time.

The authors believe that the disease may be caused in either of two ways. It may be the result of the stimulus arising from the presence of a wound meristem below the tapping cut (especially a finished cut). Such a meristem may set up secondary effects due to coagulation of the latex which it induces in its neighbourhood. These secondary effects spread the disease both laterally and in depth. The origin of the stimulus in the second case is different, though its effects are similar. When a strip of cortex is removed in the operation of tapping, a cork cambium forms in the shallow layer left overlying the cambium, and the exposed surface (the tapped surface) then proceeds to renew the bark under the protection of this cork. The stimulus caused by the abnormal activity of growth under this layer is believed to extend downwards into the still untapped bark below the tapping cut, and may be the cause of the induced meristematic activity mentioned in the last paragraph. In either case variations in the incidence of the disease may thus be due merely to variation in the sensitiveness of the response to the stimulus provided by tapping.

Thus brown bast is considered to be a physiological disorder due primarily to the operation of tapping, though other wounds may have a similar result. No case has been seen on an unwounded tree. The disease is distributed over the whole rubber-producing areas of the East, and it is probable that it is present on every estate on which trees have been in tapping for six months or more.

Well-grown or well-developed trees are more liable to it than slow-growing, poorly developed, thin-barked ones. The percentage of cases usually increases with the age of the trees, so long as tapping continues. In many instances it bears some relation to the interval between successive tappings, so that the more frequent the tapping, the greater is the liability to develop brown bast. But further investigation on this point is necessary, and also more information as to the length of time between the formation of meristem and the cessation of the flow of latex.

Preventive measures for brown bast cannot be laid down, but, according to the authors' observations, areas under alternate-day tapping usually show a smaller percentage of cases than areas under daily tapping, other conditions being equal. Resting of the trees affected is not recommended, as many cases have been seen where the trees had been rested for periods of from two to six years, but still suffered from the disease.

After reviewing the treatment already existing, the authors recommend stripping off the diseased cortex as the only effective means for curing trees affected with brown bast, and they give a detailed description of the operation. It should be followed by an application of paraffin wax to the stripped surface, in order to protect it against the attacks of insects and fungi. Special emphasis is laid on the necessity of treating the trees at an early period of the disease if large areas of bark and cortex are to be prevented from becoming useless for tapping. The authors quote the experience on a number of estates where this treatment has been systematically carried out with excellent results, and they express the hope that the time is rapidly approaching when brown bast treatment will become part of the ordinary routine work of a rubber estate.

The practical part of the book is particularly full, and the illustrations comprise numerous photomicrographs (some coloured) of the affected cortex and photographs of affected trees and trees treated by stripping. There is an appendix on 'dry' trees, in which other forms of stoppage of latex flow are distinguished from brown bast.

HORNE (A. S.). **Phloem necrosis (Brown Bast disease) in Hevea brasiliensis.**—*Ann. of Botany*, xxxv, 139, pp. 457–459, 1921.

The evidence collected so far by other workers points to a physiological cause of this disease, which is analogous to the cases of phloem necrosis described for the potato by Quanjer and for Liberian coffee by Stahel. The special anatomical features described by Sanderson and Sutcliffe [see last abstract] would appear to be a secondary development.

On transverse sections of the bark taken both from diseased and suspected trees, numerous minute golden-yellow spots of irregular outline were observed in the phloem, in the region extending from the neighbourhood of the cambium outwards. The outlines of the coloured granular areas were at times similar to those of intercellular spaces, but differed from these by being intersected by one or more waved partitions, staining more or less distinctly with ruthenium red. These golden areas proved to be sections of necrotic sieve-tubes which no longer showed a reaction for callus with soluble blue, while the waved outlines in many cases could be interpreted as transverse sections of the large vertical sieve-plates which form the dominant feature of the phloem of *Hevea* when viewed in longitudinal section. These pathological characteristics were found in material obtained both from Borneo and the Federated Malay States.

In the younger phloem the disease is confined to the sieve-tubes, but in the middle phloem region the discoloured areas are larger, as other cells—phloem parenchyma, medullary ray cells, laticiferous vessels—have become involved in the local tissue degeneration.

During the incipient stages of burr formation the wound cambiums arise in proximity to the diseased laticiferous vessels and often completely encircle small groups of vessels. As a result of the activities of the wound cambium, diseased groups of cells, including laticiferous vessels, become enclosed in a 'pocket' of stone cells. The number of meristematic zones will depend on the number of rows of laticiferous vessels affected and their disposition in the bark.

Bryce (G.). **Brown Bast and the Rubber plant.**—*Nature*, cviii, pp. 81–82, 1921.

The statement made by the writer of a note in a previous issue of *Nature* on phloem necrosis in brown bast disease of *Hevea* [see last abstract] that the diseased laticiferous tissue is enclosed in 'stone-cell pockets' is controverted. Occasionally stone-cell groups, which are abundant in normal cortex, are fortuitously enclosed in the nodule cambium at the time of its inception, but the cortex overlying old nodules, and presumably derived from the nodule cambium, is strikingly free from stone cells.

Kirchner (O. v.). **Über die Bekämpfung von Pflanzenkrankheiten, im besonderen von Getreiderost und Getreidebrand, durch züchterische Massnahmen.** [The control of plant diseases, especially rust and smut of Cereals, by means of breeding.]—*Nachrichtenblatt für den deutschen Pflanzenschutzdienst*, i, 6, p. 55, 1921.

The following is a résumé of a lecture given by Prof. von Kirchner at the autumn meeting of the German Agricultural Society (Seed Selection Division). The foundation of all selection with a view to immunization is the determination of the degree of resistance possessed by the wild and cultivated varieties of economic plants to parasitic attack. The investigations into rust of wheat, carried out by von Tubeuf, Hecke, and the speaker, extended over a period of ten years. With regard to susceptibility to bunt, experiments were started at Hohenheim in 1903 on 360 varieties (241 winter and 119 summer wheats), of which two summer spelts, one English wheat, and summer einkorn proved absolutely immune. Four summer wheats, with most of the hard varieties and Polish wheats, were very resistant. Recent investigations by Prof. Roemer of Halle have shown that there are also great differences as regards resistance to loose smut in the various sorts of wheat.

Absolute immunity to rust has not yet been secured. The degree of severity of the attack on the different sorts varies according to external conditions, but the mode in which they are attacked is characteristic of the variety. Besides einkorn, certain English varieties are resistant to both brown and yellow rust, while four are also able to withstand black rust, viz. Beardless Odessa, Ohio, the smooth, red, black-edged hard wheat, and the blue-black hard wheat. The degree of resistance to smut and rust is inherent in the variety. The quality is transmitted to descendants, but is capable of modification through external influences. In 1916 the speaker detected a striking correlation between the acid content of the different varieties and their resistance to smut and rust. He compared two winter and summer wheats, one of each being resistant to yellow rust and the other susceptible. In both cases the acid content was higher and the sugar content lower in the resistant variety. It is probable, however, that the real origin of immunity lies still deeper, and is related to the cytoplasmic constitution of the cell.

The practical significance of the foregoing observations as a basis for the selection and breeding of new varieties is briefly referred to, especially in view of the fact that rust-resistance in wheat is inherited in accordance with Mendel's laws, as was first demonstrated by Biffen in 1907 and 1912. Nilsson-Ehle and von Tschermak, however, have come to the conclusion that in this particular instance the conditions of inheritance are less simple than as stated by Biffen. The selection of smut-resistant varieties has not hitherto been considered as of such urgency, owing to the adequate protection afforded by seed-disinfection.

It is essential that this line of investigation, the object of which is to reduce or, if possible, entirely avoid the extravagant preventive and curative measures at present necessary, should be extended to other important economic crops.

Popp (M.). **Die Steigerung der Ernteerträge durch geeignete Boden-Desinfektion.** [The increased yield of crops obtained by suitable disinfection of the soil.]—*Landwirtschaftl. Jahrb.*, lv, 4–5, pp. 549–579, 1921.

The writer advocates the use of humus-carbolineum (the preparation of which is described) not only as a fertilizer, which acts by stimulating the beneficial soil organisms, but also as an excellent means of plant protection against insects and fungi. It is said to be particularly useful for spraying and painting fruit-trees, obstinate cases of canker having been completely cured by its application. Experiments have also shown that club-root of cabbage (*Plasmodiophora brassicae*) can be checked by strewing humus-carbolineum into the holes, when transplanting, at the rate of 10 to 15 gm. per plant. It should only be applied when the ground is moist, so that it may dissolve more easily.

Shunk (I. V.) & Wolf (F. A.). **Further studies on bacterial blight of Soybean.**—*Phytopath.*, xi, 1, pp. 18–24, 1921.

This disease has been described from Wisconsin (*Journ. Agric. Res.*, xviii, 4, 1919) and from North Carolina (*Phytopath.*, x, 3, 1920). Either one of two species of bacteria may cause it, namely, *Bact. glycineum* and *Bact. sojae*. Their differences in cultural characters are described.

KENDRICK (J. B.) & GARDNER (M. W.). **Seed transmission of Soybean bacterial blight.**—*Phytopath.*, xi, 8, pp. 340–342, 1 pl., 1921.

Seeds were removed from pods of soy-bean which bore bacterial lesions. Some of the seeds themselves showed lesions. Tests in sterilized soil in the greenhouse were made by planting these seeds and seeds from healthy pods. Sixteen out of 139 plants produced from seed borne under pod lesions developed bacterial blight, as did also four out of forty-seven plants from seed from diseased pods, but not from directly under the lesions. None of 124 control plants from seeds from healthy pods showed the disease. It appeared that infection may be carried externally or internally with the seed.

The organism was identified as *Bacterium sojae* Wolf.

DIEMER (M. E.) & GERRY (ELOISE). **Stain for the mycelium of molds and other fungi.**—*Science*, N.S. liv, pp. 629–630, 1921.

In order to differentiate mycelium in wood, 'a solution of silver nitrate in distilled water was applied to thin sections of the infected wood. These were allowed to stand for periods of various lengths, overnight staining giving a very satisfactory result. The sections were then examined directly or dehydrated with alcohol, cleared with xylol, and mounted in Canada balsam. Drying the balsam mounts under weights in an oven overnight appeared, if anything, to improve the stain secured.'

This was found satisfactory for conifers or hard woods. The mycelium stains blackish brown, purplish brown, or orange, and the wood was either not stained or only yellowish brown.

Gold chloride solution and 'Berlin blue' were also used with some success.

ROSEN (H. R.). **Unlike interpretations of Fuller's scale in determining degree of acidity.**—*Science*, N.S. lv, pp. 76–77, 1922.

The author points out that plant pathologists usually express acidity or alkalinity in terms of parts per thousand of normal alkali or acid required to neutralize. This is in accordance with Fuller's original description and E. F. Smith's report of Fuller's method in 'Bacteria in relation to Plant Diseases'. Bacteriologists and animal pathologists, on the other hand, have been following a 'Report of a committee of bacteriologists of the American public health association' which recommended the use of parts per hundred. Thus '+10·0 on Fuller's scale' as used by plant pathologists corresponds to '+1·0 on Fuller's scale' as used by bacteriologists in general.

STAGG (C. M.). **A new seedling disease of Tobacco.**—Abs. in *Phytopath.*, xi, 1, p. 49, 1921.

A fungus closely resembling *Fusarium affine* Faut. & Lamb. was found causing a leaf spot and stem browning of tobacco in

Kentucky in 1918. It was isolated, and reproduced the disease when used for inoculation. In very humid air it causes a type of damping off, while in dryer conditions only a slight browning or girdling of the stem results. The conidia are hyaline, one-septate, straight or slightly curved, tapering slightly at the top and 12 by 3 μ in diameter. They are borne singly at the tip of digitoid conidiophores arising usually at right angles to the septate mycelium.

BIRMINGHAM (W. A.). **A treatment for Tomato wilt on trial.**—*Agric. Gaz. of New South Wales*, xxxii, 3, p. 212, 1921.

The treatment under test consisted of watering the soil with a solution of ammonia (strong ammonia one tablespoonful, water one and a half gallons) five times a week, and of spraying the plants with a solution of saltpetre six days a week. It had been claimed that successful results had been obtained from this treatment.

The result has been disappointing in every respect. The plants not only showed no appreciable improvement after two weeks, when compared with untreated controls, but the cost of material and labour involved place the treatment out of court for large and small plantations alike.

PETRAK (F.). **Mykologische Notizen, ii. 31. Über die Schwarzfäule der Tomaten.** [Mycological Notes, ii. 31. On the black rot of Tomatoes.]—*Ann. Mycol.*, xix, 1–2, pp. 17–20, 1921.

The fungus which causes this well-known disease makes its first sporadic appearance on the leaves in the early summer, but it spreads considerably later in the season, and finally attacks the stems and fruits, the latter taking on a black colour and rotting. The author's attempts to obtain a fruiting specimen of the fungus long remained unsuccessful, all spots examined proving sterile until in the summer of 1920 well-developed examples were found.

The subepidermal, lentiform pycnidia, generally 100 to 150 μ in diameter, are distributed somewhat loosely at regular intervals, a closer grouping of two or three occurring seldom; they are attached to the epidermis at their apex, and only emerge at the small, obtusely conical, papillary ostiole, which is perforated by an almost circular pore, 15 to 20 μ in diameter. The wall is of a transparent brown colour, thin, and usually consists of only one layer of irregular polyhedral, often slightly stretched cells, measuring 5 to 11 μ. The hyaline spores, 7 to 11 by 2·5 to 3·5 μ, are cylindrical or elongated, broadly rounded off at both ends, straight or slightly bent, containing finely granular plasma and some very small oil drops, at first single-celled, later divided by a partition about midway between the ends, this point being only slightly, or not at all, constricted. No sporophores have been observed.

The fungus rarely matures on the fruit, as the hyphae which permeate the tissues are generally destroyed by yeasts and bacteria before the fruiting stage is reached. The last-named agents are themselves also able to produce a black rot of the ripe fruit, although in this case the affected parts are very soft and generally of a much lighter colour.

According to the author's experience the fruit is most frequently attacked at the stem end when it has been picked green and spread to ripen in such a way that the stem end is placed downwards. Under such conditions the fungus develops luxuriantly, and forms fruit bodies in every way identical with those observed on the stems, except perhaps that the wall in the later stages is stronger, blackish-brown, and almost carbonaceous. The spores are mostly elongated, oval, or almost globular, 5 to 8 by 1·5 to 3 μ or 3·5 to 4 μ; only occasionally were these spores found with a partition, and in such cases their measurements were up to 10 by 3 to 3·5 μ.

Of several varieties tested, 'Johannesfeuer' proved the most resistant to the disease, the fruits remaining on the plant being very lightly affected by the fungus. The author makes the following recommendations for the preservation of fruit picked early and spread for ripening: Care should be taken to pick the fruit with a short piece of the stalk; they must then be kept absolutely dry, and this can be done quite easily and cheaply by placing them on boards covered with a thin layer of straw, with the stalk pointing upwards; they should be evenly spaced and not touch; they must be guarded against damp—rain, dew, &c.—and all affected fruit should be carefully removed.

The author has come to the conclusion that the fungi described as *Phoma destructiva* Plowr., *Ascochyta lycopersici* Brun., and *Ascochyta socia* Pass. are in reality different phases of the same fungus, which he names *Diplodina destructiva* (Plowr.) Petr., the wall of the typical pycnidium having a parenchymatous structure. *Sphaeronema lycopersici* Plowr. is perhaps also only a form of this fungus. [See also Klebahn, this *Review*, i, 2, p. 47, and the following abstract.]

BROOKS (F. T.) & SEARLE (G. O.). **An investigation of some Tomato diseases.**—*Trans. Brit. Myc. Soc.*, vii, 3, pp. 173–197, 1921.

A detailed account is given of investigations into various rots of tomato fruits and certain diseases of the stems of tomato plants. The research material collected in the course of several years yielded pycnidial fungi of the *Phoma* and *Diplodina* types, together with *Colletotrichum* or *Gloeosporium* and a species of *Fusarium*. The identity of the different rot-producing fungi occurring on the tomato fruit was evidently, from a review of the literature and the examination of herbarium specimens, far from being clearly established, and a detailed study of the cultural characters and pathogenicity of the various forms isolated by the authors was undertaken in order to determine their relationships with one another and with previously described forms. After a description of the origin of the cultures and their pathogenic properties, their macro- and microscopic characters are described at length and compared with cultures and herbarium specimens of some of the earlier species.

The conclusion is reached that the species identified in the United States as *Phoma destructiva* Plowright is the same as one of the pycnidial forms isolated by the authors, though they only obtained it from fruits, while in America it attacks also the leaves and stem. On the other hand, the British fungus responsible for tomato stem 'canker' and fruit rot, which has up to the present been identified with the United States *Mycosphaerella citrullina* (C. O. Sm.) Gross., proved on comparison with authentic material of the American fungus to be quite dissimilar. It is intermediate in type between *Phoma* and *Diplodina*, and agrees with Cooke's *Phoma lycopersici*, but must be regarded as a *Diplodina* and probably identical with the *Diplodina lycopersici* of Hollós. An amended description of *Diplodina lycopersici* (Cke.) Hollós is given. *Ascochyta lycopersici* Brun. may be the same as this fungus, as also may be Plowright's *Sphaeronema lycopersici*, the type of which appears to be lost. *Mycosphaerella citrullina* has so far not been found in England, and should therefore be deleted from the list of British species. Klebahn, in his recent paper on the tomato canker fungus in Germany [see this *Review*, i, 2, p. 47], also refers it to *Diplodina lycopersici* Hollós, and describes the discovery of the perithecial stage, *Didymella lycopersici*. It is evident from the authors' studies that the limits of the genera *Phoma*, *Diplodina*, and *Ascochyta* are ill defined, and that many so-called species in these genera are merely varieties of one and the same fungus.

Another pycnidial fungus, found only once as the cause of tomato rot, has an *Alternaria* stage in its life-history like *Phoma richardiae* and *P. fictilis*. It proved to be an undescribed species to which the name *Phoma alternariaceum* Brooks & Searle is given. Forms of *Macrosporium* were frequently met with, but they proved to be non-pathogenic. *M. tomato* Cke. was not found, though the disease said to be caused by this species was described by Massee in England some years ago. It is thought likely that Massee's account of the disease was based on a mixture of forms. In America *M. tomato* has been shown to be the cause of a disease of uninjured tomato fruits.

Several strains of *Gloeosporium* and *Colletotrichum* were found to be parasitic on tomatoes, one of them being identical in every respect with cultures of *C. phomoides* (Sacc.) Chester from America, except that it did not always produce setae on artificial media. The other strains are also regarded as being merely varieties of the same species, differing chiefly in being of the *Gloeosporium* type, i. e. without setae. This is the first time that this fungus has been recorded in England.

A typical species of *Fusarium* was also isolated from rotten fruits, and proved a wound parasite of the green fruit, as in the case of the other fungi mentioned above. In the absence of comparative cultures it was impossible to identify it. It is thought probable, however, that quite a number of species belonging to this genus would rot tomato fruits if inserted in them through wounds, and in fact a pure culture of *Fusarium coeruleum*, obtained from potatoes, produced a soft rot.

A postscript refers briefly to Petrak's recent paper on black rot in tomatoes [see last abstract]. The authors do not consider Petrak justified in renaming Plowright's *Phoma destructiva* as *Diplodina*, though they admit that it is doubtful whether a sharp line can be drawn between the *Phoma* and the *Diplodina* studied by them. Still, the constancy of the spore characters in certain forms both in England and America, and the absence of inoculation and cultural experiments in Petrak's work, make the retention of both the names given in this paper seem desirable.

Hubert (E. E.). **Notes on Sap Stain Fungi.**—*Phytopath.* xi, 5, pp. 214–224, 1 pl., 4 figs., 1921.

A staining of the sap-wood in timbers, caused by *Lasiosphaeria pezizula* (B. & C.) Sacc. and *Ceratostomella* spp., is described. The former produces a greyish-olive stain which may be found both in sap-wood and heart-wood, and the latter produces a greyish-blue stain confined principally to the sap-wood. Perithecia of *L. pezizula* were found on the surface of the wood. The effect of the fungi on the tissues is described. The hyphae penetrate the walls of the wood fibres and tracheids. The *Ceratostomella* hyphae are capable of reviving after lying dormant in the wood for a considerable period.

A slight weakening of the wood was found to occur in the case of the blue stain caused by *Ceratostomella* spp. The stain further serves to hide the effect produced by wood-destroying fungi which often develop simultaneously. Blue-stained wood also seems to be unsuited for steam bending in the process of making furniture and other products.

Petrak (F.). **Mykologische Notizen, ii, 51. Diaporthe thujana n. sp.** [Mycological Notes, ii, 51. *Diaporthe thujana* n. sp.]—*Ann. Mycol.*, xix, 1–2, p. 50, 1921.

The author describes *Diaporthe thujana* n. sp., found at Mähr.-Weisskirchen on a dry twig of *Thuja*. The fungus is extraordinarily like a *Valsa* of the *ambiens* type, and is almost certain to be the ascigerous form of *Phomopsis thujae* Died., in close proximity to which it was discovered. It differs from *D. pitya* Sacc. in the euvalsoid stromata, stronger perithecial membranes, and stouter ostioles. In view of the inadequate descriptions of other species in the literature, the author prefers to regard *D. thujana* as new, although the possibility exists that it may be identical with one or other of the forms already described on conifers.

Burkholder (W. H.). **The bacterial blight of the Bean, a systemic disease.**—*Phytopath.*, xi, 2, pp. 61–69, 1921.

Bacterium phaseoli E. F. Sm. was found to be viable in bean seeds two years old, and in several cases seeds three years old produced blighted plants. Besides the common symptoms on pods, seeds, leaves, and stems, the writer found that the growing tips of young seedlings might be destroyed by the bacteria, leaving only the cotyledons, or the primary leaves might show mosaic-like lesions, or a wilting might be caused. The bacteria have been found to multiply in the vascular tissue, gaining entrance to this tissue from cotyledons, and perhaps from the primary leaves. They may break through the xylem vessels and cause lesions on the leaves or stems similar to those caused by local infection. The roots are also often infected in the xylem vessels. The organism may enter the pods and infect the seeds without causing lesions on the surface of the pods. Inoculation experiments demonstrated that the bacteria may travel through the vascular tissue.

Local infection of plants may be subsequently caused by spread of the organism by rain or insects.

It is thought that *Bacterium phaseoli* probably loses its virulence rapidly in culture.

GILMAN (J. C.) & ERWIN (A. T.). **Greenhouse propagation of Cabbage resistant to yellows.**—Abs. in *Phytopath.*, xi, 1, p. 54, 1921.

The seed was planted in flats of soil infested with *Fusarium conglutinans*, and subjected to the optimum temperature for the development of the disease. The selections were made a month later, the healthy plants being transferred to pots and later to beds in the greenhouse, and allowed to produce seed. Strains of early cabbage were thus obtained which were completely resistant to yellows.

JENNISON (H. M.). **Observations upon the bacterial blight of field and garden Peas in Montana.**—Abs. in *Phytopath.*, xi, 2, p. 104, 1921.

Pseudomonas pisi Sack. (Ps. 211. 2322033) is serious in parts of Montana, having caused an estimated loss of 25 per cent. in 1918. It is thought to be disseminated by contaminated seed. The variety Alaska is one of the most susceptible.

PETRAK (F.). **Mykologische Notizen, ii, 32. Über Ascochyta Boltshauseri Sacc.** [Mycological Notes, ii, 32. Notes on *Ascochyta boltshauseri* Sacc.]—*Ann. Mycol.*, xix, 1–2, pp. 20–21, 1921.

The author has noticed great differences in resistance to *Ascochyta Boltshauseri* Sacc. amongst the different varieties of cultivated beans in the Mähr.-Weisskirchen district. Thus *Phaseolus multiflorus* was almost immune, while 'Korbfüller-Wachs', a climbing variety of *P. vulgaris*, was only affected late in the season, when the plants had nearly finished bearing. Dwarf varieties of *P. vulgaris*, on the other hand, suffered somewhat severely, the fungus gaining a foothold during the flowering stage of the plant and damaging it by destroying its leaves. The most susceptible variety encountered by the author was the 'blauschotige Butter', and here the parasite started by forming larger or smaller, mostly very irregular spots on the leaves, which gradually spread to the whole surface and caused their death. The dead leaves dry up, but remain on the stalk, and in damp, cool weather the destruction of nearly all the leaves is a matter of only a few days, after which the stem is attacked, and this often brings about the death of the plant before the end of the flowering season.

Attempts to check the disease were not successful, and the only thing to do is to see that the leaves on which spots appear are instantly removed and burned. The disease, on its first appearance, occurs in a mild form, but on fields where it has firmly established itself it is advisable to sow climbing instead of dwarf beans, as the former are much less susceptible.

The fungus, which has characteristic large, broadly cylindrical spores with 1 to 3, more rarely 4 septa, is renamed *Stagonosporopsis hortensis* (Sacc. & Malbr.) Petr., and stated to have as synonyms *Stagonospora hortensis* Sacc. & Malbr., *Ascochyta Boltshauseri* Sacc., and *Stagonosporopsis Boltshauseri* Died. The author does not think that von Höhnel was right in regarding this fungus as an imperfect stage of *Didymellina phaseolicola* (Rob.) v. Höhn., it being, in his opinion, more likely that *Ascochyta phaseolorum* Sacc. occupies that position. *Stagonosporopsis* includes fungi having pseudo-pycnidial receptacles and hyaline, cylindrical, or elongated to short and broadly spindle-shaped spores, with one to three or more septa.

HAMBLIN (C. O.). **Downy mildew of the Vine.**—*Agric. Gaz. of New South Wales*, xxxii, 1, pp. 49–50, 2 pl., 1921.

Downy mildew (*Plasmopara viticola*) appeared in New South Wales at Albury in January 1918, and in the same month its occurrence was noted at Glenfield, while a fair amount of damage was done by the disease during the summer of 1919 round about the county of Cumberland. It was observed as early as 6th October 1920 at Richmond, but the dry weather checked its progress. On the other hand, reports from the Murrumbidgee Irrigation Area speak of very serious damage having been caused by the fungus, specimens of which were collected in that district early in November.

Bordeaux mixture at summer strength (6.4.40) has been found very effective. Where good lime is not obtainable Burgundy mixture should be substituted and used at summer strength. The commercial brands of Bordeaux paste and Bordeaux powder also gave effective control when tested in the preceding season. It should be noted that sprayings should take place at intervals of from ten to fourteen days, practically up to the time of ripening, to prevent the development of the fungus.

MANUEL (H. L.). **Downy mildew.**—*Agric. Gaz. of New South Wales*, xxxii, 10, pp. 745–747, 1921.

When the disease first appeared in the Rutherglen district of Victoria in 1917 growers were inclined to treat it lightly, but the following year only a 5 per cent. crop was picked from a district of 6,000 acres of vineyard. It has continued to spread from this first centre until practically every vine area in Victoria is now affected, and extension into New South Wales, Queensland, and South Australia has occurred.

Spraying as a regular preventive measure is recommended, as the disease has come to stay. Bordeaux or Burgundy mixture should be used, and, although no hard and fast rule can be laid down, it is advisable to make the first application when the shoots are about nine inches long, and to follow with others from time to time as new growth appears.

OSBORN (T. G. B.). **Downy mildew in S. Australia.**—*Journal Dept. Agric. South Australia*, xxiv, 12, p. 1007, 1921.

The author visited the Clare and Renmark areas, and found slight traces of the fungus on Currant, Gourds, Doradillo, and Sultana vines, both nursery stock and trellised vines. The mild attack in these areas is ascribed to the arrival of the fungus late in the season. Growers have been warned of the danger, as the fungus has already proved to be destructive in Victoria and New South Wales.

Mazzàccara (G.). **Il Bacillus vitivorus e il mal nero della Vite.** [*Bacillus vitivorus* and the 'mal nero' of the Vine.]—*Riv. di Agric.* (Parma), xxvi, 5, p. 6, 1921.

The 'mal nero' disease of the vine is found all over Italy, particularly in the southern provinces, and attacks both American and European varieties. The causal organism (*Bacillus vitivorus* Bacc.), the pathogenicity of which was first established by Baccarini, is an anaerobe, measuring 1 to 2 by 0·5 μ, that liquefies gelatine and has its optimum temperature at about 24° C. Entrance into the plant is gained through wounds caused by pruning, and vines grown in excessively fertile soft or volcanic soils are particularly liable to the disease.

Affected plants are recognized by brownish-black stripes which appear on the branches and become more pronounced as the disease progresses. The underlying tissues collapse and crack ('mal dello spacco'), the resulting lesions, which have blackened margins, reaching in some cases, especially in old branches and in the main stem, as far as the pith. The disease spreads from the apex to the base of the vine. In the vessels and other cells is found a gummy substance resulting from the activity of the bacillus on the tissues. In the spring the affected plants present a stunted appearance with shortened internodes and poorly developed foliage. The leaves may be blackened or covered with brown spots, and both the flowers and the fruit may be malformed and show teratological alterations. Numerous suckers arise around the base of the plant.

Generally speaking, affected plants die in about five years unless remedial measures are carried out in time. Preventive measures consist in clean cultivation, good drainage, and in grafting on resistant varieties, such as the 'Cataratto' and 'Minella' of Sicily. To check the disease, the blackened stems must be cut back to the base and destroyed, and all the lesions disinfected with a mixture of ferric sulphate and sulphuric acid. Young shoots affected by the disease should be removed in the spring.

Mauritius. **Annual Report of the Department of Agriculture for the year 1920.** 1921.

The Entomologist reports that cryptogamic diseases of sugar-cane were little in evidence, only a few sporadic cases of black smut being recorded. Rust disease, which was somewhat prevalent in previous years, was not reported to exist in a very severe degree in any estate. Several cases of bacterial diseases of the heart of the cane occurred in 1920 on two estates, but the attacks were, as in former years, limited to small areas.

The researches on the disease of *Filao* (*Casuarina equisetifolia*) were continued without bringing to light any specific micro-organism which could reproduce the disease experimentally. An experimental plot was selected at Grand River South East for trials relating to the transmission of the disease under natural conditions.

Report on the prevalence of some Pests and Diseases in the West Indies during 1919: Diseases of Economic Plants.—*W. Ind. Bull.*, xix, 1, pp. 31–37, 1921.

Notes are given on the distribution and severity of the following diseases in the British West Indian Islands: CACAO: Root diseases (*Rosellinia* spp.), canker and black rot of pods (*Phytophthora faberi* Maubl.), brown rot of pods, die-back and stem disease (*Diplodia theobromae* Pat.). COTTON: Soft rot of bolls (*Phytophthora* sp.), stated to have caused considerable damage in St. Vincent, West Indian leaf mildew (*Ovulariopsis gossypii* Wakef.), bacterial boll disease (external), angular leaf spot, internal boll disease, rust (a physiological affection). LIMES AND OTHER CITRUS TREES: Black root disease (*Rosellinia* spp.), unidentified root or collar diseases, die-back, wilting and damping-off of seedlings. SUGAR-CANE: Root disease (*Marasmius sacchari* Wakker, and allied species), rind fungus (*Melanconium sacchari* Massee), red rot disease (*Colletotrichum falcatum* Went), pine-apple disease (*Thielaviopsis ethaceticus*). ONIONS: Bacterial rot. FUNGI PARASITIC ON INSECTS: *Cephalosporium lecanii*, shield scale fungus, red-headed and sooty mould fungus on scale insects. *Sporotrichum globuliferum* (thrips fungus) has not been seen during the year, though introduced in Grenada.

COTTON (A. D.). **Fungi, Bacteria, etc., in Report on the occurrence of insect and fungus pests on plants in England and Wales for the year 1919.**—*Minis. of Agric. and Fish. Misc. Publ.* No. 33, pp. 26–68, 1921.

This is the first attempt—official or otherwise—to give in a convenient form a complete list of the diseases of crops of any consequence in the country, over 250 being mentioned. The resulting waste of food-stuffs must reach an enormous total, and though it has up to now been difficult to secure exact figures except in a few cases, losses of 50 per cent. from wheat rust in many fields in South-west Wales, some of which were not worth threshing, 25 per cent. from barley smut in a case in Cambridgeshire and nearly 50 per cent. in one in Shropshire, up to 75 per cent. from potato leaf-curl in gardens and allotments and the same from dry rot in a case of Scotch seed sent to Kent, 20 per cent. from tomato stripe in cases in the London area and Northumberland, and some others of almost equal magnitude, are recorded.

The relation existing between the fluctuations of individual diseases and the climatic variations of particular seasons is receiving particular attention from the Plant Pests Branch of the Ministry. The charts appended to the Report, showing the variation from the normal in temperature, rainfall, and sunshine weekly throughout the year in the six main divisions of the country, will in time, it is hoped, enable a correlation to be established between climatic factors and the incidence of disease. Weather conditions during the crop year 1918–19 were marked chiefly by high rainfall in autumn, winter, and spring, followed by an unusually dry summer which was probably responsible for the mildness of the annual attack of potato blight (*Phytophthora infestans*). On the other hand, the fact that, in spite of a wet July in East Anglia, blight was almost absent in that area suggests that there are other influences at work, the nature of which is still to be determined.

There is abundant evidence that the treatment of seed-grain against such diseases as wheat bunt, oat smut, and barley stripe disease has not yet become as routine a part of farm practice in England as in other countries, with the result that these diseases are far too prevalent. Black rust (*Puccinia graminis*) has been for many years remarkably scarce in England, but a severe outbreak was recorded during the year under review from South-west Wales. This was traced to the presence of barberry in the infected area. An attack of a *Fusarium* on wheat occurred on one of the experimental farms, but though *Giberella saubinetii* was suspected to be the cause, no perithecia were found. *Rhynchosporium graminicolum* Heins. was found on rye, this being the first British record.

Evidence was obtained that most new attacks of wart disease of potatoes were associated with the use of seed from infected districts. Seed is now regarded as the chief agent in disseminating the disease, and steps are being taken to gain a more complete control over the seed supply. Amongst the varieties immune to this disease (eighty-eight are approved by the Ministry), now so widely cultivated in the infected areas, several are reported to be also resistant to *Phytophthora* blight, though they were not severely tested during the year. Leaf-curl is increasingly recognized in England as a serious disease and appears to do more damage than mosaic, though the latter is abundant. Blackleg (*Bacillus atrosepticus* Van Hall) is believed to be on the increase. Skin spot (*Oospora pustulans* Owen & Wakef.) does little damage as a rule, but when severe on seed-tubers it can weaken or even destroy the eyes. The disease is doubtless contracted from the soil, but manifests itself after storage, particularly in spring. A cause of very heavy losses in the season 1918–19 was the faulty clamping of potatoes due to bad weather and shortage of labour, which, coupled with the inclusion of a number of infested and 'green' tubers, gave rise to exceptional heating, temperatures up to 160° F. being recorded in some cases. Where parasitic bacteria such as *B. atrosepticus* were present, the high temperature generated brought about very rapid decay, with disastrous results.

Amongst vegetable diseases, white rot in onions, a recently described disease in England, due to *Sclerotium cepivorum* Berk., was reported chiefly from the southern counties and Wales, but it occurred in a milder form in 1919 than in the preceding year. Two new cases of onion smut (*Urocystis cepulae* Frost) occurred in Westmorland and Huntingdonshire, the former being traced to seed imported from America. The disease also recurred in the three centres in which it was first found in England a few years ago. Investigations carried out in 1919 by Paine and Bewley established the fact that tomato stripe is due to a small yellow bacillus probably identical with *Bacillus lathyri* Manns & Taub., and not to *B. solanacearum* E. F. Smith as hitherto thought. Leaf spot in tomatoes (*Septoria lycopersici* Speg.) was introduced into this country from the United States in 1908 and included in the Destructive Insects and Pests Act in 1910, since when it appears to have died out.

Phytophthora fruit rot on apples (*Phytophthora cactorum* Schroet.) is a disease newly reported in Britain, a single case being found in Kent. The fungus may possibly be the cause of common and important rots occurring on fallen fruit. A few cases of the very rare leaf blister (*Taphrina bullata* Tul.) were observed on pears at Long Ashton and in the Evesham district. Plum-trees continue to be affected by silver leaf (*Stereum purpureum* Pers.), especially in the North, and whilst it is not possible to give exact data the number of fresh cases is believed to reach five figures. This disease is scheduled in the Destructive Insects and Pests Act. Following the remarkable scarcity of American mildew (*Sphaerotheca mors-uvae* Berk.) in gooseberries in 1917, possibly due to the cold winter, a recrudescence set in, and the disease had in 1919 regained its old ascendancy. Lime sulphur sprays are said to be effective in checking its spread.

Chestnut blotch of mushrooms, due to a bacterial parasite *Pseudomonas tolaasii* Paine, was reported for the first time in England in a severe form at Brentford (Middlesex), but later gradually disappeared.

A rot occurring on rhubarb plants, chiefly in Yorkshire, was found to be caused by a bacillus of the *B. coli* group. More sanitary methods of cultivation have been successful in checking the disease. *Keithia thujina* Dur., which is stated to have killed seedlings of *Thuja gigantea* in Ireland, appeared in England for the first time in 1919 near Horsham in Sussex, where it developed abundantly on the fading foliage.

VINCENS (F.). **Rapport sommaire sur les travaux effectués au Laboratoire de Phytopathologie de l'Institut Scientifique de l'Indochine du 1er Janvier 1919 au 1er Juillet 1921.** [Summary of the work carried out at the Phytopathological Laboratory of the Scientific Institute of Indo-China from January 1, 1919, to July 1, 1921.] 19 pp. Saigon, Imprimerie Commerciale, 1921.

RICE. *Sclerotium oryzae* Catt. is one of the most common fungous diseases of rice in Indo-China, and causes a great deal of damage. In one district it was evidently the cause of a form of 'tiêm'—the vernacular name for a number of different affections of the rice plant which are not distinguished by the cultivators—a disease not unlike the Italian 'brusone' which is believed by some phytopathologists to be caused by the same fungus. In India and Japan it also causes serious damage. *Piricularia oryzae* Br. & Cav., another fungus believed to cause 'brusone', was also observed on plants affected by 'tiêm', but as it was usually associated with species of *Helminthosporium*, *Cercospora*, *Cercosporella*, *Fusarium*, *Phoma*, *Sporotrichum*, *Septoria*, *Sphaerella*, &c., responsibility for the disease cannot be definitely attributed to it. *Helminthosporium*, *Cercospora*, *Phoma*, and *Sphaerella* develop on all the aerial organs, especially the peduncles of the ears, causing the abortion of a large number of flowers. They live on the grain from one year to the next, fructifying on the grain coats. *Fusarium* and *Sporotrichum* have been observed on partially aborted grain, on apparently healthy spikelets, and on young deformed and discoloured leaves, and are associated with a rather serious disease which occurs fairly frequently in Cochin China. *Sporotrichum* is apparently the cause of the disease known by the natives as 'white ring', 'shrivelled tip', &c. *Ustilaginoidea virens* (Cke.) Tak. is a curious parasite of rice, the biology of which is little understood. The fungus develops at the expense of the grain, in place of which appears an orange or olive-green mass, separating the glumes and protruding between them. The disease receives little attention from the native rice-growers, who are even inclined to regard it as indicative of a good harvest. The writer, however, thinks that it is one of the (relatively uncommon) stages of a very widespread parasite, which in other stages frequently causes partial sterility of the spikelets, in which case it is of considerable importance. Experiments are in progress to verify and extend the results already obtained with regard to this disease. *Tilletia horrida* Tak. has been recorded from Tonkin, but the damage caused by it is negligible.

RUBBER. Leaf diseases cause relatively little permanent damage. *Gloeosporium*, *Colletotrichum*, and *Phyllosticta* are of frequent occurrence, but do not directly imperil the existence of the trees. The lesions which they produce on the young twigs, however, are very apt to serve as a starting-point to more serious troubles, which spread to the larger branches and may cause serious injury. In November 1919 a parasite allied to that which produces the black rot of the vine was observed on the leaves in a rubber plantation. Comparative analyses of the soils of the diseased plots and the adjacent healthy ones showed that the former were deficient in nitrogen and phosphoric acid, and the application of organic manures restored normal conditions. A case of yellowing and abnormal leaf-fall on a large scale was found to be caused by the attacks on the young twigs of *Gloeosporium*, *Phyllosticta*, or *Phlyctaena*, or by partial invasion of young branches by *Diplodia theobromae*. Experiments showed that leaf fungi such as *Gloeosporium* can attack the young green shoots. *Cephaleuros virescens* was observed on the leaves of a young tree, but appeared to be harmless. *Phytophthora meadii* has not been observed in Cochin China.

Trunk and branch diseases are more serious than those of the leaves. 'Dryness' of green shoots and branches is of common occurrence. It is usually due to one of the fungi mentioned above. *Diplodia theobromae* is the worst of these, causing 'die-back' and other less clearly defined diseases of which a separate account has been published (*Bull. de l'Inst. Scient. de Saigon*, Nov. 1919). *Corticium salmonicolor* B. & Br. causes less damage in Cochin China than in most other rubber-growing countries, owing to the relatively long dry season which checks the development and spread of the parasite. The mycelium, however, penetrates the outer layers of the wood, and continues its development even under conditions which are unfavourable to its manifestation on the surface. This fact is important as demonstrating the futility of purely external treatment. A fuller account of this disease has been given (*Bull. de l'Inst. Scient. de Saigon*, Nov. 1920).

Phytophthora omnivora, to which the formation of various cankers on the trunks, branches, and tapped surfaces is attributed in Ceylon and Java [the author presumably refers to *P. faberi*], has not been observed in Cochin China. In the latter country similar cankers are stated to be due to fungi that normally inhabit the green twigs on the fruit, the chief being *Nectria*, *Fusarium*, and *Gloeosporium*. These cankers are frequently succeeded by a progressive woody encystment of the latex vessels, which takes place under an externally intact cortex, but in which the fungi mentioned are evidently not involved, since it appears to be due to the infection of the latex by a motile bacterium. A similar cause is assigned to the modifications in the cortex on or near the tapped surfaces, consisting of discoloration and the stoppage or great diminution of the flow of latex. ['Brown bast' is evidently referred to.]

Wounds caused by cutting back the 'stumps' used for planting sometimes become infected by common fungi such as *Diplodia*, *Phoma*, or *Phlyctaena*. Only on one occasion was a serious disease in the beds recorded. The cortex of young shoots, not more than 1 to 2 decimetres in height, was deeply corroded by a canker at the level of the soil. The primary cause of this canker was the invasion of the young tender tissues by the mycelium of a *Gloeosporium* or *Cytospora*. The disease may be described as accidental, since the long immersion of the base of these young plants in consequence of exceptionally heavy rains predisposed them to attack. A few days of fine weather brought about an immediate improvement.

SUGAR-CANE. A *Marasmius* greatly resembling *M. sacchari* occurs on diseased canes cultivated by the natives on the muddy dikes of the canals intersecting the west of the country. The attack appears to be due to the use of an excess of organic manures, accompanied by an almost total lack of cultivation. 'Sereh' disease was observed in a plantation where a few canes were being cultivated with a view to future extension. The diseased varieties had been imported, but the presence of sereh on indigenous canes is already on record in the province of Biênhoà. The disease is not likely to cause much damage as long as a careful selection of resistant varieties, of which there are many available, is made. The varieties referred to above were Pink Bamboo (imported from Hawaii) and Demerara (from Java). Investigations into the origin of the disease indicated that several fungi, *Nectria*, *Hypocrea*, and *Schizophyllum*, produce symptoms similar to those of sereh.

COCO-NUT. In December 1920 a serious case of fruit-fall before maturity occurred. The appearance of the fruit suggested a parasitic disease, and this was borne out by the presence of a *Gloeosporium* together with *Diplodia theobromae* on the rind of the fallen nuts, the *Diplodia* being also found on the peduncles still attached to the tree. *Thielaviopsis ethaceticus* Went, the conidia of which form abundantly in the central cavity of the dried nuts, might also be suspected to be a contributory cause of the disease. Comparative analyses of the soils of various plots, however, led to the conclusion that the fundamental cause was the insufficient nourishment of the roots, which was remedied by the application of nitrogenous manures. *Pestalozzia palmarum* Cke. occurs frequently on old leaves, rarely attacking young organs. *Diplodia theobromae* develops in the tissues of the petioles, and sometimes occasions the premature withering of the leaves. A *Nectria* produces a similar disease, which, however, appears to be rare.

Cotton. In December 1920 leaves submitted for examination from Cambodia were found to be affected simultaneously by the insect *Sylepta derogati* and the fungus *Ramularia areola*, producing the disease known as 'false mildew'. *R. areola* also occurred on imported varieties of cotton in the Botanical Garden of Saigon, but left the indigenous varieties practically unharmed. Anthracnose (due to *Glomerella gossypii* (Southw.) Edg.) and a canker of the collar, the cause of which was not determined, were also seen in Cambodia. *Mycosphaerella gossypiella* (Cke.) Atk. is recorded as a leaf-spotting fungus, but does not cause appreciable damage.

Cinchona. A disease, apparently due to a species of *Guignardia*, attacked young plants in Annam, especially *C. ledgeriana*. It is stated to occur also in Java. The application of copper fungicides did not check this disease, and was injurious to the young plants.

Petch (T.). **Plant pests and diseases in Ceylon.** *Trop. Agric.*, lvii, 3, pp. 192–194, 1921.

This is a progress report of the division of botany and mycology for the second quarter of 1921.

The diseases of rubber (*Hevea*) reported were:—*Fomes lignosus*, brown root disease [*Fomes lamaoensis*], *Ustulina*, *Xylaria*, and *Diplodia*. Of these, *Xylaria* is practically a new disease, no report of it having come to hand since 1909, when one case occurred. Among the tea specimens there were several cases of *Diplodia*, and one each of the rare maladies caused by *Fomes applanatus*, *Polyporus mesotalpae*, and *Polyporus interruptus*. The 'bitten-off' disease, i. e. the disease in which the roots of tea seedlings appear to have been bitten off, is probably due to a *Rhizoctonia*. This fungus also appeared on young shoots from collar-pruned bushes, which were attacked at the ground level and ringed. But neither its identity nor its parasitism has as yet been clearly established. An undetermined leaf disease of tea, possibly due to bacteria, was first observed in 1914, and occurred again this year in up-country districts. It attacks the young unfolded buds, which usually turn black in patches, though the process may extend to the whole surface and cause complete rot. In the former case the buds develop but the expanded leaves are perforated with irregular holes, or variously scalloped round the margin, this effect being due to expansion of the healthy parts of the leaf, coupled with the drying up and falling out of the attacked portions. The disease seems to be arrested after the expansion of the leaf takes place.

Sorghum growing on the Experiment Station, Peradeniya, has been attacked by *Acrotherium lunatum*, which causes a disease similar to 'wet weather mould', due to *Cladosporium*. It is new to Ceylon, as is also the collar rot of sugar-cane, which has occurred at the same place and is caused by *Hendersonina sacchari*. *Bacillus solanacearum* induced a wilt in young brinjal plants, while a *Phytophthora* found on *Cynometra cauliflora* may be identical with *P. meadii*. Work on the nut-fall and leaf-break in coco-nuts makes it evident that there are several causes, pathological and physiological, and attempts are being made to differentiate between them.

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SHAW (F. J. F.). **Report of the Imperial Mycologist.**—*Scient. Reports Agric. Res. Inst., Pusa*, 1920–21, pp. 34–40, 1921.

The cultural study of species of *Helminthosporium* on maize, 'jowar' (*Andropogon sorghum*), sugar-cane, rice, wheat, and barley was completed during the year under review. No perfect stage of any of them was discovered, but *H. teres* Sacc. on barley was observed to produce pycnidia and chlamydospores when grown on sterilized wheat straw; the latter have not been described hitherto. The species on maize and sorghum appear to be two different strains of *H. turcicum* Pass. From the results of cross-inoculation experiments it is concluded that there is no specialization of parasitism in these two strains, the fungus from one host being capable of infecting the other. They can also infect wheat, barley, oats, sugar-cane, and rice, but not *Pennisetum typhoideum*. Four cultural strains from wheat gave positive results when inoculated on maize, sorghum, oats, barley, rice, and sugar-cane, and the forms isolated from rice and sugar-cane infected all these as well as wheat. *H. teres* Sacc. from barley attacked maize, sorghum, wheat, oats, and rice. Hence it would seem that there is no specialization in these forms. *H. gramineum* Rabenh., the cause of stripe disease of barley, can be very destructive, a serious outbreak occurring during the year on a plot of 'Cape' barley; other varieties in neighbouring plots appeared to resist the disease, though cross-inoculation gave positive results. The species on barley and oats do a great deal of damage to the seedlings and young plants.

Acrothecium lunatum Wakker has been found on *Setaria italica*, *Panicum frumentaceum*, *Eleusine coracana*, and many other plants; it appears to be a weak parasite which produces small spots. A study of another species of this genus, *A. penniseti* n. sp., was published by Mitra [see this *Review*, i, 4, p. 103].

The work on chilli (*Capsicum*) diseases was continued, a paper on the die-back disease being published by Dastur in 1921, besides two other papers published in 1920. Diseases of jute are also being investigated, Shaw having published an account of that due to *Diplodia corchori* [see this *Review*, i, 1, p. 20].

Urocystis coralloides Rostrup, a rare smut on mustard (Brassica), was discovered for the first time in India in the vicinity of Pusa. An account of the species of *Cerebella* in India has been prepared by Subramaniam.

Experiments were carried out with a view to testing the efficacy of a spray for destroying water hyacinth (*Eichornia crassipes*), the spray used being a secret proprietary mixture which has given satisfactory results in other parts of the world in the eradication of the prickly pear. The results indicated that the spray effectively killed the water hyacinth, that it was non-poisonous to live-stock, that it could be easily applied by means of a sprayer of the usual type, and that rain did not interfere with its efficiency. One gallon of the spray was found to be sufficient to destroy 24 to 30 sq. yds. of water hyacinth, and this area could probably be doubled with more efficient machinery; the inventor states that the fluid costs 0·3 penny per gallon, and the cost of material would thus be 5 to 6 shillings per acre at the most.

BRYCE (G.). **Report on the work of the Botanical and Mycological Division.**—*Rept. Dept. of Agric. Ceylon, 1920*, pp. 13–15, 1921.

The following notes refer to the diseases of plants.

RUBBER. Brown bast has decreased in prevalence during the year. The writer thinks that its actual cause is still obscure, but notes that it is less severe in Ceylon than in countries where more severe tapping of the tree is customary. The morbid anatomy of the affected tissues has not yet been fully elucidated, but the condition will probably be found to be closely related in its inception to the alteration of latex vessel content preceding nodule formation, the latter being a normal feature of the disease. The root diseases due to *Fomes lignosus* and *F. lamaoensis* are still causing much loss, and the importance of removing old jungle stumps in order to check their development is again emphasized. Attacks of *Ustulina zonata* on the stem are also frequently due to neglect in removing old logs, on which it is often found fructifying. Decays of renewing bark have been less serious than in earlier years, preventive painting with Brunolinum and the like having an undoubted effect in reducing this group of diseases. Leaf fall and pod disease due to *Phytophthora faberi* and *P. meadii* have also been less frequent, probably owing to the late arrival of the monsoon rains. Fructifications of *Fomes lucidus* were twice found on Hevea, apparently occurring saprophytically, but there is a possibility that it may be a wound parasite. A species of *Meliola*, growing on the secretions of scale insects, was fairly common on the leaves, but the damage caused by it is negligible. A diseased condition of the leaf-petiole was recorded; local swelling of the tissues was succeeded by rupture, which formed a canker. A certain amount of leaf fall was caused, but no parasite was detected.

TEA. Red rust (*Cephaleuros*) was present in certain districts; it is apparently associated with an enfeebled condition of the bushes, due to shallow soil or unfavourable climatic influences. *Poria hypolateritia* continued to be a serious disease, spreading freely through the soil and very difficult to eradicate. A new branch canker caused by *Helminthosporium gigasporum* B. and Br. was recorded. The bark was killed back from the pruning cut, usually on the upper side of the branch. In conjunction with this a canker, closely resembling that caused by *Leptosphaeria*, was found, but no fungus was isolated. Severe damage was caused in one instance. Two ascomycetous lichens, *Trypethelium megaspermum* Mont. and *Verrucaria santensis* Tuck. are reported to cause stem galls of tea seed-bearers. In the first case the lichen fungus penetrates the cortex and ruptures the tissue along the line of the cork cambium. Its presence stimulates the branch to excessive growth, and a large woody swelling appears on the stem, covered by a thick, wrinkled, and warted layer of abnormal cortex containing the fructifications of the fungus. The effects of penetration by *Verrucaria santensis* are similar but less marked. The stems of seed-bearers should be covered with lime, to which both the lichens seem very susceptible. Experiments were carried out to test the efficacy of formaldehyde as a disinfectant of imported tea-seed. Its value was found to be considerable, though it has the defect of a low power of penetration in seed spread on superimposed shelves.

Coco-nuts. *Phytophthora* nut fall occurred to much the same extent as last year. Spraying with Bordeaux mixture may prove effective in checking this disease. Leaf drop due to *Phytophthora* was less frequent. Leaf break or die-back of coco-nut leaves was found to be associated with a species of *Diplodia*, the spores of which are smaller than those of *Botryodiplodia theobromae* and remain white for a longer period. 'Tapering of the crown', a diseased condition of coco-nut stems involving rapid dwindling in diameter and barrenness of the palm, has been partially investigated. It is evidently related to the condition known in Jamaica as 'pencil point'. Field observations show that many dead roots occur mingled with the vigorously growing ones. *Sphaeronema* sp. and *Pestalozzia* sp. were isolated from dead roots, but the condition, though believed to be a root disease, cannot with certainty be ascribed to the action of these fungi.

Green Manures. *Poria hypobrunnea* was again recorded as a serious root disease of dadaps and *Tephrosia candida*. *Irpex subvinosus* causes a stem disease of the latter.

Food Crops. *Piricularia oryzae* was recorded on rice, but the commonest diseases of this crop in Ceylon are those due to *Sclerotium* and *Helminthosporium*. Rice seedlings at the Peradeniya Experiment Station were badly attacked by a *Fusarium*. The point of attack was the micropyle, where pink acervuli were formed. The young shoots of the germinated seeds were coated with mycelium, but the shoots above four inches in height appeared to be immune. The most susceptible varieties were Macan Pina from Manila, and Hatiel. *Phoma glumarum* was also recorded on rice. Maize was attacked by *Puccinia maydis*. A disease of bananas at Uda Hewaheta was found to be due to the planting of suckers infested by the root-boring beetle. This resulted in the dwarfing of the new suckers.

Miscellaneous. *Mycosphaerella caricae* Sydow and *Colletotrichum caricae* Stevens & Hall were recorded on *Carica papaya*. Other new records are *Puccinia nakanishikii* Diet. on *Andropogon citratus*, *Kordyana commelinae* Petch on *Commelina nudiflora*, and *Melampsorella ricini* (Biv.-Bern.) de Toni on castor-oil plant.

SMITH (E. F.). **Effect of crown gall inoculations on Bryophyllum.**—*Journ. Agric. Res.*, xxi, 8, pp. 593–597, 10 pl., 1921.

The author, in view of contrary statements recently made, again maintains (1) that the shoots found in leafy crown galls originate from groups of totipotent cells disrupted and set growing by the growth of the tumour; (2) that the crown gall organism has a stimulating effect on the formation of shoots.

Inoculation experiments on *Bryophyllum calycinum* gave the same results as those carried out on tobacco, geranium, and other plants which had given numerous crown galls containing abortive roots and shoots. It is considered inadvisable to inoculate detached leaves, as in this case the general stimulus of separation, which in *Bryophyllum* sets all the leaf buds growing, may confuse the results.

Levine's statement that the shoots in the crown gall develop from tumour cells is controverted by the author on the grounds that the tumour cell is a disoriented degenerate cell, given over to hasty vegetative growth and tending steadily toward decay; that it is not an embryo cell and there is no evidence of its subsequent development into normal tissues, organs, or the whole plant. It is also contended that, since the tissues are not killed, the appearance of numerous shoots in various parts of the tumour, resulting from inoculations in the leaf axil, can only be satisfactorily explained by ascribing their growth to dislodged fragments of the bud, containing pre-existing groups of totipotent cells. Further, the normal cortex is lifted up by a deep-seated tumour developing under it, and grows with the growth of the tumour without being actually a part of the tumour tissue, the cells having normal orientation and functioning normally. Although they are borne on the malignant tissue they do not originate from it.

The crown gall stroma (supporting tissue of vessels and mature cells) is intimately connected with the organization of the tumour, but it is not necessarily developed out of infected cells. This can only be settled when it is possible to stain the bacteria *in situ*. Meanwhile the author inclines to the view that the stroma is a growth of normal tissues (vessels and connective cells) stimulated by the presence of the abnormal cells, just as in malignant animal tumours.

When suitable inoculations are made under a dormant bud in *Bryophyllum*—that is, immediately under a petiole—not only are shoots developed from the bud under the stimulating influence of the growing tumour, but these shoots will at times develop secondary branches, as is the case in peach trees affected by peach yellows. Axillary shoots thus produced may be the only ones present on the plant.

Inoculations directly into the dormant bud and the tissues immediately surrounding it—that is, into the leaf axil—disrupt it in various directions as the resulting tumour develops, and its fragments can be seen under the microscope to be widely separated. These fragments are able to produce shoots under the tumour stimulus, though the resulting organs may be stunted or remain mere buds owing to the restricted food and water supply.

Leaf-notch buds do not develop at all on undisturbed young shoots except when stimulated by the crown gall organism. When the inoculation is made in the vicinity of the leaf-notches most of the buds grow out into small leafy shoots, and leaves thus treated will be the only ones on the plant to bear such shoots. Single needle-thrust inoculations made directly into the dormant leaf-notch buds resulted in nearly every case in tumours and shoots, some of the smaller, slow-growing tumours bearing several shoots and roots.

Totipotent cells are rather rare in the midribs of *Bryophyllum*, hence crown galls produced in this part are usually free from leafy shoots, although it is possible to obtain them. The rarity of these cells in the midrib of *Bryophyllum calycinum* was demonstrated by sand-bed experiments which the author describes fully. If shoots are formed directly from tumour cells it is hard to understand why they should be so seldom obtained in midrib inoculations on this host.

WALKDEN (H.). **The isolation of the organism causing crown gall on Chrysanthemum frutescens in Britain.**—*Ann. of Botany*, xxxv, 137, pp. 137–138, 1921.

The author records the isolation, not previously reported in Britain, of the organism causing crown gall. It was isolated from the Paris Daisy (*Chrysanthemum frutescens*) and proved to be identical with *Bacterium tumefaciens*, the bacillus responsible for crown gall in America. Cultural studies both of the British and of an American culture received from Erwin F. Smith revealed a few minor divergences from the published accounts by Smith and his collaborators. Thus the thermal death point in the cultures examined was 44° to 46° C., while the American investigators record 51° C. The latter's classification of the organism as an acid producer seems hardly justified from the slight degree of acidity produced in dextrose and sucrose. No growth was observed to take place in Uschinsky's medium, in place of the scanty growth described in America. But these differences in no way invalidate the conclusion that the organisms causing crown gall in Britain and in the United States are identical, since they applied to both sets of cultures, and both produced typical galls when inoculated.

PAINE (S. G.) & BERRIDGE (EMILY M.). **Studies in Bacteriosis. V. Further investigations of a suggested bacteriolytic action in Protea cynaroides affected with the leaf spot disease.**—*Ann. of Appl. Biol.*, viii, 1, pp. 20–26, 1921.

The production of a bacteriolysin, which Paine and Stansfield (*Ann. of Appl. Biol.*, vi, p. 27) considered possibly to occur in *Protea cynaroides* infected with *Pseudomonas proteamaculans* P. and S., was not confirmed. The bacteria gain entrance to the leaf through the stomata. The host prevents the spread of the parasite by the development of wound cork. The explanation of the diminished number of organisms in older spots is considered to lie in the desiccation to which the tissue, cut off by the cork from its water supply, is subjected. Tests in which the organism was inoculated into a leaf of *Protea* showed reduction in number of viable organisms from 2,808,000 on the 15th day, to 16,000 on the 32nd day. On a dry leaf surface, drops containing about 4,000,000 bacteria contained only 320 living organisms in 9 days. Tests indicated that autointoxication of the bacteria was not the cause of the reduction, but that it is rather to be attributed to the reaction of the host plant which restricts the growth of the organism in the tissues by cork formation and the production of wound gum, and the ultimate death of the organism is the result of desiccation within the area enclosed by the cork

Byggets Stribesyge. [Stripe-disease of Barley].—*Statens Forsøgsvirksomhed i Plantekultur, Medd.*, 80, 2 pp., 2 figs., 1921.

Both two- and six-rowed varieties of spring barley are affected by this disease in Denmark, especially the latter. The losses are very considerable, amounting in some cases to fifty per cent. of the yield. Winter barley is less liable. The symptoms are not apparent until three or four leaves are developed, and then appear as oblong pale stripes on the leaves, which gradually elongate, finally coalescing and extending the entire length of the blade. As the leaves grow older, the stripes become dry and grey, surrounded by a brown line which separates them from the green portion of the leaf. Later the leaf shreds into strips, following the direction of the stripes. The ear, when developed at all, is misshapen and brown.

The following measures of control are recommended: Disinfection of the seed with a solution of one-half per cent. of copper sulphate (500 gm. to 100 litres of water). The seed should be immersed in the solution in a basket or loosely woven sack. Severely infected seed should be immersed for four hours, half the time being sufficient in cases of mild infection. After immersion, the seed should be spread out and dried. Instead of copper sulphate, 0·5 per cent. of formalin or 0·1 per cent. of corrosive sublimate solution may be used. The latter is a strong poison and is therefore hardly to be recommended. The times of immersion are six and two hours respectively, half as long sufficing for mild infections. The hot water treatment should only be applied in cases of mild infection. This method consists in dipping the seed twenty times in five minutes in water heated to a temperature of 56–57° C. The seed should be dried preferably in the open, as artificial drying reduces the efficacy of the treatment.

JACKSON (H. S.) & MAINS (E. B.). **Aecidial stage of the orange leaf rust of Wheat, Puccinia triticina Eriks.**—*Journ. Agric. Res.*, xxii, 3, pp. 151–172, 1 pl., 1921.

The discovery of the aecidial stage of *Puccinia triticina* is announced. Teleutospores of this rust from wheat from various parts of the United States were germinated and sown on forty-eight species of plants belonging to nineteen genera. Infection occurred only upon *Thalictrum*. Tests were then made with all the species of *Thalictrum* obtainable, with the following results: *T. occidentale* was apparently immune. Pycnidia only were occasionally developed upon *T. dasycarpum* and *T. polygamum.* Pycnidia and, occasionally, a weak development of aecidia occurred upon *T. angustifolium, T. aquilegifolium, T. dioicum, T. minus, T. minus adiantifolium,* and *T. polycarpum.* Aecidia developed vigorously on two undetermined species of *Thalictrum*, and on *T. Delavayi* and *T. flavum.* Teleutospores from wheat from certain localities failed to produce infection, indicating either a different strain of the rust, or lower vitality of these spores.

Aecidiospores were sown on *Triticum aestivum, T. aegilops, Secale cereale,* and twenty-one other grass hosts. Uredo sori were obtained in all cases on *T. aestivum*, a few on *T. aegilops*, one sorus on *Secale cereale,* and negative results in all other cases (including barley). The pycnidia and aecidia obtained are described, and the relationship of this rust, which is biologically distinct from, but morphologically similar to, other grass rusts having aecidia on the Ranunculaceae, is discussed.

Puccinia triticina is considered to be of foreign origin, wheat being an introduced host, and the most susceptible *Thalictrums* also are exotic to North America. South-western Asia is suggested as the possible original home of the rust on native wheat and species of *Thalictrum.* While the rust seems to overwinter by uredo spores or mycelium in North America, the aecidial host may be of importance in certain parts of the world in the propagation of this rust.

STAKMAN (E. C.), KIRBY (R. S.), & THIEL (A. F.). **The regional occurrence of Puccinia graminis on Barberry.**—Abs. in *Phytopath.*, xi, 1, pp. 39-40, 1921.

Barberries growing in the southern States became heavily infected when inoculated with teleutospores produced in the northern States. When these northern-grown teleutosori were kept in the south no infection was produced on barberries. Teleutospores from the south kept in the north during the summer and fall, caused infection in the south. Evidently barberries do not become infected in the south because practically no teleutospores are viable in the spring.

JOHNSON (A. G.) & DICKSON (J. G.). **Wheat scab and its control.** —*U.S. Dept. of Agric. Farmers' Bull.*, 1224, 16 pp., 12 figs., 1921.

Scab, or *Fusarium* blight, of wheat is a disease which may be caused either by *Gibberella saubinetii* (Mont.) Sacc., or by *Fusarium culmorum* var. *leteius* Sher., or by *F. avenaceum* (Fr.) Sacc., but the first named is responsible for at least 95 per cent. of the losses, which in 1919, in spring and winter wheat alone, amounted to almost 80,000,000 bushels, while a still greater quantity suffered depreciation in value. The geographical distribution of the disease is world-wide, but it does not occur in dry regions, and in the United States the zone extends only from the Mississippi valley eastwards. The development of the fungus is dependent on weather conditions, a warm, damp atmosphere during the flowering period of the host favouring its growth and spread and leading to severe local epidemics with resultant heavy losses. Besides wheat, the parasite also attacks rye, spelt, barley, oats, and various grasses, such as squirrel-tail grass (*Hordeum jubatum*), bluegrass (both *Poa pratensis* and *P. annua*), cheat (*Bromus secalinus*), and yellow fox-tail (*Setaria glauca*), while it is also responsible for the rot-producing disease found on Indian corn, on the dead stalks of which, as also on wheat straw, it hibernates in its perithecial stage. Hence the danger of growing wheat in rotation with maize that has been scab-infected, as the disease is carried over on the corn-stalks and breaks out in a particularly virulent form.

Wheat infected with scab is shrivelled, grey or whitish in colour, and light in weight (30 to 40 lb. to the bushel being the average for badly-scabbed grain), and the kernels thoroughly permeated by the mycelium are either graded as No. 3 and even No. 4, or else rejected altogether. An average sample of 60 lb., composed of numerous small samples taken from different elevators in Illinois in 1919, showed about 25 lb. of clean, 20 lb. of scabbed, 10 lb. of shrivelled, and 5 lb. of broken kernels. In bulk, scabbed grain occupies the same space as sound grain, but it weighs much less.

Scabby seed germinates poorly, and gives rise to blighted and weak seedlings, but these are often killed before they appear above ground. The disease spreads later to the heads, where the parasite continues to develop throughout the season. Its life during the perithecial stage is saprophytic, and although infection may take place by a direct discharge of ascospores on to the grain heads, the most common form of infection is by means of the summer-spores or conidia.

Complete suppression of the disease is difficult to attain, but the losses due to it can be greatly minimized by (*a*) not sowing wheat after corn, unless the cornstalks are removed and the stubble completely ploughed under; (*b*) ploughing under all crop refuse and collecting and burning all old straw and grasses in the immediate neighbourhood; (*c*) using clean, graded, and treated seed of adapted varieties; (*d*) sowing wheat when the ground is cool, winter wheat on the latest safe date of the season, and spring wheat on the earliest safe date in the spring.

DICKSON (J. G.). **The influence of soil temperature on the development of the seedling blight of Cereals caused by Gibberella saubinetii.**—Abs. in *Phytopath.*, xi, 1, p. 35, 1921.

Uninfected wheat seedlings developed best in soil temperatures below 16° C.; maize seedlings at temperatures above 20° C. Blight of wheat seedlings did not occur at soil temperatures below 12°, but was severe at temperatures from 16° to 28° C. Maize seedlings blighted at 20° C. or below, and did not blight above 24° C. Comparable results were obtained in the field.

STEVENS (F. L.). **Helminthosporium and Wheat foot-rot.**—Abs. in *Phytopath.*, xi, 1, p. 37, 1921.

An adaptation of the rag-doll seed tester, in which seedlings were grown under aseptic conditions, and moisture and temperature varied as desired, was used to study seedling infection of wheat by the *Helminthosporium* of foot-rot. Inoculation on the uninjured sheath was followed by penetration within twenty-four hours and the development of a visible brown spot within forty-eight hours. In favourable conditions the mycelium subsequently invaded the innermost leaves and caused general rotting and death. When inoculated on roots there was a general invasion of the cortex with very slight discoloration. A number of cultures of closely related *Helminthosporiums* from different sources, some sent under the names *H. teres*, *H. avenae*, *H. gramineum*, and even *H. intersemi-natum*, showed the same infecting ability. Infection is through the middle lamella. The mycelium forms appresoria, the middle and inner lamellae swell, and they and the adjacent cellulose walls change in staining reaction. On the inside of the host-cell callus-like bodies develop. A geniculate-spored *Helminthosporium* caused abundant mycelial invasion, but extended to only a few cells. Infection by the foot-rot *Helminthosporium* was secured on maize, barley, rye, corn-fodder, Sudan grass, and millet.

WESTON (W. H.) Jr. **Significant points in the life-history of the Philippine Maize mildew.**—Abs. in *Phytopath.*, xi, 1, p. 32, 1921.

A warning is given of the menace to the American corn crop caused by the presence of several destructive species of *Sclerospora* on *Zea mays* in the Orient. The Philippine species produces its conidia only at night, but may continue to do so for over two months. Conidia may be produced on corn, teosinte, sorghum, sugar-cane, *Saccharum spontaneum*, and *Miscanthus japonicus*. Oogonia are found only on the last three hosts. The conidia do not survive drying, so that spread to other countries is only likely through the transportation of oogonia in soil or on plant parts, or of infected living plants such as sugar-cane cuttings.

HEALD (F. D.). **The relation of spore load to the per cent. of stinking smut appearing in the crop.**—*Phytopath.*, xi, 7, pp. 269–278, 1921.

Single smut balls of *Tilletia tritici* were found to contain from six to nine million spores. During threshing, from 0 to 45,416 spores were found to become deposited on single grains of wheat in Washington. Tests were made by adding 0·005 to 3·0 gm. of bunt spores to 100 gm. of wheat (giving spore loads per grain respectively of about 400 to 183,000) and planting the seeds in clean soil. At least 0·5 gm. of powdered smut per 100 gm. of seed (about 35,000 spores per grain) was found necessary to produce the maximum amount of smut on the crop. In the case of naturally smutted seeds, a lesser per cent. of smut occurs in the crop than when the same number of spores per grain are added from freshly broken bunt balls, indicating that the spores retain their vitality better in unbroken balls. A spore load of 533 spores per grain was found to produce 9·52 per cent. smutted plants in the variety Jenkin's Club, whereas the same spore load resulted in no smut being produced with the Marquis variety. Marquis was seldom found bearing sufficient smut spores after threshing to necessitate seed t eatment. The author considers that the necessity of having considerable numbers of smut spores in order to secure infection indicates either a multiple infection or a chemical mass effect due to numbers of spores.

It was found possible to predict the amount of smut that may appear, from a count of the spore load of seed examined.

KOCH (ELIZABETH) & RUMBOLD (CAROLINE). **Phoma on sweet Sorghum.**—*Phytopath.*, xi, 7, pp. 253–268, 3 pl., 3 figs., 1921.

A *Phoma* was found on seedling leaves, and the leaves, seed heads, and seed of mature sweet sorghum plants from Arkansas, Kansas, Mississippi, Texas, and Virginia. The fungus caused infection in cross-inoculations upon eleven varieties of grain sorghum and sweet sorghum, and upon the forage sorghum Brown Durra. Seeds bearing pycnidia were found when planted to produce in some cases infected seedlings and to show poorer germination than healthy seeds. Slight infection was produced on sugar-cane and *Zea mays.* The cultural characters of the fungus from various varieties of sorghum are described, and while variation occurred in the morphological and physiological characters of the fungi from different sources, these variations were not considered of sufficient constancy nor degree to warrant special naming of the strains. The fungus is tentatively assigned to *Phoma insidiosa* Tassi.

The fungus was found to retain its vitality on seed for one year, but the vitality was poor at the end of two years.

RUMBOLD (CAROLINE) & TISDALE (ELIZABETH K.). **Notes on Phoma insidiosa Tass. found on Sudan grass.**—*Phytopath.*, xi, 8, p. 345, 1921.

Brownish-drab spots with indefinite outlines, bearing pycnidia of *P. insidiosa*, were found on Sudan grass. Cultures were obtained, and infection produced on Early Amber sweet sorghum.

The original culture from Sudan grass did not produce a pink stain in the medium, but the re-isolation from the sorghum produced this stain, just as the fungus found naturally on sorghum did. A number of measurements of pycnidia and conidia from leaves and cultures is given, there being considerable differences according to the source of the fungus between the limits of 45 and 198 μ for the pycnidia and 4·4 to $7{\cdot}9 \times 2{\cdot}6$ to 4·4 μ for the conidia.

ROSEN (H. R.). **Further observations on a bacterial root and stalk rot of field Corn.**—*Phytopath.*, xi, 2, pp. 74–79, 4 figs., 1921.

From rotted roots, stalks, leaves, and husks of maize in Arkansas, accompanied by brown discoloration of the nodes, the writer has isolated a rapidly growing, white bacterium, capable of reproducing the disease. Under favourable conditions, such as high humidity and temperature, the rot rapidly spreads through the thickness of the stem, the tissues collapse and disintegrate, and the stalk falls over. At times 10 to 30 per cent. of the plants may be attacked.

SEYMOUR (EDITH K.) & McFARLAND (F. T.) **Losses from rye ergot.**—*Phytopath.*, xi, 7, pp. 285–289, 1921.

Spikes of rye (*Secale cereale*) affected with *Claviceps purpurea* contain a larger number of blasted kernels or empty florets than do normal spikes. The majority of these blasted kernels or empty florets have been penetrated by the fungus. Thus in one count made, 70 per cent. of the florets were infected by the fungus, though only 21 per cent. bore sclerotia. On an average of a number of counts it was found that ergotized spikes contained only 43 per cent. of normal kernels while unergotized spikes had 69, the larger part of the difference being made up of parasitized florets without sclerotia. Hence the losses caused by the disease are decidedly greater than those merely due to the replacement of normal grain by sclerotia.

A(SHBY) (S. F.). **Relation between Cacao pod rot and Coco-nut bud rot.**—*Agric. News (West Indies)*, xx, 507, p. 318, 1921.

In view of the apprehension caused by Reinking's work in the Philippines as to the ability of the cacao pod rot fungus (*Phytophthora faberi* Maubl.) to cause bud-rot of the coco-nut, the writer carried out some experiments to determine whether the species of *Phytophthora* from cacao (*P. faberi*) and from coco-nut (*P. palmivora* Butl.) in the West Indies would cross-inoculate and whether they appeared to be identical when grown in pure culture on the same media.

Inoculations from pure cultures of the two fungi were carried out on two coco-nut seedlings, each about three feet high, by pushing a stout needle into the heart at a point about six inches above the attachment to the nut. Round the hole thus made a cup of plasticine was moulded and filled with sterilized water containing active zoospores and undischarged sporangia. The stem was surrounded by a glass lamp-chimney closed below with a perforated cork and plasticine, and above with a plug of cotton wool. Examination after four weeks showed that the young tree inoculated with the coco-nut *Phytophthora* had rotted spots on the pinnae of the heart leaf, three-quarters of an inch in diameter, both on the leaflets pierced by the needle and on those not wounded; a rot had also run down the stalk and expanded in the tender tissues below the growing point of the stem, and mycelium characteristic of the fungus was found in all the affected parts. The second tree, which had been treated with *Phytophthora* obtained from rotted cacao pods, exhibited no signs of infection, except spots under one-third of an inch in diameter on the leaflets in the heart pierced by the needle.

The experiment was repeated, in co-operation with Mr. R. O. Williams, the Agricultural Superintendent in Grenada, but this time the attempt was made on four coco-nut seedlings, of the same size as those in the preceding test, with a zoospore suspension from a pure culture of the cacao *Phytophthora* only, poured into the hearts. The trees were wrapped in damp cotton cloths which were kept wet for several days during a period of showery weather. A month later two of the trees proved quite free from spots on the young leaves or rot in the hearts, while the lapse of another month found the other pair equally free from infection.

Similar experiments were conducted with cacao pods, of which twelve large but immature specimens were inoculated with each of the two fungi from pure cultures, by placing drops of a zoospore suspension containing also undischarged sporangia at two points in each pod, after the surface had been sterilized in corrosive sublimate and well washed with boiled water. The surface of the pod covered by the drop was wounded with the point of a scalpel, the inoculated places enclosed in plasticine cells, and the pods kept in a damp chamber. Of the twelve pods inoculated with the cacao fungus, nine showed a brown rot expanding from the drops after two days, becoming wholly rotted after seven to ten days, and with abundant sporulation. The remaining pods rotted after a second inoculation. In the twelve pods inoculated with the coco-nut fungus no sign of infection could be detected after a week, and repeated inoculations produced negative results. A second series of experiments in co-operation with the Agricultural Superintendent in Grenada confirmed the above findings in every way. The pods used were mostly red and yellow Amelonado forms of Forastero, a few being Angolota, and none Criollo.

A comparison of the two fungi in pure cultures isolated from various localities in Jamaica showed only minor differences, but in none of them were oospores (the only sound basis for the natural separation of species in the genus) found. Until such spores are met with, either in cultures or under convincing conditions in nature, a decision as to whether the two West Indian forms belong to different species or are different biological varieties of one species cannot be made. The experiments recorded, although not comprehensive, indicate that the cacao *Phytophthora* does not appear to attack the coco-nut, and that cacao pods cannot be rotted by the form which causes bud-rot of the coco-nut.

Sharples (A.) & Lambourne (J.). **Observations in Malaya on bud-rot of Coco-nuts.**—*Ann. of Botany*, xxxvi, 141, pp. 50–70, 7 pl., 1922.

After a brief discussion of previous work done on the bud-rot of palms in the West Indies, India, and the Philippines, the authors describe a small outbreak of bud-rot in Malaya, in a three-acre field, in which practically every tree showed signs of the disease, while some were in a very advanced state of decay; the field was subjected daily to tidal inundation, to which, as a primary cause, the disease was attributed. A large number of specimens in all stages of decay were examined and found to contain no apparent fungal hyphae; isolations made from the advancing margin of the diseased tissue showed, however, the presence of three organisms, a red pigment producing bacillus, a bacillus resembling *B. flavo-coriaceus* Eisenberg, and a *Sarcinomyces*. These organisms were used by the authors both singly and also the first and last in combination, for a series of inoculations on mature palms. A small sterile gouge was inserted in the clean heart tissues of the bud; the tissue extracted by it was inoculated with the organisms under trial and then replaced in the bud. Most of the inoculated trees developed the early symptoms of bud-rot, characterized by the rotting and falling over of the central leaves, but subsequently recovered and put out new leaves from the side of the bud below the remains of the central shoot. Further inoculations were made with the *Phytophthora* causing black stripe of *Hevea brasiliensis* in Malaya [which the authors identify with *P. faberi* Maubl.] and with a species of *Thielavia* and a *Mucor*, all of which gave results similar to those of the first set of experiments.

The authors conclude that wound inoculations penetrating the central tissues of the bud will produce the symptoms of bud-rot, as judged by the rotting of the central leaves, with a variety of organisms, none of which can be regarded as specific to the disease. The only case in which the bud itself (the growing point) was definitely rotted was in one of the inoculations with *Phytophthora*. They consider that in most of the other work done on this disease, sufficient time was not allowed to elapse before completing the observations to judge whether the parasite was capable of killing mature trees. Inoculations on seedlings are open to the objection that the seedling has not the same defensive powers as the mature plant. Hence the authors are not prepared to admit that the cause of bud-rot has been established, and while they state that *Phytophthora palmivora* Butl. has been proved in India and the West Indies to function as an obligate parasite on the tender central leaves of the palms, they do not think that it necessarily causes rotting of the heart tissues and death of the tree.

PETHYBRIDGE (G. H.), LAFFERTY (H. A.), & RHYNEHART (J. G.). **Investigations on Flax diseases (Second Report).**—*Journ. Dept. of Agric. & Techn. Instr. for Ireland*, xxi, 2, pp. 167–187, 6 pl., 1921.

This is a continuation of the investigations reported in the same journal, xx, p. 325, 1920. The warm damp weather experienced in 1920, though eminently suitable for flax growing, favoured equally the development and spread of parasitic fungi. Special attention was directed to the following diseases:

SEEDLING BLIGHT. The method of seed infection was traced. Infected fruits are marked with reddish-brown areas, and when placed in a moist, warm atmosphere for forty-eight hours develop the fructifications of *Colletotrichum linicolum* P. & L., the cause of the blight. The mycelium penetrates within the tissues of the fruit wall to the central axis and along the extremely short funicle into the outer layers of cells of the seed-coat, where it is localized. As to the infection of the fruits themselves, the writers have practically no doubt that this occurs from already infected leaves, the fungus progressing in stages from the seed to the young seedlings, some of which do not succumb to the attack, and thence to the leaves as these are developed, until it finally reaches the fruit. It has hitherto not been possible to undertake seed disinfection trials. It is thought that the parasite may be identical with *Gloeosporium lini* mentioned by Westerdijk in *Jahrb. Ver. Angew. Bot.*, xvi, p. 4, 1918.

'BROWNING OR STEM-BREAK' (*Polyspora lini* Laff., n. gen. et. sp.). These are only two phases of a disease caused by one and the same parasite with apparently a world-wide distribution. The chemical changes brought about by this fungus cause a lignification of the wall of the fibres with the result that the stem becomes brittle in the diseased region.

As in the case of 'Seedling Blight', the transmission of the disease occurs through the seed, but attempts to check this have so far met with failure. Steeping infected seed is inadvisable, as it becomes mucilaginous when wetted, with the result that in the drying process the seeds adhere together, whilst their vitality is greatly reduced. This difficulty has been overcome by using a very fine misty spray and by employing comparatively small quantities of the following solutions: 5 and 10 per cent. aqueous solutions of copper sulphate; 2, 10, and 15 per cent. Burgundy mixture; 0·1, 0·5, and 1 per cent. aqueous solutions of mercuric chloride; and 0·37, 0·48, and 0.59 per cent. aqueous solutions of formaldehyde. The 0·59 per cent. formaldehyde solution was the only one that effectively checked the disease, but in practice it can hardly be regarded as a useful method of control, as the percentage of germination is seriously reduced, and to counteract this much greater quantities of seed than usual would have to be sown. In attempts to disinfect the seed by heating, it was found that the vitality of the fungus was not impaired when the seeds were exposed to a temperature of 50° C. for periods of from 6 to 192 hours, the longer exposures also slightly improving germination. Nor were the conidia killed at temperatures up to 80° C., prolonged up to 168 hours, but death occurred after a 30-hour exposure to a temperature of 96·5° C. A period of rest after this treatment improved the germination of the seeds considerably, but it never rose above 54 per cent., as compared with 94 per cent. in the control seeds. It follows from these trials that, for the present at least, preventive measures will have to be employed to minimize the very serious losses resulting from this disease. Care in the choice of the seed for sowing, which should never be taken from a 'browned' crop, is essential, and much valuable fibre can be saved and further spread avoided by 'pulling' a crop that shows signs of the disease.

There is an erroneous idea that white flowering flax is resistant, but this is simply due to the fact that it is generally pulled before 'browning' has become epidemic in it. A full description of the fungus is being published in a separate paper. [See next abstract.]

'RUST' and 'FIRING'. The full life-history of the flax rust, *Melampsora lini*, had not been previously followed in Europe, though known in America. The authors have found all four stages on flax in Ireland. The spermagonia appear about fifteen days after the infection of young plants with germinating teleutospores, and are followed a few days later by aecidia. The flask-shaped or spherical, immersed spermagonium has a minute beak with an ostiole opening directly underneath a stoma, or occasionally two, each beneath a separate stoma. The spermatia borne on branched stalks within the spermagonium are extruded to the exterior through the ostiole and the stoma in the form of a tendril. The walls of the spermagonium are formed of compacted hyaline hyphae with yellowish contents. All attempts to germinate the spermatia failed. The raised aecidial pustules are generally crescentic or annular in shape. In the latter case the leaf tissue within the ring is not raised and contains spermagonia. The aecidia themselves, arising beneath the epidermis of the leaf, rupture it, and thus the chains of aecidiospores lie freely exposed. Inoculations with the aecidiospores gave uredo pustules in nine days, followed by the teleutospore stage twenty-two days later. Spread takes place chiefly in the uredo-stage. Experiments have shown that the disease is not transmitted by seed that has been thoroughly cleaned, even if derived from a rusty crop. It is therefore important to remove as thoroughly as possible all fragments of the previous crop on which the teleuto-stage may occur, when preparing the seed.

'FOOT-ROT' is the name suggested by the authors for a disease which was included in their earlier report under the general designation of 'dead stalks', but is now found to be due to a definite parasitic fungus belonging to the genus *Phoma*. Its species has not been determined as yet, but it is of interest to note that on the Continent two species, *P. herbarum* and *P. exigua*, are considered harmful to flax; it does not, however, appear that exhaustive investigations into their influence on the crop have been carried out. In the disease here described the flax plants die prematurely, while the lower parts of the stem are covered with numerous dark brown or black pycnidia. Spores are produced in vast quantities in these and emerge through a minute pore to the exterior. The mycelium, ramifying in the cortical cells of the stem, destroys the fibres and chokes up the cavities of the vessels of the wood. The parasitism of the *Phoma* in question was established by inoculations with pure cultures, and it was proved that the disease can be transmitted through the soil, though it is still an open question whether this occurs under field conditions, and also whether the seed carries the disease.

FLAX WILT (*Fusarium lini*). Wilting on a large scale appears to be rare in Ireland, and in contrast with the western parts of the United States the occurrence of flax 'sick' soil as a result of the presence of this fungus is almost unknown there. The wilting of individual plants, however, is not uncommon, and in some cases may be fairly extensive. It affects both seedlings and more mature plants, but there are no external symptoms beyond wilting, and the presence of the fungus is only discovered by examining the internal tissues when it is found that the wood vessels are choked with mycelium. Laboratory experiments prove that infection may occur through the soil, and that the fungus retains its vitality unimpaired after eight months in potted soil. Whilst the results have as yet not been checked by trials in the field, they nevertheless make it appear probable that the fungus hibernates in the soil and renews its attack on the host the following season. In America, where the disease is very prevalent, the opinion prevails that it is transmitted through the seed, by means of spores mechanically adhering to the seed-coat, and disinfection of the seed is strongly advocated. It has not been possible to test this statement fully, but the interesting fact has been noted that the fungus survives the retting process, and affected plants accidentally left behind in the drying-field may conceivably carry infection to a succeeding crop. Resistant varieties have been raised in America, mainly of the oil-producing kind, but the lesser severity of the disease has made this unnecessary in Ireland. The fungus has been compared in culture with that isolated from wilted flax in America and British East Africa, and the same species, *Fusarium lini*, appears to be common to the three countries.

Botrytis disease. The species has not been determined, nor whether it is one which is common to a number of plants. On flax, infection usually occurs on the stem, at any point, and the tissues are here quickly destroyed, while the upper portion of the plant dies. In one case, however, progression of the infection from above downwards was noted in plants infested by Capsid bugs. The upper portions of these plants ceased to elongate and branched abnormally, and the *Botrytis* attack took place in these upper portions, infection being possibly favoured either by the wounds made by the insects or by the lowered vitality of the plants. The latter were killed outright before any fruits or seeds had developed. The authors consider it practically certain that the sclerotia produced by the fungus on the dead tissues survive the winter, and the disease may arise through their agency in the following year.

Sclerotium disease (*Sclerotinia sclerotiorum*). This parasite attacks a large number of different plants, but it was only once met with causing a rot of lodged flax. Inoculations with pure cultures of the fungus showed it to be a virulent parasite.

Yellowing. The most careful examination failed to reveal the presence of a parasitic organism, and the cause of the disorder, which is characterized by a chlorotic and stunted appearance of the young seedlings, appears to be, in some cases at least, a result of unsuitable soil conditions.

Lafferty (H. A.). **The 'browning' and 'stem-break' disease of cultivated Flax (Linum usitatissimum) caused by Polyspora lini n. gen. et sp.**—*Scient. Proc. Royal Dublin Soc.*, xvi, N. S., 22, pp. 248–274, 3 pl., 1921.

This is a fuller description of the organism and its effects already referred to in a paper by Pethybridge and the present author [see last abstract]. There is a Latin diagnosis of the fungus and an account of its behaviour under cultural conditions. The symptoms of both forms of the disease are dealt with in detail. 'Browning' in the crop first becomes evident about pulling time, either in isolated areas which gradually increase in extent until they coalesce, or more or less uniformly over the whole field if the primary infection is general from the start, Weather conditions influence its rate of development, spread being most rapid in warm damp weather. One diseased centre, about one foot square in area, was found to have increased in three days to an irregular area of seventy-two square feet. On the leaves the characteristic dark brown, rounded, usually sharply defined and slightly depressed spots appear either singly or in considerable numbers, as many as eight having been found on a single leaf. They do not increase in size very rapidly, and except when the attack takes place in the region of the petiole, the leaves are able to continue their functions for a long time after infection; in every case, however, the ultimate result is premature death, the leaf turning brown and either falling or remaining with its surface adhering to the stem. The diseased areas in the main stem, which are often closely associated with the presence of an affected leaf situated at a slightly higher level, appear at first as minute, elongated, light fawn to brown spots, which gradually spread, especially in a longitudinal direction, and may coalesce until practically the entire surface of the stem is covered. In dry weather the cortex frequently splits longitudinally along a diseased area, and the stem at this point becomes extremely brittle. Branches are similarly attacked and frequently girdled. Diseased petals turn brown and commonly adhere firmly to the wall of the fruit. The latter, when infected in the early stages of the growth, can easily be picked out, but detection is extremely difficult when the fruits mature, as they then lose their green colour naturally and become golden or light brown in colour. Diseased tissues contract owing to loss of moisture, and affected fruits tend to gape open, particularly in dry weather. In cases of light infection the seeds may appear normal to the naked eye, but the majority are found on closer examination to be heavily infested with the parasite.

Stem-break is produced by the occurrence of an infected area in the neighbourhood of the first node, the stem breaking across more or less completely at this point. When the fracture is complete the plant turns brown and dies, but if the woody tissue of the stem is well developed the fracture may be only partial and the parts above continue to live and grow for a time.

The hyaline, septate, and branched hyphae, which in the early stages of the disease permeate the parenchymatous tissues of the cortex and destroy the cells between the fibre bundles, discolouring and disorganizing their contents and consuming the chlorophyll granules, have never been seen to penetrate the bundles themselves, though an alteration in the chemical composition of the latter undoubtedly takes place. This alteration affects both the fibre walls and the middle lamellae, which become lignified. Young seeds attacked before the seed-coats are fully developed are totally destroyed as the embryo becomes infected, but in the more fully developed seeds the fungus is stopped by the third or fibrous layer of the seed-coat and the embryo escapes.

On and around the margins of the discoloured diseased areas, kept in a moist atmosphere, beehive-shaped, hyaline to milky, gelatinous acervuli are produced (as a rule directly over the stomata) by considerable masses of hyaline, single-celled conidia of varying shape, oval, cylindrical or curved, borne on the swollen tips of usually unbranched conidiophores emerging slightly through the stomata. Occasionally on affected stems and branches but not on leaves, submerged conidia are formed which accumulate in minute pockets beneath the epidermis until pressure from below causes them to burst to the outside. No true stromata are formed and setae have never been found. The conidia are produced in clusters at the ends of the conidiophores and occasionally for a short distance along their sides, from one to seven being formed at a time, and new ones developing after the first have fallen off. They are 9 to 20 by 4 to 5 μ in diameter. On germination in culture the amount of mycelium produced is small, but new conidia are formed in great abundance, often directly from the conidia by budding. In culture a dark-coloured mycelium of rounded cells may be formed and the conidia may occasionally take up this colour. On cooked flax stems the tips of the conidiophores may be olive-green. On all the media conidia are budded off from the sides of the hyphae on short blunt pegs, which may bear two or more spores. The conidia frequently become septate before germination. The fungus is regarded as belonging to the Melanconiales, and attention is called to certain similarities with *Microstroma*, though the latter is usually regarded (except by Maire) as belonging to the Exobasidiaceae.

Inoculations with pure cultures were successful and no evidence was obtained of varietal resistance or of separate strains of the fungus.

SANDERS (G. E.) & KELSALL (A.). **Dusts and dusting for insect and fungus control.**—*Scient. Agric.* [Canada], ii, 8 pp., Sept., 1921.

This article deals with dusts containing copper and arsenic, and is continued from a preceding article entitled 'The present status of dusting'.

Paris green is a well-known copper-arsenic dust, but is a poor fungicide and is expensive. Commercial Bordeaux powders, made usually by mixing copper sulphate solution and milk of lime and drying the precipitate, are good fungicides. A new copper-arsenic dust was devised by the authors in 1917. In 1921 about 700 tons of this dust were used in Nova Scotia. In the Annapolis Valley of Nova Scotia about 10,000 acres of apples were thus dusted in 1921, 8,500 acres were sprayed (principally with Bordeaux), and about 1,500 acres were dusted with sulphur-lead arsenate dust.

In making their dust the authors first used anhydrous $CuSO_4$, but later the mono-hydrate $CuSO_4H_2O$, was generally used. This salt is ground fine enough to pass a screen of 200 meshes per inch. Calcium arsenate is at present considered the most satisfactory arsenical salt to add to the dust. Powdered hydrated lime is added to give the necessary bulk. The strength of these dusts has been expressed in the percentage of metallic copper and metallic arsenic respectively. Thus a $3\frac{1}{2}$–$1\frac{1}{4}$ dust has been recommended since 1919 for apples, and is made up with 10 lb. of dehydrated $CuSO_4$ (containing 35 per cent. of metallic copper) and 5 lb. of calcium arsenate (containing 26 per cent. of metallic arsenic). The remaining 85 lb. are hydrated lime. For potatoes a $5\frac{1}{2}$–$2\frac{1}{2}$ formula is recommended at present. These dusts may be stored in any dry place, but should be used the same season in which they are mixed. When the dust is applied to a leaf, the first contact with water (rain or dew) changes the white powder to a blue film of Bordeaux mixture. The dust has better spreading power than sulphur dust. For an acre, 55 lb. of copper-lime dust, 73 lb. of 90–10 sulphur-lead arsenate dust, or 100 gallons of Bordeaux mixture were required.

In order to determine the relative adhesiveness of the copper-arsenic dust and of Bordeaux mixture, leaves were picked from dusted and sprayed apple-trees, and the amounts of copper and arsenic remaining after various lengths of time had elapsed, were determined. These tests indicated that as much copper and arsenic are found on the leaves immediately after dusting as after spraying, indicating that there is no greater wastage of material in dusting than in spraying. The spray was found to adhere to the leaves longer than did the dust Tests of dusts of different strengths indicated that apple leaves will stand up to six per cent. of metallic copper and four per cent. of metallic arsenic in dusts without suffering injury. Some russeting of the fruit is produced, but less than that caused by Bordeaux spray, and this russeting can be much reduced by using sulphur for the application immediately after the blossoms fall.

The scarcity of codling moth and certain other insects renders the value of the copper-arsenic dust for insect control of some uncertainty, but the dust may be slightly inferior to the spray in this respect. Dusting is equal to spraying in the control of apple scab.

SANDERS (G. E.). **Spraying and dusting.**—*Fruit Growers' Assoc. Nova Scotia, 57th Ann. Rep.*, pp. 66–92, 1921.

A brief history of the use of several preparations for the control of plant pests is given. The author reports that field tests of dusts and sprays allow the following conclusions to be drawn, with special reference to applications to apple-trees in Nova Scotia:

When less than 10 per cent. of lime is added to lead arsenate, the amount of burning is increased, but when the amount of lime is equal to the lead or more, the burning is decreased. Thus the lime usually left in a spray tank is likely to increase the burning from what is intended to be straight lead arsenate, but the addition of more lime will decrease the burning. When alkaline diluents, such as hydrated lime, talc, &c., are added to sulphur dust, the fungicidal value is reduced. Where lead arsenate is added to sulphur dust, the fungicidal value is increased. This last he thinks is mostly due to physical improvement.

Dolomite lime renders the copper in Bordeaux and copper-arsenic dust safer on foliage and fruit than high calcium lime. The copper in Bordeaux and in copper-arsenate dust has a much greater effect in rendering the arsenicals safe than the lime. The refusal of white arsenic to wet readily when placed in water and its refusal when alone to react on copper sulphate, are both overcome by the addition of a small quantity of hydrated lime.

Spray calendars and dust calendars for apples in Nova Scotia are given. The dust calendar recommended is as follows: Before the blossoms, apply copper-arsenic dust two or three times. Immediately after the blossoms, on varieties liable to russeting use sulphur-lead arsenate dust; on other varieties use copper-arsenic dust as before. A week or ten days after the last application and at equal intervals thereafter give two or three applications of copper-arsenic dust.

Practical details as to the best time of day and best method of applying the dusts are given. It would appear that many of the growers are abandoning spraying in favour of dusting. The latter is preferred because it is quicker and allows a greater acreage of trees to be protected with one outfit. Summaries of tests in Nova Scotia and elsewhere for four years indicate that dusting is equal to spraying in controlling scab and insects on apples. Dusting with copper-arsenic dust is cheaper than liquid spraying. The copper and arsenic dust is made of 10 lb. of dehydrated copper sulphate, 5 lb. of arsenate of lime, and 85 lb. of hydrated lime. 50 lb. are recommended per acre of twenty-year-old trees. The sulphur-lead arsenate dust is composed of 90 lb. superfine dusting sulphur and 10 lb. dry lead arsenate. It is used at the rate of 75 lb. per acre of twenty-year-old trees.

CHIFFLOT (J.). **Les maladies cryptogamiques des Abricotiers dans la vallée du Rhône.** [Cryptogamic diseases of Apricot trees in the Rhone valley].—*Ann. des Épiphyties*, vii, pp. 315-322, 1921.

The importance of the fruit production of the Rhone valley is shown by the fact that in 1920 over 10,000 tons of apricots and peaches were dispatched to the various markets and sold at an average price of fr. 120 per 100 kg. The apricot orchards, interspersed with market gardens, are situated on the low-lying parts bordering the river and on the slopes of the valley. Cultivation is neglected and little is done to check diseases, with the result that returns are much below what they should be.

The two principal diseases found on the apricots are brown rot due to *Stromatinia* [*Sclerotinia*] *laxa* Ehrenb. (*Monilia laxa* (Ehrenb.) Sacc. and Vogl.), which some phytopathologists look upon as a form of *Stromatinia* (*Monilia*) *cinerea* Bon., and *Clasterosporium carpophilum* (Lév.) Aderh. (*Coryneum Beyerinckii* Oud.). The former attacks flowers, buds, fruits, and twigs, which mummify and become covered with the grey efflorescence of the *Monilia* stage. This mould is also found on the base of the petioles and on the cicatrices left by the fallen buds and flowers, while affected twigs exude through the ruptured cuticle a gummy secretion, at times abundant. Damp weather favours the development and the spread of the parasite, which is essentially a low temperature organism. The years 1913, 1915, and 1916 were particularly favourable to it, the fruit yield in France being reduced by 80 to 90 per cent. Infection probably takes place through the stigmas when the flowers first open, and spreads rapidly through flowers and buds to neighbouring twigs and from these in due course to the fruits.

The second disease also attacks the flowers, twigs, and fruit but does less damage than the first. On the twigs pink spots are formed which later turn brown and may give out a gummy secretion, this being the only point of resemblance to the *Monilia*. The leaves are also covered with pink spots which become brown and fall out. The fruit is sometimes severely affected, the pulp drying up between the brownish spot and the centre of the fruit.

Treatment is the same for both diseases. Rotted fruits and dead wood should be burned, not buried, and the trees sprayed during the winter with Bordeaux or Burgundy mixture or neutral verdet. Several applications during January, February, and just before and after flowering are recommended. Scott's self-boiled lime sulphur is also stated to be efficient and easy to prepare. Of the varieties of apricots grown in the Rhone valley, Luizet is the most resistant and is followed by Abricot d'Ampuis, Blanc rosé, Paviot, and Poizat, in order of resistance.

LEONIAN (L. H.). **Studies of the Valsa Apple canker in New Mexico**—*Phytopath.*, xi, 6, pp. 236–243, 1921.

Twigs, branches, or the main trunk of apple-trees in New Mexico were found to bear cankers covered with the fruiting bodies of a fungus, mostly pycnidia apparently identical with the *Cytospora* described by Stevens (*Ill. Agric. Expt. Stat. Bull.*, 217, 1919). A few perithecia were, however, found, which resembled *Valsa leucostoma* (Pers.) Fr. Both pycnidia and perithecia were developed in culture and their relationship demonstrated. Inoculations with conidia on steamed apple twigs were found to yield only pycnidial stromata, but similar cultures from ascospores gave both forms of fructification. Inoculations in the field with conidia and ascospores of the fungus, and also with conidia from cultures of a plum strain of *Cytospora leucostoma*, gave rise to typical lesions and fruiting bodies. *Cytospora chrysosperma* was found to be unable to attack apple-trees.

A cultural study of the fungus indicated that cane-sugar and sodium chloride, under proper conditions, acted as stimuli to the formation of perithecia on oatmeal agar. Inoculation experiments on apple-trees in the field showed that the fungus is a weak wound parasite, and will not attack vigorous trees. In natural attacks discoloured sunken lesions are formed which may extend along the entire length of the branches. The margin of the lesion is wrinkled, peeling, and split, with often also a purplish zone which marks the advance of the fungus. On the trunk the bark becomes swollen and soft at first, then dries and shrinks. The effect of a trunk canker is to give the tree a sickly appearance, the leaves remaining small, fading, and dropping off. In branch attacks the parts dry up and defoliate more rapidly.

RAVAZ (L.) & VERGÉ (G.). **Sur la germination des spores du mildiou de la Vigne.** [On the germination of the spores of the Vine mildew.]—*Comptes Rendus Acad. des Sciences,* clxxiii, 25, pp. 1421–1423, 1921.

Certain of the natural water supplies in the neighbourhood of Montpellier have been found to inhibit the emission and germination of the summer zoospores of *Plasmopara viticola,* while the town water supply and water distilled in glass give irregular results. This unfavourable action, which cannot be explained by differences in electrical conductivity, can be neutralized by the addition of minute quantities of sulphuric or carbonic acid or even of copper sulphate.

In rain water, dew, and twice distilled water germination is regular.

Attempts were made to study the toxic effects of various substances added to rain water. It was found that besides the toxic effect other factors were important, especially the volume of solution, its surface tension (which affects the degree of immersion and wetting of the spores), and the concentration of the spores in the liquid. It was found that the spores do not germinate in rain water containing 1 : 50,000 of sulphuric acid or between 1 : 300,000 and 1 : 400,000 of copper sulphate (corresponding to an average of 1 : 1,000,000 of metallic copper); sodium carbonate is active only in the proportion of 1 : 7,000 to 1 : 8,000; while saturated solutions of sulphate of lime do not prevent germination. Spores sown in solutions of lime and of soda, kept under glass jars from which all the carbonic acid has been eliminated, failed to germinate up to dilutions of 1 : 70,000 to 1 : 80,000 for lime and 1 : 20,000 for soda, but in ordinary air these solutions very rapidly lose their toxicity owing to carbonization which, in the case of the lime solutions, becomes apparent in less than twenty-four hours by the formation of a surface film of calcium carbonate crystals. A six per cent. milk of lime sprayed on leaves kept over night in damp air under a glass jar will not react to phthalein the next morning. It takes, therefore, a very short time, in some cases less than a night, for the lime contained in copper mixtures to be more or less completely neutralized, and this fact explains the lack of success obtained with fungicides in which lime is the only active substance.

It has been stated that atmospheric water can dissolve only extremely small quantities of copper, too small to inhibit germination of the spores of *Plasmopara viticola*. The authors, however, found on examining dew from leaves sprayed with a weakly alkaline copper mixture, that it contained a high proportion of copper, corresponding to from 1 : 7,000 to 1 : 10,000 of copper sulphate. Rain water collected after passing over sprayed leaves showed proportions of from 1 : 50,000 to 1 : 10,000 of copper sulphate according to the heaviness of the rainfall, and in such water germination did not take place. The water remained toxic even when collected up to twenty days from spraying, though there had been several heavy falls of rain in the intervening period.

The authors conclude that lime loses its fungicidal properties too rapidly to be of practical value, while lime and copper mixtures resist the action of rain and dew and yield sufficient quantities of copper to inhibit germination of vine mildew spores for a long time after application.

Hauman (L.) & Parodi (L. R.). **Los parásitos vegetales de las plantas cultivadas en la República Argentina.** [Vegetable parasites of cultivated plants in the Argentine Republic.]—*Revista Fac. Agron. y Vet.* [B. A.], iii, 3, pp. 227–274, 4 figs., 1921.

This brings up to date the account of parasitic fungi found on cultivated plants in the Argentine Republic published by the senior author in 1914 (Hauman-Merck, L., 'Les parasites végétaux des plantes cultivées en Argentine et dans les régions limitrophes'. *An. Mus. Nac. Hist. Nat. B. Aires*, xxvi, pp. 163–225). It includes notes on the symptoms, treatment, and distribution of the various diseases, together with bibliographical references. One hundred and ninety-five diseases (including those caused by bacteria) are dealt with, followed by a brief description of one algal and seven phanerogamic parasites. The account terminates with a host-index and bibliography.

Janchen (E.). **Der Kartoffelschorf.** [Potato scab.]—Reprinted from *Oesterr. Zeitschr. für Kartoffelbau*, i, 3–4, 1921.

The author states that though true wart disease of potatoes

[*Synchytrium endobioticum*] has not yet appeared within the present limits of Austria, the less serious potato scab diseases have caused some alarm amongst growers who are not always able to distinguish them from wart disease. Scab is not responsible for more than a superficial injury to the tubers, but disfigures them and reduces their market price.

Basing himself on Wollenweber's monograph (Der Kartoffelschorf. *Arb. Forschungsinst. Kartoffelbau*, 2, 1920), the author distinguishes the following varieties of scab in Europe. 'Shallow scab' ('Flachschorf'), due to *Actinomyces tricolor* Wr., *A. intermedius* (Krüg.) Wr., and *A. nigrificans* (Krüg.) Wr. (the last two also attacking beetroot); 'deep scab' ('Tiefschorf') caused by *A. incanescens* Wr., and 'knobby scab' ('Buckelschorf') caused by *A. aerugineus* Wr. Other species that can cause scab of potatoes are *A. xanthostroma* Wr.; and *A. albus* (R. D.) Gasp., with its varieties *ochroleucus* (Neuk.) Wr. and *cretaceus* (Krüg.) Wr., the last named also attacking beetroot. Some of these species are also probably responsible for scab in carrots.

In addition to the scabs caused by species of *Actinomyces* there is another form, the spongy, powdery, or corky scab due to a different organism, *Spongospora subterranea* (Wallr.) Johns. (*S. solani* Brunch.), which does more damage as it penetrates more deeply, and can even cause the destruction of large portions of the tuber.

The characteristics of the different scabs are described. In shallow scab light-brown areas, rough, and as if covered with cork dust, appear on the surface of the periderm. The spots are generally small and round, but in severe cases may coalesce into larger areas. Torn pieces of the epidermis generally cover the roughened surface. Deep scab is distinguished by pits formed in the skin owing to the destruction of a portion of the periderm. These pits have an irregular, rough surface, and are often covered with scale-like remains of the dead tissues. By coalescing, shallow pits of larger extent may be formed, but infection never penetrates really deeply into the tuber. Knobby scab is characterized by small, slightly rounded or hemispherical protuberances, surrounded by torn pieces of skin, which arise as the result of an abnormal stimulation of the outer tissues of the tuber by the parasite. This is the form that is most liable to be mistaken for the early stages of wart disease, but it can be distinguished by the swellings never exceeding 1 cm. in diameter and having a smooth or slightly roughened, never an irregularly serrated or cauliflower-like surface It is of less frequent occurrence than the others.

It is stated that *Actinomyces* scab is generally found on alkaline soils, *Spongospora* scab on those that are somewhat acid. Dry sandy soils favour the former, and dry years are generally also favourable to it. The different forms do not, however, react in exactly the same way to these factors.

Control measures have not generally given satisfactory results. Scab is chiefly a soil-borne disease, transmission by infected seed tubers being of very secondary importance. In scab-infected soil a three or four years' rotation or the planting of resistant varieties is recommended. The following resistant varieties are mentioned: Helios, Hindenburg, Jubel, Lucya, and Topas. These are also highly resistant to wart disease. Susceptible to both wart and scab diseases are Alma, Ella, Goldspende, Nero, Imperator, Industrie, Johanna, Magnum Bonum, Primel, Schladener Ruhm, Silesia, Up-to-date, and Westfalia. Resistant to scab, but susceptible to wart disease are Deodora, Prof. Gerlach, and Geheimrat Haas, while the contrary is the case with the variety Juli and some others. In the case of *Spongospora* scab, liming the soil is recommended, while the use of acid fertilizers (ammonium sulphate and superphosphate) together with green manuring is advised for *Actinomyces* scab. Disinfection of the tubers with corrosive sublimate or formaldehyde is sometimes advisable, especially when opening new potato fields.

LYON (H. L.). **Three major Cane diseases: mosaic, sereh, and Fiji disease.**—*Bull. Expt. Stat. Hawaiian Sugar Plant. Assoc.*, Bot. Ser. iii, 1, pp. 1–43, 4 pl., 27 figs., 1921.

MOSAIC. This disease, which the writer identifies with that known for many years in Java under the name 'gele strepenziekte' (yellow stripe disease), is widely spread in Hawaii, Porto Rico, Louisiana, Florida, Cuba, Jamaica, Trinidad, and Barbados, while there are indications that it has been present for at least twenty years in Argentina, where it is now of general occurrence in the cane plantations.

The primary and critical symptom, and the only one on which a diagnosis should be based, is the appearance on the leaves of patches or blotches of a green colour several shades lighter than the normal green tissues which surround them. These blotches are most distinct when the leaves first unroll from the terminal bud (spindle), so that the newly-opened leaves should be the first to be examined when seeking evidence of the presence of the disease. The green tissues of the leaf-sheath are affected in the same manner as those of the leaf-blade, but the blotches are always less conspicuous. Mosaic does not, as a rule, induce an appreciable change in the size or shape of the leaves, but stunted shoots of affected Striped Tip sometimes terminate their efforts to grow by producing a few twisted and distorted leaves, giving them the aspect of canes about to succumb to Fiji disease. While some varieties of cane may carry mosaic year after year without showing any symptoms except the mottling of the leaves, others develop very marked secondary symptoms, one of the most frequent being the mottling or marbling of the stem; in varieties with a green rind the blotches develop strong red and purplish tints, while in canes with a normally red or purple rind the mottling is the result of a diminution or loss of the normal colours, the blotches appearing green on a dark background. The cankering of the stem observed in Porto Rico is, according to the writer, only an extension of the mottling of the rind to a point which results in the death of the affected tissue; the cracks or cankers thus formed in the rind afford easy entrance to various fungi which attack and destroy the soft tissues within the stem. In Hawaii, however, no case of similar cracking has yet been observed.

In a few varieties the disease affects strongly the growth of the plant, which may produce small and deformed canes or no canes at all. This symptom is common in the Striped Tip and Yellow Caledonia varieties in Hawaii.

As a rule, mosaic does not by itself cause any marked change in the internal tissues of the stem. In canes long affected, however, there may sometimes be found irregular masses of internal tissue which are more or less stained and discoloured, ranging from light red to a very dark brown or almost black.

Despite much careful investigation, the writer and his associates were unable to locate by microscopic examination or cultural methods, any organism in canes affected with mosaic which might be responsible for the disease. Numerous experiments carried out on a highly-susceptible variety in the field with a view to conveying the disease by artificial means from affected to healthy plants, gave but a low percentage of positive results, which were furthermore invalidated by the natural spread of the disease in the plots used as checks. In the few experiments where canes grown in tubs and carefully isolated in a glass-house were employed, only negative results were obtained. Most of these attempts were made with juices extracted by pressure from affected canes, especially from near the growing point. The characters of the disease indicate that the causal factor operates at or near the growing point. The actual injury to the chlorophyllous tissue is accomplished while the leaf is still rolled up in the spindle.

According to the author's observations, mosaic is not induced in the sugar-cane either directly or indirectly by soil conditions; it is not transmitted through the soil, and does not hold over in the soil from one planting to the next. If a diseased stool is removed and a healthy cutting is planted in its place, the latter invariably gives rise to a healthy stool which will remain healthy throughout several seasons unless reinfected from outside. The author cites the case of a large field where over 90 per cent. of the canes were diseased; the field was cleared of the diseased stools and replanted with healthy cuttings, which produced a stand of canes in which the disease never appeared.

The progress of the disease in individual cane stools would seem to indicate that the causative agent does not migrate to any extent, if at all, through the tissues of the stem from one shoot to the next, but that the infection usually spreads by an aerial route from shoot to shoot, even in the same stool. In almost all cases when a leaf is mottled the corresponding eye will contain the infection, and any shoot developed from it will show the disease. But cuttings from parts of diseased stools which bear unmottled leaves may give perfectly healthy canes, and it is even possible to get healthy ratoons from stools in which every shoot has shown the disease.

No cane variety grown for sugar production in Hawaii is immune to mosaic, but some varieties are so very resistant that for practical purposes they may be considered immune. Striped Mexican, Badila, and Demerara 1135 are the best canes in this class. Yellow Caledonia is only moderately resistant, while Lahaina, Striped Tip, and Demerara 117 are very susceptible. Seedling canes are almost invariably as susceptible as are their parents. The variety known as Kavangire, which is only another name for Uba, is unsuitable for sugar production in Hawaii, but is stated elsewhere to be immune. The true Cavengerie, on the other hand, is very susceptible.

It should be held axiomatic that mosaic lessens the sugar manufacturing capacity of the plant. The losses caused by it vary according to the variety of cane grown. In Striped Tip the plants can be rendered utterly worthless. Even in Lahaina, which carries the disease without showing marked evidence of injury, actual tests made by the author showed that the stools from diseased cuttings yield only 60 per cent. as much sugar as stools from healthy ones.

Mosaic can be controlled only by the use of resistant varieties and by planting cuttings from none but healthy canes (if possible from disease-free fields) carefully selected by an experienced staff. When the attack is limited, it should be eliminated at once by removing and destroying all affected canes.

Sereh. Sereh is believed to be an infectious disease. but so far the causative agent has not been determined. It suddenly appeared in West Java in the early eighties of the last century, and it has since been reported from Borneo, Sumatra, Malacca, India, Mauritius, Australia, Formosa, Hawaii, and Fiji. Some of these reports however, were based on insufficient evidence or a mistake in the diagnosis. Thus the author is satisfied from personal investigations that the Fiji report was incorrect, and also that the Hawaiian condition formerly attributed to sereh is not that disease.

In some varieties of sugar-cane (e.g. Cheribon), sereh arrests the growth of the canes, the majority of shoots remaining short and stunted, and the whole stool assuming the aspect of a tuft of lemon-grass (the native name for which in Java is 'sereh'). In other varieties, as for instance 247 B, the growth of the affected canes is not impaired. these growing as rapidly and to the same length and diameter as the healthy ones, but being much lighter in weight and yielding far less juice and sugar. The tissues inside diseased stalks usually contain vascular bundles of a red colour, due to the presence of a red gummy substance in the vessels; these are not very conspicuous in Cheribon, and are hard to find until after the shoots are ten months old. In 247 B, on the other hand, they are numerous, and constitute the one critical symptom on which a certain diagnosis can be based. In certain varieties (e.g. 247 B), diseased canes develop copious adventitious roots which grow under the leaf-sheaths from the aerial nodes. An additional symptom may consist in a lack of sap in the central tissue of the internodes, which is then white and strongly resembles an axillary strand of pith. In the older internodes near the base of the cane, this pithy central tissue often breaks down, leaving a cavity of considerable size. Of late years it has been shown that the failure of a cane, the leafy top of which has been removed, to produce lateral shoots from its upper eyes is a direct evidence of the presence of sereh.

Experience in Java has proved that cuttings obtained from canes affected with sereh invariably give rise to badly diseased stools, and the symptoms are always more pronounced in each succeeding generation. The practice of ratooning had also to be abandoned there, as the stands thus obtained showed such an increase of the disease as to render them valueless.

Measures for the control of sereh are limited to the use of resistant varieties, mostly seedling canes (none of which, however, according to the author, combines really high sugar-producing properties with immunity to sereh), and to planting cuttings obtained from healthy canes. It was early noticed that the disease did not flourish at high elevations, but was confined to the lowland fields. This led to the development of the well-known hill nursery system in Java. The canes for seed are first grown at an elevation of 5,000 to 6,000 feet, and cut when six to eight months old. The cuttings are used for planting secondary nurseries at 2,000 to 2,500 feet, and the cane from these is again used to plant nurseries at about 1,000 feet, from which the seed for the plains is obtained. At each stage a rigorous selection is practised, and if proper care be taken to exclude all affected cuttings it is only necessary to renew the stock from the mountains every four or five years. Even without the use of mountain seed some plantations in Java manage to keep the disease under control by selection of disease-free cuttings from their own fields.

Fiji disease. After a very full description of the disease [see next abstract], based on material obtained from Fiji and Australia and field observations in the former locality, the writer states that during the past year he has turned all his material over to Dr. L. O. Kunkel for further study. At the present time, all that can be said regarding the organism held to be responsible for the disease (for which the author proposes the name *Northiella sacchari*) is that it is always present in all of the stem and leaf galls of canes affected with Fiji disease; that it has been found in incipient galls only three millimetres below the growing point of the cane stem; and that in developing galls the individual organisms have been observed to divide simultaneously with the nuclei which they accompany. The author also states, basing himself on the discovery of Fiji disease in New Guinea in 1914, that the disease, which was considered as endemic in Fiji, may well have been imported there from New Guinea with some of the many cane varieties which have, from time to time, been taken from there for purposes of cultivation on the sugar estates of Fiji and Australia. The New Guinea cane variety Badila was noticed at an early date to be exceptionally resistant to the disease, and recent information indicates that it is still the favourite cane in Fiji, where, up to the present, no more resistant variety has been found. The sugar industry at Fiji, at one time gravely threatened by this disease, is now thriving. This is due not only to the use of resistant varieties and the selection of healthy cane for seed, but also to the system of rotation followed. As a rule, only first ratoons are taken, and then the land is kept under beans for a year before again planting cane. The disease is rare on poor soil, and cane grown on such soil is largely used for seed.

Reinking (O. A.). **Fiji disease of Sugar cane in the Philippine Islands.**—*Phytopath.*, xi, 8, pp. 334–337, 2 pl., 1921.

The Fiji disease of sugar-cane has been present in the Philippine Islands since at least 1916, but no authenticated report of its presence was given until December 1920, when the author made an examination of the infected fields and found that the disease was extremely destructive, especially to imported varieties such as Java 247 and Hawaii 109, the losses amounting in some cases to 50 to 75 per cent. Indigenous varieties (Cebu Purple, Lamao White, Negros Purple) were much less severely affected, even when growing intermingled with heavily infected Hawaiian or Java varieties; the use of these canes, combined with crop rotation in the fields, would therefore appear to be an effective method of control of the disease in the Philippines. It has not been observed on the wild sugar-cane (*Saccharum spontaneum*).

The most constant symptom of Fiji disease, and the only one in the early stages of infection, is the occurrence of elongated, raised galls extending lengthwise on the under side of the leaves, either on the main vein or on the smaller veins, and varying in length from 2 mm. to 6 cm. or more. The young galls are of a lighter green than the normal tissue of the leaf, and are translucent if the latter is held up to the light. Later they become much thickened, opaque, frequently turning reddish in spots, then brownish, and in some cases may burst open, exposing a brownish mass. They do not extend through the leaf, there being only a slight yellowing on the upper surface to mark the position of the gall below. In advanced cases galls may also be found on the leaf sheaths, but they have never been observed on the stems of the canes; they are present in abundance on old dead and dried leaves, which may be a source of infection.

Badly infected plants remain small and stunted (owing to the shortening of the internodes) and have a bunchy growth of leaves at the top. An excessive number of shoots is developed, and the leaves produced are small, slender, and of a darker green than normal; this darker colour is present even on canes that have been affected apparently for a few months only; otherwise, in the latter case, the appearance of the sugar-cane is normal except for a slight stunting, more upright leaves, and the production of galls.

In diseased plant canes, the root system is small, bunchy, and slightly rotted; in diseased ratoons it is also smaller and more decayed than ordinarily. A rot may extend from the dead roots into the stem, though it is not always associated with this disease, and appears to be a secondary trouble caused by some organism that attacks the weakened canes. New shoots arising from the base of diseased plants often have a yellow streak running down the central group of unfolded leaves; in advanced cases these shoots may be rotted and the diseased condition may extend for a short distance into the stem. The shoot rot is characterized by a yellowing of the exposed leaves and a subsequent reddening of the young rolled-up leaves within the sheaths. The leaves finally die, and the entire inner part of the shoot is affected by a soft brown rot. These conditions are probably due to the attack of secondary organisms, the disease being sometimes not accompanied by rotting. Usually there is no discoloration of the interior tissues of the canes of diseased stools except at the nodes where a shoot arises, and just above the root system; at these points a yellowing or reddening of the tissues may be present. In a few cases entire canes, from the roots to the top, have been observed to be somewhat pithy and soft, without showing any discoloration or decay; the tops of such plants are very bunchy, and numerous galls are present on the leaves.

Frequently in plant canes one stalk of a stool is visibly diseased, while the rest appear to be unaffected; it is reported, however, that tops taken from such apparently healthy stalks will carry infection.

Plasmodia-like bodies are found in young and old galls; they are light-coloured in the former, brownish and more granular in the latter. These bodies occur also in the cells of the young shoots that arise from the base of diseased plants. Other bodies of a fungoid nature are present in the rotted roots and base of the stem; this would indicate that a fungus is responsible for the disease, but it will be necessary to establish the connexion by isolation and inoculation experiments before it can be accepted. At present, all indications tend to show that the causal factor gains entrance to the plant through the root system, and that it may remain in the soil for at least a year.

The constitution of the soil appears to have no influence on the disease, which attacks susceptible varieties with equal severity on heavy clay and lighter loam soils. It is always more severe in ratoon than plant canes.

ASHBY (S. F.). **The mosaic, mottling, or yellow stripe disease of Cane.**—*Leaflet Dept. Agric. Jamaica*, 13 pp., 1 pl., 1920 [Rec. June, 1921].

The mosaic disease of sugar-cane has been recently found to be rather widespread in Jamaica. Its symptoms [see abstract p. 184] are described in detail. In cases of secondary infection the first leaf affected has few of the pale green marks, and these are mostly near the base of the blade or close to the midrib, but each successive leaf shows an increase in the number. If the infection is primary, an additional symptom usually occurs in the form of white opaque flecks or stripes on the pale patches; these perfectly white stripes are long (up to several inches) and usually very narrow, but may become broader by fusion. While the light or yellowish green patches may sometimes disappear on older leaves owing to partial regeneration of the normal ground tint, the white stripes and flecks undergo no change. This white striping of the leaves in primary infections has not been reported from Java and Hawaii, although it is present on all affected varieties in Jamaica and apparently also in Porto Rico. The red or yellow stripes that appear on the stems of affected canes (the former on varieties with yellow stems, the latter on the red-stemmed canes) are most marked on the younger joints protected by the leaf-sheaths; on the older joints exposed to light the development of the natural colour masks the effect. Where the infection is primary, similar white markings to those found on the leaves frequently occur and persist even on the older joints. Affected canes show a tendency to split along these white stripes, and the stem cankers already reported from Porto Rico are caused in this way, the underlying tissues becoming browned or reddened. In Hawaii and Java similar cankers have not been observed.

No micro-organism capable of causing the disease has been isolated from affected canes, but the disease may be regarded provisionally as due to an ultra-microscopic organism. Attempts to infect healthy leaves of sugar-cane by rubbing them with crushed diseased leaves have usually failed, but as far back as 1902 Kamerling in Java claimed to have transmitted the disease by injecting sap. The work of Brandes (*Journ. Agric. Res.*, xix, pp. 131–138 and 517–521, 1920) has recently shown that insects can carry infection, *Aphis maydis* having been proved to carry the infection from sorghum to cane and vice versa, and the sorghum mosaic derived from cane being transmissible to maize by the same insect. It has been stated that the disease was noticed to spread more rapidly in Porto Rico during and following an abundant infestation of leaf-hoppers (*Tettigonia* sp.), and also it is probable that the cane-fly (*Stenocranus saccharivora*), very abundant at times in Jamaica, may be an active carrier of the disease.

There is conclusive evidence that sugar-cane plants can become infected in two ways, which the author distinguishes as primary and secondary infection. Primary infection is derived from the use of tops or cuttings from infected canes, the disease being conveyed in the seed-piece. It is not definitely known whether it can be equally conveyed in the true seed, the evidence so far being negative. Secondary infection results in the appearance of the disease in growing healthy shoots, the infection occurring near the growing point, and every successive leaf, joint, and eye subsequently developed showing the disease. If the infection occurs when the cane is some months old several of the oldest leaves and the corresponding eyes and joints will be free from the disease and the upper part only of the stalk is affected; in such a case the tops will transmit the disease if used as seed-pieces, while the lower joints may give rise to healthy plants and ratoons.

Convincing proof that secondary infection is air-transmitted and may be very active is of rather recent date. The author cites a number of observations and experiments by various workers bearing on this type of infection. It has been noticed that active secondary infection may be quite transient, or may be permanently rare in some localities, and that spread may be much more vigorous on cane planted at certain times of the year than at others. There is no very definite knowledge as to the influence of weather and soil on the intensity and persistence of secondary infection, though it has been stated in Java that sound seed-pieces from cane grown on light land produced plants which contracted infection more readily than plants from seed-pieces cut from cane grown on heavy soil, and also that weather conditions may at times strongly influence secondary infection, plants cut back during the rainy season frequently showing a marked increase of mosaic on the new growth.

Observations in Jamaica show that serious reduction in the tonnage of the crop results from the disease, actual tests indicating that complete infection might cause losses of from 6 to 48 per cent. The yield of juice in severe cases is also reduced, and its composition may be affected adversely. Of the thick varieties grown in Jamaica, B 208, B 6450, and Poaole (the same as the Hawaiian Cavengerie) endure the disease badly. Apparently none are immune, although Ribbon and Transparent are more endurant than those last mentioned. The resistance may vary appreciably in the same variety in different regions and on different types of soil under similar climatic conditions. On the other hand, mosaic does not appear to have been reported on any of the thin varieties, and the thin Uba cane (Kavangire of Porto Rico and Argentina, not to be confused with Cavengerie) has proved to be immune in Jamaica as elsewhere. Under favourable conditions it yields as heavy a tonnage as any known thick cane and ratoons well.

The measures adopted for controlling the disease depend on certain well-established facts: (1) The disease is always transmitted in seed-pieces cut from affected stalks; tops from such canes always carry the disease, but in cases of late secondary infection the lower parts of the cane may be free from the virus and give healthy shoots when used for planting. (2) Infection can be transmitted by aerial agencies from diseased to healthy plants. (3) Infection is not retained in the soil. They consist in the selection of tops and cuttings from healthy plants and in the eradication of diseased plants from the young plant and ratoon fields. The latter measure is the more practicable if the amount of disease does not exceed 20 per cent.; beyond this limit roguing out is not done, as the loss arising from an uneven stand and the expense of supplying will probably exceed the immediate loss from disease. It is of much importance that the inspection of the young plants be made as early as feasible in order to get rid of all primarily infected shoots which may act as centres of secondary infection if left. A second inspection should always be made three to four weeks later. Young ratoons should be treated in the same way, and the affected shoots should be dug out and chopped up so that no further growth can occur. If a heavily infected ratoon field is replanted with sound seed, the old stumps should be destroyed and not left half buried.

B(ARBER) (C. A.). **The mosaic or mottling disease of the Sugar-cane. The main facts of the case to date.**—*Intern. Sugar Journ.*, xxiii, pp. 12–19, 1 pl., 1921.

A summary of the literature, especially the discussion in the pages of the *Louisiana Planter* in 1919–20, regarding the damage that mosaic is capable of causing to the sugar-cane, is given. While in Hawaii and Porto Rico the losses are very serious, Cuban experience is the reverse, Grey (*Louis. Plant.*, Aug., 1919, p. 90) stating that it does no damage in that island, and that it can be eliminated by improved cultural methods. In the Argentine also, though mosaic is of long standing there, and though Fawcett (*Louis. Plant.*, Jan., 1920, p. 39) found better cultivation had no effect and considers the disease incurable, it does little harm to the cane varieties now grown, most of which are thin kinds. In Java it has been recognized as causing appreciable loss, but is apparently controlled by the continual planting of sound seed; it is suggested also that the disease was, in any case, less virulent in Java than the later outbreaks in the New World, possibly because the Java canes had acquired some degree of resistance from their long cultivation in the presence of the disease. In San Domingo the disease is widely distributed, but does not assume the severe form found in Porto

Rico, and stem infection has not been observed. In this locality and also in Cuba it has been suggested that growth on virgin soil may have something to do with the relative mildness of the disease. In Cuba secondary infection seems to be rare, and transmission only through diseased sets makes it difficult for the disease to hold its own.

The thin varieties of Argentina are mostly Java seedlings with North Indian blood in them of the Saretha group of canes; they are not in the least immune, but the effect of the disease is slight, and perfectly good yields may be obtained from fields with 100 per cent. infection. The Uba and so-called Japanese canes which are immune or resistant possibly all belong to the Indian Pansahi group. Neither of these classes can be recommended for growth in typically tropical areas, and unfortunately all the well-known canes of commercial value and multitudes of seedlings suitable for tropical cultivation are susceptible, over 1,000 kinds having been tested. The degree of susceptibility, however, varies, and some of the Louisiana canes are especially mentioned as being particularly hopeful in this respect.

The influence of local conditions is apparently considerable, and is, the author thinks, deserving of fuller investigation. There is the strongest evidence that insects of the sucking kind, often powerful flyers, are concerned in the spread of infection in the field. The period of incubation in secondary infection appears to be from two to three weeks, and the disease appears within six weeks or two months of planting.

Reference is made to the similar mosaics of other cultivated cereals and grasses, especially to the work of Brandes in showing that sorghum, crab-grass, foxtail, and a species of *Panicum* became infected when enclosed in a greenhouse with diseased sugar-cane. The possibility that wild grasses bordering cane-fields may act as sources of infection is a very serious one when measures of control are contemplated. The control of the disease is stated to be in advance of our scientific knowledge of its character, and depends primarily on eradication, seed selection, and the use of immune or resistant varieties. The results of the eradication campaign in Porto Rico are stated to have been eminently satisfactory.

Williams (C. B.). **Sugar-cane pests and diseases in Trinidad in 1920.**—*Bull. Dept. Agric., Trinidad and Tobago,* xix, 3, pp. 111–121, 1921.

The mosaic disease was first discovered in Trinidad at the beginning of 1920, and was then confined to an area around the Government Experiment Station at St. Augustine and about forty isolated localities throughout the island. There was evidence at first that it had been introduced through St. Augustine, but subsequently another estate was found to be heavily infested both in nursery plants and old ratoons, indicating that the disease had been present for several years at least and suggesting a second point of introduction.

The visible effect of the disease on the health and growth of the plant varies considerably in different varieties, and is most distinct in cases where the plants have been grown from infected cuttings; in some varieties the infected plants are without exception small and stunted, and may be less than one quarter of the average size of the healthy plants, while in other varieties the difference is scarcely noticeable. A table is given of the effect on a number of varieties grown.

Many other plants in Trinidad have, at times, mottled leaves closely resembling mosaic, but the sugar-cane mosaic has so far only been found on maize and one local species of grass. The presence of the mosaic on maize, although making the extermination of the disease more difficult in the wet season, is not very serious in itself, as no maize is grown for at least three months in the dry season, so there is no danger of its carrying the disease on from one season to the next.

Observations during 1920 indicated that there was practically no spread of the infection from diseased to healthy plants during dry weather. There are indications that spread is in some way connected with moisture, and on one estate the greatest spread was found to have occurred along the banks of a small river; in another case, where the infected stools were placed in long beds running down a slope, and across a small flat moist area at the bottom of the slope, the original infection was evenly distributed on both slope and flat, but the secondary infection was considerably greater on the latter than on the former.

There now seems to be no doubt that the disease is spread chiefly, if not entirely, through the agency of insects, but in Trinidad the insect carrier is unknown. The author did not see leaf scale; aphids do not seem to exist on the sugar-cane, and the cane-fly (*Stenocranus*) is extremely rare. Experiments made with the frog-hopper (*Tomaspis saccharina*), corn leaf-hopper (*Peregrinus maidis*), cane leaf-hopper (*Tettigoniella laudata*), and a cane membracid (*Ceresa vitulus* F. var. *minor* Fowl.) failed to give any conclusive results. The only other common insect in the fields which seems sufficiently abundant to account for the spread is the mealy bug, and experiments with this are proceeding.

Field experiments also failed to establish the occurrence of infection through the soil, and the author concludes that there is little or no danger of infection by replanting in old holes from which diseased stools have been removed.

Contrary to the general statement that all cuttings taken from a diseased plant will reproduce the disease, the author proved by experiment that quite healthy cuttings which do not carry the disease can be obtained from canes recently infected at the top, if the cuttings are taken far enough from the infected point. In field infections the cane becomes infected from the growing point or leaves, and it takes an appreciable time for the disease to descend the stalk to the ground level. The spread from one stalk to another in a stool is still slower, and in many cases does not occur at all, so that cane stools may be frequently found with one stalk well infected and the others healthy. Experiments are now being made to find out whether it might be possible in some cases to prevent the infection from spreading to the underground part of the stool by cutting off the recently infected stalks close to the ground, as it would then be possible to keep mosaic disease under control towards the end of the year by a more frequent removal of the diseased shoots without the costly and wasteful eradication of whole stools. Experiments are also planned to test the possibility of poisoning the diseased shoots when cut to prevent new growth from these portions of the stool.

Control work was started as soon as the disease was identified, but during the wet season it soon got out of hand. In certain districts, however, it has been greatly reduced. A new campaign, for which £3,000 was voted, was planned for the dry season of 1921. Eradication of diseased stools is the method adopted.

CAUM (E. L.). **A contribution to a check-list of Sugar-cane fungi.**—*Bull. Expt. Stat. Hawaiian Sugar Plant. Assoc.*, Bot. Ser., iii, 1, pp. 66–97, 7 figs., 1921.

The author has made an attempt to list all the fungi which have been reported on *Saccharum officinarum*, either as parasites or saprophytes, in any part of the world. The parasites and saprophytes are distinguished, and synonyms and bibliographical references to the original descriptions are given. Figures and diagnoses of *Lophodermium sacchari* Lyon (*Hawaiian Plant Rec.*, ix, p. 601, 1913) and *Phyllosticta hawaiiensis* Caum (ib., xx, p. 278, 1919) are included. The list terminates with a general classification of sugar-cane fungi.

KUNKEL (L. O.). **A possible causative agent for the mosaic disease of corn.**—*Bull. Expt. Stat. Hawaiian Sugar Plant. Assoc.*, Bot. Ser. iii, 1, pp. 44–58, 12 pl. (one coloured), 1921.

The symptoms of the disease as indicated by mottling or striping of the leaves, leaf-sheath, and rind, and the dwarfing of the plant, due chiefly to shortened internodes, are described; and the occurrence of elongated pockets within the tissue of the stalk, distinguished at first by a water-soaked appearance and later by a pale yellow or brown colour, is reported. At an advanced stage the cells of these pockets collapse, and elongated cavities are left within the stalk. A number of varieties of maize were tested for resistance to the mosaic, and the following showed lesser infection and appeared to be somewhat resistant: Sweet corn: Country Gentleman, Stowell's Evergreen, Adam's Corn; Field corn: St. Charles White, Lancaster Surecrop, White Guam, Yellow Guam, Cuban Red, Hybrid No. 1415, and U.S. Selections Nos. 77, 120, and 125; Pop corn: Queen's Golden and White Rice. The following varieties suffered severely from the disease: Sweet corn: Cosmopolitan, Black Mexican, Early Fordhook, Burpee's Earliest Catawba, and Golden Bantam; Field corn: St. Charles Yellow, Commercial White, Reid's Yellow Dent, Boone County White, and U.S. Selection No. 119.

Diseased and healthy tissues of maize plants were studied cytologically, and intracellular bodies, believed to be living organisms, were found invariably to be present in most of the diseased cells, and to be absent from healthy tissues. In the leaves the intracellular bodies occur in the leaf tissue of the lighter green areas, while in the stalk they are found in the elongated pockets above described. These bodies vary greatly in size and shape. They appear to increase in size as the diseased condition of the cell becomes more severe. They are never spherical, but irregular and amoeboid, and they are always on or near the host-cell nucleus. When the body is not lying against the nucleus, it may be connected with the latter by a thin, veil-like appendage. A thin membrane may surround these bodies, although they usually appear to be naked. The contents may be reticulated or made up of strands, and at a late stage small granules are scattered in the reticulum. No nucleus was demonstrated, though deeply staining granules are often present which might possibly be nuclei. There may be a single large or many small vacuoles, or sometimes none at all. The best results were obtained from fixing the tissue in Flemming's weaker solution and staining with Flemming's triple stain.

Studies of free-hand sections of living tissue showed that the host-cells are in a state of great protoplasmic excitation. The intracellular bodies were not seen to show independent movement. The host-cell nucleus may enlarge greatly, and the cell itself also usually enlarges. Diseased cells may die, as in the case of the cavities in the stalk. The presence of intracellular bodies is more difficult to demonstrate in the leaf tissues than in those of the stalk, but they are nevertheless present in the leaves quite as regularly as in the stalk. All tissues of the leaf and stalk may contain them, but they have not been found in the grain or in the roots.

The yellow-stripe (mosaic) disease of sugar-cane is considered to be similar to or identical with the corn mosaic. A granular substance such as found by Matz (*Journ. Dept. Agric. Porto Rico,* iii, pp. 65–82, 1919) in discoloured cells of yellow-striped cane was also found by Kunkel in cane and corn stalks affected with mosaic, but was considered to be different from any stage of the intracellular bodies above described that the author has seen, and he is unable to suggest what relation it may have to these diseases.

The intracellular bodies are considered to be possibly similar to such structure as the Negri bodies (*Neuroryctes hydrophobiae*) found in animals affected with rabies, and with *Cytoryctes variolae* found in the skin cells of man and apes affected with small-pox. Though these bodies have not been cultured, and there is no definite proof that they are etiologically related to the diseases they accompany, nor even that they are living organisms, they are believed by some to be protozoa.

KUNKEL (L. O.). **Amoeboid bodies associated with Hippeastrum mosaic.**—*Science,* N. S., lv, p. 73, 1922.

The occurrence of bodies similar to those found in the cells of corn affected with mosaic [see preceding abstract] is reported in the light green portions of mosaic leaves of *H. equestre* Herb.

DASTUR (J. F.). **Die-back of Chillies (Capsicum spp.) in Bihar.**—*Mem. Dept. Agric. India,* Bot. Ser., xi, 5, pp. 129–144, 2 pl., 1921.

Die-back is caused by *Vermicularia capsici* Syd. The disease appears about the latter part of September or beginning of October in Bihar (India) in seasons of high humidity. Late sown plants, and plants growing under shade, were found to be affected only slightly. The fungus commonly attacks the stem at the growing point or the flower-bud, and the plant dies back as the attack spreads downwards. The infected part of the stem assumes an enamelled white appearance, sharply defined from the healthy part by a black line. The fruits are also attacked, the attack being visible usually only when they turn red, and rarely appearing on those that mature after the beginning of December; black spots, which may turn greenish or greyish, develop, badly diseased pods becoming eventually straw-coloured or whitish. The spots are covered with acervuli and stromata. The fungus penetrates as far as the seeds, the hyphae entering the seed-coat by boring their way through the outer cellulose wall, without necessarily forming an appressorium. They then pass through the cavity of the cells, and swell up at the point of contact on the thickened cellulose and lignin inner walls. A fine process is put out from the swelling which bores through the wall, delignifying it. The fungus will remain alive within the seed for at least a year, and when the seed germinates the embryo may be killed, or may develop into a diseased plant, or even into a healthy plant in dry weather. The microscopic details of the attack on different parts of the plant, and of the formation of the fructifications are given.

The fungus was cultured, and its appearance in culture is described. No perithecial stage was found. Inoculation experiments resulted in infection of seedlings under moist conditions, and growing points and flowers were also infected. The success of the inoculations and the spread of infection depended on the amount of moisture in the air, a very high degree being required. From field observations it appears that an average relative humidity of over 85 per cent. is necessary to cause serious damage. Mature fruits were readily infected, but not green fruits. The fruit may become infected by the hyphae themselves passing through cracks in the cuticle; or processes from the hyphae may bore directly through the latter, an appressorium being always formed in this case. Infection was also brought about on seeds by inoculation, no appressorium being formed. Flowers of *Carica papaya* were infected by artificial inoculation, and a certain amount of infection was brought about in pods of *Vigna catjang* and *Dolichos lablab*, and in fruits of *Solanum melongena* and *Citrus* sp. Inoculations of *Mangifera indica*, *Musa* sp., *Phaseolus vulgaris*, *Lathyrus odoratus*, *Allium cepa*, *Saccharum officinarum*, and *Sorghum vulgare* failed.

Seed selection from healthy pods did not prove practicable in controlling the disease under field conditions. The use of fertilizers (especially forcing manures on late sown crops) or of shade may prove to be valuable in lessening the loss. Two applications of a one per cent. Burgundy mixture reduced the percentage of diseased fruit considerably, and the sprayed plants had decidedly less die-back. Spraying also prevented subsequent loss from the development of the fruit rot in store.

The occurrence of *Choanephora cucurbitarum* (B. & Rav.) Thaxt. (see *Ann. of Bot.*, xxxiv, p. 399, 1920), on chillies is again recorded. Shaded and late-sown crops suffered less from this disease, as in the case of the *Vermicularia* disease.

Edgerton (C. W.) & Moreland (C. C.). **Eggplant blight.**—*Louisiana Agr. Exp. Sta. Bull.*, 178, pp. 1–44, 18 figs., 1921.

The yield of eggplants (*Solanum melongena*) in Louisiana is usually reduced at least one-half by *Phomopsis vexans*, which causes the worst disease known in this crop. Leaf spots, fruit rot, stem cankers, and twig blight are produced, and also a damping off of young seedlings. These different types of the blight are fully described. The fungus is carried over winter on and inside the seed. The pycnidia are variable, the larger ones having sometimes more than one chamber or more than one mouth. They may produce spores of the *Phyllosticta* or of the *Phlyctaena* type, developed in the same or in different pycnidia. A species of *Diaporthe* occurs on dead stems of eggplant, which cannot be distinguished from *Phomopsis vexans* in pure culture, but which did not produce disease on inoculation. The disease may easily be produced after seven to nine days' incubation by inoculation with *P. vexans*. The fungus is able to penetrate the uninjured tissue of the host, but did not infect potato, tomato, pepper, or certain wild species of *Solanum*. The use of a 1–300 formaldehyde solution on the seed was found to reduce the amount of disease slightly, but not to eliminate it.

Certain varieties of eggplant are less susceptible to the disease than others. Of the three varieties commonly grown, Black Beauty, Mammoth Purple, and Florida High Bush, the last is much the most resistant. Rotation is absolutely necessary, as the fungus lives over from year to year very readily on fragments of old plants left in the field. Not less than a three years' rotation is recommended, and the old plants should be burned as soon as the crop is over.

It is doubtful if spraying will be found profitable, though when properly done it reduces the disease to some extent.

Vuillemin (P.). **Un nouveau champignon parasite de l'Homme, Glenospora gandavensis.** [A new fungous parasite of Man, *Glenospora gandavensis*.]—*Comptes Rendus Acad. des Sciences*, clxxiii, 7, pp. 378–380, 1921.

In a previous report (*Comptes Rendus*, cliv, pp. 141–143, 1912) the author gave the essential characters of the genus *Glenospora* Berk. & Curt., the species of which were formerly variously distributed among the genera *Stemphylium*, *Graphium*, *Cephalothecium*, and *Verticillium*.

A true fructification is not known. Propagation is ensured by the thallus, certain cells of which act as thallospores. The thallospores, detached by the breaking up of articulations, are arthrospores of the type characteristic of the Mycodermaceae. Some of them (*oidia*) are cells preserving the structure of the vegetative hyphae; the remainder are chlamydospores which accumulate reserves under their thickened membrane. The latter have been mistaken for conidia when they are terminal and more or less uniform, but conidia differentiate themselves from the thallus as soon as they appear and fall off naturally when ripe. The regularity of the terminal chlamydospores, which are besides connected by transitions with the polymorphous lateral and intercalary chlamydospores, allows at the most of distinguishing them among arthrospores by the name of '*aleuries*'.

Glenospora graphii was previously known in diseases of the ear and of the cornea. In 1916 Chalmers and Archibald described *Glenospora khartoumensis* from mycetomas in the Sudan, and in 1917 *Glenospora semoni*, in France, on a soldier returned from India. A new species has just been discovered in a culture from Ghent, isolated by Prof. M. Henseval from the expectoration of a patient suffering from fetid bronchitis.

The '*aleuries*' of these four parasites of man are smaller than those of the plant parasites. In the latter they are $10\,\mu$ in diameter or more, while their average dimensions are 6 to $6{\cdot}7 \times 4$ to $5\,\mu$ in *Gl. graphii*, 4 to 5×3 to $4\,\mu$ in *Gl. khartoumensis* and *Gl. semoni*, and 6 to 10×5 to $8\,\mu$ in the Ghent species, which the author names *Glenospora gandavensis*.

The culture sent from Belgium was covered with a white dust with black spots, from which arose dark agglomerations, the largest of which measured 3 mm. The dust was found to be composed of cells measuring 8 to $13 \times 1{\cdot}6$ to $3{\cdot}5\,\mu$ and resembling *Mycoderma*. The dark spots and agglomerations contained chlamydospores measuring 6 to 10×5 to $8\,\mu$ in which were refractive drops under a reddish-brown wall.

From the chlamydospores the colourless cells were obtained, and reciprocally. In all cases germination gave rise to hyaline hyphae which soon became septate and then broke into fragments. Branching took place only in a thick drop, in which aeration was bad; it began then at the base of the germ-tube as it issued from the chlamydospore, and extended in all directions.

The fungus grows well at temperatures from 20° to 37° C. with an optimum of 32° to 35° C. In weakly-aerated media (Veillon agar and the bottom of liquids) the hyaline, branched hyphae, without chlamydospores, predominate. In Veillon test-tube stab cultures nothing is to be seen in the superficial layer to a depth of 2 to 5 mm.; immediately beneath this sterile stratum the colony expands; below this expansion it shrinks again or is interrupted and reappears lower down in patches which grow smaller as the supply of oxygen diminishes. The fungus prefers slightly acid media, and itself increases the acidity. Cultivated on the surface of maltose agar the colony assumes, like *Gl. semoni*, the form of a black cupola with light-coloured fringes. On carrots the cultures blacken on about the fourth day; on the fifth day branched sporophores are found.

The chlamydospores have the same diversity of position and form as those of *Gl. graphii*. When they form at the end of several closely placed branches and their support shows one or two varicose swellings beneath them, they give the same appearance that led *Gl. graphii* to be included in the genus *Verticillium*. The intercalary chlamydospores may remain cylindrical and of the same diameter as the hyaline cells. The rounded chlamydospores in the neighbourhood of those formed terminally should not be mistaken for chains of conidia.

Hyaline cells of the usual size have been observed escaping as from sheath through the truncated tip of a $4\,\mu$ thick hypha, resembling the supposed endoconidia which form the slender basis of the genus *Chalara*. Such cells are, however, only a vegetative rejuvenescent form by which the arthrospores renew their wall and get rid of their old membrane.

SALMON (E. S.). **On forms of the Hop (Humulus lupulus L.) resistant to mildew (Sphaerotheca humuli (DC) Burr.)**—*Ann. of Appl. Biol.*, viii, 3–4, pp. 146–163, 1921.

The investigations into the resistance to mildew of 'wild hop' seedlings raised from seed obtained from Vittorio, Italy, which have been continued through seven seasons (1914–1920) and of which a preliminary account has been given in previous articles, have now been brought to a close.

In the course of greenhouse experiments carried out in 1920, the author found that 200 cuttings ('clone-plants'), which had been raised vegetatively from 23 different seedlings, remained wholly immune to the disease throughout, while 53 cuttings taken from 14 different seedlings showed susceptibility to it. 'Semi-immunity' in a more or less marked degree was observed in 20 clone-plants originating from 7 seedlings, of which one had not been tested before, while the remainder had given the same result in preceding seasons. The plants were in every case exposed to artificial as well as to almost constant natural infection, and the severity of the test can be gauged from the fact that all of the 63 cuttings of various commercial varieties of hops standing in the same greenhouse became naturally infected within three weeks. Of the 53 susceptible plants 34 were severely affected, and the mildew persisted on all of them until the end of the growing season. All the experimental cuttings were taken from the parent plants, growing in the hop-garden attached to Wye College, in the winters of 1917, 1918, and 1919, and it is important to note that cuttings taken in successive years never showed the slightest tendency to change from immunity to susceptibility, or vice versa. From the tests undertaken the fact emerges clearly that the differences in susceptibility shown by the particular seedlings are inherent and not brought about by special environmental influences.

In summarizing the results obtained during the full period of seven seasons, the author gives a detailed account of the behaviour of 52 seedlings, selected from 480, which is the total number kept under observation from 1914 onwards, first as one- or two-year seedling plants in the greenhouse, and secondly as older, flowering plants transferred to the experimental hop-garden at the College, where they were grown strictly according to the practice usual in a commercial hop-garden. In the open, natural infection was relied upon to determine the degree of resistance shown by mature plants, a method which proved satisfactory. Mildew was present generally in the garden from 1916 to 1920, and in a particularly severe form in 1916, 1919, and 1920. Five out of the 27 seedlings which were persistently immune under greenhouse conditions retained this immunity in the open, but it is probable that even these five would have shown a slight degree of susceptibility under particular weather or growth conditions. As the majority of the seedlings which proved completely immune in the greenhouse also showed considerable resistance in the open, the author suggests that the term 'commercially resistant' can be applied to them. But it must not be assumed that immunity in the greenhouse is infallibly indicative of like immunity or even commercial resistance in the open, for a few of the strains have proved to be not commercially resistant when taken outside. Nevertheless, there is the most convincing evidence that the distinctive characters in regard to immunity are inherent and constitutional; they are not modified by changing conditions of cultivation or the like, and the behaviour in any one season is reproduced with scarcely any variation in other seasons. As an illustration, the case of a seedling may be cited which was planted out in the hop-garden in 1914, and successfully withstood the attempts at infection either through inoculation or by natural means. Although its immediate neighbours were severely attacked by mildew and one of them had its crop of hops totally destroyed by it in 1918, the plant in question remained untouched until, in 1919, at the beginning of August, after a spell of abnormally dull, cold weather, a few small patches of the disease were found on some of the young leaves. All traces of mildew disappeared, however, with the return of normal, i.e. hot and sunny, weather conditions. In October it was still free, though intertwined with a mildewed plant. At the end of August, 1920, notwithstanding the fact that the plant was close to two varieties so severely attacked that all their hops were destroyed, no sign of mildew could be detected on its leaves or hops. When examined again in October, the leaves were free but a trace of the disease was noted on the hops, chiefly at the tips.

Passing on to the plants that showed 'semi-immunity' in the greenhouse the records indicate that, planted out in the open, two seedlings have varied in susceptibility from 'immune' to 'slightly susceptible', while a third has exhibited the latter grade consistently. These three strains may therefore be classed as 'commercially resistant', while the remaining four are only just outside this category.

The author finally analyses the separate records of the two sexes of the seedlings, of which 189 proved to be male and 291 female. The latter showed the higher degree of susceptibility with a 'highly susceptible' percentage of 56·70 (including a large proportion of totally destructive cases). This compares with 24·34 per cent. in the males, and here no case of complete loss of crop has to be included, while on the other hand the male group produced six absolutely immune plants. But the author thinks it unsafe to consider this a proof of the greater lack of resistance in the female plant, owing to the fact that observations as to the incidence of the disease were generally made at a period peculiarly favourable to infection in this group. Both sexes would have to undergo the tests at a time when each could provide the same amount of infectible material, i.e. the male and female inflorescences, young hops, and leaves of the axillary side-shoots, in order to settle the question of the degree of resistance possessed by each. At any rate it is of interest to note the fact that of the 27 seedlings showing immunity in the greenhouse, 14 were female and 13 male.

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JAGGER (I. C.). **Bacterial leaf-spot disease of Celery.**—*Journ. Agric. Res.*, xxi, 3, pp. 185–188, 2 pl., 1921.

The cause of this celery disease, which occurs chiefly in the States of New York and Michigan, is *Pseudomonas apii*, n. sp. (group no. 211.2322033). The spots are of a rusty brown colour, irregularly circular in outline, and rarely exceed 5 mm. in diameter. They can be distinguished from *Septoria* leaf-blight spots only by the absence of pycnidia. Whilst in severe cases older leaves are killed by the bacterium, the injury usually consists in the disfiguring of the foliage and possibly in a reduction in growth of the plants. Leaf blades are the principal parts attacked, the petioles seldom, if ever, suffering from the disease. Inoculations on parsley (*Petroselinum*) failed. Details of the morphological and cultural characters of the pathogen are given.

The disease can be very well controlled by spraying with Bordeaux mixture, but not with lime-sulphur.

SMITH (E. F.) & GODFREY (G. H.). **Bacterial wilt of Castor bean (Ricinus communis L.).**—*Journ. Agric. Res.*, xxi, 4, pp. 255–261, 13 pl., 1921.

Inoculations, by means of delicate needle pricks, of cultures of *Bacterium solanacearum*—the causal organism of this wilt—produced the disease in a more or less pronounced degree in the following plants: tomato, nasturtium (*Tropaeolum majus* L.), cotton (only young seedlings), vanilla (*Vanilla planifolia* Andrews), sunflower (*Helianthus annuus* L.), garden balsam (*Impatiens balsamina* L.). The authors also obtained successful inoculations on a series of jimson weeds (*Datura stramonium* L.), and fuchsias were shown to be equally susceptible.

Extensive investigations carried out in Florida seem to point to the soil as being an influencing factor in the appearance or otherwise of the wilt. It is surmised that the disease is more likely to develop on newly-cultivated land than in fields that have been bearing crops for many years. At any rate, facts observed so far bear out this contention. The disorder is likely to prove fatal to small *Ricinus* plants, two or three inches high, but it is also found in larger specimens up to several feet high, and the wilting may be sudden or it may come about slowly. The first signs of the disease often appear after a period of wet weather of several days' duration. More of the wilt is seen in hot, dry weather. A plant may recover temporarily during moist weather or during a cool night following a hot, dry day. In the more severe cases death is the ultimate result, while in others, where the attack had not been severe enough for a fatal termination, a marked dwarfing of the plants resulted; this appears to be typical.

Plants observed in the vicinity of Miami, Fla., and at other points, especially in heavy soils, showed signs similar to wilt, but this was found to be more likely due to asphyxiation of the roots caused by too high a water table. The bacterial wilt is distinguished from this and other known diseases of the castor bean by the typical browning of the vascular system near the base of the plant, which is more or less pronounced, and extends in some cases into the woody part of the stem. In addition to this symptom, it is always possible, with the aid of a good hand lens, to observe drops of bacterial exudate at the freshly cut ends of the vascular tubes, especially if the plant is still green.

MATSUMOTO (T.). **Studies in the physiology of the fungi. XII. Physiological specialization in Rhizoctonia solani Kühn.**—*Ann. Missouri Bot. Gard.*, viii, 1, pp. 1–62, 6 figs., 1921.

Rhizoctonia was isolated from potato, bean, lettuce, dahlia, eggplant, and *Habenaria* sp., principally from California and Missouri. Fifteen isolations were studied, but these were reduced by preliminary tests to six types which were studied intensively. Some strains blacken potato agar during growth and others do not, while there is also a considerable difference in their rate of growth at 38° C. and other temperatures. All six strains hydrolysed starch and inverted cane sugar, but there was marked variation in enzyme activity between different strains. Maltose was used by the fungi about as readily as dextrose, but lactose seemed to have much less nutritive value; the strains differed also in their utilization of these sugars. All the strains utilized inulin, glucose, fructose, galactose, and amygdalin without evidence of much specialization. Cellulase was present in the mycelium in somewhat variable amounts.

The various strains of *Rhizoctonia* differ in their nitrogen metabolism, as evidenced by their growth with casein, peptone, asparagin, and legumin. No strain utilized caffeine. Potassium nitrate, ammonium sulphate, and ammonium nitrate are available sources of nitrogen, potassium nitrate being preferable. Only two strains could utilize potassium nitrite and these with two others caused some reduction of nitrate; one strain produced no reduction. Trypsin and erepsin were present in all strains. The fungi grow best on acid media, the favourable hydrogen-ion concentration being about P_H 3·8. The strains varied in their tolerance of acid and alkali; in general, they increased the active acidity of the medium during growth. Inadequate aeration repressed growth and the formation of sclerotia.

Fusion was found to occur between hyphae arising from different mycelia of the same strain, and between hyphae of certain similar strains. Two strains would each fuse with none of the others.

Inoculation tests on beans, lettuce, potatoes, and eggplants showed that certain strains would attack all these hosts, others only certain hosts, and two strains attacked none of them. The highest pathogenic capacity was manifested when inoculation was made on the host from which the culture originated. The pathogenicity of one strain was somewhat modified by transfer to a host plant different from that from which it was originally obtained. The growth characters of another form on liquid media were changed (apparently permanently) after successive transfers on other culture media.

Infection of a host takes place most readily through the roots, and penetration was found to be mechanical, the fungi entering directly through the cuticle.

The strain from potato stem from California and one from *Habenaria* were considered identical, of importance pathologically, and perhaps the same as the 'new strain' of Rosenbaum and Shapovalov (*Journ. Agric. Res.*, ix, p. 413, 1917). Strains from sclerotia on potato tuber from Missouri, and from stem of navy bean from California, were considered to be two specialized forms of the same fungus. A strain from a potato stem from California was found to have much smaller hyphae ($3-6\,\mu$ in diameter, in contrast to a diameter of $7-14\,\mu$ in the other strains), it produced no reduction of potassium nitrite, would fuse with no other strain studied, and was not found to be pathogenic. This strain may prove to be a distinct species. The sixth strain was insufficiently studied to admit of definite conclusions as to its taxonomic relations.

APPEL (O.). **Die wirtschaftliche Bedeutung der Pflanzenkrankheiten und die Mittel zu ihrer Bekämpfung.** [The economic importance of plant diseases and the means of controlling them.]—Reprinted from *Arbeiten der deutschen landwirtsch. Gesellsch.*, cccxiv, 18 pp., 1921.

The economic importance of plant diseases can hardly be overestimated. According to Eriksson the annual losses from rusts in cereals in all the grain-growing countries amount to $1\frac{1}{4}$ milliards of marks [gold marks are intended throughout]. The rust epidemic of 1891 is calculated to have caused a loss in wheat and rye of some 170 million marks in Germany. In 1911 Bavaria lost 26 million and in 1916 Saxony 47 million marks from yellow rust. The losses from smut must be almost as great, although exact statistics for Germany are not available. In a normal year, however, the damage to winter wheat in Saxony from smut fungi was calculated to be $6\frac{1}{2}$ million marks. It must be remembered that these and similar figures represent only a fraction of the total losses of cereals due to disease. Losses in storage are also very great. Taking the losses caused by all pests to stored grain at 5 per cent., the storage losses in cereals during the harvest year 1916 are calculated to have amounted to approximately 1,102,364 tons in Germany, while an average annual loss of 10 per cent. can be allowed with considerable accuracy for stored potatoes. Potato blight (*Phytophthora*) reduced the potato yield by one-third, valued at about 2½ milliard marks [? gold marks], in 1916. Approximate statistics only are available for fruit-growing, but estimating the average annual pre-war value of the fruit crop at 360 million marks, the total in favourable years was 25 per cent. above this figure and in unfavourable ones 25 per cent. below it. Thus there is an approximate difference of 180 million marks between the highest and lowest yields, of which at least 50 per cent. is attributable to pests and diseases. The destruction of conifers and other trees by insect and fungous pests is equally responsible for considerable monetary losses. Thus the single fungus *Trametes pini* is responsible for an annual loss of several million marks in Germany; whole stands of trees of various sorts are not seldom affected by the honey agaric; and the incidence of blister rust on Weymouth pines frequently reaches 30 to 40 per cent. In 1910 a 200 hectare plantation of 40 to 80 year old oaks in Croatia was entirely destroyed by mildew, and not only are similar cases known in Germany but it has been found that the stunting effects of ordinary attacks of this fungus are so great that it takes eight years for affected trees to make a growth equal to that of healthy ones in five years.

The various methods of preventing and controlling plant diseases are briefly reviewed, and the necessity for an extension of government regulations in dealing with plant diseases is urged. It is stated that during the war the incidence of smut on wheat increased to such a degree, in consequence of the scarcity of fungicides, that fields with 10 to 20 per cent. of smutted ears are not uncommon, while others with as much as 60 to 70 per cent. can be found. Steeping wheat seed grain as a precaution against bunt is now generally recognized as essential, and has actually been made compulsory, with very satisfactory results, in Würtemberg. Many of the larger seedsmen are now supplying steeped seed, and recently there has been a growth of the practice of treating wheat and barley against loose smut by the methods introduced in Germany not only in large scale apparatus suitable for handling considerable quantities but also on smaller farms. The stripe disease of barley is being treated in the same way. Extensive precautions are also being taken in Bavaria to exterminate the snow-fungus (*Fusarium nivale*), the amount of disinfected seed having increased from 900 cwt. in 1911 to 100,122 cwt. in 1913. The shortage of copper and sulphur (of which the requirements for agricultural purposes in 1915 were 5,800 and 5,000 tons respectively) led to the introduction of substitutes and secret preparations, the latter industry assuming such a dangerous extension as to demand government interference. There is no lack of guidance in the practical measures required to check plant diseases in Germany, the State Biological Station at Dahlem alone having distributed over 6½ million leaflets up to 1918.

ASHBY (S. F.). **Report of the Microbiologist, 1920.**—*Ann. Rept. Dept. of Agric. Jamaica for 1920*, pp. 24–25, 1921.

In bananas the Panama disease or banana wilt is on the whole under good control, though a few new cases have occurred in

hitherto uninfected localities. Trash collected at the fruit-receiving dépôts is a probable source of infection, against which cultivators are warned.

In coco-nuts a few cases of bud-rot have been observed, but the incidence of this disease was restricted by the drought of 1919–20. The leaf-bite diseases have ceased to occur in the epidemic form which followed the hurricane years 1915–17, and many trees have thrown off the attack naturally. The prevalence of die-back has increased, apparently in connexion with the drought. Recently a species of *Rhizoctonia* and a *Pythium* have been isolated from partially diseased roots of trees affected with this disease, and these fungi are probably important factors in bringing about root deterioration. In Hawaii a species of *Pythium* has been isolated from the roots of cane, banana, taro, pineapple, and rice, and found to cause the decay of cane roots inoculated with it in sterilized soil. Both *Rhizoctonia* and *Pythium* have also recently been found associated with root disease of sugar-cane in Porto Rico. Coco-nut trees affected with die-back should be treated in such a way, when not too old, as to promote regeneration of the roots. Forking, removal of immature nuts, and the application of bluestone to the soil round the trunks may help to restore such trees.

The mosaic disease of sugar-cane is somewhat widely distributed, but does not as a rule occur in a severe form. A serious reduction of tonnage on account of this disease has been found in all the cultivated varieties, though Transparent withstands it better than the ribbon varieties. Some seedlings, such as B 208 and B 3922, are severely affected. Uba (Kavangire) appears to be immune in Jamaica. The practices of seed-piece selection and roguing out of affected plants from the young crop are recommended.

SNOWDEN (J. D.). **Report of the Government Botanist for the period 1st April to 31st December, 1920.**—*Ann. Rept. Dept. of Agric. Uganda for the nine months ending December 31, 1920*, pp. 43–46, 1921.

This report consists chiefly of notes on the diseases of plants in Uganda arranged under the following heads:—

COFFEE. *Hemileia vastatrix* B. and Br., frequently succeeded by 'die-back' (*Colletotrichum coffeanum* Noack), was prevalent. Recent experiments by Small [see this *Review*, i, 1, p. 3] indicate that the various *Colletotrichums* attacking coffee, cacao, tea, and fruit trees in Uganda are closely related to one another, or perhaps only varieties of the same fungus. Pure cultures of *C. coffeanum* produce a *Glomerella* indistinguishable from *G. cingulata* (Stonem.) S. and v. Sch. The writer has also found a *Glomerella* stage associated with *C. coffeanum* on dead twigs of coffee in the field. *C. camelliae* Mass. on tea is one conidial form of *G. cingulata*, and another form has been found during the year on the Avocado pear. Root diseases (*Hymenochaete noxia* and (?) *Sphaerostilbe repens* B. and Br.) were not much in evidence, while the damage caused by the following fungi, recorded in previous years, was also negligible:—

Cercospora coffeicola B. and Cke, *Fusarium coffeicola* P. Henn., *Periconia byssoides* Pers., *Phoma* sp., *Phomopsis* sp., *Septoria* *coffeae* Wakef., *Capnodium brasiliense* Puttem., and *Polyporus coffeae* Wakef.

Rubber. Bark and cortex diseases seem to be on the increase. Black thread, generally considered to be due to *Phytophthora* sp., was very prevalent at Kampala, nearly 50 per cent. of the total number of tapped trees being affected in some cases. Reports from other plantations indicate that brown bast is the more serious disease, but only two cases were seen at Kampala. There were a few cases of *Botryodiplodia theobromae* Pat., but root diseases (the same two as on coffee have been recorded) were unimportant. There is no authentic record as yet of *Ustulina zonata* (Lév.) Sacc. on *Hevea* in Uganda. Parasites of minor importance on rubber are *Cephaleuros mycoidea* Karst. and *Phyllosticta ?hevea* Zimm. on leaves; *Coniothyrium* sp. causing a canker on stems and branches; *Gloeosporium alborubrum* Petch on young stems; *Pestalozzia palmarum* Cke and *Leptosphaeria* sp. on apices of stems; *Phoma heveae* Petch, and *Phomopsis* sp. on branches; *Megalonectria pseudotrichia* Speg. and *Fusarium* sp. on dead bark; *Tubercularia versicolor* Sacc. on the healing surface of tapped bark; and *Helicobasidium* sp. on roots.

Cacao. Die-back, due to *Botryodiplodia theobromae*, was prevalent and severe, the trees in many cases being killed right down to the ground. The action of the fungus is very rapid and the dead leaves remain on the branches, giving the tree a scorched appearance. Cacao has been somewhat neglected of late, and die-back is consequently on the increase. The spores of this fungus can infect *Hevea*, so that great care should be taken to destroy all diseased branches. Pod-rot (*Phytophthora faberi* Maubl. and *Colletotrichum* sp.) and hardening of pods (*Colletotrichum incarnatum* Zimm.) are fairly common, while *C. theobromicola* Del. causes a die-back of twigs. *Capnodium brasiliense, Cephaleuros mycoidea, Phyllosticta* sp., *Megalonectria pseudotrichia,* and *Nectria flavolanata* B. and Br. are of little economic importance.

Tea. Both old and young leaves are attacked by *Colletotrichum camelliae,* one of the conidial stages of *Glomerella cingulata,* with which a *Pestalozzia* is sometimes associated. A *Pestalozzia* is also found on the discoloured spots caused by mosquito blight (*Helopeltis bergrothii*) but it has not yet been ascertained whether it can attack uninjured leaves. *Cephaleuros mycoidea* does comparatively little damage.

Fruit Trees. *Glomerella cingulata* (found in both conidial and perithecial stages) causes a fruit rot and die-back of twigs of Avocado pear. The conidial stage of a very similar fungus has been reported on the fruits of *Anona muricata* growing in the vicinity of the Avocado pear. Citrus-trees are attacked by *Colletotrichum gloeosporioides* (Penz.) Sacc. and bananas by *Gloeosporium musarum* Cke and Mass. Other parasites which occasionally occur are *Cephaleuros mycoidea* on Avocado pear and guava, *Puccinia pruni* Pers. on peach leaves, and (?) *Sphaerostilbe repens* on the roots of the mango.

Cotton. Much damage is done to the bolls in wet weather by *Glomerella gossypii* Edg. with its conidial stage *Colletotrichum gossypii* Southw. The stems are also attacked at times by this fungus. *Ramularia areola* Atk. (grey mildew) was fairly prevalent on the leaves, sometimes accompanied by a *Macrosporium* which produces large discoloured patches. A species of *Botryodiplodia* was found causing a die-back of the stems. These diseases appear to be on the increase, and strict attention should be paid to the annual burning of the plants in order to keep them in check. *Cercosporella gossypii* Speg. and *Uredo gossypii* Lagerh. have also been recorded on cotton in Uganda.

MINOR CROPS. Sugar-cane leaves are attacked by *Leptosphaeria sacchari* van Breda which does little harm. Much damage was done to wheat by *Puccinia triticina* Eriks., recorded for the first time in Uganda. It was accompanied by (?) *Helminthosporium sorokinianum* Sacc., also reported for the first time. *Puccinia graminis* Pers. and *Ustilago tritici* Jens. were recorded on wheat in previous years, as were *Sphacelotheca sorghi* (Link) Clint. and *S. reiliana* (Kuehn) Clint. on sorghum. Rice was attacked by a *Helminthosporium* and a *Leptosphaeria*. The leaves are covered with yellowish-brown spots and have the appearance of being scorched by fire. *Puccinia sorghi* is the only disease of maize hitherto reported. The leaves of *Voandezia subterranea* ('mpandi') on the Kampala plantations were attacked by a *Cercospora*, probably an undescribed species. Other parasites which occasionally attack pulse crops in Uganda are *Aecidium vignae* Cke on *Vigna sinensis* and *V. catjang*; *Aecidium glycines* P. Henn. on *Glycine javanica; Ascochyta phaseolorum* Sacc. on *Vigna catjang; Cercospora personata* (B. and C.) Ellis on *Arachis hypogoea; Erysiphe polygoni* DC. on *Pisum sativum; Meliola bicornis* Wint. on *Glycine javanica*, and *Uromyces appendiculatus* (Pers.) Link on beans and *Vigna sinensis*. The leaves of cassava (*Manihot utilissima* and *M. palmata*) are frequently attacked by *Cercospora Henningsii* Allesch. but little harm is done. Ceara rubber (*M. Glaziovii*) is attacked by *C. cearae* Petch. Potatoes at Kampala were severely damaged by (?) *Alternaria solani* (E. and M.) Jones and Grout, the foliage being almost entirely destroyed and the growth of the tubers arrested. Native tobacco is sometimes attacked by *Cercospora raciborskii* Sacc. and Syd.

PUTTICK (G. F.). **The reaction of the F_2 generation of a cross between a common and a durum Wheat to two biologic forms of Puccinia graminis.**—*Phytopath.*, xi, 5, pp. 205-213, 1921.

The author, at the Minnesota Station, made a study of the parasitic capabilities of two biologic forms of *Puccinia graminis tritici* on the F_2 generation from a cross between *Triticum vulgare* (var. Marquis) and *T. durum* (var. Mindum). The Marquis parent was susceptible to one form of the rust, and Mindum resistant to this form; Marquis was resistant and Mindum susceptible to the other form of rust. The forms of rust used had been studied previously and found to be constant. Each F_2 plant was inoculated with both forms: with one form when the seedlings were about eight days old; and later on, after the results of the infection with this form had been recorded, the infected leaves were removed, and inoculations were made with the other form. It was found to be more difficult to infect older plants than to infect seedlings, but the difference was attributed to the fact that older plants retained a film of moisture less easily than seedlings.

The data obtained on the reaction of each of the F_2 plants are given in detail. All gradations between complete susceptibility and immunity to both forms of rust appeared in the F_2 generation. Since biologic forms differ in their parasitic capabilities on the same variety of wheat, their genetic composition cannot be the same. Each of the two tried was, however, of constant genetic composition since the action of each was uniform. The factors of susceptibility must be located in the host plant. Possibly a single pair of genetic factors, with modifying factors to account for the various grades of infection obtained, may explain the manner of reaction to one of the forms of rust used, but evidence of a similar condition in the case of the other form of rust was not obtained. Of a total of 388 F_2 plants tested, thirty-five were highly resistant to both forms of rust. The author considers that varieties of wheat commercially resistant to stem rust over fairly extensive crop areas can be produced.

ROSEN (H. R.). **The behaviour of telia of Puccinia graminis in the south.** - *Mycologia*, xiii, pp. 111–113, 1921.

P. graminis is rarely found on barberry in the southern portions of the United States, and in general is less destructive on cereals there than the leaf rusts. The stem rust is, however, often prevalent on *Agrostis palustris, Phleum pratense,* and *Elymus australis.* Teleutospores are not commonly produced in Arkansas, and in general are undersized and abnormal, and fail to germinate in the spring. An exception is found in the case of *Elymus australis,* which may develop considerable amounts of the teleuto-stage, with normal spores which germinated profusely the following spring. *Berberis trifoliolata* was infected artificially by the sporidia produced.

RAND (F. V.) & CASH (LILLIAN C.). **Stewart's disease of Corn.**— *Journ. Agric. Res.*, xxi, 4, pp. 263–264, 1921.

This wilt, caused by *Aplanobacter stewarti* (E. F. S.) McCul., has been observed in most parts of the United States, but not in Minnesota, Wisconsin, Michigan, northern New York, Vermont, New Hampshire, and Maine. Cultures of the causal organism have been obtained from most localities where the disease has been noted by the authors, and experiments have proved that it is transmitted neither through the soil nor by proximity to diseased stalks, but that the seeds of affected plants are the most probable carriers as the organism has been isolated from their endosperm.

Under 20 per cent. infection usually occurs, but instances of 100 per cent. infection have been met with among the earlier varieties. Moisture and high temperature favour the development of the disease, and it has been found that anything which retards the germination and early development of the seedling lessens the chances of infection from the seed. The latter, if infected, may be rendered safe for planting by a dry heat 'pasteurization' at 60° to 70° C. for one hour. Other control methods are still in the experimental stage, but it seems clear that northern-grown seed is less likely to carry infection than that grown further south.

HENNING (E.). **Den växthygieniska betydelsen av lerläggning eller sandkörning av uppodlade Kärr- och Mossmarker. I. Förberedande studier och försök.** [The value of clay or sand as fertilizers for crops grown in reclaimed swamps and bogs. I. Preliminary studies and experiments.]—*Meddel. Centralanst. för försöksväsendet på Jordbruksområdet*, 214, 36 pp., 2 pl., 1921.

The writer has been continuing experiments commenced in 1918 (*Meddel.* 179) to confirm his statement that the admixture of clay in marshy soil prevents the occurrence of the 'yellow-tip' disease of oats which is prevalent on such soils. The history of the reclamation of swamps and bogs in Scandinavia is briefly outlined, together with the fertilizer experiments carried out by various societies interested in the matter.

The 'yellow-tip' disease is evidently of a purely physiological character, no parasitic fungi having been detected during repeated investigations carried out in various localities and extending over a period of two years. It seems to be due to malnutrition caused by lack of moisture at a certain stage of development. Drought prevents the plants from assimilating the nutrient elements of the soil, though the author's experiments have shown that this can to a certain extent be counteracted by the use of artificial fertilizers or farmyard manure.

The yellowish-brown colour of the plants, which spreads outward from the midrib, is considered to be symptomatic of a lack of potassium in the soil. Analyses of the latter made in the different localities showed a low percentage of potassium as compared with other elements (0·03 – 0·06 per cent.). The experiments conducted in 1919 (in which year the month of May was exceptionally dry) showed that the addition of potassium, either by itself or in combination with other salts, greatly improved the condition of the oats and gave them a fine green colour. Previous workers have shown that lack of potassium or phosphoric acid produced stunting of the root-system and (in wheat) weakness of the straw, and that though the early development of plants growing in soils deficient in potassium may be more vigorous than the normal, later on yellow spots, gradually turning brown or greyish-white, appear between the veins of the leaves. This symptom characterized several of the plots investigated by the author during the period under review. Deficiency of potassium imparts a dingy, greyish-green colour to the grain, which ripens very slowly, and is liable to shed. It also arrests the development of flowers and fruit, and causes premature withering. These effects are not produced by a corresponding shortage of phosphoric acid or nitrogen.

Both years' experiments proved that neither fertilization with potassium alone, nor with a complete fertilizer, was able to ensure normal development of the leaves, but this was effected by the admixture of clay with the soil. The following is an analysis of the clay used in the experiments:—Water, 11·80 per cent.; phosphoric acid (P_2O_5) soluble in 20 per cent. hydrochloric acid, 0·16 per cent. of the dry substance; potassium (K_2O) calculated the same way, 0·63 per cent. Reaction to litmus slightly acid. The clay, which apparently helps to retain the moisture in the soil and assists in the development of the root-system, should be mixed with lime only if it contains ferrous sulphide. It is stated that an addition of sand to these soils also has a good effect.

HENNING (E.). **Den växthygieniska betydelsen av lerslagning eller sandkörning av uppodlade Kärr- och Mossmarker. II. Nya försök mot gulspetssjuka, utförda 1921.** [The value of clay or sand as fertilizers for crops grown in reclaimed swamps and bogs. II. New experiments with yellow tip disease during 1921].—*Meddel. Centralanst. för försöksväsendet på jordbruksområdet*, 226, 14 pp., 3 diagr., 1 pl., 1921.

The first experiment was carried out at Rehnstad in Östergötland on bog land. The field had been ploughed in the previous autumn, and was divided into plots of 5 × 4 metres. Some of these received on 2nd May 300 gm. of 40 per cent. potash, others 600 gm. superphosphate added to the potash, while lime was added to the other two in a third set. Clay was applied two days later to some plots in the proportion of 2 hectol. per plot, either alone or in addition to the phosphate. Each treatment was applied to three plots, and there were three untreated controls. Mixed seed of Victory oats and yellow barley was sown on 14th May. All the plots, except those treated with clay, were slightly damaged by night frosts in June, but previous experiments have shown that the yellow-tip disease occurs independently of frost. The injuries inflicted by the latter are easily distinguishable from those caused by yellow-tip, as they occur chiefly at the base of the young leaves, while in yellow-tip the entire edge of the leaf is damaged at once. According to Lind, plants attacked by yellow-tip are particularly liable to frost-injury on account of malnutrition.

The best crops were obtained from the plots to which either clay alone or clay with phosphate was added. The applications of potash or potash with superphosphate were not successful, the crops being severely attacked by yellow-tip, and full of weeds. One of the untreated control plots produced a good crop with few weeds, while the other two gave very bad results. Geological and chemical analyses failed to supply any explanation of the discrepancy.

The following is the analysis of the clay used in the experiments:—Water in air-dry sample, 6·20 per cent. Soluble in 20 per cent. hydrochloric acid: phosphoric acid (P_2O_5) 0·13 per cent.; potassium (K_2O) 0·54 per cent.; lime (CaO) 0·87 per cent. (all in percentages of the dry substance). Reaction: alkaline. It is noteworthy that the admixture of phosphate led to no increase in the yield of the grain, though that of straw rose on an average by 2·4 kg. The strikingly low yield of grain, ranging from 0·9 to 1 kg., was due to poor development of the ears, possibly the result of the excessive drought. The clay evidently diminished the loss of water, thereby facilitating the formation of the ears, but was insufficient, on the decomposed peat, to promote a full development of the grain. A good fodder crop, however, was obtained by the use of clay where other fertilizers gave nothing but weeds.

The second experiment was conducted at Sickelsjö on much the same lines, in a field which had been sown with grass for two years past, while from 1916 to 1918 it bore cereal crops which were more or less destroyed by yellow-tip. Earlier tests have shown that yellow-tip is usually found immediately following root-crops rather than grass, and this was confirmed in the present experiment so that no results were obtained in regard to the disease. The plots treated with clay and clay with phosphate showed a marked tendency to lodge.

COCKAYNE (A. H.) & CUNNINGHAM (G. H.). **Lemon brown-rot and its control.**—*New Zealand Journ. of Agric.*, xxii., 5, pp. 271–274, 1921.

Lemon brown-rot (*Pythiacystis citrophthora* Sm. and Sm.), first recorded in New Zealand in 1907, appears at present to be on the increase, and a considerable amount of damage is caused by it in citrus orchards, both by the actual destruction of fruit on the tree and by the killing of laterals and even larger branches. The special conditions necessary for the production of fruiting bodies of this fungus, and its inability to cause general infection when these conditions are absent, render the disease comparatively easy to control.

In America the fungus in question has also been found on almonds, apples, cherries, peaches, and pears, but in New Zealand it seems so far to be confined to the lemon.

The disease first shows in the orchard by the appearance of small groups of dead, brown leaves, which form a conspicuous contrast to the olive-green of the healthy foliage. On the young laterals small, brown, dead areas, which remain flush with the surface of the normal cortex, are developed. The leaves on these attacked laterals turn brown and die, but remain hanging on the tree.

The first stage of infection on the fruit is a brown sunken spot, which rapidly spreads till the whole fruit is of a rusty brown colour and somewhat softer to the touch than usual. A peculiar pungent smell, characteristic of the disease, is emitted when the fruit is cut open.

Pythiacystis citrophthora is normally a soil organism living saprophytically on decaying vegetable matter, and thriving only in moist conditions. Thus no fruiting bodies are ever formed from the lesions on the branches or from those on the fruits while the latter remain on the tree. If infected fruit falls to the ground, however, and the soil is sufficiently wet, the whole fruit and surrounding soil may become covered with hyphae bearing the sporangia of the fungus. These sporangia discharge a number of zoospores which move rapidly about by the aid of two ventral cilia in drops or films of water. The zoospores are the active agents in the spread of the disease on the trees. They may either be splashed up on to the foliage with soil particles during heavy rain, or swim from place to place in the film of water which sometimes covers the leaves. After a time they settle down, lose their cilia, and, if suitably placed, germinate and produce a long hypha which penetrates the cuticle and epidermis of the leaf or fruit. Once inside, this primary hypha branches repeatedly, absorbing the cell-contents of the internal tissues, which turn brown and die. If the lemons are packed in cases, the hyphae grow out from the infected fruit and penetrate the tissues of the healthy ones with which they come into contact. Except by this vegetative method, the fungus cannot cause further infection until it is enabled, by an excess of moisture, to develop sporangia. Every lesion on the twigs, and on the fruit while still attached to the tree, is due to infection by zoospores developed in sporangia produced either by the fungus in the soil or by fallen infected fruit. In no case can zoospores be developed on the tree itself, or on the fruit while still attached to the tree. Thus the whole object of control must be to eliminate the conditions which render sporangial development possible on the soil, or to prevent the transference of zoospores from the sporangia to the tree. The oospores of the fungus are not known.

During the summer, dryness of the surface soil may be maintained by thorough cultivation immediately beneath the tree, so as to form a dry layer two or three inches deep. Reproduction of the fungus will thus be effectually prevented. In winter, however, this dry zone cannot be maintained, and it is therefore necessary to protect the trees against infection by the zoospores. Two methods of securing this are in general use in California. The first is the cutting out of all laterals and branches in contact with the ground, and the removal of all growth which might be spattered by rain to a height of two feet above the soil. A second method is that of cover-cropping the ground during the winter. Such a crop, acting as a blanket, entirely prevents the upward carriage of zoospores by means of rain splashes. A considerable range of crops is available for this purpose, *Lotus hispidus* (or *angustissimus*) being very suitable in the Auckland and Tauranga districts. From 6 to 8 lb. of seed per acre are required, and the average cost is about ten shillings. Self-sowing usually occurs in subsequent years, so that the initial process need not be repeated. Further south, crimson clover or vetch are preferable to *Lotus hispidus* as cover-crops. King Island melilot (*Melilotus indica*) is the main cover-crop in California, but its use is not advocated in New Zealand. On reasonably fertile soil, Western Wolths rye-grass (one bushel of seed per acre) is a cheap and effective cover-crop. Emphasis is usually laid on the nitrogen-collecting character of the legumes, but the value of this feature can easily be overrated in New Zealand lemon orchards.

Pythiacystis citrophthora may occur in certain soils to a depth of three feet or more, so that soil-treatment is not practicable. Spraying the trees is also ineffectual, since the disease spreads most rapidly immediately after heavy rain, when fungicides are of little use.

Fungoid diseases attacking Lemons.—(Horticultural Division) *New Zealand Journ. of Agric.*, xxiii, 2, pp. 108–109, 1921.

Spraying tests were carried out with lime-sulphur compound and Bordeaux mixture in the Auckland groves with the object of determining the following points:—(1) The spray giving the best results; (2) the best and most economical period to apply the same; (3) the strength at which to be applied for control of verrucosis [*Cladosporium citri* Mass.], grey scab [*Sporodesmium grisum* McAlp.], and *Pythiacystis citrophthora* Sm. and Sm. The results were as follows:—

Lime-sulphur. Strength 1–30: Will hold diseases named fairly well in check, if intelligently applied. Two sprayings in the season are ample, viz., after the blossom-petals of the main and of the autumn flowering have fallen. Weakly trees on the lighter soils will not stand this spray, and well-grown healthy trees were considerably defoliated with three applications during the season. 1–35: Results equal to 1–30. No defoliation with two sprayings in season, but slight scorching with four applications. 1–40: Almost equal to 1–35. No defoliation using four sprays. 1–50: Considerable infection always in evidence on trees sprayed at this strength. May be dispensed with as valueless for control. 1–30 followed by 1–40 (when main-crop flowers and autumn flowers respectively have fallen): Only very slight infection noticeable at any time on these trees. Very slight defoliation after 1–30 application.

Bordeaux mixture. Formula 4–4–40: An absolute control of the three diseases was maintained with two applications of this formula, after the falling of blossoms in the main crop and autumn respectively. Scorching of foliage hardly noticeable, but slight discoloration of fruit and wood. 4–4–40 followed by 5–4–40: Same periods as above. Results better than any lime-sulphur-treated trees, but not so good as two applications of 4–4–40 at the same times. 6–4–40: This was not applied at petal-falling period in these tests, and therefore a comparison cannot be made in relative value to 4–4–40 used then. Considerable scorching results from its use at any period, however, and the formula is therefore not to be recommended except for the purpose of overtaking bad infection in a very dirty grove.

It is concluded, therefore, that as a spray to combat fungous diseases attacking lemons, Bordeaux still maintains the first place. The 4–4–40 formula used at the right periods—two applications per annum—will effectively control these diseases. Except in cases of severe infection, this compound need not be used at a greater strength, and the use of 5–5–40 and 6–4–40 leads to defoliation. The excessive use of Bordeaux invariably leaves its mark upon the tree, and often on the fruit. The wood gradually becomes scorched, and the sap-cells are injured thereby; so far, however, this appears to be a necessary condition of the control of the fungus.

The fruit is of a much better appearance and the wood is less damaged by scorching when lime-sulphur is used than with Bordeaux mixture. The disease-control is not, however, so effective.

LEE (H. A.). **Citrus-canker control: a progress report of experiments.**—*Philipp. Journ. of Science*, xix, 2, pp. 129–171, 2 pl., 1921.

During the spraying experiments attempts were made to render the copper in the fungicides more readily available for action against the canker organism [*Pseudomonas citri* Hasse]. In the case of Bordeaux mixture the excess of lime was reduced to just the amount sufficient to precipitate all the copper, while with Burgundy mixture enough sodium carbonate was added to precipitate the copper with no residue. The compounds thus obtained were known as neutral Bordeaux and neutral Burgundy mixtures respectively. Ammoniacal copper carbonate, formalin, and neutral lead arsenate were also used. A 'sticker' was employed consisting of 2 lb. of resin dissolved with heat in a solution of 1 lb. of sodium carbonate in one gallon of water. The amount used in these experiments was one quart of the 'sticker' to fifty gallons of the spray mixture. Bordeaux and Burgundy mixtures were the only sprays that were used with any degree of success, and they were not wholly effective. The amount of control obtained depended largely on the variety sprayed, and in some cases was not on an economic basis.

Other factors which materially contributed to a reduction of the disease were: (1) the use of clean-up sprays. In many cases of heavily infected trees, a spray of formalin 1–80 caused the dropping of cankered leaves on sweet orange, grape-fruit, and mandarin orange trees. This concentration, however, was too strong for limes and lemons, on which it caused too severe defoliation. Greater injury resulted from the use of this spray in rainy weather or towards nightfall, owing to the relatively slow evaporation of the formalin. (2) Stimulation of growth at climatic periods unfavourable to canker development. New growth was stimulated during the early part of the dry season, the necessary pruning having been carried out at the end of the rainy period. Thus the foliage was able to mature and harden during the dry season, when there was comparatively little danger of infection. With the recurrence of the rainy season it had acquired a considerable degree of resistance. In the case of grape-fruit and lime the results were somewhat less satisfactory than with the other varieties. (3) Control of insects. Cankers are often found along the edges of leaves bitten by chewing insects, and also in the trail of the leaf miner. Lead arsenate was frequently added to the fungicides with a view to exterminating these insects. (4) Construction of windbreaks. The wind is a powerful agent in the dissemination of citrus canker, not only by spreading the organism in the usual way, but also by wounding the twigs and foliage, and thus exposing them to penetration by the bacteria. Windbreaks consisting of dense thickets of bamboo, 10 to 15 metres in height, have proved very effective.

Wide differences exist in the degree of susceptibility to canker of the various species and varieties of citrus. Mandarin oranges, citrons (*C. medica*), calamondins (*C. mitis*), and Kumquats (*Fortunella japonica*) are very resistant, and control is almost superfluous. To the class of susceptible but easily controlled forms belong the American-grown lemons (*C. limonia*), the Mediterranean varieties of the sweet orange, the Tahiti lime (*C. aurantifolia*), and the Unshiu or Satsuma oranges (*C. nobilis* var. *unshiu*). Somewhat more difficult to control are the Florida varieties of the sweet orange, the Natsumikan of Japan, many of the pomeloes, and several strains of navel oranges. The latter exhibit a considerable range of susceptibility. The Triumph grape-fruit also belongs to this class. Successful canker control is possible on these varieties, but it is uncertain as yet whether it is economically feasible. Lastly in the extremely susceptible West Indian lime and American grape-fruit varieties, canker control, though possible in a few cases, necessitates an extravagant use of sprays and time, and it is not economically practicable.

An attempt was made to obtain complete eradication of citrus canker by the application of strong formalin sprays and Bordeaux mixture, together with careful pruning, on a small isolated plot of calamondin, mandarin orange, and lime trees. Negative results were obtained, the canker recurring in a number of cases after all apparent sources of infection were removed. More exhaustive experiments would be necessary before this evidence could be regarded as conclusive in the case of the less susceptible varieties, though it is probably correct for the limes. In a district, such as Florida, where the extremely susceptible varieties predominate, the total exclusion of the disease, the complete eradication of all affected hosts should it appear, or the substitution of more resistant species or varieties, are apparently the only means of preventing heavy losses from citrus canker. Control of the disease, impracticable in these cases, is well worth while in areas where the less susceptible varieties are grown, in some of which, as in Alabama and Mississippi where varieties such as Satsuma predominate, it may be even unnecessary.

LYON (H. L.) & LEE (H. A.). **Citrus canker in the Hawaiian Islands.**—*Phytopath.*, xi, 9, p. 377, 1921.

The disease has been found in two orchards, one near Honolulu, and one at Kilauea. Since citrus growing is of minor importance there, eradication measures are not considered advisable.

BURGER (O. F.). **Variations in Colletotrichum gloeosporioides.**—*Journ. Agric. Res.*, xx, 9, pp. 725–736, 1 pl., 2 figs., 1921.

Wither-tip, leaf-spot, anthracnose, and tearstain of citrus plants are all caused by *C. gloeosporioides* Penzig, and have been found in Florida, California, the West Indies, South America, Australia, and Malta. The diseases appear to be worst in moist regions.

The author studied forty-six cultures of the fungus from California and other States. In culture they were found to vary as regards the colour of mycelium (white, grey, greenish, black), amount of aerial mycelium, and abundance of spores produced, but similar variations were found in successive transfers of the same isolation. There were, however, certain constant differences between the various strains in the size of the spores. The medium used affected the morphological characters of the fungus, and some of the modifications induced by prolonged culture on a particular medium were more or less persistent. In plate cultures of certain isolations, parts of the growth, usually in wedge-shaped or fan-like areas, sometimes showed mycelium of a different colour from that of the rest of the growth. These variations continued when transfers were made from the modified areas, and are regarded as mutations.

The author concludes that *C. gloeosporioides* is a polymorphic species made up of a number of strains. *Gloeosporium limetticolum* Clausen is probably one of these strains. Several strains of *C. gloeosporioides* produced the perfect stage when first isolated; this agreed with *Glomerella cingulata*.

LIPMAN (C. B.). **A contribution to our knowledge of soil relationships with Citrus chlorosis.**—*Phytopath.*, xi, 8, pp. 301–305, 1921.

Yellowing or blanching of citrus leaves was found to occur on soils with excess of calcium and magnesium carbonates (calcareous subsoils) or sodium and potassium carbonates. Such soils have a markedly alkaline reaction. The highly calcareous subsoils are mostly found underlying heavy black 'adobe' or 'dry bog' soils at a depth of from one to two feet.

Areas used formerly as sheep corrals, or sometimes areas habitually used for building camp fires, give the second type of chlorosis-inducing soils, rich in alkali carbonates and highly basic. An analysis of a 'corral' soil, and an adjacent soil on which normal citrus trees were growing, was made. The 'normal' soil had, in soil extracts, much greater total solids, non-volatile solids, volatile solids, nitrates, calcium, and magnesium than the 'corral' soil, but less phosphorus, potassium, and sodium. The iron content was about the same in the two. The explanation of chlorosis is considered probably to lie in the physiological balance of the salts in the two types of soil, as instanced by the diametrically opposite grouping of NO_3, Ca, and Mg on the one hand and P, Na, and K on the other, and the relation of magnesium and phosphorus is considered to be especially significant.

PATOUILLARD (N.). **Le Botryodiplodia theobromae sur le Cotonnier.** [*Botryodiplodia theobromae* on the Cotton plant.]—*Rev. de Bot. Appliquée*, ii, 6, pp. 41–42, 1922.

A number of cotton plants (*Gossypium punctatum*) received from Dahomey were found to be severely attacked by a fungus which the writer believes to be a local form of *Botryodiplodia theobromae*. The infected plants were stunted, the leaves being few and misshapen, and the fruit imperfectly developed, black, and remaining closed. The lint was in a shapeless agglomeration, often completely blackened, and always unfit for use. The cortex and wood of the stem and root were of an abnormal grey colour, caused by the brownish hyphae of the mycelium ramifying between the cells.

At the base of the stem, on an oval swelling several centimetres in length, small, isolated, black protuberances were found which traversed the epidermis and emerged on the exterior. They were also found, in decreased numbers, towards the upper part of the stem, and also on the larger branches and on the surface of the capsules. They were formed of a single or more commonly several black and hirsute pycnidia, with coriaceous cell-walls united by a stroma which was either compact and thick or consisted merely of fleecy hyphae. On the capsules the pycnidia were closely grouped, rounded, and with a smoother surface (sometimes quite smooth), than those at the base of the stems which were oval and pointed at the extremity. According to the maturity of the spores, their colour varied from white to brown, and finally black. They were smooth, oval, at first continuous, hyaline, granular, and with a large central drop, then uniseptate and brown, measuring 15 to 24 by 9 to 12 μ.

The fungus is believed to be a wound parasite, and to be found throughout hot regions, occurring with slight variations on a large number of the most diverse host plants.

Pests of the Oil Palm in the Portuguese Congo.—*Bull. Imp. Inst. Gt. Britain*, xix. 2, pp. 205–206, 2 pl., 1921.

The following description of *Ganoderma lucidum* (*Fomes lucidus*) as it occurs on the oil palm (*Elaeis guineensis*) in the Portuguese Congo, is compiled from the notes of Mr. R. Swainson-Hall. The fructification appears at or near the base of the trunk, and is generally about 10 to 20 cm. thick by 20 to 30 cm. wide, forming a semicircular sconce or bracket projecting from the trunk in the horizontal plane; the under side is velvety and of an ashen-white colour, occasionally with a yellow or greenish-yellow tinge. The external surface is hard, while the inside is softer and more closely woven. The internal tissues of affected trunks become friable and emit a musty smell. The presence of the disease is first indicated by the falling over of the older whorl of leaves, though the most certain symptom is the development of the fructification which only appears after the fungus is well established. The whole of the older whorl of leaves falls away from the erect or normal position and hangs down parallel with the trunk, the centre or youngest spike being the last to fall over. A longitudinal section through the base of the trunk reveals an ashen-grey powdery mass of rotten tissue with a very musty smell. *Ganoderma lucidum* is considered to be closely related to *G. applanatum*, if not actually another form of the same species.

Zeller (S. M.) & Owens (C. E.). **European canker on the Pacific Slope.**—*Phytopath.*, xi, 11, pp. 464–468, 4 figs., 1921.

Since 1911, when European canker was identified on the apple in Oregon, the disease has been reported from various localities in that State and in California. Cankers due to *Nectria galligena* Bres. or its imperfect stage, *Fusarium willkommi* Lind. have now been found in this region on several apple varieties, namely Red Cheek Pippin, Bismarck, Delicious, Winter Bellflower, Spitzenburg, and Newtown; and on D'Anjou, Howell, and Bosc pears.

The concentric arrangement of callus rings in old cankers, which is such a characteristic feature of the disease in Europe and the north-eastern part of the United States, is almost or entirely absent on the Pacific slope. Possibly on account of climatic conditions, the cankers spread very rapidly, extending from several inches to one or two feet in a single season, and remain more or less closed. Infections appear to take place chiefly at small, sappy, pruning cuts, or in the crotches of large branches or of the fruiting or leaf spurs. Sun scald, winter injury, or other physiological disturbances assist infection.

The fungus sometimes starts in the periphery of cankers produced by *Neofabraea malicorticis* on the D'Anjou pear. In many cases of winter injury both to Bosc and D'Anjou pears, *Nectria cinnabarina* (Tode) Fr., which appears to exist as a parasite at least on partially devitalized wood, also gains a foothold.

In Oregon the cankers on D'Anjou pear have been observed early in June, mostly as a result of infection the same spring. The stromatic cushions bearing macro- or micro-conidia first appear very near the seat of infection, but, as the canker increases in size, new ones develop further out. The perithecia develop later in these conidial pustules. The duration of the conidial stage is from the early spring to October at least.

In the early stages of the canker, especially on pear, the raised portions of the bark have a spongy, oedematous character. This condition is succeeded by an irregular peeling off of the epidermis. The exposed portions of the cortex are black and moist. As the cankers grow older, the diseased bark becomes cracked and furrowed, sometimes irregularly, but often on more or less concentric lines. These concentric fissures probably represent a periodicity of growth of the fungus due to atmospheric changes, and must not be confused with the concentric annual growths characteristic of the open type of canker found in other regions.

RANKIN (W. H.) & HOCKEY (J. F.). **Mosaic and leaf curl of the cultivated Raspberry.**—*Canada Dept. of Agric., Division of Bot. Circ.* 1, new ser., 3 pp., 1922.

The two diseases of the cultivated red raspberry here dealt with have been in the past both included under the name 'yellows'. Recent work has shown them to be distinct. They have been reported at various times as a cause of serious loss in different parts of North America, and mosaic has increased in the Niagara district during the past two years, until it is now epidemic, an average of 20 to 30 per cent. of the commonly cultivated Cuthbert variety being affected. The few plantations of the variety Marlboro are even more severely attacked. The Herbert raspberry, on the other hand, is only slightly affected (1 to 3 per cent.) except when grown adjacent to the other two. Since the diseased bushes never recover, the position is serious.

Mosaic can be recognized, even from a distance, by the dwarfing of the canes, the sparse yellow foliage, and thin growth. The leaf symptoms are best seen on the current year's suckers, on which, before the middle of June, the leaves show large, irregular, green blisters which arch upwards, the tissue between the blisters being yellowish. Later on the top leaves show a fine, yellow, speckled mottling. Leaves put out during very hot weather do not show symptoms. On the fruiting canes the leaves are only about half the normal size and show the green blisters or yellow speckling. The fruit is worthless on bushes diseased for more than a year, being dry and tasteless. Spread takes place chiefly along the rows, not missing any bushes.

Plants with leaf-curl are marked by bearing leaves on both first and second year canes that are darker green than normal and have the midrib bent downwards throughout its length. A similar bending of the main lateral veins causes a downward curling of the whole of the leaf margin. The tissue between the veins arches upwards and is crimped along the veins. The fruiting laterals are short and upright, and the suckers, after the bush has been diseased for a year or two, are dwarfed and usually end in a yellow, stunted top. The fruit is dry and seedy and should not be picked. As the affected bushes are worthless they are usually dug out early and the average incidence of the disease (from 2 to 6 per cent. in the Cuthberts) noted in 1921 in the Niagara area represents only the annual loss. The Marlboros and Herberts are rarely attacked.

Both diseases are infectious and are spread by the same agent, the small plant louse *Aphis rubiphila*. The variety Herbert is believed to be avoided by these insects ordinarily, though they will pass to it when it grows near the others. This is believed to be the reason why it usually escapes when grown alone. Infection is not spread by the pruning or cultivating implements, and new plants may be safely set in spaces from which diseased ones were removed. The aphid is believed to be the only agent of spread.

For control it is recommended to plant only disease-free stock and to remove all diseased plants at the time of year when spread does not take place (i.e. when the aphids are not active). It is not believed that the aphids can travel far, as no winged stage has been found. Varieties possessing true immunity are apparently not known as yet.

PROTZEN (K.). **Die Krebsfrage in physiologischer Beleuchtung.** [The canker problem from a physiological aspect.]—*Deutsche Obstbauzeit.*, lxviii, 6–7, pp. 62–63, 1922.

The author states that investigations during a number of years indicate that canker in apple-trees is constantly associated with water-logged acid soils, and soils rich in nitrogen and deficient in minerals, while it is infrequent on moderately fertile, non-acid, permeable sandy and clay soils. It is invariably prevalent where the subsoil consists of pyrites or peat. Certain varieties of apple have a hereditary predisposition to the disease.

Two trees of a susceptible variety were planted close together in marshy soil with a peat subsoil, building refuse and lime being mixed with the soil round one. In three years the latter was a fine tree with excellent fruit and free from canker, while the other was literally covered with cankers. A low-lying apple orchard periodically flooded with the albuminous lye from a starch factory had all the trees cankerous from the nitric acid developed in the soil. The same was the case in several orchards on sandy soil flooded with ditchwater, where the subsoil contained sulphate of iron, the acid in this case being sulphuric.

The acid is believed to act chiefly on the medullary rays, which are weakened and unable to stand the effects of frost and other destructive agencies. The *Nectria* associated with canker is believed to be a purely secondary occurrence.

Susceptible varieties are stated to include Golden Pearmain, Landsberger, and Bellefleur, while Gravenstein, Boskoop, and Grey Reinette are seldom attacked even on 'canker soils'.

PEYRONEL (B.). **Una grave malattia del Mandorlo prodotta dal Fusicladium amygdali Ducomet.** [A serious disease of the Almond produced by *Fusicladium amygdali* Ducomet.]—*Nuovi Ann. Minis. Agricoltura*, i, pp. 27–44, 7 figs, 1921.

The author reports a serious disease of almond trees, observed at Rome in 1919. It is caused by a fungus identified as *Fusicladium amygdali* Ducomet (*Ann. École Nat. d'Agric. Rennes*, iv, 1910).

The symptoms are a more or less heavy defoliation, especially of the lower branches, combined with dropping of the blossoms and young fruit in the spring. By the beginning of October the affected trees were almost bare of leaves and many of the twigs were dead. The parasite overwinters on the branches and attacks the buds and new shoots in the spring, but does not make much progress until these and the leaves have reached a certain stage of development. The blossoms and fruits are not directly attacked, their dropping being apparently due to lowered vitality of the bearing twigs with, in some cases, infection of the fruit stalks. The older branches and those of trees fully exposed to the sun were more resistant to attack than younger ones or the succulent branches of shaded trees.

The disease on the leaves appears in the form of small rounded or sub-polygonal spots, covered with a velvety olivaceous conidial efflorescence, on the underside, the upper surface being less often and less markedly spotted. The spots progress, especially on the larger fleshy leaves of the younger shoots and in shaded parts, until they may cover the whole surface of the leaf, which then dies and falls off. On the smaller, tougher leaves of older shoots and those exposed to the sun, the spots may remain minute, without coalescing, and gradually turn reddish and dry up. Though surface extension is checked in these cases, the mycelium penetrates through the thickness of the leaf and causes a spot on the corresponding part of the upper surface. Ultimately the diseased area is cut off and falls out, leaving a perforation similar to the 'shot hole' caused by *Clasterosporium carpophilum*, but not leading to much defoliation.

On the branches the spots are chiefly on the lower shaded surface especially near the buds. On young, succulent parts they are dark green, later becoming pale and oily in appearance and then brown and with raised crusts which may extend over large patches. On older and exposed branches the spots are reddish from the development of anthocyanin, later becoming brown and crusty as a result of the formation of wound cork in the sub-epidermal tissues. The centre of the spots may ultimately become depressed from drying up and collapse of the tissues. The olivaceous efflorescence formed by the conidial fructification is found on young branches, on shady parts, and at the periphery of the old crusts. It may be absent, but usually forms freely in moist weather on the succulent shady parts. Many of the affected branches wither, drying up from the tip backwards.

The fungus is a sub-cuticular parasite in the earlier stages of its development both on the leaves and branches, remaining confined to the cuticle, or between the latter and the cellulose part of the outer epidermal wall. It only penetrates the underlying tissues after their death. The sub-epidermal cells are killed in advance of penetration, but whether by drying out or by the diffusion of a toxin was not ascertained. On the branches a layer of cork is formed in the cortex, which is most strongly developed in the older or more exposed parts; in young succulent shoots it is thin (though often very extensive), or may even be absent, the walls merely becoming suberized in this case. The mycelium ultimately penetrates the hypodermal layer, at first between the cells, but after their death within them. Penetration is most marked in the upper angle of the buds. The bud scales are also filled with mycelium, and pycnidia were found in this locality, though the author is not able to say definitely that they belong to the same fungus. Small, sub-cuticular stromatic aggregations of mycelium are often found, especially on the branches.

The dendritic mycelium of the sub-cuticular stage is hyaline and thin-walled at first, then turns brownish and thick-walled as the cuticle is destroyed. The deeper mycelium also turns brown after the cells are killed. Conidia are formed in a manner similar to those of *Fusicladium pirinum*, on olive-brown erect conidiophores, which may be forked above and frequently show knee-bends where the earlier conidia were inserted. The conidiophores are up to 120 μ long by 4 to 7 μ broad, with 1 to 3 septa, and numerous papillae towards the tip marking the points of insertion of the conidia. The latter are variable in form, often piriform, clavate, or fusiform, apiculate, and slightly narrowed in the middle where there is sometimes a transverse septum. Before germination most of the unicellular conidia become septate at this point, a second septum also occasionally developing. They are most frequently 15 to 20 by 4·5 to 5·5 μ in diameter.

The fungus is considered to be xerophilous and very closely related to *Fusicladium cerasi* and *F. pruni*, with which it is perhaps morphologically identical though differing in its parasitic properties. The author is inclined to doubt whether differences in infective capacity on different hosts form a good ground for separating species.

Treatment on the same lines as commonly practised against apple and pear scab is believed by the author to be likely to be effective in controlling the disease, though he has not had an opportunity of testing it experimentally. Snails are said to play a part in disseminating the conidia, which survive passage through the alimentary canal and germinate freely in the excreta.

DUFRÉNOY (J.). **Les maladies du Melon.** [Diseases of the Melon.] —*Ann. des Épiphyties*, vii, pp. 405–420, 16 figs., 1921.

A serious disease of melons in the south-west and south-east of France is described in detail. It appears to be due to a double infection by a *Fusarium*, which the author identifies as *F. solani* (Mart. p.p.) var. *cyanum*, subvar. ?, and a motile Bacterium not identified. The latter is present from the commencement of the lesions and always precedes the infection by *Fusarium*, which is believed to be of a secondary nature. The morphological and cultural characters of the fungus are fully described.

The disease causes a collar rot and a wilt, the latter being the result of a cankerous necrosis of the underground parts of the plant, and therefore not a true vascular wilt. The aerial parts are said to be affected by toxic action at a distance from the seat of infection, and take an oily translucent appearance, distinct from that induced by drought. No evidence is detailed establishing the existence of this toxin.

Infection occurs through the rootlets, usually at the tip, which rots, dries up, and turns brown, or through lesions caused in the roots by the destruction of lateral rootlets. The browned vascular tissue of infected roots can be traced to the collar or even higher up the stem, lateral spread of infection taking place to a lesser extent. Above the limit at which the mycelium of the *Fusarium* can be detected in the vessels the brown colour is still present, the walls of the tracheids and neighbouring cells being delignified, thickened, granular, and suberized. There is an abundant development of tyloses, and numerous bacteria are found in these and in the lumina of the vessels. The wood parenchyma is filled with a yellow gum, and the cortex and medullary rays in the vicinity react by the production of a layer of cork which tends to isolate the infected area.

The common variety, Cantaloup de Bellegarde, is the most susceptible to this disease, which the author thinks can be best combated by the selection of resistant strains. Attacked plants should be pulled out and destroyed, contamination by the accidental transport of infected soil or implements from diseased to healthy fields avoided, and a long rotation practised.

Other bacterial diseases of melons, including one which resembles the wilt caused by *Bacillus tracheiphilus*, not hitherto reported in France, are briefly referred to.

ROBERTS (J. W.). **Plum blotch, a disease of the Japanese Plum, caused by Phyllosticta congesta Heald & Wolf.**—*Journ. Agric. Res.*, xxii, 7, pp. 365–379, 1 pl., 1921.

Plum blotch has been present in Georgia since at least 1905 on the Japanese plum (*Prunus triflora*), but the causal organism, *Phyllosticta congesta*, was first described by Heald and Wolf on the leaves of *Prunus* sp. in Texas in 1911. Lack of demand, coupled with the great susceptibility of the Japanese plum to diseases and pests, have led southern growers, particularly in Georgia, to abandon its cultivation, but should this be revived, the writer thinks that the disease under discussion will prove a formidable obstacle, as it is very destructive and its control would most likely present serious difficulties. The varieties affected were Abundance, Burbank, and an unnamed seedling. Not only the fruit, but the leaves and possibly also the twigs, were attacked, the lesions produced by the parasite greatly resembling those of apple blotch caused by *P. solitaria* E. and E. The fruit was rendered almost worthless, being marked when unripe with raised dark-coloured areas, roughened by small blisters and depressions, and when ripe, with irregular brown patches consisting of an aggregation of from four to twenty small sunken spots. The affected tissues become hardened and leathery but do not decay. Small spots are also found on the leaves, sometimes as many as 200 on a single leaf. On the twigs there are small, light-coloured, sunken areas, but the pycnidia found here were empty, so that a positive identification could not be made. Elsewhere the spots bore numerous ripe pycnidia, those on the leaves being usually single in each spot. Morphologically the fungus is similar to *P. solitaria*. It is not known how it is carried over from one season to another but it is thought probable that it may winter on the twigs and possibly also on the leaves and fruits.

Notwithstanding the similarity existing between *P. congesta* and *P. solitaria*, the writer prefers to keep them separate, the more so as his repeated attempts to inoculate plums with *P. solitaria* failed. On the other hand, spores obtained from cultures of the plum fungus on sterile apple twigs applied to healthy plum fruits and leaves produced characteristic lesions of the disease.

No attempts have been made to control plum blotch, but in view of the injury to the fruit of the Japanese plum caused by effective solutions of fungicides, the writer foresees considerable difficulties in this direction.

GÄUMANN (E.). **Over een bacterielle vaatbundel ziekte der Bananen in Nederlandsch-Indie.** [On a vascular bacterial disease of the Banana in the Dutch East Indies.]—*Meded. Inst. voor Plantenziekten*, 48, 134 pp., 8 pl., 18 figs., 1921. [English summary.]

The most important banana diseases may be divided into three groups. (1) The Philippine bacterial disease; (2) the Pusa disease; and (3) diseases of the Panama type. In the last-named group must be included a disease first observed in Java in 1915, and named the Java vascular disease. Although nearly all the bananas grown in Java are attacked, no external change is apparent in 90 per cent. of the affected plants. In cases of extreme susceptibility, however, there are certain irregularities in the external development of the plant, especially partial or total arrest of the growth of the heart leaf, longitudinal splitting of the outer leaf-sheaths, and premature wilting of the crown. The internal symptoms are the discoloration and death of the vascular bundles of the rhizomes, and, in severe cases, also of those of the aerial parts. In some varieties the cell-sap exuded from these vessels is red in colour. Neither the external nor the internal symptoms are peculiar to the Javanese disease, the former resembling those caused by several other parasites, and the latter agreeing with those of the Panama disease.

Experiments have shown that the vascular bundles of absolutely healthy plants are practically free from organisms. Amongst cultivated bananas this was only observed in some plants of Pisang Radja that had been grown from seed. With relatively healthy plants, in which discoloured bundles occur in the root stock but not in the aerial parts, various organisms, especially bacteria and spores of species of *Fusarium*, are carried upwards by the sap stream. Furthermore, it is not uncommon to find local vascular lesions of relatively small extent both in the root stock and in the aerial parts, usually the result of external wounds. The organisms that were found in these local vascular lesions were shown to be incapable of producing disease in sound tissue. Of those found in lesions of greater extent, often extending from the rhizome up into the stem and sheaths, six species of *Fusarium* were isolated, which represent only a selection from the mass of strains of *Fusarium* occurring in the discoloured vascular bundles in different localities. This *Fusarium* flora is not uniform throughout the Archipelago; neither can any one species be demonstrated as constantly as *F. cubense* in the West Indies. Inoculation experiments with the isolated strains gave negative results, the *Fusaria* being unable either to grow into or discolour the healthy bundles. They are therefore not pathogenic, and none of the strains thus obtained can be considered identical with the *Fusarium* of the Panama disease. *Oedocephalum spinulosum* n. sp. was twice isolated from severely diseased rhizomes, and a Chytridiaceous fungus with sporangia and zoospores was found in the vessels, mingled with bacteria. The latter is doubtfully referred to the genus *Pseudolpidum* as (?) *Ps. musicolum* n. sp. Experimental evidence was obtained that these two fungi, of which a Latin diagnosis is given and the first is figured, are non-parasitic. Eight different species of bacteria were also isolated, of which only one, which is provisionally named *Pseudomonas musae* n. sp., was able to produce the characteristic vascular discoloration when inoculated through borings into the rhizome, aerial stem, and leaves, and is regarded as the cause of the disease. The successful inoculations were made in part on plants of Pisang Radja raised from seed. In the rhizome inoculations, the discoloration of the vessels was found to have extended 6 cm. or more in five days, while from those in the stem and leaf nerves it reached 40 cm. in the same time. The bacillus was re-isolated from the diseased vascular bundles. The injection of larger quantities of this organism, the morphology and physiology of which are very fully described, produced the typical external symptoms referred to above. Twelve plants were inoculated by boring the rhizomes, of which the seven that remained (five were lost by accident) were found a year later to be stunted, thin, and without suckers, except in two cases. One was dead and one had the stem split. The other plants in the field were healthy and had fruited. The discoloration of the vessels was confined to the rhizome in the still living plants. Further experiments showed that other genera of the Musaceae were susceptible to infection by *Ps. musae*, various species of *Ravenala*, *Strelitzia*, and perhaps also *Heliconia*, having been successfully inoculated.

The symptoms and pathological tissue changes in diseased plants are stated to be in part the result of secondary organisms that follow the primary cause of the disease. The latter brings about a discoloration and breaking down of the vessels. The mixed bacterial flora that follows extends this destruction and causes the invasion of the neighbouring cells. A copious formation of gum takes place, completely stopping the sap channels. *Fusarium* hyphae penetrate soon after the bacteria and grow up through the vessels and other cells of the bundles, completing their destruction.

The disease is disseminated chiefly by the planting of infected suckers, and possibly also by the cutting-knife, as in the gum-disease of sugar-cane. *Ps. musae* was isolated from the soil, which must therefore be regarded as a possible source of infection. All varieties seem equally susceptible, though in the case of *Musa textilis* the progress of the disease is less rapid. In West Java certain varieties, such as Pisang Radja and Radja-Sereh, are more liable than others, but this was not found to be the case elsewhere and may possibly be due to climatic conditions.

Control measures do not seem to have much prospect of success. The use for propagation of very young suckers before they have time to be penetrated by the parasite is recommended, the cut surfaces being treated with a disinfectant before planting. Subsequent infection through the root-system, however, may occur. The breeding of immune or resistant varieties is excluded, owing to the uniform susceptibility to the disease of all the Java varieties. The importation of banana rhizomes from America is considered undesirable.

The author does not consider that *Fusarium cubense* has been conclusively proved to be the cause of the Panama disease. He believes that the action of this fungus is similar to that of the species of *Fusarium* associated with the Javanese disease, and that in all probability it should be regarded only as a secondary factor in the causation of the disease. Owing to its toxic activity, however, the effects of *F. cubense* are more severe than those of the species found in Java and distinguish the genuine destructive Panama disease from the milder forms of wilt described above. Almost all those who have studied the Panama disease report the presence of bacteria in the vessels of diseased plants, and the author believes that the primary cause of both diseases will be found to be a bacillus, though he does not suggest that the same species is necessarily concerned. Other diseases of the same type for which a similar origin is suggested are those described by Basu in India, by Hori in Japan (Bonin Islands), and by various writers in Australia. Bunchy top [see this *Review*, i, 4, p. 108] seems to be included in these.

GÄUMANN (E.). **Onderzoekingen over de bloedziekte der Bananen op Celebes I.** [Investigations into the blood disease of Bananas on Celebes Island.]—*Meded. Inst. voor Plantenziekten,* 50, 47 pp., 8 pl., 1921. [English summary.]

For some years an extremely serious disease of bananas has been prevalent in Celebes and a neighbouring small island. The symptoms of this disease (which the natives have named 'blood' disease), are apt to be confused with those of the much less harmful Javanese vascular disease [see last abstract] which is common in the same area, as elsewhere throughout the Dutch East Indies. The blood disease, which is at present restricted to the localities mentioned, presents two distinct groups of characteristic symptoms, which involve the leaf crown and the fructification respectively.

The visible effects on the leaf crown are relatively late in appearing, usually after the fruit stalk comes out. First one of the younger leaves, generally the third or fourth from the youngest, begins to show discoloration, broad, light yellowish-brown stripes extending from the midrib towards the margin of the leaf. This condition may persist for some time without apparently affecting the rest of the leaf crown or the development of the fruit. Then suddenly the whole crown turns yellow, the leaves fall over, and the curious appearance is presented of a more or less green fruit stalk hanging down out of a withered crown. Only in one case has the writer known discoloration of the leaves to occur in young plants. In the fruits also the symptoms develop late, usually at the beginning of ripening, the fruit clusters up to that time being quite normal. They then turn yellow or brown, especially on the side touching other fruit in the bunch, become marked with darker spots, and appear exactly as though they had been baked. Finally they collapse and decay.

In the rhizomes and stem the disease causes similar changes to those produced by the Javanese vascular disease, especially as the reddened slime may also be found at times in the latter. The alterations in the fruits, however, are peculiar to the present affection. A yellow or brown discoloration of the central vascular bundles first occurs. This is not unlike the condition produced in the fruits in very severe cases of the other disease, but whereas in the latter no further extension takes place, the discoloration in blood disease extends into the placentae and parenchyma, and even to the bundles of the fruit rind. All the diseased bundles are filled with bacterial slime. The entire fruit then turns yellow, and its flesh is gradually dissolved. The cavity thus formed is filled to the base of the fruit with a slimy, brownish-red fluid containing innumerable bacteria. The fruits finally collapse and decay into a rotten mass. This fruit rot is absolutely characteristic of the blood disease.

In contrast to the Javanese disease, where the symptoms are produced by the more or less mechanical interference with the food supply, resulting from blocking of the vessels, the changes in the leaf crown in the blood disease seem to be due more to some physiological disturbance. The vascular interference is much less extensive in this disease than in the other, and is insufficient to account for the symptoms, which the author thinks are more likely due to the action of a toxic substance carried into the green parts from bacterial infection lower down. The symptoms first become strongly marked at the time when the physiological processes of the plant are especially active, namely, when the fruit stalk is formed and a great quantity of food material is being transferred from the rhizome to the developing fruits.

The inoculation experiments carried out were for the most part made with pieces of diseased tissue or some of the bacterial slime, without isolation of the specific organism. They were directed to establishing the presence of a pathogenic organism in the rhizome, discoloured bundles of the false stem, diseased tissue of the fruit, and in the reddish-brown liquid that ultimately fills the fruits; and to reproducing the symptoms of the disease by inoculations from these parts. From the rhizomes the results were somewhat contradictory, though the author is satisfied that the organism is present there, and can reproduce the disease if inoculated into rhizomes, false stem, and fruit. From small pieces of the discoloured vessels of the false stem infection was obtained with complete success on false stems and fruit, but was irregular on the rhizomes. Pieces of the yellowed parenchyma of diseased fruit and also the liquid in rotted fruits in the last stages of the disease were fully infectious on fruits and false stems of healthy plants, while the former caused some discoloration of the vessels in the rhizome, but none was produced by the liquid. Infections from yellowish fruit were found to cause the withering of the whole crown when made in the false stem, and to spread to the fruits when made in the axis of the fruit cluster.

Isolations were made of the organisms present in rotting fruits, by first inserting some of the liquid into sound fruits, and then making isolations from the margin of the resulting discoloration. Of the various bacteria that developed only one, a yellowish bacterium which will be fully described later, was found capable of reproducing the disease. Work with this organism is still incomplete.

The disease appears to be endemic in the whole of South Celebes. Not only is infection transmitted by the use of suckers from diseased plants, but experiments indicate that it is capable of independent life in the soil. Soil likely to be contaminated was used to inoculate healthy fruits and gave rise to the disease in some cases. Furthermore, evidence was obtained that it can be disseminated through the air, and the direct application of the bacterial slime from rotted fruits to the stamens during flowering caused infection of the fruits through the style to appear about a month later. It is possible that insects may play a part in disseminating the disease in this manner, especially as cases of natural infection of this type have been observed.

The author believes that there is no connexion between the two banana diseases on which he has worked, though in Celebes both may co-exist. His observations and experiments have convinced him that the blood disease is not a secondary infection superimposed on the common Javanese disease, and this should greatly simplify the question of its control.

Attempts to deal with it by the selection of resistant varieties have not given satisfactory results. Over one hundred varieties, indigenous and imported, were kept under observation from 1918 to 1920, but in the end they were all found to be diseased. The question of degree of varietal susceptibility has not yet been studied. On the first appearance of the disease the affected plants should be cut down and the rhizomes grubbed out, and piled in heaps on which lime should be placed. Burning them is difficult and slow. The natives sometimes dig deep trenches in infected fields, and fill them with lime before replanting. The rhizomes used for planting are then placed in a mixture of water and wood ash for a quarter of an hour, after which they are placed in the trenches and again plentifully fertilized with wood ash. Another measure frequently adopted on the first signs of discoloration is to cut away the suckers and then to dig a trench round the base of the affected plant, filling it with a thick layer of ash. The plants are said to bear good fruit as a result of this treatment, which probably acts by supplying a potash fertilizer at the critical stage of the disease. Until further work on the control of the disease has been carried out the author recommends the prohibition of the export of propagative stock and of fruits from the areas in which the disease occurs.

PRITCHARD (F. J.) & PORTE (W. S.). **Use of copper soap dust as a fungicide.**—*Phytopath.*, xi, 6, pp. 229–235, 1921.

The dust was made as follows: 'A hot aqueous solution of resin fish-oil soap or potash fish-oil soap solution of about the consistency of syrup was poured into a saturated solution of copper sulphate and stirred to bring all the soap into contact with the copper. The soap solution was made just thin enough to cause a chemical reaction with the copper sulphate.' The mixture was kept hot until the reaction was completed. The precipitate of copper salts of fatty acids was dried in the air and ground to a powder. Copper soap dusts containing crystalline copper sulphate and soap in the proportion of 1 to 4 and 1 to 6, respectively, by weight, were thus prepared. Lead arsenate at the rate of 2 lb. to 1 lb. of crystalline copper sulphate, and calcium arsenate at the rate of ½ lb. to 1 lb. crystalline copper sulphate were used in certain dusts. These dusts were tried under field conditions in 1919 and 1920, in comparison with copper soap liquid, Bordeaux mixture, and Sanders' copper-lime dust on tomatoes for the control of *Septoria lycopersici*. Good results were obtained in these tests from the copper soap dust, which has for two years at the Arlington experimental farm given as good control of tomato leaf-spot as 4–4–50 liquid Bordeaux mixture. It spreads, floats, and adheres better than Sanders' Bordeaux dust. It is cheaper than Bordeaux spray, considering the cost of application. The 1 to 4 and 1 to 6 copper soap dusts appeared to be equally effective.

MACCIONI (M.). **La pasta Caffaro e il supersolfo nella lotta contro l'Exoascus deformans.** [Caffaro paste and super-sulphur as means of combating *Exoascus deformans*].—*Bull. R. Soc. Toscana di Orticultura*, xlvii, 1–2, pp. 7–9, 1922.

In February 1921, experiments were carried out at the College of Pomology in Florence to ascertain the effects on *Exoascus deformans* of super-sulphur (4 per cent.) and Caffaro paste (2 per cent.). [See this *Review*, i, 3, pp. 66–67.] The results were that, though the disease was not entirely prevented, its incidence was greatly reduced by each of the fungicides, especially after two applications. The development of the fungus was checked, and the affected trees were able to put out fresh shoots. The untreated controls were unable to ripen their fruit owing to the heavy damage caused to their foliage by the disease.

WÄHLING (G.). **'Solbar' und 'flüssiger Schwefel' zur Bekämpfung des Apfelmeltaues, des amerikanischen Stachelbeermeltaues, usw.** ['Solbar' and 'liquid-sulphur' for the control of apple mildew, American gooseberry mildew, &c.].—*Deutsche Obstbauzeit.*, lxviii, 3, pp. 31–32, 1922.

The writer records successful results with both these preparations in experiments carried out for the Hanover Chamber of Agriculture. The apple mildew was in a virulent form in consequence of the hot weather, but was readily checked when taken in time, though it is noted that neglect of immediate spraying when the first signs of mildew appear greatly increases the difficulty of control. The most susceptible varieties are stated to be those with broad light-coloured or narrow grey-green leaves, especially the latter. But under the conditions of the season, even the normally very resistant Charlamowski variety was severely affected.

Pear scab (*Fusicladium*) was checked, and gooseberry mildew completely eliminated, by these preparations, repeated sprayings being given in the latter case as soon as the shoots were 15 to 20 cm. in length. One application was sufficient after flowering. Winter spraying is also necessary in this disease. Both disinfectants also proved extremely valuable in the control of club-root of cabbage. Though the plants were in such a condition that an improvement was scarcely to be expected, the application resulted in their gradual recovery and subsequent luxurious growth.

The writer strongly recommends the use of liquid in preference to powdered sulphur, as being cheaper, simpler, and more effective in consequence of its more equal distribution. 'Solbar' and 'liquid sulphur' are equally effective, but the latter is easier to manipulate and better in practice.

SEVERIN (H. H. P.). **Minimum incubation periods of causative agent of curly leaf in Beet leaf-hopper and Sugar Beet.**—*Phytopath.*, xi, 10, pp. 424–429, 4 figs., 1921.

Curly leaf is not transmitted by seeds from infected plants; 22,738 such seeds have been planted without a case of the disease developing. The beet leaf-hopper (*Eutettix tenella*), the only known carrier of the disease, is not infective when it first hatches from the egg, and it is therefore possible to carry out experiments with insects that are known to be free from infection.

The leaf-hoppers do not merely mechanically transfer the pathogenic factor: this fact was noted by Smith and Boncquet, and confirmed by the author in the following experiment. Non-infective nymphs were allowed to feed one to two minutes on a diseased leaf, then transferred at once singly to healthy plants, and allowed to feed for five minutes or less. This experiment was repeated forty-four times, but in no case did the healthy plant become diseased. Twenty-three of the nymphs, after feeding as above, were placed in a cage with a healthy beet; it remained healthy at the end of forty days; the twenty-one remaining nymphs were put in another cage with a second healthy beet, which became diseased, showing that the leaf-hoppers may sometimes become infective after a time, from feeding for one or two minutes on an infected beet. That infection of healthy beets by the leaf-hoppers is not a mechanical mass-infection phenomenon was demonstrated by allowing nymphs to feed for five minutes on diseased leaves, then transferring three nymphs to each leaf of a healthy plant for ten minutes, using thus six to twenty-one nymphs per plant: twelve beet seedlings so treated remained healthy. The 131 nymphs thus used were then divided among six cages, each containing a healthy plant; in only one of these cases was curly leaf developed, thus showing that though the leaf-hopper can become infective subsequently, after feeding five minutes on diseased plants, this is by no means a regular occurrence.

Tests were made in order to determine the minimum length of time required for leaf-hoppers to become infective after feeding on a diseased plant. This was found to be four hours at an average temperature of 100° F. (max. 103°, min. 94°). At lower temperatures more time was required, and negative results were obtained even after forty-eight hours at an average temperature of 67° to 73° F., but other factors (latent condition of disease-producing agent ?) than temperature may operate.

The minimum incubation period of the causative agent of curly leaf in the sugar beet, as judged by the length of time after inoculation required to cause the plant to become capable of infecting leaf-hoppers that fed on it, was found to be five days at an average temperature of 72·8° F. The leaf-hoppers feeding on beets may become infective as much as two days before visible symptoms of curly leaf appears on the plants on which they feed. Infected nymphs do not lose their infectiveness during moulting.

Robbins (W. W.). **Mosaic disease of Sugar Beets.**—*Phytopath.*, xi, 9, pp. 349–365, 1921.

This disease was found in increasing amount in Colorado during the years 1917 to 1920, and is distinct from curly-top which is rare in this region. The symptoms are fully discussed, the most characteristic being the mottling of the leaves, usually with some malformation (puckering of the mesophyll, bending back of the leaf near the tip, cessation of growth, and curling of the leaf margins), especially when the plants are grown in the greenhouse. Knot-like swellings on the veins and protuberances on the leaves, characteristic of curly-top, are not found in mosaic. Vascular and other adjoining tissues of affected plants show a pathologic condition resembling the phloem necrosis recorded for potato plants. Many of the phloem elements are filled with a brown substance and their walls are darkened and thickened. Starch transportation in the leaves is impeded. Plants sometimes lose the mosaic appearance later in the season, but probably still have the disease, for their roots when planted out give shoots bearing mosaic symptoms on their first leaves.

A number of observations and experiments are recorded which demonstrate that aphids (*Myzus persicae*) carry the infectious principle from plant to plant. The period of incubation was found to be from twelve to twenty-four days. Attempts to transfer the disease artificially by needle inoculations, injection of juice, and insertion of crushed mosaic leaves into slits in the leaf petioles and crown were unsuccessful. No evidence of seed transmission was obtained. The virus retains its vitality in beet roots, topped and held over winter to be planted out for the production of seed for the following season. This is the only method of over-wintering thus far known.

This is believed to be the first time mosaic has been reported on sugar beet, though other varieties of beet are affected in Europe.

Magrou (J.). **Symbiose et tubérisation.** [Symbiosis and tuberization.]—*Ann. Sc. Nat.*, sér. x, iii, 4, pp. 181–275, 9 pl., 9 figs., 1921.

The author undertook the present work with a view to verifying whether Noël Bernard's hypothesis of the fungal origin of tuberisation, demonstrated by him to be true in the orchids, could be established experimentally in other groups, more particularly in the potato (*Solanum tuberosum*) and *Orobus tuberosus*. The former presented the difficulty that in the course of long centuries of careful selection and cultivation it has become a highly domesticated plant, living in conditions very different from those of its natural habitat, and has lost the fungal symbiosis which is the rule for wild tuberous plants and which exists in the case of the Chilian wild potato (*Solanum maglia*), and of other perennial Solanaceae such as the nightshade (*S. dulcamara*). In order to study the part played by symbiosis in the development of the cultivated potato, the author sought, therefore, to restore the plant to its original normal conditions of existence in the presence of its former symbiont. For this purpose he sowed potato seeds in an uncultivated piece of waste land, under some bushes of nightshade in the roots of which the specific symbiotic fungus had been found to be present. On examining the plants raised from these seeds a few weeks later he found their roots to be invaded by a fungus identical with the normal symbiont of *Solanum maglia* and *S. dulcamara*. The plants grew further in two quite distinct ways: in some, the secondary shoots growing from the base of the main stem developed either into leafy aerial stems or into long underground stolons which never formed tubers; while in the others the secondary shoots developed into short stolons thickened into tubers behind their terminal bud. The microscopic examination of serial sections of the roots showed that each of these types of growth corresponded to a different reaction of the plant to the invading organism. In the tuber-producing plants the roots were widely invaded by a living mycelium, having the distinctive features of that of an endotropic mycorrhiza, showing that in this case a symbiosis had been established between the fungus and its host. In the plants without tubers, on the other hand, the fungus had also penetrated some cells of the roots, but had been rapidly digested by them. The invaded areas contained the fungus in a state of complete degeneration, and the invasion had evidently been very restricted in extent and duration.

The experiments showed that, under identical conditions, tuberization of the potato plant took place only when the latter had adapted itself to a state of symbiosis with the specific endophyte, and that in a poor soil and in conditions nearly the same as those under which wild plants grow in nature, symbiosis can be a decisive factor in the production of tubers.

Investigations carried out with *Orobus tuberosus*, the roots of which normally harbour a symbiotic fungus, gave similar results. Seedlings of this species grown under aseptic conditions in nutrient agar did not produce tubers, and their basal buds gave rise to leafy aerial stems, while in seedlings cultivated in soil in the presence of their specific symbiotic fungus, the differentiation of the basal buds was inhibited at an early stage, and they formed into tubers; microscopical examination showed that in this case the roots were invaded by the fungus and that symbiosis was established. In an annual species of *Orobus* (*O. coccineus*) it was found that the roots were freely invaded by the endophyte, but the latter was rapidly digested and killed by the root cells.

The evolution cycle of *Solanum tuberosum* is characterized by a well-marked alternation of the phases of differentiation and of tuberization. The tuber, on being sown, starts to develop its eyes (buds) into leaf-bearing stems with or without rudimentary flowers, while the secondary buds at the base of the stems grow into slender underground stolons which often turn upwards at their extremity and appear above ground to give rise to new leafy stems; after a certain time, the apical buds of the stolons cease differentiating into stems and begin to produce tubers, while the further development of the aerial parts of the plant is checked and they finally die. In *Orobus tuberosus*, on the other hand, once the tubers are formed by coalescence of the basal buds, they continue to grow in volume indefinitely, at the same time producing buds which develop into slender stolons which, in their turn, can produce aerial stems. Of these two typical forms of development, the first is connected with intermittent, and the second with continuous, symbiosis.

In the Ophrydeae also two different forms of development may occur according to whether the plants grow in or out of symbiosis with fungi; in the former case they are reduced to a single aerial stem and their basal buds produce perennial organs; in the latter they are bushy from the very start and possess no perennial organs. In the cases in which similar essential vegetative differences characterize two species of the same family, such as *Mercurialis perennis* and *M. annua*, the same relationship can be traced between symbiosis and the external growth of the plant. In the former, which has thick rhizomes and a stem unbranched at the base, there is a well-established endotropic mycorrhiza, while in the latter, where there are no rhizomes and the stems branch from the base, the roots are free from living fungus, though digested fragments are numerous. Statistical data as to the distribution of mycorrhiza indicate that, as a general rule, wild perennial plants harbour symbiotic fungi, while annual plants are free from them. The study of three annual plants (*Orobus coccineus, Mercurialis annua, Solanum nigrum*) has shown that, like their perennial congeners, they can be penetrated by endophytes, but that they very soon get rid of the latter by an active process of digestion which the author compares with phagocytosis. As soon as the mycelium reaches the middle layer of the cortex of the roots and begins to form into clumps, the latter are digested by the cells penetrated by them, and degenerate completely; the digested hyphae can still be recognized, but they have lost all the structural characters of a living mycelium; the protoplasm has disappeared and the walls are retracted and take a deeper stain than is usual.

The relations between endophytic fungi and the plants which harbour them may be of different kinds. Against the invasion of the former there may be a more or less successful resistance on the part of the latter. If the fungus gains the upper hand, destructive parasitism results. Successful defence is indicated by the degeneration of the fungus after a relatively brief period. When virulence and resistance balance, symbiosis is established; symbiosis is thus a state of equilibrium between the immunity reactions of the host and the parasitic activities of the invading micro-organism. The processes made use of by the higher plants in resisting invasion are of three kinds: first, the fungus may be stopped by the mechanical resistance opposed by the cell walls of the organs attacked; secondly, when this resistance is conquered, it can be checked by a more or less early 'phagocytosis', i.e. digestion by the cells it invades; and lastly, in the case of both organisms becoming mutually adapted to life in common, it is evident that these two processes having failed to keep out or destroy the fungus, some further method must be made use of to keep its development within bounds. This the author thinks is to be sought in the physico-chemical properties of the cell-sap. He compares the formation of clumps and 'arbuscules' in endophytic fungi to the agglutination of bacteria under the influence of humoral immunizing bodies. Noël Bernard claimed to have demonstrated the presence of specific antibodies in the orchids. Fungicidal and agglutinating humoral properties are, therefore, believed by the author to reside in the cell-sap of the host plant, and to be an important means of defence against invading fungi. Thus a remarkable parallel can be drawn between the processes used by plants to resist fungous attack and the immunity reactions in animals.

The effect of the endophyte in provoking tuberization is believed to be the result of an increased concentration of the cell-sap, brought about by the enzymic activity of the fungus. This is based on the fact that tuberization in the orchids and other plants can be produced in the absence of the fungus by growing in concentrated media, and experiments have shown that certain of the endophytes increase the concentration of the solutions in which they are cultivated. Hence it is probable that, under artificial conditions of cultivation, plants like the potato develop tubers even in the absence of their endophyte, because they are grown in rich soils with a relatively high molecular concentration of the soil solution.

ROMELL (L. G.). **Parallelvorkommen gewisser Boleten und Nadelbäume.** [Association between certain Boleti and Conifers.]—*Svensk Botan. Tidskr.*, xv, 2–4, pp. 204–213, 4 figs., 1921.

At Kristineberg, on the west coast of Sweden, the writer was struck by the occurrence of the butter fungus (*Boletus luteus*) in fairy rings round the young plantations of mountain pine (*Pinus montana*). In other parts of the district the fungus in question is practically absent. Further investigations and inquiries in different parts of the country confirmed this association, though the fungus was also found under *Pinus austriaca* and *P. silvestris*. Similar instances have been recorded by other writers, e.g. Quélet, who states that *Boletus boudieri* occurs in association with *Pinus halepensis* and *P. pinaster* (*Flore mycologique de la France et des pays limitrophes*, 1888). So also *Boletus elegans* is found only under the larch, being present even before the special larch humus, composed of larch-needles, &c., has been formed. The writer has seen it in Swedish plantations of three-year-old larches (*Larix europea*, *L. sibirica*, and *L. leptolepis*).

In the case of *Boletus luteus* at Kristineberg, it was specially noticed that no trace of any modification in the soil, due to the action of the pines, was discernible. The association cannot therefore be explained in the same way as certain other cases of specialization, such as the exclusive occurrence of *Naucoria suavis* under alders and *Tricholoma psammopus* under larch, which are due to a preference of the fungus for a particular type of humus. Wherever pines were present *Boletus luteus* showed no marked preference for any particular type of soil, thriving equally well in dry sand or heavy clay.

Attempts to trace a direct connexion between the mycelium of the fungus and the roots of the pines could scarcely be expected to give conclusive evidence that the Boleti are concerned in mycorrhiza formation, but the observations carried out lead the writer to believe that such is the case. The chief difficulty of definitely proving that these fungi form mycorrhiza is the fact that their spores have not hitherto been germinated, in spite of numerous attempts, and probably require very special conditions for germination.

SPENCER (E. R.). **Decay of Brazil nuts.**—*Botan. Gaz.*, lxxii, 5, pp. 265–292, 5 pl., 3 figs., 1921.

Brazil and cream nuts (the seeds of *Bertholletia nobilis* Miers and *B. excelsa* Humb. and Bonpl.) are harvested and transported from January to March, when heat and moisture favour fungous growth, and very often cargoes of these nuts arrive at their destination with nearly one-third spoiled. In spite of legislation, Brazil nuts reach the consumer containing from ten to twenty-five per cent. of spoiled nuts, and in 1919 the loss resulting therefrom and falling directly on the consumer, was, in the United States alone, estimated to exceed $850,000. As these nuts do not become rancid very readily, they are not placed in cold storage either during transit or on arrival, and very frequently the rooms in which they are kept by the retailer are very hot and not always dry, thus encouraging fungous attacks. The pericarps differ in porosity, and the more porous readily become infected under these conditions. The fungus may enter the nut through the pores of the shell, provided the water content of the kernel is adequate for its support, and given favourable storage temperature. Another possible, and perhaps more usual, point of entry is offered by the narrow cavity found in the micropylar angles of the seed which extends the entire length of the shell.

The following diseases are described:

1. *Black crust.* Fully five per cent. of all unsound Brazil nuts are found to have this disease, which cannot be detected externally. The affected kernel is dull black in appearance and—in cases where the whole nut is attacked—reminiscent of a large sclerotium. The blackened portion consists of a thin layer, 100 to 250 μ in thickness, and is apparently quite unconnected with the tissues beneath, which, apart from their light brown colour and pungent nutty odour, seem normal. The mycelium is confined to the endosperm, and is often free from admixture with any other organism, so that isolation is easy. The fungus is a species of *Pellionella*, differing in its conspicuously larger spores from the only species of this

genus previously described, *P. deformans* Penz. and Sacc. It is named and described as *Pellionella macrospora* n. sp.

2. *White mould.* Less common than the preceding and responsible for not quite one per cent. of the decay in Brazil nuts, this disease is not easily detected, though affected nuts are below the average in weight, and on being opened the kernel is found covered with a white fluffy mycelium, which penetrates to the centre of the radicle and fills all the cracks and cavities. Soon after exposure the very tenuous hyphae collapse and the endosperm, which is sulphur-yellow in colour and more than twice the normal thickness, becomes visible. The organism is a *Cephalosporium*, *C. bertholletianum* n. sp.

3. *Dry rot.* This is caused by a species of *Fusarium* belonging to the section Eupionnotes of Wollenweber. The shell of affected nuts is mottled, and on the whole the colour is lighter than normal, while the weight is much below the average. The kernel is sound in appearance, but adheres more closely to the shell and is in reality a mass of mycelium. No perithecia were observed in culture, but sclerotia appeared on autoclaved rice.

4. *Aspergillus decay* has already been reported by Kuhl ('Ueber eine eigenartige Veränderung der Paranuss,' *Pharm. Zentralb.*, li, p. 106, 1910). The cases examined by the author are not easily detected, as there are no external symptoms except in the most advanced stages of the disease, when there is appreciable loss in weight. The odour of the affected kernel is very rancid and slightly putrid, while the taste is at first sour and later very bitter. It is thought that the disease is far more prevalent than commonly believed, but in its advanced stages it is less frequently met with than 'black crust'. Kuhl considers that nuts affected by the fungus, which he identified as *A. flavus* Mont., are poisonous, and states that the discoloration caused by it is not pronounced enough to prevent their consumption. The mycelium penetrates to the centre of the radicle, and appears as a white mould on the walls of the central locule, which is filled with a mass of spores when the kernel cracks open. Cultures submitted to Thom were stated to belong to the *A. tamari* series [see this *Review*, i, 3, p. 91].

5. *Bacterial decay.* A hitherto apparently undescribed spore-bearing bacillus, with which the author is dealing in a separate paper, occurs on Brazil nuts, rendering the shell black and greasy, usually causing a rancid odour, and converting the remains of the kernel into a small white mass.

6. *Actinomyces decay.* This is due to an apparently undescribed species, to which the author has given the name of *Actinomyces brasiliensis*, n. sp. The nuts affected with this disease are empty, and give a characteristic musty odour when opened. The inner shell wall is covered with pinkish, velvety pustules, having a diameter of one to several millimetres. An intercellular proteolytic enzyme is produced by this organism, and also by the bacillus mentioned in the preceding paragraph.

7. *Phomopsis decay.* Of the experimental nuts, which were bought from wholesalers and retailers, only one was found affected with this disease. It is due to *Phomopsis bertholletianum* n. sp., a species differing from *P. aucubicola* Grove only in having shorter

A-spores and in occurring on an unrelated host. There is no external symptom of the diseased condition of the nut, the odour being pleasant and taste agreeable even when the mycelium has penetrated into the radicle a considerable distance.

8. *Bitter rot* is caused apparently by a *Myxosporium*, but examination could not be carried far, as neither the mycelium nor the spores in the specimen to hand were viable.

The organisms mentioned are fully described, and notes on their cultural characters are given.

ATKINS (W. R. G.). **Note on the occurrence of the finger and toe disease of Turnips in relation to the hydrogen-ion concentration of the soil.**—*Scient. Proc. Royal Dublin Soc.*, xvi, N. S., 32, pp. 427–434, 1922.

The occurrence of the finger and toe disease (*Plasmodiophora brassicae*) has been associated for a long time past with a deficiency of calcium salts in the soil. The author has recently examined soil samples from two adjacent fields in Cork County, of which one grew healthy turnips without a trace of the disease, while the other was so badly infected that turnips or cabbages could not be grown in it. The soil in both these fields was clay, but they contained 0·17 and 0·40 per cent., respectively, of lime, the latter being in that which bore healthy crops. The calcium content in this case is very near the border-line for the occurrence of the disease, previous observers having reported it in clay soil with 0·39 per cent. of lime. The acidity of the samples was determined by the colorimetric method, the bad field being found more acid than the good field by P_H 0·1 (P_H 6·6 and 6·7 respectively). The actual numerical concentrations of hydrogen ion were, respectively, C_H 0·25 and $0{\cdot}20 \times 10^{-6}$ gm. per litre.

The exact manner in which a deficiency of calcium salts makes the plant more susceptible is not known, the possibility that it is due to an inhibitory action of a neutral or slightly alkaline medium on the growth of the parasite requiring to be tested by more exact methods (such as that here employed) of determining the acidity of diseased and healthy plants.

ERIKSSON (J.). **Das Leben des Malvenrostpilzes (Puccinia malvacearum Mont.) in und auf der Nährpflanze.** [Life of the Mallow rust fungus (*Puccinia malvacearum* Mont.) in and on the host-plant.] *Kungl. Svenska Vetenskapsak. Handl.*, lxii, 5, 190 pp., 31 figs., 1921.

As a result of observations and experiments extending over the period from 1912 to 1920, the author considers that there are two distinct stages or phases in the vegetative development of the common Mallow rust, *Puccinia malvacearum*. The first of these is the ordinary mycelial condition resulting from infection from sporidia produced on a normal short promycelium. The mycelium developed from these sporidia produces new rust sori in eight to ten days after infection. The other phase corresponds with the author's well-known conception of the mycoplasm, and is derived from infection by conidium-like bodies produced on the end of a long germ-tube by segmentation of the tip of the latter. It does not form sori while in the mycoplasmic stage. The teleutospores formed by this rust are of two kinds, indistinguishable morphologically. One, which the author terms autumn spores, is borne on young plants in the first season of their growth and on second-year plants from the end of July to October. These spores can germinate according to circumstances in both the manners referred to above—either by forming a promycelium and sporidia or by a germ-tube with conidia. The second form, the summer spores, is developed on second-year plants during the months May, June, and July. It germinates only by the formation of a germ-tube with conidia. Hence the autumn spores can give rise to either a normal mycelium or a mycoplasm, while the summer spores form only the latter.

The course of the disease corresponds to these two functions of the infecting spores. In newly-planted plants there may be a period of complete freedom from infection, followed by a period of mild attack in June and July. This is followed again by a period of very severe infection in August when every leaf may become covered with pustules. In certain cases the first period of mild infection does not appear, and the author distinguishes the plants in which this occurs as belonging to 'healthy lines'. Such healthy lines, if kept free from outside infection, will grow through the autumn without showing any signs of rust, but they will become infected in late July or early August if growing near previously diseased plants belonging to what the author calls 'diseased lines', that is those which show the early period of mild attack. In the author's view the healthy lines become infected by the autumn spores borne on the diseased lines. These autumn spores appear in the first year (on plants sown in May or June) during September and October, but also reappear in the second year as early as the end of July. Healthy lines infected by them become diseased lines. In some cases the autumn generation of the fungus persists into the spring of the following year and may lead to infection with a development of sori on healthy lines in the vicinity as early as May. This was only observed in 1914. When precautions were taken to remove all diseased or suspicious leaves, &c., that had lasted through the winter, only the usual mild outbreak occurred in May to July.

The two phases of the vegetative life of the parasite are differently affected by the action of fungicides added to the soil. Weak solutions of copper sulphate (1 to 3 per cent.) will check the development of the mycoplasmic stage, and can produce a decided effect in reducing the first or mild period of the annual rust outbreak from May to July. They have no effect whatever on the second, virulent, period from August to October. The solution was found not to injure the hollyhock plants in concentrations below 6 per cent.

It is believed that the vitality of the pathogen in diseased lines may become lowered under certain conditions. Thus, in 1915 and subsequent years the first (mild) period of attack was absent in several of the diseased lines; and in 1918 and 1919 two diseased lines became healthy, presumably from the extinction of the vitality of the internal germ. A heavy outbreak in the autumn on seedlings of the first year is not necessarily followed by a severe attack on the same plants in the second year of their growth. There are also indications of varietal and individual variations in resistance and susceptibility to the rust.

BROWN (W.). **Studies in the physiology of parasitism. VIII. On the exosmosis of nutrient substances from host tissue into the infection drop.**—*Ann. of Botany*, xxxvi, 141, pp. 101–119, 1 fig., 1922.

In the earlier papers of this series attention was chiefly directed to certain aspects of the influence of a parasite on the host plant which it attacks. The converse relation of host to parasite is examined in the present paper, as it appeared not improbable that the host plant might be able to influence in some way the behaviour of the parasite.

The author gives a detailed description of a series of experiments carried out by him with a view to establishing the influence of passive exosmosis of nutrient materials from the cells of the host plant through the cuticle on the behaviour of a parasite prior to penetration. The method of experiment was generally as follows: drops of distilled water of a standard size were laid on the surface of plant organs (foliage leaves and petals of flowers) and allowed to remain there for a certain time. They were then removed and examined to see whether any change had taken place in them due to their having been in contact with the plant. Two methods of examination were adopted: (1) determination of the electrical conductivity of the fluid, and (2) determination of the effect of the fluid on the germination of fungal spores, *Botrytis cinerea* being the organism used in the tests.

The conclusions arrived at by the author are that drops of water that have lain on the surface of the leaves and petals of a number of plants show increased conductivity (due to the leaching of electrolytes from the tissues) as compared with the original distilled water or with water which has lain for an equal time on glass slides. The amount of this increase varied with different plants used in the experiments, an important factor being the ease with which the surface can be wetted. If a new drop is placed where a previous one has been removed for testing, the exosmosis is increased. Rubbing the surface, even though gently, also increased the conductivity figure obtained. Better contact, through better wetting, appears to be the main cause of the increase in both these cases. In many cases (especially floral leaves) there is a marked parallelism between this increase in conductivity and the increase in the capacity of the drops to promote the germination of spores as compared with that of the original water. In some plants, however (e.g. broad beans), drops that have lain on foliage leaves, though showing a comparatively high degree of conductivity, display no greater power of promoting spore germination than drops of pure water, and sometimes (*Tradescantia*) may actually give a lesser germination, even extending to almost total inhibition. Not only is there a quantitative difference in the substances exosmosed from different plants, but evidently there is a qualitative difference also, these substances sometimes having no nutrient value or even inhibiting germination. Indirect proof of the exosmosis of nutrient materials can be obtained by a study of the incubation times of infection in different cases. The addition of nutrient to the infection drop has the effect of accelerating the incidence of attack, or in extreme cases brings about attack where none ordinarily occurs (e.g. on leaves of broad bean). Hence it might be anticipated that in plants which allow a large exosmosis to take place into the infection drop the time required for infection would approximate to that required for spores sown in a nutrient-extract infection drop, while in those that do not allow free exosmosis it would be delayed. It was found that with petals of *Cereus*, which allow free exosmosis, spores sown in pure water attacked almost as readily as those sown in turnip extract, whereas with *Gloxinia*, which gives a low conductivity figure in drops placed on the petals, the former attacked distinctly more slowly than the latter. A similar result was obtained when rose petals and those of *Cereus* were inoculated in an atmosphere of carbon dioxide, which is known to inhibit the germination of *Botrytis* spores, but can be neutralized by the addition of nutrient material; the former (which earlier tests had shown to give a low conductivity figure) were unattacked, the latter attacked. A further test was based on the fact that *Botrytis* spores will not germinate in pure water if sown too densely, but will do so at the same density in a nutrient solution. On *Cereus* petals the exosmosis of nutrient was evidently sufficient to permit germination at high densities of sowing, and free infection resulted, while with sweet pea, which gave a lower conductivity figure in the earlier experiments, there was little infection.

The rate of exosmosis into drops containing spores is identical with that into spore-free drops, up to and for some time after penetration by the fungus has taken place. This affords a striking confirmation of the view expressed in the earlier papers of this series that there is no diffusion of the active toxic principle of *Botrytis* through the unbroken cuticle, and that there is no effect on the host plant prior to this penetration, in other words, no 'action in advance of penetration', as claimed by earlier workers with this fungus.

Though these results do not touch on the problem of immunity in such cases as are furnished by some of the rusts, they have a bearing on a certain type of immunity such as that shown by bean leaves against *Botrytis*. Here the incidence of attack is dependent on the nutrition present in the infection drop. If there is no nutrient the attack fails, but if nutrient is present it takes place readily. [See also this *Review*, i, 1, p. 7.]

SOMMER (H.). **Kohlhernie-Bekämpfung mit Uspulun im Jahre 1921.** [Control of club-root of Cabbage with uspulun in the year 1921].—*Deutsche Obstbauzeit.*, lxviii, 5, pp. 43–44, 1922.

The application to heavily infected soil of a minimum strength of 0·5 per cent. solution of uspulun, preceded if possible by similar treatment of the plants in frames, almost entirely arrests the disease. Inoculation of the seed-bed soil with uspulun powder (120 gm. per sq. metre) gave less satisfactory results, but in the writer's opinion this was due to the fact that the seed was sown on the same day. Eight to ten days should elapse between inoculation and sowing, and the soil should be well watered immediately the powder has been mixed in.

Regulations for the importation of Potatoes, Currants, and Gooseberries into Canada.

By Orders in Council passed on 21 March 1922, the sections of the Regulations under the Destructive Insect and Pest Act, Canada, dealing with potato canker [wart disease, *Synchytrium endobioticum*] and the importation of currants and gooseberries on account of White Pine blister rust [*Cronartium ribicola*] were amended as follows: Subsection (a) of Section 7 was rescinded and the following substituted: Section 7. The importation into Canada of the following is prohibited: '(a) Potatoes from Europe, Newfoundland the Islands of St. Pierre and Miquelon, and the States of California Pennsylvania, and West Virginia. All shipments of potatoes from the United States of America shall be accompanied by a certificate duly signed by the consignor or stating the name of the State in which the potatoes were grown.'

The amendment under subsection (f) of Section 7 passed on 4 April 1919, was rescinded and the following substituted: Section 7. The importation into Canada of the following is prohibited: '(f) All species and varieties of currants and gooseberries (*Ribes* and *Grossularia*), but not including the fruits of these, from all foreign countries. Provided, however, that the importation of said vegetation shall be permitted without any restriction into the province of Ontario from the State of New York.'

Regulations governing the importation of Potatoes into the United States.—*U.S. Dept. of Agric. Federal Hortic. Board, Washington D. C., Letter of Transmittal*, 7 pp., 17 Feb. 1922.

The following regulations are adopted and shall be effective on and after 1 March 1922, and shall supersede the regulations governing the importation of potatoes into the United States, which were promulgated to take effect on and after 1 March 1921. Regulation 2 is amended in such a way as to permit the entry of potatoes only from countries free from potato wart or other injurious potato diseases and insect pests new to or not widely prevalent or distributed within and throughout the United States. Such country must further agree to examine and certify all potatoes offered for export in compliance with these regulations. Potatoes will be admitted into the United States only through the port designated in the permit, and the entry of potatoes will only be permitted if the exporting country has an effective quarantine prohibiting the importation of potatoes from any country known to be invaded by potato wart or other injurious diseases or pests. Consignments of potatoes will be submitted to inspection at the port of entry. Except in cases of bulk shipments, only containers not previously used for potatoes are to be employed.

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Waterhouse (W. L.). **Studies in the physiology of parasitism. VII. Infection of Berberis vulgaris by sporidia of Puccinia graminis.**—*Ann. of Bot.*, xxxv, 140, pp. 557–564, 19 figs., 1921.

The author's investigations to determine the mode of entry into the host-plant of the sporidia of *Puccinia graminis* Pers. have led him to the conclusion—already arrived at by other workers in the same laboratory in the case of *Botrytis cinerea* and *Colletotrichum lindemuthianum*—that the means employed by the parasite for this penetration is mechanical pressure exerted by the germ-tube, and not, as previously held, the dissolving action of the fungus on the cuticle of the host. It was found that germinating sporidia of *P. graminis* adhered readily to the slide, and could be stained, washed, &c., without loss. The writer ascribes this adhesion to the fact that the germ-tubes possess a mucilaginous sheath, which stains faintly with dilute aqueous gentian violet, similar to that of *Botrytis cinerea*, the outline of the sheath being emphasized by aggregations of particles which are found at a distance from the main wall of the germ-tube.

The germ-tube may elongate considerably and become septate (in one case observed it attained a length of over 1 mm.), the production of long tubes being most frequent when the sporidia germinate in water. Frequently, after a slight elongation, the germ-tube swells into a vesicle, which, in some cases, is large and in contact with the glass slide, being thus of the nature of an appressorium. This also is surrounded, at times, by a mucilaginous investment. The production of these vesicles, which may give rise to secondary germ-tubes, is more common in nutrient media than in water. On the leaf, germination may be marked by the production of a definite germ-tube, which either develops quickly into a vesicle, or may grow on for some distance and even ramify before it becomes closely adpressed to the surface, In other cases no definite germ-tube is produced, but a short beak-like hypha arises directly from the end of the sporidium, pressing down on, and sometimes slightly indenting, the surface of the cuticle. Actual penetration is by a very fine style-like branch which arises either from the end of the germ-tube, when there is one, or from the short beak at the end of the sporidium, when no germ-tube is formed. This branch penetrates through the outer wall of the epidermal cell in about twenty hours. After entry into the cell it immediately swells into an elongated vesicle, which branches and gives rise to the uninucleated mycelium that invades the tissues of the host. At the moment of entry there is no alteration in the nuclei of the epidermal cell or in the cellulose layers underlying the cuticle. On the upper surface of the barberry leaf, where no stomata are present, entrance into the host always occurs by puncture of the cuticle, the necessary leverage being obtained by the close adhesion of the sporidial beak or germ-tube to the leaf surface through the action of its mucilaginous investment. A very careful study of the cuticle at the point of entry revealed no swelling or alteration in its staining properties, and there was no evidence of any chemical action on it.

Even in hollyhock leaves, in which there are stomata on the upper surface, the author confirmed Eriksson's observation that the sporidia of *Puccinia malvacearum* infect by direct penetration of the cuticle.

TRUE (R. H.). **The significance of calcium for higher green plants.**—*Science*, N. S., lv, pp. 1–6, 1922.

After a brief review of the literature of the subject, the results of work carried out by the author and his collaborators are discussed.

When seedlings were grown in solutions of Ca and Mg salts there was a well-defined equilibrium concentration below which the roots were not able to absorb, and ions leached out from the roots to the medium. Above this minimal point absorption took place in greater or less measure. At no concentration tried (up to 900×10^{-6} gm. norm. per litre) was there any evidence of injury from Ca, but in the stronger solutions Mg caused characteristic injury and death.

The presence of Ca ions also permitted the absorption of other nutrient ions that, offered in unmixed solutions, would be unabsorbable, and enabled the plant to retain ions that in their absence it would be unable to retain. In other words, the Ca ions may be said to make the others physiologically available to the plant. Thus when the soil solution is deficient in Ca ions, other nutrient ions present are largely out of reach, and such a solution may even leach mobilized nutrients from seedlings.

The rôle of Ca in the cell-wall is then discussed. The calcium pectate of the middle lamella has been previously shown to be a stiff colloid formed when pectic acid meets Ca ions. According to various authors, this acid results from the action of the enzyme pectase on the mother substance pectin.

There appears to be considerable freedom in the shifting of cell-wall materials into and out of the pectic acid condition, and (when Ca ions are present) the consequent appearance of calcium pectate layers. These shifts appear to be due to self-regulated chemical responses to stimuli, the internal causes being perhaps due in the first instance to external conditions. From the work of Sampson (*Bot. Gaz.*, lxvi, pp. 32–52, 1918) it would appear that the abscission phenomena in injured *Coleus* plants are due to a change of cellulose into pectic acid, induced by irritation stimuli, and the pectic acid, being greatly in excess of the Ca ions, creates a thin, mechanically weak, colloidal medium. In proportion as the pectic acid exceeds the Ca, the latter is diluted and removed from its original seat. The conversion of cellulose into pectose is stated to be a usual feature of ageing cell-walls, and the shift from pectose to pectic acid follows easily. The changes in firmness of fruits and vegetables resulting from the action of parasitic or saprophytic fungi seem to be due to the removal of Ca by acids formed directly or indirectly by the fungi, so that the firm pectate layers become pectic acid or something closely akin; since the latter lacks mechanical strength, softening of the tissues follows.

Both K and Mg can replace Ca in forming pectate walls. The K pectate is readily soluble in water, and its presence causes a great increase in the permeability of the cells, so that organic substances will leach out from the roots into the solution; and, in the opposite direction, copper sulphate, for example, will be taken up rapidly into all the tissues of the root. Mg pectate is less permeable than K pectate, but more permeable than Ca pectate. Fatal action to roots in Mg solutions does not develop until all the Ca of the middle lamella has been replaced by Mg. It is suggested that Mg ions can then penetrate the deeper structures of the cell. No kation has been found which can replace Ca in the middle lamella without injury to the plant.

Cell-walls and protoplasm are in close relationship. For instance, a dozen or more layers of cells surrounding the embryo of wheat are, during germination, absorbed, and finally the innermost walls of the ovary are cemented to the outer integument. The protoplasm seems to extrude substances through the cell-wall to form this cementing substance. These substances are perhaps Ca ions and pectose.

A certain quantity of Ca ions must be in the medium in order that plants may grow normally. Other ions required by the plant are unabsorbable in the absence of Ca ions. Thus some light is thrown on the practical problem of the value of lime in soils, and these observations on cell physiology suggest one way, perhaps of many, in which higher green plants find calcium necessary.

JOHNSON (J.). **The relation of air temperature to certain plant diseases.**—*Phytopath.*, xi, 11, pp. 447–458, 2 figs., 3 pl., 1921.

The author gives a general review of his experiments at the Wisconsin Agricultural Experiment Station in examining the part played by atmospheric conditions in the occurrence and severity of plant diseases. For this purpose, chambers in which the temperature and humidity of the air were controlled, the construction of which is fully described and illustrated, were used.

Temperatures as low as 12° or 15° C. could be maintained only during the winter months, when the greenhouse temperature was kept at or below 22° C. The humidity in the chambers was controlled within a normal variation not exceeding two or three per cent. Provision was made for the regular renewal of the air, and the evaporating power of the air was measured in each chamber. On the whole, the methods adopted proved satisfactory, their few defects not being sufficient to influence the final results of the experiments. In the present paper some temperature relations of mosaic and wild fire of tobacco and late blight of potato are considered.

Two methods were used in investigating the influence of temperature on tobacco mosaic. In the first case the plants were inoculated and left in the chambers for a fortnight, when they were placed on a greenhouse bench at a temperature varying from 18° to 24° C. The second method consisted in placing already diseased plants in the chambers and there observing the course of the disease. The incubation period was longer in full winter than in February and March, presumably owing to the slower rate of growth of the host plant. Air temperature has a marked effect on the incubation period, the optimum for the activity of the virus being between 28° and 30° C., and the maximum nearly 36° C. The absolute minimum is perhaps undeterminable as the development of the symptoms is slowed down by reduced growth of the host plant, and symptoms are probably not produced at all unless there is some growth of the host, which does not occur at low temperatures. When severely affected plants are placed at a temperature of 36° to 37° for about a fortnight, the newly developing leaves are free from mosaic, while the older ones regain a more or less normal appearance. This is probably due to the arrest of the detrimental action on chlorophyll production, but the reappearance of the symptoms when the plants are subjected to a lower temperature shows that the virus is still present. The optimum temperature for enzymic activity usually lies between 37° and 40° C., and in this respect the results are considered to furnish further evidence against the enzymic theory of mosaic diseases.

The effect of soil temperature on tobacco mosaic appears to be largely a matter of growth response in the host, air temperature being of much greater significance; thus a soil temperature unfavourable for host development will increase the incubation period, even when an air temperature favourable for the host and virus is maintained.

Tobacco plants inoculated with the 'wild fire' organism, *Bacterium tabacum* Wolf and Foster, were placed in the chambers simultaneously with the mosaic disease series, infection being produced through needle-pricks from a suspension of the organism in water. Conclusive evidence was obtained that the progress of wild fire under the conditions of humidity maintained is very vigorous in wounded leaves at a temperature as high as 34° C., the optimum being between about 27° and 32°, and the maximum apparently just beyond 37° C. Infection can occur and progress at a relatively low temperature, the minimum being below 15°. The maximum temperature for the growth of *Bact. tabacum* in culture is apparently close to 35° C., the optimum temperature probably ranging from 25° to 30°. The wild fire organism thus is capable of attacking the tobacco leaf at a temperature at which it does not seem able to grow in culture.

In experiments on the late blight of potato (*Phytophthora infestans*) the plants were usually inoculated and left outside the chambers until signs of infection occurred, when they were placed inside at different temperatures. The progress of the disease was shown to be insignificant below 25° C. as compared with that at higher temperatures. The optimum appears to be between 25° and 32° and the maximum above 36°. The most important fact demonstrated was that *Phytophthora* is a fairly vigorous parasite at temperatures as high as 32° to 35° C. The action of the fungus on the host corresponds closely with its growth in culture in the same temperature chambers, though, as in the case of *Bact. tabacum*, the fungus seems to be relatively more vigorous on the host than in culture. Growth was appreciable on potato agar at 35–36° C. Hence it is concluded that the progress of late blight of potato is favoured by relatively warm humid weather, though it is known that original infection by zoospores is promoted by low temperatures. Late blight should, therefore, be most severe when these low and high temperatures succeed each other at the proper interval of time.

TRÖNDLE (A.). **Über den Einfluss von Verwundungen auf die Permeabilität nebst ergänzenden Beobachtungen über die Wirkung des Sauerstoffentzuges.** [Notes on the influence of wounding on permeability, with complementary observations on the effects produced by deprivation of oxygen.]—*Beihefte Bot. Centralbl.*, xxxviii, Ab. 2, 3, pp. 353–388, 1921.

The writer's experiments were carried out on young roots and leaves of *Lupinus albus*, *Vicia faba*, *Allium cepa*, and *Pisum sativum*, principally the first two, and while agreeing in the main with the outcome of previous work, the results obtained extend our knowledge respecting the influence of traumatic action on the biological processes of plants. It has been demonstrated that not only may an injury bring about an important reduction in the permeability of the cells, but that this reduction can, under certain conditions, extend to the complete inhibition of the absorption of salts. The reaction is discernible after a very short interval, probably less than ten minutes, and the area affected and also the vigour of the reaction depend on the strength of the stimulus and the distance of the cells from the wound. The radial distance through which the action was perceptible in these experiments was up to 1·5 cm. or more. There is a distinct connexion between the length of time during which the stimulus acts and the vigour of the response of the reaction. Thus, up to a certain optimum time of action the reaction increases, but beyond this point, as the irritability is dulled, the reaction gradually diminishes again until a normal condition is once more reached. It was found in needle-prick injuries that the reaction was distinct after ten minutes, reached its maximum in thirty minutes, and a continuation of the stimulus after this time was followed by a gradual diminution of the response until after about two hours normal conditions were restored. In regard to the influence of distance from the wound, it was found that there was complete inhibition of the absorption of salts in the immediate vicinity of the wound, gradually shading off to normality as the distance increased.

The strength of the stimulus depends to a great extent on the nature of the injury. Thus the complete separation of portions of tissue brought about by incisions influences the largest area, decapitation of the root comes next, then needle-pricks in large numbers, while the weakest response was obtained by the application of two needle-pricks.

The effect of the wound stimulus in reducing the permeability can be balanced by placing the injured roots in hypertonic solutions; the absorption of salts then depends on the strength of the concentrations. The loss of permeability is therefore not due to the production of a condition of rigidity in the protoplasm. A reduction in permeability also occurs through immersion of the roots in pure hydrogen. This action is believed to be due to the effect of a lack of oxygen on the living protoplasm.

The significance of the wound reaction here described in conserving the cell substances through the closing of the cells to their passage outward is referred to.

YOUNG (H. C.) & BENNETT (C. W.). **Studies in parasitism. I. Toxic substances produced by fungi.**—*22nd Report Michigan Acad. Science*, 1920, pp. 205–208, 1921.

It was reported by Coons and Goss (*Report Michigan Board of Agric.*, 1917) that the filtrate from cultures of *Fusarium oxysporum* was as effective as the fungus itself in causing wilting of potato plants.

The authors have confirmed this in experiments with a virulent strain of *F. oxysporum* grown on Richards's solution having a PH value of 5. The effect of the filtrate on freshly cut stems of potato, tomato, and celery was determined at periodical intervals. It was found that the growth of the fungus at first increased the acidity of the solution until a PH value of 3·8 was reached, but the acidity then progressively decreased until at the end of forty days the solution was distinctly alkaline (PH 7·4). The filtrate caused wilting in all three plants tested, the period required to induce wilting becoming shorter (from forty-eight to eight hours) as the culture grew older and the solution less acid, in the case of the potato, while with the other two plants the time required first decreased, then increased, and finally decreased again. The wilting was evidently not due to the formation of acids, but to some substance of an alkaline nature or which was formed when the solution became alkaline. The time required to cause wilting rapidly decreased after the PH of the filtrate was higher than that of the cell sap (4·8 to 5·8 in potato and tomato). But wilting was not hastened by altering the reaction of uninoculated Richards's solution, the period of wilting remaining constant (forty-eight hours) when cut potato stems were placed in a check solution at all values from PH 3·8 to 7·4.

Further research showed that autoclaving for fifteen minutes or boiling for thirty minutes did not alter materially the wilting period of the filtrate, nor was it affected by filtering through Berkefeld filters or diatomaceous earth. A test for alkaloids gave a positive reaction, but when the ether soluble alkaloids were separated and brought to the same concentration as the original filtrate, the wilting period was greatly increased. The alcoholic precipitate of the filtrate, with reaction and concentration brought to that of the original filtrate, was effective in causing wilting of potato stems. The active factor may be an alkaloid, toxin, or enzyme, but can scarcely be an organic acid.

Gram (E.). **Ti Aars Sprøjtningsforsøg.** [Ten years' spraying experiments.]—Reprinted from *Jydsk Landbrug*, xxvi, 7 pp., 1921.

This gives a summary of the results of over 800 experiments in spraying of potatoes against blight (*Phytophthora*), conducted in various parts of Denmark from 1911–20. The average increase in yield due to spraying is estimated at 12 to 14 per cent. for the whole period. In years in which there was no disease the spraying increased the gross weight of the crop by two per cent. It should therefore be carried out every year. The experiments show that, generally speaking, the increase of dry substance is proportionately higher than that of the gross weight. Thus, estimating that spraying increases the gross weight from 100 to 110, the tubers from sprayed plants will also contain one-half to one per cent. more dry substance than an equal weight of tubers from unsprayed plants. This rule applies especially to the variety Richter's Imperator.

The best time for digging sprayed potatoes appears to be during the first few days of October. Thus in 1919 sprayed potatoes dug on 2nd October gave a yield of 21 per cent. more than unsprayed. Even as early as 18th September there was an increase of 13 per cent. over those not sprayed. Long delay is apt to lead to a slight diminution in the yield, especially of unsprayed potatoes.

Practically all the experiments point to the advisability of spraying twice rather than once a year, the increase in the yield being 15 to 18 per cent. and 10 per cent. respectively. In cases where only one spraying is practicable, all preparations should be made by the middle of July, and the treatment applied on the first day the disease is observed. The best results are likely to be obtained by the use of 2 per cent. Bordeaux mixture twice a year. Excellent results have also followed the use of 1 or 2 per cent. Burgundy mixture.

Köck (G.). **Die Schwarzbeinigkeit der Kartoffeln, ihre Ursache, wirtschaftliche Bedeutung und Bekämpfung.** [Blackleg of Potato, its causes, economic importance, and control.]—Reprinted from *Oesterr. Zeitschr. für Kartoffelbau*, i, 9, 3 pp., 1921.

In 1921 blackleg of potato (*Bacillus phytophthorus* Appel) was more severe in Austria than ever previously recorded. The author gives a short popular description of the disease and emphasizes the necessity of controlling it by the careful selection of seed-tubers. No seed should be taken from diseased plants, and if a field is badly infested it should not be sown with potatoes for a period of three to four years. The present system of certifying seed potatoes followed in Austria is the same as in Germany, up to ten per cent. of blackleg plants being allowed, but the author thinks that the experience of the last year indicates the necessity for more stringent regulations, as in America, where only 2 per cent. is allowed.

Köck (G.). **Einiges über Kartoffelkonservierungsmittel.** [Remarks on preparations for the preservation of Potatoes.]—Reprinted from *Oesterr. Zeitschr. für Kartoffelbau*, i, 10, 4 pp., 1922.

Of late years heavy losses have been sustained in potatoes stored for the winter in pits and cellars, from various types of rot (*Phytophthora*, *Fusarium*, bacterial rot) in Austria. Attempts at preventing or reducing this damage, especially the spread of infection from diseased to sound tubers after storage, by dusting the potatoes with sulphur, gave negative results. Various proprietary preparations for the same purpose have been introduced in Germany and Austria, three of which, Megasan K, Beka-Erdäpfelschutz, and Uspulun-Colus, have been officially tested in carefully controlled experiments. The results were unsatisfactory and their use in practice is not advised. The only measures that can be recommended at present are to remove carefully all diseased potatoes before storing: care should also be taken to store the potatoes in as dry a condition as possible in dry pits or cellars, well protected against frost and as well ventilated as possible, while in the case of store cellars the walls should be freshly whitewashed before use, and the tubers should be examined once or twice during the winter in order to pick out all rotted ones.

Janchen (E.). **Die Dürrfleckenkrankheit der Kartoffeln.** [Early blight of Potatoes.]—Reprinted from *Oesterr. Zeitschr. für Kartoffelbau*, i, 6, 3 pp., 1921.

The author gives a popular account of early blight of potatoes caused by *Alternaria solani* (E. and M.) Jones and Grout, for which are given as synonyms *Macrosporium solani* Ell. et Mart. and *Sporidesmium solani varians* Vanha. The disease is stated to occur in Austria, Hungary, and Czecho-Slovakia, and has been at times confused with *Phytophthora* blight. Like the latter, it is said to attack tomatoes also. The thin-leaved early varieties of potatoes are said to be more susceptible than the thick-leaved late ones. In severe attacks the yield may be seriously reduced.

Successful control can be secured with copper fungicides such as Bordeaux mixture or Bosna paste. The first application should be made as soon as the spots appear and should be followed by one or two more at intervals of two to three weeks. The removal and burning of diseased parts at the end of the season and rotation are other useful measures.

Murphy (P. A.). **Investigation of Potato diseases.**—*Canada Dept. Agr. Exp. Farms Bull.* 44, 2nd ser., pp. 1–86, 35 figs., 1921.

Investigations of late blight, blackleg, leaf roll, mosaic, and curly dwarf and related diseases in Canada are reported.

Late blight (*Phytophthora infestans*) is very serious in eastern Canada. During the five years 1915 to 1919 an average of 21·3 per cent. of the crop from unsprayed plants developed rot during storage. An average of 130·5 bushels per acre yearly increase in yield of marketable potatoes was obtained from spraying with Bordeaux. A minimum of four thorough sprayings at about two week intervals, beginning about the first of August, is recommended for Prince Edward Island. The cost per application per acre is figured at $0·70 to 1·65 according to the type of sprayer and amount of material used. Home-made Bordeaux mixture was found to give better results than Burgundy mixture or commercial preparations. Lime sulphur was worse than useless on potatoes. It was found to be better to spray before rather than after a rain, provided the spray had had a chance to dry. The rot of tubers may be caused by *Phytophthora* alone, but frequently bacteria or *Fusaria* gain entrance to tubers primarily injured by the *Phytophthora*. It is concluded that late blight is the preponderating cause of tuber rot in the Maritime Provinces. A report of studies on the factors which influence rot infection is made, and indicates that the surface soil contaminated with shed conidia is a more serious source of infection at harvest-time than partly blighted foliage, and is also more serious than subterranean infection by conidia washed down into the soil during the growing period. Experiments clearly showed that rot is considerably reduced by removing the foliage two weeks or more before digging the tubers so as to allow enough time for the shed conidia to be killed; nine days was not enough to render the soil free from infection. Imperfect spraying, especially when stopped too soon, may result in more rot in the tubers than no spraying, because it may keep the foliage green and in an infective condition until harvest-time. Other practical suggestions for preventing rot are given.

Blackleg (*Bacillus atrosepticus*) is sometimes severe in eastern Canada, particularly under damp and cool conditions. The disease was not found to spread in the field, nor to attack a plant unless the sett was already infected. The tuber rot was not found to spread in storage under the conditions observed. Tests of treating setts and uncut tubers with solutions of corrosive sublimate and formaldehyde showed that some injury follows the treatment of setts. The temperature during June seems to be the critical factor in determining the amount of blackleg that will develop.

Leaf roll is discussed at length and is reported to be rare in the Maritime Provinces, but common in Ontario and Manitoba. The 'primary stage' of leaf roll, as described by Dutch workers, is rare or absent in Canada. The disease reduces the yield greatly, but was not found to become more severe in successive years, nor were any plants observed to recover from it: tubers from diseased plants always carry the infection to the new plant. The locality in Canada in which uniform trial lots of healthy and leaf roll potatoes were grown was found to influence the yield, the best yields from leaf roll (and also from mosaic) seed being obtained from regions with the highest average temperatures. Infection was found, as has been previously recorded, to spread from diseased to healthy plants in the field. The disease was not induced by merely exposing the plants to unfavourable environmental conditions. Different tubers from the same plants were planted in Bermuda, Prince Edward Island, and Ottawa, and gave practically identical plants, healthy or leaf roll, in the three places. Infection of neighbouring plants was found to take place more rapidly in Bermuda than in Prince Edward Island. In tests throughout Canada it was found that infection to neighbouring rows developed most extensively at Ottawa, where it crossed five rows. At Thunder Bay, on the other hand, no spread was noted. Leaf roll is considered to spread through the soil in Canada, perhaps through the agency of some soil-inhabiting animal. The soil was not found to remain infected. The questions of varietal susceptibility and general control are discussed; the Green Mountain group is stated to be but little affected; clean seed, selection, and the use of seed plots are recommended.

Mosaic is prevalent in most of the Maritime Provinces, Quebec, and Ontario, especially on Green Mountain, Bliss Triumph, and some other varieties. It is reported occasionally not to develop on plants grown from the tubers of diseased plants. It was found to be more infectious than leaf roll, but no evidence was obtained that it becomes progressively worse in succeeding years. As in leaf roll, the locality has a marked influence on the severity of the disease, both diseases being affected in the same way. In western Canada the symptoms may be suppressed. Early planted potatoes developing under cooler conditions may show worse mosaic symptoms than potatoes planted later. Mosaic may spread considerable distances, probably by insect carriers. Spread to adjacent plants occurred at Thunder Bay, where there was no spread with leaf roll.

Curly dwarf is considered to be rare or absent in Canada.

Crinkle is described as a disease probably distinct from mosaic and leaf roll, in which the plants are bushy, dwarfed, somewhat paler than healthy plants, and the leaves are puckered and curved downward. Instead of distinct spotting, diffused, slightly yellowish areas occur over the foliage. As death approaches this colour is heightened, and accompanied by rusty brown spots. The foliage is brittle and easily injured. Affected plants were not found to recover. Crinkle is considered to be responsible for a serious 'degeneration' of potatoes at Ottawa, probably having been brought in from Europe. It is believed to be identical with the form of curly dwarf described by Quanjer in Holland as 'Welfingziekte', but to be distinct from ordinary European curly dwarf. Mosaic does not develop into crinkle at Charlottetown (Prince Edward Island), nor were plants affected with crinkle found to develop mosaic symptoms in that locality. Both diseases may be present in the same plant.

Leaf drop is differentiated as a disease in which the leaves drop, from the lower upwards. The plants are upright in habit and the leaves may be puckered or normal. Eventually the plant stands as a bare stalk with a cluster of yellow leaves at the top. A slight browning of the vascular area of the tubers was found, and bacteria were isolated but did not prove pathogenic. The disease may, however, be similar to Appel's 'bacterial ring-disease'. Leaf drop is transmitted by the tubers, and some of the observations indicate that both it and crinkle are infectious diseases capable of being transmitted from one plant to another in the field. It is second to crinkle as a cause of deterioration of potatoes (Green Mountain and Irish Cobbler) near Ottawa, and also occurred at Charlottetown, where it was first noticed in 1915 on imported potatoes.

Streak, as described by Orton, was found, and proved to be infectious by introducing diseased tissue into a healthy petiole, but no causal organism was isolated. It is considered that tubers from diseased plants may give rise to extremely dwarfed plants the following year. Spread by insects is suspected.

The author considers that the term 'curly dwarf', as commonly used, refers to a complex of diseases, the real relationships of which are not yet determined, and suggests that the name should be restricted to the type described and figured by Appel.

MURPHY (P. A.). **The sources of infection of Potato tubers with the blight fungus, Phytophthora infestans.**—*Sci. Proc. Royal Dublin Soc.*, xvi (N. S.), 29, pp. 353-368, 1921.

Phytophthora tuber rot may be more abundant following a less severe attack of the foliage blight, occurring late in the season, than when it follows a severe outbreak which runs a rapid course. Increased tuber infection may occur if the plants are sprayed early in the season but the later spraying is omitted. Any circumstance which preserves the foliage until late in the season but then allows it to become partially blighted increases the amount of disease in the tubers. Under such circumstances the tuber rot develops most seriously some time after digging the potatoes. The bulk of potatoes which develop the blight in storage contract infection when the tubers are being dug, and the amount of blight thus developed is, generally speaking, in relation to the amount of blight on the above-ground parts at and previous to the time of digging. This infection comes about either from contact of the tubers with partially blighted foliage, or from contact of the tubers with soil contaminated by spores shed fairly recently from the leaves. Such contaminated soil remains capable of inducing blight in freshly dug tubers which are brought in contact with it over a period of at least ten days, and probably longer. Evidence was obtained that the blight does not spread from tuber to tuber even in moist pits to any considerable extent, if at all. The field and experimental data were obtained in eastern Canada [see last abstract] and in Ireland.

MURPHY (P. A.). **The bionomics of the conidia of Phytophthora infestans (Mont.) de Bary.**—*Sci. Proc. Royal Dublin Soc.*, xvi (N. S.), 34, pp. 442-466, 1922.

The experiments here described prove that conidia of *Phytophthora infestans* (Mont.) de Bary, kept in soil out of doors during a period of dry weather, may remain viable and capable of infecting potato tubers for a period of at least three or four weeks. The spores were found to retain their vitality longer in loam than in a quick-drying medium like silver sand in tests carried out in Petri dishes in the laboratory, the soil being uniformly slightly moist at the beginning of the experiment. In the same kind of soil (loam) kept indoors in pots, they survived for twenty-six days when the soil was waterlogged and forty days when it was nearly dry or moderately moist. Contaminated dry soil kept in plugged tubes in a saturated atmosphere at 20° C. infected tubers in some cases as freely after forty-four days as when fresh. This was the longest survival obtained.

It is noted that conidia placed in soil remain without producing any apparent mycelium. They are able to survive temperatures up to 30° C., providing sufficient moisture is present, for twenty-six days, but a lack of moisture and high temperature is a fatal combination. It was found impossible to keep ungerminated conidia in an infective condition in air saturated with water-vapour for more than nine days. Large quantities of water, passed slowly through initially contaminated surface soil, failed to destroy the latter's power of infecting tubers after more than four and a half days, and at any time during this period the soil itself was more infective than the water which had passed through 10 cm. of it.

Germination proceeds actively at temperatures of 10 to 15° C., when, as a rule, zoospores result, germ-tubes being produced in small numbers; exceptionally, the majority form germ-tubes, this being apparently due to some condition of the conidia themselves. Nutrient solutions do not seem to favour germination by tube, but they tend to impede perfect zoospore formation, which on the other hand is stimulated by abundance of oxygen and by the absence of competing organisms, such as bacteria, protozoa, and *Penicillium*. Germination by a germ-tube is the regular method at 22°–23° C., but far fewer spores germinate than at the lower temperatures; it is also the usual method in old conidia. Germination which has been delayed through lack of oxygen or by contamination with the organisms mentioned, or by thick seeding of conidia, or by ringing cover-glasses with paraffin, may subsequently be induced by the addition of fresh water, and is then usually by germ-tubes.

By reducing the supply of oxygen to a point which just permits germination, or by gradually cutting it off altogether after germination has occurred, the so-called secondary conidia are produced. As they are usually formed under water, the term 'hydro-conidia' is suggested. They have a characteristic appearance, with a prominent papilla and a yellowish oil drop. Not only are they formed on the germ-tubes of conidia after limited growth, but smaller though otherwise similar ones are borne by germ-tubes from zoospores. They are materially more resistant to unfavourable conditions in water than are the ordinary conidia. They germinate usually by germ-tubes (of which there may be several arising from any part of the spore), which may again bear a tertiary conidium, and the process may be repeated at least once more; under favourable conditions, however, zoospores may be produced. The germination of secondary conidia has been observed twenty-four days after the original conidia were placed in water, and the germ-tubes from these were still living after ten days more.

The germination of the zoospores is favoured by an abundant supply of oxygen. Their germ-tubes can live for at least a week in water, and when secondary conidia are formed it is probable that this period can be prolonged.

It is believed that the conditions of the soil atmosphere, particularly its fluctuations in oxygen content, are such as would account for the prolonged vitality of the fungus in the soil by means of the processes here described. This is in sharp contrast to the limit of existence of fresh ungerminated conidia in competition with other organisms in water, which is about five to seven days. Hence unlike most fungi, the endurance of *Phytophthora infestans* increases after germination of its spores: at any rate, under conditions that are commonly met with in nature.

LÖHNIS (MARIA P.). **Onderzoek over Phytophthora infestans (Mont.) de Bary op de Aardappelplant.** [Observations on *Phytophthora infestans* (Mont.) de Bary on the Potato plant.] —[Thesis submitted to the Rijks University of Utrecht.] H. Veenman, Wageningen [Holland], 96 pp., 6 pl., 1922. [English summary.]

Phytophthora infestans, *P. nicotianae*, and *P. erythroseptica* grew abundantly on white bean agar with as much as 40 per cent. of saccharose, and some growth was made even with a saccharose concentration of 60 per cent. Sporangia were produced in concentrations up to 25 per cent. of saccharose. Immature oogonia and oospores of *P. infestans* were found twice in cultures on raw potatoes, and also on Quaker oat agar. Zoospores were formed in a minimum time of thirty minutes in water at 8 to 18° C. The spores lost their power of germination after one hour's exposure to the air in a room.

The mycelium of *P. infestans* in potato tissue can be stained differentially by a solution of Sudan III in alcohol-glycerine. The mycelium may grow intercellularly by replacing the middle lamella, or intracellularly. No mycelium was found in cork cells or vascular bundles. In infected tubers the eyes are usually surrounded by a small area of healthy tissue, or are dried up, but once or twice the mycelium was found to grow out of a very young bud in a raw potato culture. In potato leaves the blackening of host cells keeps pace with the progress of the mycelium, but in tubers the discoloration produced occurs after the mycelium has penetrated some distance. The browning of the tissue in tubers is considered to be a host reaction rather than a toxic effect. The author never found the mycelium of the fungus growing from a diseased tuber into a sprout, and blight developed no earlier on plants from infected tubers than on plants from healthy tubers in several experiments; the author concludes that the 'appearance of late blight appears to be possible in the absence of infected seed tubers, and while infection from neighbouring fields is impossible. The infection of the sprout from the diseased seed tuber is not the normal way of propagation from season to season.' No evidence was obtained that *Phytophthora* spores were introduced into fields on the surface of the tubers planted.

In five instances a diseased tuber was found in the soil before *Phytophthora* appeared on the leaves, and in two of these instances subsequent leaf infection did not occur. This is considered to 'point to another way of existence of *Phytophthora* than in the potato plant'. Whether this is in the soil or not has not been determined. While it is probable that the stage of development of the host-plant has some influence on the moment of outbreak of the disease, it is not considered to have any effect on susceptibility to contamination from neighbouring infected plants. Under laboratory conditions young sprouts can be readily infected.

The evidence obtained indicated that infection of tubers in the field probably occurs normally through slight wounds in the potato skin, and not through the eyes, lenticels, or unbroken epidermis.

Experiments were made to determine whether *P. infestans* might spread from tuber to tuber in the soil by way of the stolons, but the results indicate that this method of spread probably does not occur. Healthy tubers with wounds may be infected by contact with diseased tubers during digging or in storage. The length of time during which infection can occur after a wound has been made in a tuber varies with the stage of ripeness in the tuber. In young tubers in July no infection was obtained by inoculation after three days from the time the wound was made; in winter, infection was still possible twenty-six days after wounding. Wound-cork does not appear to be the only factor, however, that protects against infection.

The mechanism of resistance of tubers to infection was studied. No differences between resistant and susceptible varieties as to rate of growth of the fungus in the parenchyma, thickness of skin, or rate of wound-cork formation was found. The variety 'Bravo', which produces tubers resistant to the disease, differed from other varieties tested in that there was a tissue of highly resistant quality in the boundary layer between cork and parenchyma. The reason for resistance of leaves of certain varieties to infection is uncertain; osmotic pressure relations can hardly determine the degree of resistance, since, as noted above, the fungus grows normally in cultures in agar with sugar at a higher osmotic pressure than is ever found in the leaves.

MARRE (E.). **La selection des Pommes de terre en Hollande.** [The selection of Potatoes in Holland.]—*Rev. de Bot. appliquée*, ii, 8, pp. 129–132, 1922.

The writer gives an account of the methods employed in Holland to preserve healthy potatoes from degeneration. The first step consists in harvesting the tubers from a field of healthy plants, rejecting any plants which show the slightest trace of disease or a poor yield. The following January or February another inspection of the seed-tubers is made, those finally selected being planted in an isolated field which has not been used for potatoes for three or four years at least. The tubers of each plant are kept separate and are planted in order of size in rows at a distance of at least four metres apart, the intervening spaces being occupied by beetroots, beans, or other crops not belonging to the Solanaceae. As early as possible any plant showing signs of disease is eliminated, so that the harvest consists of the tubers of healthy plants only. The same process is repeated in the third and fourth years, only those strains being propagated which have throughout remained healthy.

This method of individual selection is undoubtedly superior to any other, but on account of the time and care which it exacts the method of mass selection may be substituted. The latter consists in eliminating from the field any diseased plants or healthy plants immediately surrounded by diseased ones, and mixing the yield from the remainder.

Quanjer has shown that degeneration is a result of infection, which acts more rapidly on certain soils, especially turf. An experiment with various kinds of soil showed that potatoes planted in clay retained their health better than those grown in sand, turf, or reclaimed meadow-land. Quanjer attributes this decline of potatoes on turfy soil to the greater prevalence of aphids in such localities.

QUANJER (H. M.). **New work on leaf curl and allied diseases in Holland.**—*Royal Hort. Soc., London, Rep. Internat. Potato Conference of 1921*, pp. 127–145, 20 figs. [Received March, 1922.]

The following diseases of the potato are described and illustrated:

Leaf roll does not become manifest in newly infected plants until the middle of summer, and sometimes the foliage symptoms may not appear until the following season. The first symptoms (primary leaf roll) are a rolling and upward position of the upper leaves, the upward bending of the stalks of leaves and leaflets being typical. Sometimes a reddish colour is prominent on these upper leaves. The progeny of primarily diseased plants produces secondary leaf roll, in which the lower leaves show the symptoms at the beginning of summer. The rolled leaflets stand upright and are funnel-shaped, rigid, and brittle; a yellowish discoloration proceeds from the tips and the margins, followed in certain varieties by a reddish or violet tinge. Phloem-necrosis always occurs in the stalks and veins of leaf roll plants, and the transport of starch from the leaves is inhibited. This is the only one of the diseases in which pathological changes in the phloem have been found. Secondary leaf roll plants remain small and produce only a few small tubers. Net necrosis and spindling sprout have not been observed as regular symptoms of the disease. As shown by Oortwyn Botjes in 1920 and Schultz and Folsom in 1921, aphids transmit the disease. In the field, the more the climate favours the development of aphids, the farther the infection goes. Tomatoes and other Solanaceous plants infected by grafting with tops of affected potatoes, may carry leaf roll without showing the symptoms as clearly as potatoes show them, and can afterwards infect healthy potatoes by grafting. No other insect was found so well adapted to transmit leaf roll as aphids are.

Marginal leaf roll is rarer, the rolling is restricted to the borders of the leaflets, and phloem-necrosis does not occur. Its infectiousness is not yet determined.

Mosaic is characterized by pale patches on the leaflet, which differ but little in shade from the darker portions; the mottling is quite indistinguishable in hot, dry summers, and faintly diseased plants show then only a somewhat crinkled and glistening appearance. The progeny of infected plants develops a crinkled or curled appearance, which takes the form of curly dwarf in certain varieties. It is known that aphids carry the disease, and it can be transferred by grafting to tomato and tobacco, but not by rubbing healthy plants with diseased.

Aucuba-mosaic (so called on account of its resemblance to the variegation of *Aucuba japonica*) is characterized by prominent localized yellow patches. It is not serious. The leaves do not curl.

It can be transmitted by grafting to other potato or tomato plants, but on the latter it is distinct from the common tomato mosaic. When Aucuba-mosaic potatoes are grafted on *Datura stramonium*, *Solanum dulcamara*, *Nicotiana tabacum*, *Atropa belladonna*, and *Hyoscyamus niger* these plants do not show symptoms, but will transmit the disease back to potato.

Duke of York mosaic is named from the variety of potato on which it was first found. Pale patches occur between the veins of the leaflets, and the margins of the leaflets curl upwards slightly.

Crinkle is a disease described first by Murphy in Canada [see above, p. 250] and present in England, Scotland, and Holland. The symptoms resemble those of mosaic, but there are marked corrugations, and the margin and tips of the leaflets curl downwards. The leaflets are brittle, turn yellow prematurely, and the lower leaves may drop off. Necrotic areas are often found in the parenchyma, near the conducting tissues of the phloem. It can be transmitted by grafting to potato, tomato, *Hyoscyamus niger*, *Datura stramonium*, and *Atropa belladonna*, and field observations indicate that it is probably also carried by aphids like leaf roll and mosaic.

The author traces briefly his work on these diseases in Holland, and gives observations made during his travels in other countries. He has isolated the diseases mentioned above in pure form, and finds it a useful practice to transmit questionable cases of disease to a variety in which the reaction to the various diseases is known.

These several diseases are not considered to winter over in the soil. The possible nature of the causative agents is discussed briefly, the author declaring in favour of ultra-microscopic organisms, of which there must exist a whole world. Leaf roll, mosaic, and crinkle were found in wild South American species and varieties of potato.

Control measures are discussed, and it is considered that the losses caused by these diseases may be reduced by a proper system of seed selection.

PERRET (C.). **Sur les maladies des Pommes de terre.** [Report on Potato diseases.]—*Ann. des Épiphyties*, vii, pp. 304–314, 1921.

As a result of experiments and observations made in 1920 at the Experiment Station of Merle (France), the author states that three types of potato degeneration are prevalent in the basin of the Loire, namely : (1) Leaf roll type (Quanjer's phloem-necrosis) characterized by a peculiar deformation of the foliage, the production of the tubers in close proximity to the base of the stem, and lesions in the sieve-tube tissues of the stalk. This type of degeneration seems to be but little influenced, if at all, by the mode of storage of the seed-tubers and is not to be detected by germination tests. (2) Type producing dwarfed plants or sterile tubers (probably 'filosis'). Cases of mosaic seem to be associated with this type, but the author is not yet in a position to establish a definite correlation between mosaic and filosis. The development of this form of degeneration is delayed by storing the seed tubers in cold and aerated rooms and by exposing them to light before sowing. (3) Mixed type, with characters of both the preceding. In all three types a considerable proportion of the seed tubers remain undecayed during the growing season. While both phloem-necrosis and mosaic diminish considerably the yield of the crop, they do not seem to have any appreciable influence on the chemical composition of the tubers. In plots planted for three successive years with three varieties introduced in 1918 the percentage of leaf roll in each succeeding year was 0, 50, 100; 0, 30, 50; and 20, 90, 100 respectively, showing the progressive increase of the disease year by year. No *Phytophthora* attacks have been noticed at Merle during the last three years, and this fungus does not seem to play any part in the degeneration of the leaf roll type. Manuring experiments showed that nitrogenous manures in high doses help in reducing the gravity of phloem-necrosis and mosaic symptoms, but not in eliminating these diseases; they have no restrictive action either on blackleg or *Rhizoctonia*, and do not help in reducing the number of tubers attacked by the common scab. Two of the varieties studied were characterized by great resistance to leaf roll, with susceptibility to mosaic and *Phytophthora*. The experiments showed that all seed tubers from a plant suffering from phloem-necrosis give rise to plants with symptoms of leaf roll, while a seemingly healthy plant, growing among diseased ones, may produce either healthy or diseased progeny. The author concurs in Quanjer's view that there are no immune plants, some plants remaining accidentally free from disease. He is also inclined to agree with Quanjer as to the contagious nature of phloem-necrosis, although some observations would seem to contradict this theory. The control measures recommended are a careful and systematic selection of healthy seed and the establishment of regional stations for the producing of improved varieties. No evidence was obtained that the introduction of seed-tubers from cold or more northerly regions was productive of good results.

Krantz (F. A.) & Bisby (G. R.). **Relation of mosaic to running-out of Potatoes in Minnesota.**—*Minn. Agric. Exp. Stat. Bull.* 197, 31 pp., 18 figs., 1921.

Tests with varieties of potatoes were begun at Minnesota in 1883, and large numbers of seed-lots were brought together from various parts of North America and Europe for comparison. As early as 1886 'degeneration' or 'running-out' was evident in most, if not all, of the 365 so-called varieties that were being tested. Workers at this time attributed this 'running-out' to 'loss of constitutional vigor in the plant, due to long-continued propagation from the same stock', or to similar vague causes, but the authors believe the explanation lies in the introduction of mosaic (using the term in a broad sense) with some of the tubers brought to the Station for trial. The spread of the disease through all the lots followed, and it was perpetuated by planting each year some of the progeny of the infected plants. References to older English literature indicate that the same or a similar disease occurred in England at least as early as 1782, and was apparently noted even in 1764.

During the last few years more definite study of the 'run-out' condition of potatoes at Minnesota has shown that the trouble is of the mosaic type. As far as is known, leaf roll plays only a subordinate part in producing this condition in Minnesota. The plants showed mottling of the leaves, and also often crinkling and dropping of the lower leaves. Tests showed that the trouble could be transmitted by inoculation, by rubbing juice from affected plants into stems or leaves of healthy plants, or by grafting stems or tubers of diseased and healthy plants together. The mosaic was transmitted to tomato by grafting. No transmission through the soil was demonstrated, and when healthy tubers were planted in soil containing the roots and tops of mosaic plants, the plants produced appeared healthy. Plants were kept free from the disease in the field by enclosing them in cloth cages, which prevented insect transmission.

Tests of the influence of environment on the development of the trouble were made during six years, since it has been a common belief that run-out plants may be restored to vigour by growing them in a more favourable environment. These tests showed that when tubers from plots badly affected with the mosaic disease were removed to northern Minnesota and planted, improvement did not take place: partially diseased lots of potatoes appeared to recover after a few years, probably through the elimination of the diseased tubers in sorting the seed, under conditions where the disease was not so actively transmitted in the field.

Out of several hundred varieties and strains tested at St. Paul, none showed immunity to the disease.

The use of disease-free stock, and the production of seed from a plot isolated from sources of infection, with early removal of any suspected plants, are recommended as methods of control.

Cotton (A. D.). **The situation with regard to leaf-curl and mosaic in Britain.**—*Royal Hort. Soc. London, Rep. Internat. Potato Conference of 1921*, pp. 153–166. [Received March, 1922].

Experiments and observations in England and Scotland indicate that the mosaic and leaf roll types of diseases (causing the so-called 'deterioration' of potatoes) are transmitted by aphids. In Scotland the spread is slight, on account of the milder or later attack of aphids than in many parts of England. Both diseases are more abundant in the warmer and drier parts of the country, where aphid attacks are more severe.

Plants affected with leaf curl (leaf roll) were found to give from 21 to 64 per cent. less yield than healthy plants. Mosaic apparently did not cause quite as much reduction in the yield. Difference in varietal susceptibility to these diseases are recorded, lists of susceptible varieties being given, and Great Scot being noted as undoubtedly highly resistant.

A number of tests and observations with various varieties in several parts of England, Scotland, and Wales are recorded. Some of the observations in Scotland are of interest as showing that leaf curl, if introduced into certain areas, will persist from year to year so long as seed from the affected crop is used, but that there is little tendency for the disease to spread. In other words, the conditions in these areas are not unfavourable to the disease, but only to the aphids. The value of immature seed may lie in the avoidance of aphid-carried infection merely through early lifting. Further research on the prevalence of aphids in different parts of the country, and on the influence of meteorological and soil conditions and abundance of alternative food plants on these insects is advocated.

Suggestions to growers in avoiding these troubles are given, and include isolation of seed plots, roguing, and in the use of seed from plants free from the disease.

In the discussion of the paper (pp. 166–168) M. É. Foëx reported added evidence obtained in co-operation with Dr. Quanjer that leaf roll plants always showed phloem-necrosis, while plants suffering from mosaic, crinkle, &c., had none. M. Foëx found that the necrosis usually appeared first in the angles of the cell-walls, and was a process of pectic degeneration, which became arrested probably through the formation of lignin and suberin. The specimens that he selected were from plants with leaf roll or one or other of the other diseases, as well as from healthy plants, and a piece of the petiole was submitted to Dr. Quanjer without informing him of the source. The latter's diagnosis of leaf roll from the histological symptoms in the phloem was in every case correct, all the other specimens being correctly pronounced free from leaf roll.

Ducomet (V.). **À propos des semis de Pommes de terre.** [On raising Potatoes from seed.]—*Journ. Soc. Nat. Hort. de France*, Sér. 4, xxii, pp. 126–131, 1921.

Wishing to test the efficacy in checking degeneration of raising potatoes from seed, as opposed to vegetative propagation, the writer undertook a series of experiments of which the present paper is a preliminary record.

The practice of raising from seed is by no means so complicated as it is usually represented. Without any special precautions 22 kg. per 10 sq. metres were obtained from seed. It is also not necessary to wait until the berry is ripe before gathering it, since the seed can equally well be extracted when the berry is under half its normal size. In variability and vigour the green seed is not inferior to the ripe. This was confirmed by experiments with Marvel of America and Czarina. An important factor, which is frequently overlooked, is the choice of the mother-plant. Here, as elsewhere, bud variation is partially hereditary.

The term 'regeneration' requires some elucidation. It comprises two distinct conceptions, retention and improvement: retention of a type in its varietal characters (qualitative conception), and improvement of that type as regards productivity, vitality, &c. (quantitative conception). Considering first the former it is evident that without at least partial stability of racial attributes, there can be no regeneration. Either these attributes are transmitted to all the descendants (total heredity), or they persist integrally in some of the descendants only (partial heredity). The conflicting opinions of experimentalists on the subject of regeneration are due primarily to the natural diversity of the varieties with which they worked, their constitution (pure or hybrid races), and their stability or polymorphism when propagated.

By way of illustration, one of the writer's own experiments is recorded. Seed plots of Marvel of America were sown for several years in succession. In 1918, 500 plants were grown from the seed of a single inflorescence. The following characteristics were noted:

height very variable, from 0·25 m. to 1 m. and more; habit erect or drooping; leaves pale or very dark green, heart often red; leaflets very tenuous or thick, hard, brittle, covered with bristles or almost smooth; plants precocious or very late, bearing sometimes many and sometimes few stolons; colour of tubers ranging from red to white, that of flesh from pure white to yellow, with frequent production of anthocyan; shape very variable, sometimes spherical, often elongated, the ratio of length to breadth sometimes reaching 2·5. Not one of the progeny was identical with the mother-plant. It is interesting to note that five plants showed distinct evidences of dimorphism or polymorphism, red or variegated tubers being associated with unpigmented. These tubers, planted in 1919, gave rise to plants differing in habit, foliage, flower, and precocity, as well as in the shape and colour of the tubers and in resistance to *Phytophthora*, so that variation may continue in subsequent years, even when the plants are propagated asexually.

The writer's conclusions are that reproduction from seed results in diversification and usually degradation. The great majority of the plants raised by him from seed were manifestly inferior to the mother-plant, from the morphological point of view (small, irregular tubers, rhizomatous plants), physiologically (leaf roll, crinkle, and dwarfing) and pathologically (susceptibility to *Phytophthora*). A few plants only were found to be superior to the parent in resistance to *Phytophthora*, starch content, and productivity.

Ducomet (V.). **De la dégénérescence des végétaux multipliés par voie asexuée (en particulier de la Pomme de terre).** [The degeneration of plants multiplied asexually (the Potato in particular).]—*Journ. Soc. Nat. Hort. de France*, Sér. 4, xxii, pp. 255–273, 1921.

The author reviews the literature on degeneration of plants published during the past 150 years, and presents briefly the points of view held by various authorities during that time. Some workers have contended that sexual reproduction and the formation of seeds are necessary to maintain a species of plant in full vigour; others, considering that a number of wild and cultivated plants perpetuate themselves indefinitely without seeds, have considered that degeneration is not a necessary concomitant of asexual propagation. The common association of pathologic symptoms with degeneration has been noted by many workers.

Taking the potato, which is the plant most frequently considered to degenerate after asexual propagation, it is pointed out that the average yield per acre has increased during the past century; if, however, degeneration be considered the change in state of a given variety, it may then be noted that certain varieties have been in existence for 50 to 100 years without degeneration. Various symptoms of disease, particularly of the leaf roll and mosaic types, have been commonly noted as occurring on degenerated potato plants. The writer concludes that degeneration is but a word used to express the external appearance of a physiological or pathological state of the plant; that degeneration is only the consequence of disease or poor adaptation of a plant to its environment; and that, in the potato at least, propagation by asexual means cannot be held to lead inevitably to degeneration of a variety. It is true that new varieties can be produced by sexual reproduction, some of which may be superior to the parents, but replacement of a variety by another is not renovation in the proper sense of the word.

SALAMAN (R. N.). **Degeneration of Potatoes.**—*Royal Hort. Soc. London, Rep. Internat. Potato Conference of 1921*, pp. 79–91. [Received March, 1922.]

The author gives an historical sketch of the ideas held by various workers since 1786 as to the nature of degeneration of potatoes, and points out that these workers had all remarked on symptoms that call to mind mosaic or similar troubles. It is pointed out that the vine, banana, sugar-cane, and *Helianthus tuberosus* have long been propagated asexually without 'degeneration'. Furthermore, if degeneration in potatoes is due to exhaustion, all representatives of the variety wherever grown, being of the same age, should degenerate simultaneously, which is conspicuously not the case: degeneration may occur in seedlings, while some varieties have, on the other hand, been in successful cultivation for fifty years. Certain varieties, as Edgecote Purple, Barley Bounty, and others, have shown immunity to 'degeneration' at Barley. If 'degeneration' be due to senility, the egg and pollen cells also should be affected, and seedlings raised from crosses between degenerated plants should also be degenerate: but the author found that such seedlings were similar to those raised from crosses made before the parents became degenerate, although he thinks that occasionally the germ cells may become infected. The conclusion is reached that 'in the opinion of the writer degeneration is but a symptom of a disease, and this disease is probably mosaic . . .'. Immature seed tubers may be preferable because they have escaped infection. It is believed that the plant breeder can solve the problem presented by the so-called degeneration of the potato, by the production of varieties immune to mosaic and similar diseases.

RICHARDS (B. L.). **Pathogenicity of Corticium vagum on the Potato as affected by soil temperature.**—*Journ. Agric. Res.*, xxi, 7, pp. 459–482, 6 pl., 1921.

Potatoes were grown in soil at approximately constant temperatures of 9, 12, 15, 18, 21, 24, 27, and 30 degrees C. Some of the soil was sterilized and inoculated with pure cultures, or with sclerotia from tubers, of the *Rhizoctonia* stage of *Corticium vagum*. In some cases unsterilized soil was similarly inoculated, and plants in uninoculated sterile or non-sterilized soil were used as checks.

The potato plants grew most rapidly during their early stages at 24° C., but 18° C. was found to be the optimum soil temperature for the later stages. At soil temperatures above 24° C. excessive branching, shortened internodes, decreased leaf segmentation, and decreased stem diameter of the plants occurred. The *Rhizoctonia* produced lesions on potato stems at soil temperatures of 9° to 27° C. The fungus caused two types of stem injury: destruction of the primordia of the young shoots before they appeared above ground, and cankering of the cortex of the underground stems. The former injury was confined to temperatures below 21° (above 21° the rapid growth of shoots, and decreased pathogenic power of the fungus, prevented this injury) with a maximum at about 12° C. The cankers were most serious at 18°, although even at 9° the damage was large. At and above 24° the fungus was of minor importance.

Rhizoctonia attacked the potato stems more vigorously in unsterilized than in steam sterilized soil.

GROVE (W. B.). **Mycological notes. VI.**—*Journ. of Bot.*, lix, pp. 311–315, 1921.

The fungus of chief interest to pathologists mentioned in this part of the 'Notes' is *Placophomopsis heveae* n. g., n. sp. It occurs on the bark of Pará rubber trees, apparently as the cause of a fatal disease, in Uganda. The pycnidia are of the *Phomopsis* type, but more solid, and based on a subiculum or thin stroma somewhat as in *Placosphaeria*. The subiculum and pycnidia are at first completely hidden by the unblackened periderm, between which and the cortex they develop. Later on, the growth of the pycnidia causes a small fragment of the periderm overlying each to be cast off, leaving them exposed but not projecting. At a late stage the pycnidia fall out, leaving little pale depressions. Their walls are very thick, being composed of ten or twelve layers of dense pseudoparenchyma, of which only the outer two or three are dark brown. Both A- and B-spores occur, either separately or, when together, usually with an excess of the former.

GROENEWEGE (J.). **Over de oorsak van rustiness op rubber van Hevea brasiliensis.** [On the origin of rustiness on rubber from *Hevea brasiliensis*.]—*Meded. Algemeen Proefstat. voor den Landbouw*, xi, 19 pp., 3 figs., 1921. [English summary.]

Rustiness in sheet rubber develops usually when freshly rolled sheet is left in a moist place for twenty-four hours or is dried too slowly. It is due to species of Saccharomycetes and *Oidium*, which develop at the expense of the constituents of the serum enclosed in the rubber. The fungi form a layer of the consistency of butter on the sheets when fresh, which falls apart in scales on being stretched after drying. Quebrachite, proteins, and sugars are the nutrients for these organisms present in the serum, the last being of slight importance. Only one of the yeasts isolated, *Torula heveanensis*, was able to assimilate quebrachite. This organism has thick-walled oval cells, 4–6 μ in diameter, and gives circular colonies which assume a light brown tinge in old cultures on rubber-serum agar. *T. heveanensis* is able to assimilate both quebrachite and proteins, whereas the other organisms involved (*Willia javanica*, *Oidium* sp., *Torula* spp., &c.) are entirely dependent on proteins both for their carbon and nitrogen. *Bacterium prodigiosum*, which can also cause rustiness, grows well in a slightly acid medium containing quebrachite and proteins.

Freshly rolled rubber becomes immune to rustiness if kept for several days under water, because under such conditions the nutrient substances of the serum are removed. The water-soluble substances are dissolved out, and the proteins present in the surface layers of the rubber are also brought into solution by tryptic enzymes secreted by a rich bacterial growth which develops in the water.

When the extracting process is performed under sterile conditions, the water-soluble substances (including quebrachite) alone disappear, the proteins being held in the rubber, which maintains its susceptibility to rust. Dry rubber which has been allowed to soak in water again is practically immune against rustiness. Investigations show that this immunity is attributable to a loss of permeability after drying, which greatly hinders the movement of the water-soluble substances and therewith the supply of nutrition to the organisms causing rustiness. The diffusion of the tryptic enzymes secreted by yeasts and the species of *Oidium* is also rendered practically impossible. These changes in permeability are permanent.

STEVENS (H. P.). **Mould prevention.**—*Bull. Rubber Growers' Assoc.*, iv, 3, pp. 132–133, 1922.

Reference has been made in earlier reports by the author to the incidence of mould on smoked sheet rubber and the means of prevention. The remedial measures hitherto adopted were not altogether satisfactory, and a search has been made for a fungicide which would be effective when added to the latex before coagulation, or dusted on the sheet rubber when packed. Experiments have recently been made with a new preservative, sodium silicofluoride, which is cheap, apparently effective, and free from injurious effects on vulcanization. Tests were carried out, using as a control ordinary estate smoked sheet rubber, with sheet sprinkled with sodium silicofluoride, sheet prepared from standardized latex to which sodium silicofluoride had been added in the proportion of 1·8 gm. to 3,000 c.c. latex, and sheet prepared with the addition of 3 gm. sodium silicofluoride to 3,000 c.c. latex, acetic acid in the proportion of 1 : 1,200 being used for coagulation in the last two.

The conditions of transit were favourable to mould growth. The control and the sprinkled sheet were mouldy when unpacked, while the other two showed scarcely a trace of the fungus. Thus the mere sprinkling of the sheet with sodium silicofluoride is ineffectual, but the addition of this preservative to the latex is an excellent preventive of mould, and sheet prepared from latex thus treated gave satisfactory results on vulcanization, the rate of cure being somewhat more rapid than in the control. No difference could be detected in feel or appearance between these two samples and the control, after cleaning the latter. The process is regarded as being still in the experimental stage.

KEUCHENIUS (P. E.). **Die Rindenbräune der Hevea brasiliensis.** [Brown bast of *Hevea brasiliensis.*]—*Centralblatt für Bakt.*, Ab. 2, lv, 1–4, pp. 14–74, 33 figs., 1921.

Brown bast is now the most important and widespread disease of *Hevea* in eastern Asia, but its origin in all probability dates back to the earliest tapping of the tree. Reports commenting on the occurrence of nodules on the trunks have appeared from time to time since 1887, when Cross described the phenomenon from the valley of the Amazon. Petch was the first, in 1905, to record the symptoms in detail. That it was not until the year 1917 that its serious nature was recognized is probably due to the fact that the great areas of rubber planted during the 'boom' about 1910 were by 1917 at an age in which the incidence of the disease becomes really marked. The average yearly loss from brown bast in a plantation of 18,000 hectares under the author's observation may be estimated at 3 to 5 per cent., and the cost of treatment at about 100,000 Dutch florins per annum, the value of the rubber lost being at least an equal sum. After five and a half years of tapping, 46 per cent. of the trees in another, ten-year-old, plantation were affected. Careless thinning-out has combined with the disease to reduce the yields from older plantations, since good latex yielders were removed as well as diseased trees. This is probably the reason why many of the plantations of twenty years of age and upwards in the Malay Peninsula yield annually only about 500 lb. of rubber per acre. Up to the present, brown bast is known to occur in the Amazon valley, Dutch and British Guiana, Dutch East Indies, India, Ceylon, and the Malay Peninsula, but it will undoubtedly be found wherever *Hevea* is cultivated.

In the diagnosis of the disease attempts have been made by various investigators, for instance, Harmsen, Rands, and Bobilioff, to establish an early recognition by a microscopic examination of the tissues, but the author believes that a sure diagnosis can only be furnished by the external symptoms. These may be briefly described as the drying-up of the latex flow over the whole extent or a part of the tapping-cut, the affected area being frequently succulent and assuming a greyish-brown to sepia discoloration; further, the disease is capable of metastasis. Symptoms visible through the bark elsewhere than at the tapping-cut first appear months later. The formation of woody nodules is far from being a constant symptom.

The disease invariably appears only following a wound, which in practice means that it is the result of tapping, though occasionally untapped trees may develop it as a consequence of accidental injury from animals or implements. The breaking of branches in a storm may also give rise to an attack.

By the process of metastasis brown bast may shift from one area of the bark to another, working upwards to the right and following the right ascending spiral of the latex tubes. In such cases the appearance of the disease at a second tapping-cut situated higher up can be shown to be due to a continuous extension from the area first affected. A similar metastasis frequently occurs when a large branch is cut or torn off, a rapid extension along a band which may be several yards in length taking place from the diseased area lower down. Extension downwards may also occur when, for instance, the base of the stem is injured by wild pig.

The author has frequently observed that metastasis sets in if tapping is continued after the cut is partially affected, and brown bast soon spreads over the entire length of the cut and beyond its margins. This aspect of metastasis appears to have escaped the notice of earlier investigators. Metastasis clearly occurs only when healthy latex vessels are exposed which directly communicate with the diseased ones, and the latex vessels are the channels through which it takes place. An isolation-cut penetrating as far as the cambium is, therefore, an absolute preventive of spread by metastasis, and the writer has successfully employed this method on many occasions without having had a single failure. Tapping may safely be continued in the healthy bark if the discoloured area is thus isolated in the early stages of the disease. Resting the trees is also an important measure since metastasis will not take place along sound latex tubes unless these are open at the ends and latex is flowing from them.

The author is unable to find any foundation for the theory that high yielding trees are more susceptible to brown bast than the less prolific. A statistical examination of over 900 trees showed that the difference in susceptibility was negligible. The influence of rainfall, on the other hand, is marked, the disease being much more prevalent during the rainy season (January to April). The type of soil is only indirectly connected with the incidence of the disease, in so far as it influences the development of the trees. Luxuriant development, such as occurs on laterite soils, appears to promote the disease, mainly as a result of the exclusion of light. Poorly developed trees growing on clay soil are less liable to attack, as the light is better able to penetrate the relatively sparse foliage of their crowns. Experiments in thinning carried out in 1917 showed that the percentage of disease decreased in proportion to the number of trees removed. The influence of rainfall appears to act both by increasing the soil and atmospheric humidity and by reducing the intensity of radiation owing to the presence of clouds. Numerous observations have convinced the writer that brown bast occurs in a much more virulent form where there is insufficient light and excessive humidity. The area covered is more extensive, the course of the disease more acute, and the depth of penetration in the bark more profound. Pratt's observation ('Brown bast on rubber trees, its cause and spread.'—*Malayan Tin and Rubber Journ.*, vi, 1917) that the incidence of brown bast is higher when the tapping-cuts approach the ground is fully confirmed by the present writer. The percentage of disease is extremely low when the cuts are situated a yard or so above the level of the soil. It is frequently stated that an increase in the number of tapping-cuts results in a corresponding rise in the percentage of disease. The author, however, concludes that there is no correlation between the number of cuts and the frequency of brown bast. The experiments of Rands [see this *Review*, i, 5, p. 139] are not accepted, since his determination of the percentage of attack was based on microscopic symptoms only, and these the author considers unreliable. On the other hand, the position of the cuts in relation to one another seems to be of considerable importance, the system of having two or more cuts one above another causing a marked increase in the disease. The so-called 'change over system' has the opposite effect.

A tangential section through recently affected tissue reveals a yellow or brownish discoloration of the walls or middle lamellae of the medullary ray cells and of the adjacent latex vessels and sieve tubes. Many intercellular spaces are filled with a yellowish-brown substance, sometimes in granules. The lumina of various cells and of the latex vessels and sieve tubes may be filled with a similar substance, which on histological grounds the author agrees with Rands in regarding as wound-gum. The formation of woody nodules is only a secondary complication developed around groups of primarily diseased elements.

A process of spontaneous healing takes place underneath the diseased layers of the bark, consisting in the formation by the cambium of healthy layers. The affected layers undergo a gradual necrosis, longitudinal fissures arising in the diseased bark which later dries up and is thrown off in the form of irregular scales.

The period of incubation of brown bast is stated to be very brief, ranging, in the cases investigated by the author, from five to eleven days. The author states that he is the only investigator of brown bast who rejects the theory of a physiological origin. He has isolated bacteria from the diseased tissues which develop slowly in culture while similar tests with healthy bark failed to give colonies. He believes these bacteria to be the cause of the disease, and explains the failure of other investigators to secure successful inoculations with the similar organisms isolated by them, by the peculiar difficulties in this disease of establishing conditions favourable to infection. The disease is one affecting the latex vessels and carried in them. The pressure in these vessels is, however, ordinarily high, and even if the organisms could be introduced into the vessels artificially they would not spread. Successful infection could only be expected during periods when there is a negative pressure in the vessels, and this is difficult to secure. Hence the failure of all attempts to reproduce the disease by inoculation is not considered to be sufficient to disprove its parasitic origin.

An important phenomenon which the author thinks cannot be explained by the physiologists is that of metastasis. The fact that brown bast remains stationary when the tree is allowed to rest may be accounted for on physiological grounds as resulting from exhaustion, wound reactions, or assimilatory disturbances; these cannot, however, explain the arrest of metastasis by isolation when tapping is continued outside the isolated area. If a physiological cause were involved, isolation would tend rather to exaggerate than diminish the ill effects, and the resumption of tapping would at once bring about a recurrence of the disease. The only possible explanation of the phenomenon of metastasis in brown bast is that the latex vessels contain either bacteria or enzymes (or a 'contagium vivum fluidum') which are conveyed with the stream of latex set in motion by tapping. An enzymic theory does not account for the influence of light, humidity, and position of the tapping-cut on the incidence of the disease, nor does it explain the presence of bacteria in the affected tissue. The bacterial infection hypothesis is therefore the more probable of the two.

The writer's own view of the origin of brown bast may be summarized as follows: The disease is infectious, and is caused by facultatively parasitic bacteria which are of general occurrence in the soil and atmosphere. Two of these have appeared in the isolations made, and apparently either or both together may produce brown bast. These bacteria are capable of infection only under the influence of a temporary physiological condition, namely, the loss of positive pressure in the latex vessels after tapping or after a wound. They live exclusively in the latex vessels and are not capable of penetrating other portions of the bark. The brown discoloration of the cells near the latex vessels is a reaction resulting from the arrested functioning and death of the latter. The latex coagulates, so that the disease cannot spread until tapping is resumed, while the bacteria are held in check by the coagulum. When a part of the bark is tapped which is connected with the diseased area, a current of latex, in which a certain number of bacteria are probably conveyed, moves from the affected tissue towards the wound, and this gives rise to metastasis. The first infection probably occurs through the cut ends of the latex vessels, and is favoured by anything that tends to prolong the latex flow and retard coagulation at the cut surface. The influence of light (which accelerates coagulation) and shade and humidity (which delay it) is thus explained. Rain also increases the possibilities of contamination of the tapping-cut.

To test these views, seventy-six trees were selected and, immediately after tapping, the cut was covered with cotton wool, soaked, in alternate trees, in corrosive sublimate and in ditch water. After a month eight of the trees treated with ditch water were attacked by brown bast and only two of the disinfected. The latter infections were probably to be attributed to showers that diluted the disinfectant.

The methods of combating brown bast in common use, viz. stripping, scraping, and scraping combined with an application of hot tar, are discussed, but are considered to be inferior to the system of treatment which the author has introduced on an area of 18,000 hectares under his care. In this method the boundaries of the discoloured area are exactly determined by scraping away the bark almost to the cambium, and the affected part is then completely isolated by cutting a groove about 1 cm. outside the limits of the disease, reaching to the cambium. Tapping may then be resumed below the isolated area or elsewhere. The trees are examined twice a month, and all cases of brown bast are immediately isolated in this manner. After two or three months woody nodules are often formed in the diseased bark, which can be detected by a few cuts with the tapping-knife, and these must be removed. This method requires only half the labour employed in scraping according to the old system.

B[OBILIOFF ?] (W.). **Over den invloed van teer op de regeneratie van den bast bij Hevea brasiliensis.** [On the effect of tar on bast renewal in *Hevea brasiliensis*.]—*Teysmannia*, xxxii, 10, p. 467, 1921.

Harmsen's treatment of brown bast disease with hot tar (see this *Review*, i, 5, p. 140) is based on the assumption that the bast is more rapidly renewed after its application than untreated bast. This question has recently been studied by Steinmann (*Arch. voor Rubbercult.*, v, p. 495, 1921). The favourable effect of the treatment claimed by Harmsen could only be brought about by a stimulation of cambial activity, but detailed researches have proved this to be non-existent. The increased thickness of the bast under the tar is due exclusively to development in the area containing stone-cells. No more latex vessels are found under the tarred surface of the bast than elsewhere. The thickening of the hard bast under the tar is negligible, and there is no multiplication of the latex-yielding tissue. In short, the treatment with hot tar as at present practised is useless for the purposes claimed.

BALLY (W.). **Over bast regeneratie bij Hevea.** [On bast renewal in *Hevea*.]—*Meded. Proefstat. Malang*, 36, 12 pp., 13 figs., 1922. [From the *Arch. voor Rubbercult.*, vi, 2, Feb., 1922.]

The author's experiments confirmed Gandrup's view (*Arch. voor Rubbercult.*, pp. 465, 549, 1921) that there is no difference in the formation of the latex vessels under tarred and untarred surfaces, and that the application of tar is therefore superfluous. Tar is a good preventive of stripe canker and mouldy rot, but may be satisfactorily replaced by a less expensive disinfectant such as carbolineum. The results of a series of tests show that the application of external remedies produces a stimulation of the phellogen, which does not, however, influence cambial development.

CHIPP (T. F.). **Another 'Wet Rot', and Poria hypobrunnea.**—*The Gardens' Bull., Straits Settlements*, II, 12, pp. 429–432, 1921.

Some strong shoots from the stump of *Spathodea campanulata*, which had been left in the ground to coppice in the Singapore Botanic Gardens, suddenly ceased growth when eight feet high, shed their leaves, and died. The base of these shoots, as well as the crown of the old stump, which was about three feet above ground-level, were found to be pervaded by yellowish-brown lines, similar to those caused by *Poria hypobrunnea*, while the wood of the collar and root laterals was soft and friable. The outer layers of the wood were stained a yellow brown, and the hyphae had collected under the bark to form a dense felt-like ferruginous plate of large size. On other parts of the collar the hyphae had spread over the surface of the bark, forming stout reddish strands, cohering into narrow plates. The fungus had many of the characteristics of *P. hypobrunnea*, but differed widely in its fructifications, which formed a plate 16 by 12 inches in size, exposed by the fallen bark. They are resupinate, 1 mm. thick, corky, of a ferruginous brown surface and texture, rather darker in the older specimens. The pores are medium-sized and irregular, while their setae are stout, sharp-pointed, and 15 to 20 μ long. The pear-shaped, white, darkly opaque, smooth spores, measuring 6 by 4 μ, have a small hyaline mucro. The fungus is related in its general appearance to *Fomes pomaceus* and agrees with the latter except that its spores cannot be called hyaline. The effects of this fungus are somewhat similar also to those caused by *Fomes pseudoferreus* (formerly known as *Poria hypolateritia*), which is quite prevalent in Malaya. The confusion between *P. hypobrunnea* and *F. pseudoferreus* in Malaya is discussed in a note by Mr. G. E. Perry, which is included in the present article. Both attack the roots of *Hevea brasiliensis*, the former especially in Ceylon, where it has been fully described by Petch (*Trop. Agric.* lii, 1). *P. hypobrunnea* has recently been identified in Malaya by Perry on specimens of *Hevea* from Selangor and Perak, and this is believed to be its first definite recognition in the country. Infected stumps and trees examined by Perry showed the characteristic red mycelial strands and plates adpressed to the surface of the roots. An account of the disease, based on Petch's description, is given by Perry, who considers that its recent recognition should not cause alarm in Malaya, as it has probably been prevalent for some time but not identified.

The author points out that the characters of the disease of *Spathodea campanulata* indicate that other fungi besides the two mentioned above are capable of causing a wet rot of the base of trees similar to the wet rot of rubber, though the present record refers to a tree which, whilst exotic to Malaya, is not a native of the continent from which the Pará rubber-tree was imported.

MEDALLA (M. G.) & REYES (G. M.). **Fiji disease of Sugar-cane.**—*The Philippine Farmer*, vii, 1, pp. 3 and 5, 1921.

The writers refer to the considerable amount of notice recently given to this disease, and state that although it is serious on a number of varieties, alarmist statements as to the losses caused by it are hardly justified; the disease may be minimized or entirely avoided by simple methods, and there should be no occasion for great apprehension in the Philippines. It has been known in Mindoro since about 1916, and in Luzon nearly as long.

The main symptom of the disease is a greater or lesser stunting of affected shoots according to the susceptibility of the variety, the leaves of the affected cane showing a bunchy, broom-like appearance; the younger newly-formed leaves are crumpled, and there is a growth of side shoots from the upper eyes. At a later stage small elongated galls, extending longitudinally along the veins of the leaf, are found. These do not appear on the native canes until quite late in the disease. The writers point out that ratoon crops are more severely affected than the plant cane.

No parasite has ever been isolated in culture from the diseased tissues, but protoplasmic bodies strongly suggestive of protozoon organisms can be observed under the microscope. The exact nature of these bodies has not been established so far, but the disease is known to be infectious, and there is definite evidence that it is transmitted by seed points.

The first step of importance in controlling the disease is to exclude the moving of seed cane and other cane material from affected plantations into disease-free areas. Growers in infected areas should plant only resistant varieties, among which Rose Bamboo, Striped Singapore, and Badila are reported to give good results in Fiji. The disease may also be minimized in affected areas by planting only seed points from disease-free stools, and in this connexion the authors cite a letter from Mr. Pemberton, of Suva, Fiji Islands, to the effect that the disease is now under complete control in Fiji. This result has been obtained by the rigorous selection of seed for planting, free from any outward evidence of the disease. This is done by specially experienced men passing along the rows and cutting seed only from the stools which show absolutely no sign of the disease; if an otherwise vigorous stool shows even a single affected cane, no cutting is taken from it, and it is either entirely removed and sent to the mill to be ground or dug out and burnt. This simple selection of seed from only healthy stools seems to have resulted in an effective control of the disease, but the writers were informed by independent planters that a brief laxity in the application of this method for a few seasons results in a quick ascendant recurrence of the disease in all of the newly-planted fields.

WILLIAMS (C. B.). **Report on the Froghopper-blight of Sugar-cane in Trinidad.**—*Mem. Dept. Agric., Trinidad and Tobago*, i, 170 pp., 11 pl., 32 figs., 1921.

Section vii of this report deals with the root disease of sugar-cane. There are two apparently distinct groups of fungi attacking cane roots in Trinidad, the *Marasmius* type and the *Odontia-Himantia* type. In the *Marasmius* type the most conspicuous external symptom is the matting of the leaf-sheafs, especially near the base of the stem, by a white mycelium resembing dried paste. The spores are produced on small mushrooms, which vary in size, number of gills, and colour of the stalk according to the species of *Marasmius* concerned. At least two occur in Trinidad, one with white and the other with purplish-black stalks. This mushroom stage is not often found. *Odontia* in its vegetative stage also mats down the basal leaf-sheaths of the cane, but on pulling them apart a feathery fungus is seen containing numerous minute stellate crystals. This form, which is only found in positions hidden from the light, is known also as *Himantia stellifera.* On the outside of sheaths infested by *H. stellifera* is found a closely-felted granular-surfaced fungus producing numerous spores. Two very similar species of this type have been described as *Odontia sacchari* and *O. saccharicola.* In the opinion of Nowell, Johnston, and Stevenson the *Odontia* is the fruiting stage of the *Himantia*, and the writer's own experience of the constant close proximity of the two fungi tends to confirm this view.

These fungi are facultative parasites, and when parasitic they grow in the roots and root-stock of the canes, causing the death of the smaller roots and staining the tissue of the larger ones. The symptoms of the disease are arrested development and an appearance of suffering from drought, even in moist weather. The leaves curl inwards at the edges and turn pale. The internodes of the upper part of the cane do not elongate, the leaves remain crowded together, and adventitious roots are thrown out below the matted leaf-sheaths in an attempt to obtain moisture. The infection rarely spreads above ground to any extent inside the cane, and under favourable conditions healthy shoots may be put out by diseased root-stocks. The disease appears to be particularly severe in Trinidad, destroying larger areas than elsewhere.

The conditions determining the extent of parasitism of the fungus are not clearly understood, the amount of visible fungus being no indication of the degree of damage caused. The injury is most conspicuous after abnormal spells of dry weather at an unusual season (from September to November in Trinidad). Susceptibility to the disease, which is known in all the chief sugar-growing districts, is aggravated by previous injury, insufficient nourishment, badly-aerated or water-logged soil, and excessive soil acidity, but the exact influence of these factors is not sufficiently known and needs further detailed investigation.

In section ix of the report the part played by root disease in the causation of the sugar-cane 'blight' which has done so much damage of recent years in Trinidad is discussed. The writer states that there is now no doubt that injury by froghoppers (*Tomaspis saccharina*) is by far the most important immediate cause of blight. The part played by root disease is nevertheless considerable, blighted fields being almost invariably affected by it, and the amount present being more or less proportional to the severity of the blight. But typical blight can exist when froghoppers alone are present, and it is concluded that the weakening effect of the insect results usually in a rapid spread of the root fungi, which are thus secondary parasites, though at times they may, in the end, cause greater injury than that due to the primary parasite—the froghopper.

Elsewhere in the report it is stated that the green muscardine fungus (*Metarrhizium anisopliae*) is probably the most important natural agent in the control of the adult froghopper, but is closely dependent on weather conditions. Attempts to infect cane fields artificially have not given conclusive results. A species of *Empusa* is a secondary controlling agent.

VAN DER BIJL (P. A.). **Notes on some Sugar-cane matters.**—*Journ. Dept. Agric., S. Africa,* ii, 2, pp. 122–128, 5 figs., 1921.

Root disease is caused in Natal and Zululand by the soil fungus known as *Himantia stellifera* or the stellate-crystal fungus. It cements together the basal leaves of the cane, and on opening the stool interwoven white threads of the fungus may be seen in the ground between the roots. By smothering the young buds the fungus lessens the stand in ratoon crops, and also prevents the growth of planted cuttings. The root system becomes impaired and the plants are thus unable to derive the necessary water supply from the soil. *Himantia stellifera* also occurs on 'umthente' grass (*Imperata arundinacea*) and probably on other grasses. It is a weak parasite on cane, and control methods should be directed towards promoting vigorous growth of the plant, conservation of the soil moisture, and aeration of the root system. On no account must cuttings affected by this fungus be used for planting.

'Ring-spot' (*Leptosphaeria sacchari*) and 'eye-spot' (*Helminthosporium sacchari*) are the commonest leaf diseases, being especially favoured by cool, damp atmospheric conditions and localities. A *Phoma* is usually associated with the *Leptosphaeria*, and is stated by the author to constitute a stage in the life-history of the latter. As a rule these diseases are not severe enough to necessitate treatment, but an attempt should be made to secure immunity by means of selection.

As the stalk of the cane is the sugar-containing region, the fungi occurring on or in it should be considered both in their effect on the plant itself and in their effect on the sugar stored up in the cane, whether as causing a loss of this substance or the formation of products which may later cause trouble in the mills. Diseased stalks generally show a reddening of the tissues, and suspicious cases should be avoided for planting. In Natal and Zululand two widely-distributed fungi are responsible for a reddening of the interior of the stalks and an inversion of the stored-up sugar. They are *Melanconium sacchari*, the 'rind disease' fungus, and *Cephalosporium sacchari*. The former is easily recognizable by the way the spores break through the rind of the cane in long, kinky, black threads or velvety black patches; according to the prevailing moisture conditions. The second fungus has not been observed to fruit on standing cane, but its spores probably form in abundance when infected cane decays. Owing to its long period of growth, sugar-cane is particularly susceptible to drought and other adverse conditions, which weaken the stalks and make them specially liable to attack by fungi. Careful consideration must therefore be given to external influences and conditions of growth in avoiding these diseases. Stalks allowed to over-mature are also less resistant to fungous diseases. The inversion of sucrose or the formation of undesirable disintegration products in the stalk owing to fungous attacks may also have serious consequences. The annual loss of sucrose caused by stalk fungi is a good deal higher than is usually suspected.

Colletotrichum falcatum, the cause of the red rot disease of cane stems, which has been recorded from nearly all other cane-growing countries, has not hitherto been found in this area.

Schizophyllum commune commonly occurs in Zululand on old cane-stalks lying on the ground, but the author has never seen it on standing cane. It has been recorded as a wound parasite of cane in Java and elsewhere.

A constitutional derangement marked by the occurrence in the internodes of strips of spongy tissue or cavities surrounded by spongy tissue is reported, and stated to be similar to a condition recorded in Java as occurring on cane in which growth has been irregular for some reason, suoh as a set-back followed by rapid development. The cells in the spongy tissue are dead, filled with air, and without sucrose. These spongy stalks are very liable to fungous diseases.

An examination of the anthers and pollen of the Uba and other varieties of cane which have arrowed in South Africa indicates that the failure of attempts at cross-pollination or selfing is due to one or other of the following causes: the anthers appear to have lost the power of opening, and such pollen as they may contain is not liberated: the pollen is remarkably scanty in the anthers; what pollen there is differs from the normal in certain aspects, which suggest sterility, being irregular in shape instead of circular as in normal cane, and devoid of starch. A variety with normal viable pollen must therefore be procured before success in raising cane seedlings can be expected.

HARTER (L. L.), WEIMER (J. L.), & LAURITZEN (J. I.). **The decay of Sweet Potatoes (Ipomoea batatas) produced by different species of Rhizopus.**—*Phytopath.*, xi, 7, pp. 279–284, 1921.

The Yellow Jersey variety of sweet potato was inoculated with the following species of *Rhizopus*:—*R. nigricans* Ehrnb., *R. reflexus* Bain., *R. chinensis* Saito, *R. tritici* Saito, *R. artocarpi* Racib., *R. delemar* (Boid.) Wehm. & Hanz., *R. maydis* Bruderl., *R. nodosus* Namysl., *R. oryzae* Went & Geer., *R. microsporus* v. Tieg., and *R. arrhizus* Fisch. Rot was caused by all the above species except

R. chinensis and *R. microsporus*. 'Pure lines' of the fungi were used for inoculation. The various species of *Rhizopus* can be grouped into high, intermediate, and low temperature forms, thriving best at 30°–40° C., 20°–35° C., and 15°–20° C. respectively. *R. nigricans*, *R. artocarpi*, and *R. microsporus* are mentioned as low temperature forms, *R. maydis* is an intermediate, and *R. chinensis* a high temperature form.

These results show that other species of *Rhizopus* than *R. nigricans* may cause rot of sweet potatoes in storage. Judging from the inoculation experiments, the amount of damage caused by any particular species will depend to some extent on the temperature, the most successful inoculations having been obtained when the potatoes were incubated at the temperature best suited for the growth of the species used.

HARTER, (L. L.) & WEIMER, (J. L.) **A comparison of the pectinase produced by different species of Rhizopus.**—*Journ. Agric. Res.*, xxii, 7, pp. 371–377, 1921.

Recent investigations by the authors [see this *Review*, i, 2, p. 64] showed that *Rhizopus tritici* Saito, an organism parasitic on sweet potatoes, produces a powerful intracellular and extracellular pectinase; further experiments [see last abstract] proved that nine species of *Rhizopus* are parasitic on sweet potato and that the species differ in degree of parasitism, both as regards the percentage of infection and the rapidity of decay. The writers have now carried out a series of experiments to determine whether pectinase is produced by all species of *Rhizopus*, and, if so, to what extent; and whether its production is any indication as to the parasitism of the species. They studied the secretion of pectinase in eleven species [those mentioned in the preceding abstract], all of which were found to produce pectinase and to exude some of it into the culture solution. Under identical conditions, the amount of pectinase varied with the species. Four of those tested (*nigricans*, *microsporus*, *chinensis*, and *artocarpi*) have a comparatively small amount of pectinase in their mycelium, and two of these (*nigricans* and *artocarpi*, both of which are parasitic on the sweet potato) also secrete a relatively small amount into the solution. On the other hand, *chinensis* and *microsporus*, two non-parasitic species, while retaining a small amount of enzyme in the mycelium, secrete a comparatively large quantity into the culture solution. The other species produce relatively large amounts of pectinase, some of which is exuded and some retained, except in *delemar*, where most of the enzyme is given up to the substratum. The activity of the enzyme was measured by the time necessary to cause complete maceration of trial disks of sweet potato. The results do not reveal any simple relation between pectinase production and parasitism under the conditions of the experiments.

MATZ (J.). **The Rhizoctonias of Porto Rico.**—*Journ. Dept. Agric. Porto Rico*, v, 1, pp. 1–31, 28 pls., 1921.

The present paper deals in detail only with the mycelial and sclerotial stages of the species of *Rhizoctonia* referred to below. A *Corticium* stage, however, is mentioned and figured in association with *R. microsclerotia* Matz. It is stated to be similar to the *C. vagum* stage of *R. solani*. Cultures were obtained by suspending the hymenium over an agar plate, the fallen basidiospores being located and their germination observed. They gave a mycelium and sclerotia identical with those of *R. microsclerotia*. No sporing stage has been observed in connexion with the other species studied.

The author's list comprises both soil-inhabiting and aerial forms of the genus, but is not intended to be exhaustive, the chief aim being to secure accuracy in determining the species found during a period of about four months. This can only be done by cultural methods, as some of the species seldom, if ever, produced sclerotia on the host plant, and a recognition from the mycelium alone is usually impossible. A surprising case of polymorphism was observed in connexion with a *Rhizoctonia* found on cowpeas which, morphologically, did not differ from *R. microsclerotia* on *Ficus carica* in Florida [Matz. *Phytopath.*, vii, p. 110, 1917] in so far as its characters on the host plant were concerned, but which, when grown in culture on steam-sterilized bean-pods, invariably produced much larger sclerotia, the diameter being about 1 cm. as compared with the usual 0·5 mm. This difference was found to occur constantly on bean-pods, no matter whether mycelium or a small sclerotium was transferred to the tubes. On cornmeal agar, however, in addition to one or two larger ones, small sclerotia generally appeared on the surface of the agar, similar to those of *R. microsclerotia*. In other collections from cowpea the fungus proved to be identical in all respects with the species found on the fig in Florida.

Although no exact estimate can be made, the damage caused by the different species of the genus to economic plants in Porto Rico is quite considerable. They have been obtained from banana, bean, beet, carrot, celery, celeriac, citrus, corn, cowpea, eggplant, hollyhock, lettuce, field pea, pepper, Natal plum (*Carissa grandiflora*), roselle, sugar-cane, tomato, and yautia. Hardly any of the species found were confined to a single host plant. Sugar-cane, cowpea, and bean have at least three species parasitic on them in Porto Rico, besides, on sugar-cane and bean, *R. solani*. Plants producing abundant foliage are more liable to attack during suitable weather conditions, as the density of the shade, by conserving the humidity of the air, favours the growth of the fungus. It is of interest to note that the aerial forms of the genus produce sclerotia much more freely than the underground forms, which are protected from the sun and wind by a layer of soil.

A key to the characters of the following species is given and the latter are fully described, a list of host plants being furnished in each case. *R. microsclerotia* Matz on cowpea, carrot, bean (*Phaseolus* sp.), *Carissa grandiflora*, and hollyhock; *R. macrosclerotia* n. sp. on bean petioles and stems; *R. dimorpha* n. sp. on cowpea and bean; *R. grisea* (*Sclerotium griseum* Steven.) on sugar-cane; *R. solani* Kühn in its mycelial stage on bean-pod, citrus, roselle (*Hibiscus sabdariffa*) seedling, celery, tomato stem, lettuce leaves, sugar-cane roots, banana roots, pea, and other hosts; *R. pallida* n. sp. on sugar-cane roots, roots of pepper (*Capsicum* sp.), and on young maize seedlings; *R. ferrugena* n. sp. on sugar-cane roots; *R. melongena* n. sp. on eggplant (*Solanum melongena*); *R. alba* n. sp on leaves of *Apium* sp. The last four are not usually found on the aerial parts of plants, attacking chiefly the underground organs.

The illustrations include a number of photomicrographs showing the cultural characters of the species and the appearance of the sclerotia and branching hyphae in culture.

MOESZ (G.). **Mykologiai Közlemenyek. IV Közlemeny.** [Mycological communications. Fourth communication.]—*Botanikai Közlemények*, xix, 1–6, pp. 44–66, 13 figs., 1921. [German summary.]

In this paper several new species are described, and figures and notes given on various fungi, chiefly Deuteromycetes and smuts.

Phomopsis daucicola Moesz n. sp., on dead carrot-stems, is stated to be probably the conidial stage of *Diaporthe denigrata* Winter, both fungi forming commonly a broadly effused, brown or black stroma on the stems. *Phomopsis denigrata* (Desm.) Trav., although rather closely allied, is considered to be a distinct species, as it does not seem likely that the same *Phomopsis* could occur both on *Daucus* and *Brunella*, and there is a separate *Diaporthe*, *D. desmazieri* Niessl, on the latter. The writer believes that the hook-shaped conidiophores described by Allescher and Diedicke in the fructifications of *Phomopsis denigrata*, are really the B-spores of the fungus.

Septoria allii Moesz n. sp. differs from both *S. alliicola* Bäumler and *S. ranojevinicii* Bubák. It occurs on the dry leaf-sheaths, chiefly on the veins, of *Allium oleraceum*, and has pycnidia measuring 116 to 180 μ and conidia 16 to 36 by 2 to 3 μ, continuous, curved, and with narrowed ends.

PALM (B. T.). **Een gevaar voor de tabakscultuur in Deli.** [A menace to Tobacco cultivation in Deli.]—*Bull. Deliproefstat. te Medan-Sumatra*, xiv, 9 pp., 1921. [English summary.]

Generally speaking, the diseases affecting tobacco in the two chief tobacco-growing centres of the Dutch East Indies, Deli in Sumatra and the Vorstenlanden in Java, are the same, namely, the bacterial brown rot or 'slime disease' caused by *Bac. solanacearum* E. F. Sm., the wilt disease due to *Phytophthora nicotianae* Breda de Haan, the foot rot (*Sclerotium rolfsii* Sacc.), and the bacterial leaf disease or 'black rust' produced by *Bact. pseudozoogloeae* Honing. In Deli much the most destructive disease is the bacterial brown rot, *Phytophthora* wilt being less important, while in the Vorstenlanden conditions are reversed. *Sclerotium rolfsii* can do much local damage at times in Deli, while the 'black rust' is present every year, but its severity is closely dependent on temperature conditions.

In the Vorstenlanden, increasing damage is also caused by an *Oidium*, and a similar mildew has recently been observed by the writer in Sumatra, on the Karo plateau towards the centre of the island, attacking native-grown tobacco. A number of the fields in this area were seriously affected by mosaic disease, while the leaf spot caused by *Cercospora nicotianae* Ell. et Everh. and the 'black rust' were also present. The mildew was first detected at a site about 1,500 metres above sea-level, and was later found to be extensively distributed and to occur on several varieties of tobacco similar to those grown in Deli. The attack commences with isolated white patches on the leaf, which gradually extend along the veins. The patches are seldom found on the under side, and only in exceptional cases is the whole surface covered. The diseased leaves frequently turn yellow and dry up prematurely. The lower (older) leaves are first attacked, then the younger ones on the same plant. This preference for the lower leaves would greatly add to the seriousness of the disease in Deli. In some cases observed by the writer on the plateau every leaf of a plant was attacked.

The fungus is a typical member of the Erysiphaceae, the white patches being formed of fine hyphae on which conidia are produced in large numbers. The length of the conidiophores varies between 150 and 210 μ, and their width between 12 and 17 μ; the conidia are oblong-cylindrical, obtusely rounded at both ends, $25-40 \times 15-20 \mu$. It is therefore probably *Erysiphe cichoracearum*, the mildew which does so much damage to tobacco in other countries. Perithecia were not found, so that exact identification was not possible.

In view of the rapidity with which the disease spreads from place to place, constant vigilance will be necessary to check its advance to the coastal plain of Sumatra, in which the Deli plantations are situated. The shortest distance between the affected localities of the central plateau and the nearest tobacco estate is only about fifty kilometres, and there is a considerable movement of agricultural products from the plateau. The adoption of legislative measures to prevent spread is considered impracticable. Treatment is likely to be very difficult; sulphur dusting is the only method tried in the Vorstenlanden that has checked the disease, but the tobacco treated in this way was found unsuitable for fermentation.

HAENSELER (C. M.). **Fungi injurious to paints.**—*Report of the Department of Plant Pathology of the New Jersey Agric. Coll. Exper. Stat. for the year ending June 30, 1920*, pp. 605–607, 1921.

The author gives a progress report, in which he notes that *Aspergillus* spp. and *Penicillium* spp. are sometimes the cause of discoloured painted surfaces, and that *Dematium pullulans*, *Cladosporium* spp., *Phoma* spp., and an unidentified fungus are important in causing discoloration. *Cladosporium* and *Aspergillus* were also found to cause injury to varnished surfaces.

Tests showed that these fungi cannot derive their full nourishment from linseed oil, and evidently utilize the foreign matter on the paint as at least a partial source of nourishment. The damage is greatest in humid and warm atmospheres. Paint made with lithopone was most subject to attack by fungi, and pure white lead carbonate paints next; zinc oxide and mixed paints showed only occasional colonies. Different kinds of wood tested showed that no influence was exerted on the kind or amount of growth when the same paint was applied. The addition of 1 per cent. by weight of copper sulphate, 4 per cent. of benzol, or 2 per cent. of mercuric chloride, zinc chloride, carbolic acid, or toluene, each failed to prevent growth of the fungi.

SPIERENBURG (DINA). **Een onbekende ziekte in de Iepen.** [An unknown disease of Elms.]—*Tijdschr. over Plantenziekten*, xxvii, 5, pp. 53–60, 1 fig., 1921.

The disease here described is believed to be entirely new to the Netherlands, and was first brought to the notice of the Phytopathological Service in the autumn of 1919. During 1920, further complaints were received from all parts of the country, so that it appears to be already widely distributed. The examination of the diseased wood indicated that in a few cases the attack began in 1917, but, as a rule, the symptoms were confined to the annual rings of 1918, 1919, and 1920.

In the tops of trees in leaf are dry and withered masses of dead leaves and branches in the midst of the living foliage. The branches are dry, wrinkled, and have a singed appearance, the smaller ones being bent at the tip. The buds for the next year's shoots are mostly small and dried up, and the remaining living foliage dry and brittle. Often the green leaves have dry brown edges. Sections through the wood of the branches and trunks reveal a circle of small brown specks occupying one or more of the outermost annual rings. In the thinner twigs the whole thickness of the wood may be marked by these brown specks, which extend to the tip of the twig. Sometimes large areas of the inner wood of thick branches are discoloured by an infiltration issuing from the brown specks of the outer annual rings. The roots, occasionally the trunk, the discoloured rings, and sometimes the pith of diseased trees may also be marked by large brown spots, darker in colour than the specks in the rings. The walls of the wood vessels and of the parenchyma and medullary ray cells are coloured brown.

Of the two varieties of elm principally used for street-planting and other ornamental purposes, *Ulmus monumentalis* and *U. campestris latifolia*, the former is the more susceptible to the disease.

The beetle *Eccoptogaster scolytus* F. was found in many of the diseased trees, except at Oud-Beierland, but the writer thinks that it follows the disease and has nothing to do with the causation of the latter; nor has the cicada, *Typhlociba*, which was found on the leaves and branches. A number of fungi were also isolated from the diseased material, including *Graphium penicillioides*, *Cephalosporium acremonium*, and species of *Fusarium*, *Phoma*, *Botrytis*, *Didymochaeta*, *Verticillium*, and *Pestalozzia*. Inoculations were undertaken with the first two of these fungi, hitherto with negative results. The writer is, indeed, by no means satisfied that the disease is caused by a parasite, being inclined rather to attribute it to physiological disturbances due to excessive drought, severe frost, or defective soil conditions.

Cases of one-year-old trees attacked by the disease are reported from nurseries at Oudenbosch, while an average annual loss of 20 per cent. is estimated in nurseries in another locality, but it is not certain that all these cases can be attributed to the disease in question.

The only instructions for treatment which can be given at present are to cut away the dead branches, applying carbolineum or tar to the wounds, and to refrain from pruning. Trees attacked by beetles should be painted with 30 per cent. carbolineum in May.

WALKER (J. C). **Onion smudge.**—*Journn. Agric. Res.*, xx, 9, pp. 685–722, 6 pl., 10 figs., 1921.

'Smudge' is considered the best common name for the onion disease commonly attributed to *Vermicularia circinans* Berk., a fungus which, the author thinks, is more properly called *Colletotrichum circinans* (Berk.) Voglino. The disease is widely distributed on white varieties of *Allium cepa*, and other varieties also are susceptible. The shallot (*A. ascalonicum*) and leek (*A. porrum*) also are attacked, but it has not been found on garlic (*A. sativum*).

The disease is confined to the scales and neck of the bulb, and occurs only on unpigmented portions of coloured varieties. Smudge reduces the market value of the crop and results in shrinkage in storage and premature sprouting.

The fungus is described in detail. It belongs to a group of species in which the acervuli are formed on a subcuticular basal stroma. It is considered that the connexion with *Cleistothecopsis*, as reported by Stevens and True, is not yet proved. A large number of species of *Colletotrichum* coincide closely with *C. circinans* as to spore measurements and general characters. A comparison was made with *C. fructus* (S. & H.) Sacc., described as causing a fruit rot of apple. *C. circinans* was found capable of rotting apples, but at a slower rate than *C. fructus*. The latter fungus developed on outer scales of onion bulb, but did not penetrate farther. Thus there are differences in pathogenicity between the two species and slight morphologic differences were also found.

The cultural characters of the fungus are described. The conidia are sensitive to desiccation, except that in spore masses a few spores may survive for four months or more. The stromata retain their vitality for at least two years.

The fungus may cause damping-off of onion seedlings, but otherwise does not attack actively growing plants. It invades the dry outer scales as the bulb approaches maturity, and following harvest there is a further gradual invasion of the dormant cells of the fleshy scales. In severe cases the entire bulb may be penetrated. On germination the spores form appressoria, from which an infection tube develops and penetrates the cuticle. After a period of subcuticular development the underlying cell-wall is softened and the fungus penetrates more deeply, causing collapse of the epidermal and subjacent cells. The cuticle does not share in this softening, but remains intact until the acervuli are formed. Infection occurs at or above 10° C., but progress is slow below 20°, and the optimum is about 26°. Conidia are produced abundantly between 20° and 30° C. under moist conditions, and are disseminated chiefly by spattering rain. The disease develops most rapidly in the field under damp soil conditions and soil temperatures of 20° to 30° C. Very hot, dry weather checks its progress. Artificial drying of onions immediately after harvest checks smudge, and it does not spread from bulb to bulb in storage except under very moist conditions. The fungus overwinters as stromata in the infected scales.

Experiments with spraying and dusting the bulbs and necks of onion plants failed to check the disease. The important control measures are protection of the harvested crop from rain, rapid and thorough curing, and the provision of well-ventilated, cool (33° to 36° F.) storage.

RODWAY (L.). **On Polyporus pulcherrimus.**—*Papers and Proc. Roy. Soc. Tasmania*, 1921, p. 176 [1922].

Polyporus pulcherrimus n. sp. is described. It is commonly found on the trunk of the evergreen beech, rarely on a eucalypt. The fungus is a wound parasite but spreads to the living wood. Though closely related to *P. confluens* it differs from the latter in several important particulars, such as its bright crimson colour, watery consistency, and larger, oblong spores.

Summary of Laws and Regulations in force in Ceylon in respect of plant pests and diseases.—*Dept. of Agric. Ceylon, Bull.* 48, 6 pp. 1921.

Ordinance No. 5 of 1901, 'the insect pest and quarantine ordinance', empowers the Governor in Executive Council to make regulations for preventing the introduction into Ceylon of insect or fungous pests or plant diseases, and for preventing the spread of such pests and diseases in the island. The regulations still in force under this Ordinance which are wholly or partly concerned with fungous diseases are as follows:

The importation of cacao plants from the Dutch East Indian Colonies is prohibited. All such plants may be destroyed without compensation.

The importation of pepper plants (except dried seed for commercial use) from India is prohibited.

The importation of seeds or plants of *Hevea* (any species) is prohibited.

The revised rules regarding disinfection and fumigation include the following: The importation of tea seed from India and of coconuts in husk is prohibited except at the port of Colombo; but husked coco-nuts, and also tea seed from India, if accompanied by a certificate from a scientific officer of the Indian Tea Association or the Imperial Department of Agriculture stating that the leaf disease called blister blight (*Exobasidium vexans*) does not exist within ten miles of the estate on which the seed was grown, may be exempt from these regulations.

[By a recent regulation (*Ceylon Govt. Gaz.*, No. 7,235, of Dec. 23, 1921) this last exception is cancelled, and the following substituted: No tea seed shall be imported either directly or indirectly from any place in India.]

Ordinance No. 6 of 1907 provides for the destruction of plant pests and the sanitation of plants in the colony. The Governor in Executive Council may proclaim in the Gazette any insects, parasitic plants, and fungi to be pests, and may prescribe measures for prevention, arrest, and eradication of such pests. The Governor may also appoint a Plant Pests Board consisting of four to seven members to serve for three years in any revenue district. This Board may enforce the carrying out of the measures in regard to proclaimed pests, compensation not being given unless granted by the Governor in Executive Council. The following proclamations dealing with fungous diseases have been issued under this Ordinance, and are still in force :

Coco-nut trees infected by the fungus *Thielaviopsis ethaceticus*, which causes the stem-bleeding disease, are to be treated by cutting out and burning the diseased parts, scorching the wound and applying hot tar.

Hevea fruits infected by the fungus *Phytophthora faberi* must be burnt or buried with lime. The diseased cortex is also to be excised and burnt.

Fallen or dead coco-nut trees attacked by the species of *Phytophthora* causing nut- and leaf-fall must be destroyed by fire, together with all diseased fruits and fallen leaves.

Importation of Pará Rubber plants into Malaya.

By notification No. 1011 of June 11, 1920, amended by notification No. 1531 of Sept. 30, 1921, under section 22 of the Agricultural Pests Ordinance, 1918, Straits Settlements, and by notification No. 3931 of Aug. 26, 1921, under section 21 of the Agricultural Pests Enactment, 1913. Federated Malay States, the importation of any plant of Para rubber into the Straits Settlements or Federated Malay States from any place outside them is prohibited except with the written permission of the Director of Agriculture, Federated Malay States and Straits Settlements, and subject to the terms and conditions (if any) imposed by him. All species of *Hevea* are covered by these notifications, and the term plant includes the stem, root, leaf, flower, or fruit, and any product or part thereof whatsoever, whether severed or attached.

Decree of the President of the French Republic of March 8, 1921, prohibiting the importation of living plants, fruits, and seeds of the Chestnut, as a guard against Endothia parasitica.—*Journ. officiel de la République française.* [Abs. in *Internat. Rev. Sc. and Prac. of Agric., Rome,* xii, 5, p. 642, 1921.]

Importation into and transport in France of living plants, fruit, and seeds of chestnuts coming directly or indirectly from the Far East is forbidden, and also from countries which have not adopted preventive and control measures against the chestnut-tree disease caused by *Endothia parasitica*.

Importation permits will, however, be issued by the Ministry of Agriculture on conditions determined according to the advice of the consultative committee on epiphytes.

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IMPERIAL BUREAU OF MYCOLOGY

REVIEW

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WALKER (J. C.) & JONES (L. R.). **Relation of soil temperature and other factors to Onion smut infection.**—*Journ. Agric. Res.*, xxii, 5, pp. 235–262, 3 pl., 1921.

The cotyledon of the onion is susceptible to attack by *Urocystis cepulae* for a period of about three weeks from germination, after which it becomes resistant and infection fails. Onion seeds germinate and growth occurs at all soil temperatures from 10° to 31° C., the most rapid germination and best top growth taking place from 20° to 25° C., while as a rule the best root growth is got below 20° C.

Smut infection occurs freely at soil temperatures of from 10° to 25° C., but there is a decided diminution in infection at 27° and complete freedom from the disease at 29°. In these experiments the air temperature was kept uniformly at 15° to 20° C.

When plants bearing incipient infections were exposed to an air and soil temperature of 30° to 33° C. the progress of the infection was inhibited, even if it had extended to the stage when pustules were beginning to appear (ten or twelve days). The effect was permanent in so far that no further development of the fungus occurred when the plants were again returned to the lower temperature (15° to 20°) after twelve to fifteen days at the high one. On the other hand, a high air temperature alone, the soil temperature being kept at 20° to 25°, permitted free infection and subsequent development. These results suggested that the inhibitory effect of the high soil and air temperatures was due to some marked alteration in the metabolism of the host plant and not merely to a direct effect on the growth of the fungus in the heated aerial parts of the plant.

A comparison was made between the development of the disease in plants grown at 15° to 20° and at 24° to 28° C. of both air and soil. A high degree of cotyledon infection resulted in both cases, but at the higher temperature the plants tended to outgrow the disease and the cotyledons were lost before infection of the first true leaf occurred. In field experiments complete freedom from the disease was attained when the daily mean soil temperature at one to two inches depth remained at or slightly above 29° C. for two or three weeks.

These results were correlated with the observed incidence of the disease in the United States. In the Southern States onions are grown, during the critical period of infection (August–September in Texas), at a mean air temperature above that at which the disease is inhibited, and it is probable that the temperature of the upper layer of the soil is higher by several degrees. In these regions the disease has not appeared, though there must have been many opportunities for its introduction. In the north, on the other hand, the temperature during the critical period for infection is relatively low and the disease is prevalent from New York to Oregon.

Soil moisture variations were found to have little effect, only inhibiting infection at very low or very high extremes, at which the germination and growth of the host is also retarded.

JONES (F. R.) & VAUGHAN (R. E.). **Anthracnose of the garden Pea.**—*Phytopath.*, xi, 12, pp. 500–503, 1 pl., 2 figs., 1921.

Anthracnose caused by *Colletotrichum pisi* Pat., which caused great damage to peas in some areas in Wisconsin in 1912 and 1920, differs little in general character from that due to the more common *Ascochyta pisi.* It occurs on all the aerial parts of the plant, and though it has not been detected on the seed itself, there is apparently no obstacle to the penetration of seeds in diseased pods. On leaves the lesions are irregular in shape, smoky grey or brown near the margin and lighter brown at the centre. On pods they are usually lighter in colour, more nearly circular, and dark brown at the margin, while on the stem they are elongated, occasionally extending all around the circumference, and after the spores develop are ashy when dry and copper-coloured when moist. Setae are sometimes produced in great abundance on stems. On nearly mature stems, rusty areas of considerable extent may occur where the spores are produced in tiny acervuli.

The importance of the disease in the United States is probably slight, owing to its limited distribution, but there is a possibility of destructive epidemics occurring under suitable conditions.

The host range of the fungus includes horticultural varieties of *Pisum sativum* L. and also *P. sativum umbellatum* (Mill.), *P. elatius* Bieb., and *P. jomardi* Schrank. It was not possible to infect varieties of bean and clover; the spores germinate abundantly on clover leaves, but in no case observed did the germ-tube penetrate the epidermal cell. In culture the surface usually becomes covered with black sclerotial bodies merging to form a crust, upon which only a few spores are found. Mature woody sweet clover or pea stems were the best substrata for the production of acervuli, which are golden yellow or salmon coloured. Setae are produced sparingly.

The conidia germinated readily on agar plates at temperatures from 10° to 30° C. in 18 hours. In 24 hours spores germinated at temperatures down to 7° C. At 21° C. spores germinated and produced appressoria on the leaf-surface in 26 hours. The appressoria are formed very close to the end of the spore. They are irregularly rounded structures, reddish-brown in colour, and generally situated near the edge of an epidermal cell. After 36 hours at 21° C. the fungus had penetrated the epidermal cell directly below the appressorium and begun to produce a mycelium.

MATZ (J.). **Una enfermedad dañina de la Habichuela.** [A harmful disease of the Bean.]—*Est. Exper. Ins., Porto Rico, Circ.* 57, 8 pp., 1 pl., 1921.

The writer states that the disease of the bean (*Phaseolus* sp.) caused by *Rhizoctonia microsclerotia* is little known outside Porto Rico, the Philippines, and India. Since 1918 its occurrence has been under observation in some localities on the island, and it has broken out abruptly at each successive harvest, remaining in an inactive condition until the plants are mature. It can easily be recognized, as it causes the collapse of the leaves into a sticky mass, the dark and rotting appearance of the foliage being characteristic. When falling, these diseased leaves may adhere to other healthy parts of the plant, owing to the way they are stuck together by the fungus, and further infection takes place. The sclerotia, 0·5 mm or less in diameter, round, dark or sometimes white, and easily detachable, occur all over the stalk, petiole, and veins of the leaf, and on falling on the soil may remain viable there for months until favourable circumstances for germination arise; young plants, when not sown too densely, are not attacked, as the free admission of light and air to the surface of the soil inhibits germination of the sclerotia. The latter first germinate, as a rule, when the ground is densely covered by the crop and humid conditions prevail under and around the plants. The fungus then spreads to the lower leaves and rapidly passes along the stem to the upper parts of the plant. The stem itself is rarely directly damaged by the parasite as the tissues are too resistant, but the tender leaves and pods succumb easily.

The author recommends that beans should be sown so that they may ripen before the rainy season sets in; localities sheltered from all air-currents should be avoided; infected plants should be destroyed; and suitable crops (e.g. tobacco or maize) should be grown in rotation with beans, on infected soil. Burning dead stalks and other refuse on the ground is said to be a good practice, while spraying with Bordeaux (3–3–50) is effective in small plantations.

Hawthorn in relation to fireblight.—*New Zealand Journ. of Agric.*, xxii, 4, p. 255, 1921.

In view of the part played by hawthorn in the spread of fireblight in New Zealand [See this *Review*, i, 1, p. 22] the Noxious Weeds Amendment Act, 1921, permits the declaration of hawthorn as a noxious weed, either throughout the district of a local authority, or in a part or parts of the district only, and, furthermore, the planting of hawthorn is prohibited in New Zealand.

TROTTER (A.). **A Walnut disease.**—Abs. in *Boll. mensile della R. Staz. di Patologia vegetale*, ii, 7–9, pp. 106–107, 1921.

In the *Rivista Agraria*, Professor A. Trotter, of the Royal

College of Agriculture at Portici, describes a disease of the walnut-tree met with in the province of Naples, which he calls the 'nerume' or black disease. The attacked trees are restricted in growth, their leaves turn yellow, and the young fruits fall off prematurely in June. In the more severe cases large branches or even the whole tree may wither. Sometimes a blackish mucilaginous fluid exudes through fissures in the bark of the branches, but the most striking and constant symptom is the blackening of the living tissues immediately under the cortex, especially at the base of the trunk, and in the thicker roots. The disease, which seems to present some analogy with the 'mal dell' inchiostro' (ink disease) of the chestnut, is associated with a fungous mycelium in the tissues of the larger roots, extending as far as the collar of the tree, but the pathogenicity of this fungus has not been proved. The diseased walnut-trees grew in a poor and shallow soil, with a rocky, almost impermeable, subsoil, and were thus in conditions unsuitable for their growth.

Departmental Activities: Botany.—*Journ. Dept. of Agric. S. Africa,* iii, 5, pp. 407–408, 1921.

Cases of an onion disease due to *Botrytis allii*, not previously reported by this department, have been received from the Cape. It may be detected, in the growing stages of the plant, by the appearance in wet weather or in the morning after heavy dew of a grey mould on the leaves, followed by the wilting of the affected parts. The most serious consequence, however, is the rotting of the bulb. The fungus infects the leaves at the top of the bulb, then gradually works down and starts a characteristic rot in the bulb which nothing can stop. In order to prevent its spread in the storehouse it is advisable to pick over the onions carefully, and burn any that show the least sign of the disease. In the early stages on the leaves the disease can be checked by spraying with Bordeaux mixture (4–4–50).

Besides crown gall and hairy root of the apple, many cases of the apple-cracking disease caused by *Coniothecium chromatosporum* have occurred, while a disease of apple twigs due to *Phoma mali* has also been reported. The latter usually affects only twigs of young trees, and fruits, the discoloured areas produced on the former having the appearance of being scorched by fire.

Departmental Activities: Botany.—*Journ. Dept. of Agric. S. Africa,* iii, 6, p. 500, 1921.

A disease of the Avocado pear tree, the cause of which is at present unknown, is under investigation. Judging from the severity of the infection and the disastrous results to the tree, it is regarded as likely to prove of a very serious nature. The disease develops in the woody tissues, where it produces grey to brownish, irregular, slightly raised blotches of a cankerous nature.

COOK (M.T.). **Report of the Department of Plant Pathology of the New Jersey Agric. Coll. Exper. Stat. for the year ending June 30, 1920,** pp. 557–577, 1921.

The diseases under investigation are listed. In addition to subjects noted elsewhere in these abstracts, Dr. Cook worked with the transmission of *Sclerotinia cinerea* from year to year, the causes of tomato fruit rots, and the removal of fruit tree cankers; Dr. W. H. Martin on physiological diseases of potatoes; Mr. C. M. Haensler on spraying pears and cherries, and on egg-plant wilt; and Mr. R. F. Poole on the control of sweet potato and tomato diseases. Among the plant diseases listed as epidemic are root-rot of pea, leaf and fruit spot (*Fabrea maculata*) of pear and quince, *Rhizoctonia* stem cankers of tomatoes and cabbage, and stem rot of sweet potatoes. Under the title 'Falling foliage' (pp. 570–573) Dr. Cook reports that beech and apple leaves turned brown along the margins and between the veins and fell in large numbers during the spring and summer. This is attributed to a period of low temperature while the leaf buds were developing. Spray injury from lime-sulphur, atomic sulphur, and arsenicals was also frequent on the foliage and fruit. Brown rot of the peach (*Sclerotinia cinerea*) was especially severe in 1919, and peach scab and cherry leaf-spot abundant. Under 'Field studies on potato diseases' (pp. 573–577) Dr. Cook reports that blackleg (*Bacillus phytophthorus*) [*B. atrosepticus*], which was destructive a few years ago, is now very rare in New Jersey, probably because of seed certification work. Powdery scab was found not to develop under New Jersey conditions. *Rhizoctonia* is injurious. The amount of infection on the seed tubers was found to be no index of the severity of this disease in the field. Corrosive sublimate gave better results than formaldehyde in seed treatment experiments. Dry rot, attributed to *Fusarium oxysporum*, is common, but not serious. Tipburn of the foliage is most severe during hot weather following a wet season. Mosaic is serious on American Giant and the less grown Green Mountain and Bliss Triumph varieties. It is reported to increase in severity from year to year. Leaf-roll is very serious on the Irish Cobbler variety.

HAYES (H. K.) & STAKMAN (E. C.). **Resistance of Barley to Helminthosporium sativum P.K.B.** — *Phytopath.*, xi, 10, pp. 405–411, 1921.

H. sativum, which causes spot-blotch disease of barley, can also attack wheat, and this or a very similar fungus has been found to be a common cause of foot rot of wheat, rye, and wild grasses, in Minnesota (*Minn. Agric. Expt. Sta. Bull.* 191, 1920). Manchuria barley is fairly resistant, but is unpopular because of its long rough awns. The results of breeding work to produce smooth-awned barleys demonstrated that the question of resistance to *H. sativum* must be considered in the progenies produced.

Crosses were made between Lion, a smooth-awned variety, susceptible to *H. sativum*, and Manchuria, a rough-awned, resistant variety. A study of certain of the F_3 families obtained showed that a gradation occurred, some families being as resistant as Manchuria, some as susceptible as Lion, and some intermediate. It was found that F_3 families could be selected which combined smooth awns and other desirable agronomic and botanical characters with resistance to *H. sativum*. The resistant families were, in general, the best yielders when the trial plots were exposed to an artificially produced epidemic of spot blotch disease.

The relative resistance of eighteen commercial varieties of barley to *H. sativum* is given, and it is concluded that there is evidence that resistant barleys of any desired botanical group of *Hordeum* can be produced.

VERHOEVEN (W. B. L.). **De strepenziekte van de Gerst.** [The stripe disease of Barley.]—*Tijdschr. over Plantenziekten*, xxvii, 10, pp. 105–120, 4 pl., 1921.

Stripe disease makes its first appearance on barley seedlings when about a month old in the form of two or three pale stripes which become more distinct as time goes on. Finally the tissue dies and a brown discoloration is produced. In severe cases the leaves or even the whole plant may be destroyed.

The early stages of the disease are frequently overlooked, but when the ears are formed the symptoms become much more conspicuous. The dark brown stripes, of which as many as eight may occur on one leaf, run longitudinally and finally split up, giving a frayed appearance to the plant. The discoloration is accompanied by limpness of the leaves, which droop down against the stalk. The leaf-sheaths and nodes may also be attacked, and in moist conditions the formation of spores on the latter can be observed. As a rule the lower leaves are attacked first, the infection gradually spreading upwards. In affected plants all or nearly all the shoots show the disease.

The development of the ears is greatly influenced by the disease, and three types may be distinguished. In the first the ear may emerge entirely from the sheath, the grains being present but not filled. The awns and glumes are limp and darker in colour than the normal. The upper part of the last joint of the stem is also often darker than usual. It is to this type that the disease owes its name of 'deaf ears'. While the healthy ears droop with the weight of ripe grain, the 'deaf' ears stand erect by reason of their lightness. In the second type the ear is arrested in its development, the topmost joint of the stem ceasing to grow before the ear is completely out of the sheath. The awns may emerge but are often misshapen, and there is practically no grain. The third type is the most common; in this there is a complete absence of visible ears, the latter remaining enclosed in the leaf-sheaths.

The diseased plants are scattered among the healthy ones, owing to the fact that infection is chiefly transmitted by the seed.

Stripe disease is caused by *Helminthosporium gramineum*, which forms a mass of spores on the leaves, nodes, and ears of the affected plants. These spores are disseminated on to the healthy grain either during vegetation or at the time of threshing. The sowing of such infected grain usually results in diseased seedlings. Some writers mention the possibility of flower-infection, the fungus reaching the interior of the grain as a result of infection during the blossoming period. The proportion of grains infected in this way must, however, be very small, since thorough disinfection of the surface of the seed reduces the number of diseased plants to a minimum.

Stripe disease of barley is frequently confused with the leaf spot disease [caused by *Helminthosporium teres*], but the two may easily be distinguished by the following points: Stripe disease is characterized by the presence of longitudinal stripes, and spot disease by that of irregular spots, separate and never forming stripes. There is no gradual discoloration of these spots, and the leaves do not split or droop. Furthermore, spot disease occurs in patches, infection being transmitted from one plant to another, and the ears are normally developed in this disease.

The damage caused by stripe disease varies considerably, sometimes amounting to more than half the crop. Early sowing and seed disinfection can do much towards reducing these losses. Different sorts of barley vary considerably in their degree of susceptibility to the disease. Mansholt winter barley III is very susceptible, Mansholt winter barley II being less so. The latter, however, is susceptible to rust. Bochum and Groningen winter barley are moderately susceptible. A new variety, Fletum, appears to be very resistant, but it has not been long enough on the market for thorough testing. As regards summer barley, the Golden variety is fairly susceptible, Princess, Swan's Neck, and Chevalier somewhat less so. Practically speaking, however, the problem of susceptibility is of less importance in this disease than in cases in which treatment is difficult or impossible, since stripe disease can be simply and effectively controlled by seed treatment without undue expense or injury to germination.

The author's experiments during the past few years to test the respective efficacy of a number of fungicides gave unsatisfactory results in the case of formalin, corrosive sublimate, and hot water. With the two former the percentage of diseased plants was increased rather than reduced, while hot water was injurious to germination. The best results were obtained by steeping the seed in copper sulphate, Uspulun, or Germisan B 14, the treatment recommended in each case being as follows: (1) One quarter kg. of copper sulphate dissolved in 3 litres of water per hectolitre of barley. (2) Uspulun solution (at least 1 per cent.), 7 litres per hectolitre of barley. (3) Germisan B 14 (4 per cent.), 3 litres per hectolitre of barley. The last named is only provisionally recommended as it has not yet been fully tested. Great care must be taken to mix the solution thoroughly through the heap so as to wet every grain, a procedure which takes about ten to fifteen minutes to treat effectively a hectolitre of barley.

DONKIN (J. E.). **Bunt-resistant Wheat.**—*Journ. Dept. of Agric. S. Africa*, iii, 6, pp. 561–563, 1921.

The writer gives the results of experiments in testing the resistance to bunt of twenty varieties of wheat, representing all the types grown in South Africa, and including *T. durum*, *T. polonicum*, *T. turgidum*, *T. compactum*, in addition to common wheats (*T. vulgare*), the last named consisting of bearded and beardless, early and late varieties. Carefully selected grains of uniform size were heavily infected with *Tilletia* spores and sown in double rows, one row of each variety being cut off about one inch from the ground as soon as the plants commenced to pipe (this being considered equivalent to grazing). The outcome of the two years' tests (1918 and 1919) demonstrated the total immunity of the *T. polonicum*, *T. turgidum*, and most of the *T. durum* strains (only one of the latter—Wild Goose—showed a 2 per cent. infection during 1918), while the *T. vulgare* varieties had an average infection of from 19 to 35 per cent. An Indian variety of *T. compactum* (Pusa A 88) was bunted to the extent of 10 per cent. for the uncut and 12 per cent. for the cut plants. The rainfall during the growing season of the 1918 test was nil, while in 1919 there was an inch and a quarter in September.

Whilst the immunity of *T. durum*, *T. polonicum*, and *T. turgidum* varieties has been clearly established under the conditions of these experiments, farmers are advised to continue the growing of the common types in localities where these are successful, as the immune species are not first class milling wheats.

FROMME (F. D.). **Incidence of loose smut in Wheat varieties.**—*Phytopath.*, xi, 12, pp. 507–510, 1921.

During a wheat disease survey in Virginia in 1920 it was observed that all fields of the beardless variety Leap Prolific were practically free from loose smut (*Ustilago tritici*). On the other hand, Stoner, an extensively grown bearded variety, was generally and uniformly infected, most of the fields having about 3 per cent. of smut. Data from other States collected in 1919 showed that Leap averaged 0·1 per cent. infection against 3·6 per cent. for Stoner. In the absence of experimental data it is impossible to state whether this immunity of the Leap variety is a matter of inherent resistance or merely of escape from infection. A superficial comparison of the blooming of the two varieties has not revealed any significant differences which might account for the contrast, both having been seen to open during pollination. Possibly a thorough study of this point may disclose some difference in the duration of exposure or other feature which will provide a mechanical basis for the comparative immunity of Leap.

The available data indicate that, as a group, bearded varieties are more susceptible to loose smut than the beardless. A test carried out in 1921 on twenty bearded and sixteen beardless varieties showed that the average number of smutted ears per row in the bearded group was about three times as much as that found in the beardless (12·7 and 4·6 respectively).

MCKINNEY (H. H.) & JOHNSON (A. G.). **Wojnowicia graminis (McAlp.) Sacc. and D. Sacc. on Wheat in the United States.**—*Phytopath.*, xi, 12, pp. 505–506, 1921.

During a search carried out in Kansas in June 1921 for the perithecia of *Ophiobolus graminis* Sacc. and other organisms associated with a disease having the general field and plant symptoms of take-all or foot-rot of wheat, mature pycnidia of a fungus were rather frequently met with. This fungus agreed in every respect with the description of *Wojnowicia graminis* (McAlp.) Sacc. and D. Sacc. (*Hendersonia graminis* McAlp.) which McAlpine suspected to be the pycnidial stage of *O. graminis*.

Perithecia of the latter were not seen. This appears to be the first record of *W. graminis* in America.

Shortly after this discovery both the pycnidia of *W. graminis* and the perithecia of *O. graminis* were found on dried wheat plants from Arkansas affected with take-all, and also mature pycnidia on plants similarly attacked from Oregon. The pycnidia were found on the lower leaf-sheaths above and below the soil-line. They usually broke through the sheath in the same way as the perithecia of *O. graminis*, from which they are indistinguishable by the naked eye.

Preliminary investigations of the cultural characteristics of the two forms do not indicate any close genetic connexion.

EVANS (N. S.). **'Black point' of Wheat.**—*Phytopath.*, xi, 12, p. 515, 1921.

A comparatively high proportion of the kernels of the durum wheats in the Upper Mississippi Valley are often partially or totally discoloured, especially at the embryo end. Numerous isolations from typically discoloured kernels have given a species of *Helminthosporium* resembling *H. sativum* P. K. & B. A number of inoculations were made in the field at Madison, Wisconsin, water suspensions of conidia being applied to the heads of Acme and D 5 wheat when in flower. Under favourable conditions an abundance of 'black-pointed' kernels resulted.

RUMBOLD (CAROLINE) & TISDALE (ELIZABETH K.). **Phoma insidiosa on Sorghum.**—*Phytopath.*, xi, 12, pp. 513–514, 1921.

The examination of type specimens has now confirmed the authors' provisional determination of this fungus [see this *Review*, i, 6, p. 170]. Search in sorghum seed collections at Washington enabled them to find it on a number of sorghum varieties from China, India, Africa, and Curaçao.

MILLARD (W. A.). **Report on fungoid diseases. In Report on experiments with Wheat conducted at the Manor Farm, Garforth, and in the North Riding, 1921.**—*Univ. of Leeds and Yorkshire Council for Agric. Education Circ.* 123, pp. 8–9, 1922.

In the middle of May 1921 there was a severe outbreak of rust, the enormous number of uredospores produced giving many of the varieties a conspicuous reddish tinge. The attack was one of the worst experienced for many years. As usual in Yorkshire, most of the damage (in this case 99 per cent. of it) was caused by *Puccinia glumarum*. The varieties most affected were, in the following order, Benefactor, Hawk, and White Stand-up. In the case of Benefactor only was the fungus found on the ears between the chaff and the grain as well as on the leaves and straw. None of the wheats was immune, but four varieties, viz. Squarehead's Master, Standard Red, Little Joss, and Iron II were only moderately attacked, the last named being particularly resistant. The relative susceptibity to rust of these varieties corresponds closely with the results of earlier observations.

The only other important fungous diseases of wheat were mildew (*Erysiphe graminis*) and bunt (*Tilletia tritici*). Mildew appeared later in the year than usual, and after the short spell of rain during late July and early August the attack was very severe. Varietal susceptibility was not observed. Bunt was more prevalent than usual, the varieties most affected being White Stand-up and Marshal Foch.

CAMPBELL (J. A.) & TAYLOR (W. H.). **Lemon-Culture: Directions for New Zealand growers.**—*New Zealand Journ. of Agric.*, xxiii, 6, pp. 330–335, 1921.

Notes are given on the symptoms and treatment of the chief diseases of lemons in New Zealand. Brown rot (*Pythiacystis citrophthora*) is stated to be the most troublesome; a full account of it has recently been published [see this *Review*, i, 7, p. 211].

Verrucosis (*Cladosporium citri*), or lemon and orange scab, is characterized by warty excrescences of varying sizes on the fruit and leaves, which become covered with a delicate mould, grey at first, then dusky, and finally black. This condition, which is dependent on an excess of moisture in the atmosphere, depreciates the value of the fruit and debilitates the tree. It can be avoided by preventive spraying with Bordeaux mixture, but where the disease has become firmly established through neglect, a drastic spraying programme with 4–4–40 Bordeaux must be carried out. Three or four applications should be made at intervals of three weeks, commencing when the main crop has set, and resumed again in the autumn.

Melanose (*Phomopsis citri*) affects the fruit, young shoots, and leaves. Small, brown, raised, wax-like spots, profusely scattered over the affected parts, characterize the disorder. The spots coalesce, where plentiful, into irregular patches, which crack in lines. These linear markings arrange themselves into circles or parts of circles, and are diagnostic of the disease. The development of the fruit is inhibited and the resulting disfigurement renders it unattractive. Only young and succulent tissues are subject to attack, fruit approaching maturity becoming immune. Spraying with Bordeaux mixture, 4–4–40, just before blossoming and again when the fruit has set, is recommended.

Anthracnose (*Phoma citricarpa*), also known as black-brand and black-spot, is characterized by the appearance on the fruit of irregular, depressed spots that resemble the markings produced by a searing-iron.

Grey-scab, due to *Sporodesmium griseum*, can be recognized by the formation of small grey or dusky spots on leaves and fruit, which coalesce into well-defined patches. Both these last diseases can be checked by spraying with Bordeaux mixture.

Collar-rot (*Fusarium limonis*) is very prevalent, and no improvement can be looked for until cultural methods have altered for the better. Planting on badly-drained or otherwise unsuitable soil is always followed by disaster, and trees raised by layers or cuttings are admittedly very susceptible. The rot may originate at the collar of the tree, but as a rule the starting-point is at the roots, and the first above-ground symptoms are the sickly and yellow appearance of the leaves, often followed by the dying-back of the branches. A badly affected tree must be carefully dug out and burned with the roots and quicklime should be mixed with the soil before replanting. If only one or two roots are affected, these should be cut out and the soil well limed. The same applies to diseased bark, and when the characteristic gummy exudation has ceased the wound should be disinfected, thoroughly scraped, and painted over with coal tar.

Bark-blotch (*Ascochyta corticola*), until recently only recorded as occurring in Australia, has now been observed also in New Zealand; two outbreaks have been reported from the Auckland district in trees of Australian origin. Although this disease in its symptoms and general effect is very similar to collar-rot, the absence of a gummy exudation and the fact that the bark splits and lifts from the wood facilitate differentiation. The treatment is the same as for collar-rot, but the wood laid bare by removal of the bark should be only lightly scraped.

Mottle-leaf is a physiological condition due to malnutrition. Lack of nitrogen causes the leaves to take on a mottled appearance, and the yellow areas of varying extent on them indicate an insufficiency of chlorophyll. In the more acute forms the tree becomes stunted in growth. The only remedy is to apply humus to the soil, as this appears to facilitate the absorption of the various plant foods, more especially nitrogen.

Sooty mould (*Capnodium citricola*), which grows in the secretions of certain scale insects, is avoided by eliminating the latter.

Various insect pests are also discussed and remedial measures recommended. In a paragraph devoted to the question of spray-injury, the authors call attention to a curious fact brought out in recent spraying experiments in Australia, that trees when in a semi-dormant state, instead of supporting stronger solutions as might reasonably have been expected, are on the contrary much more liable to injury than healthy trees in full growth. The prevalent carelessness in mixing sprays is said to be a frequent cause of damage to the trees, and frosts are responsible for a good deal of injury to both fruit and foliage.

McClelland (T. B.). **The Coffee leaf spot (Stilbella flavida) in Porto Rico.**—*Porto Rico Agric. Exper. Stat., Mayaguez, Bull.* 28, 12 pp., 4 pl., 1921.

The leaf spot of coffee is the cause of heavy and continuous losses to growers in Porto Rico, but it is believed that with care many of the abandoned regions could again be worked at a profit, coffee being the most promising crop for certain areas of the Island. The climatic conditions most favourable for the growth of *Coffea arabica* equally foster the development of the disease, Fawcett's description of which (*Porto Rico Agric. Exper. Stat. Bull.* 17, p. 11, 1915), is quoted at length.

In 1917 the renovation of part of an abandoned coffee plantation was undertaken. The annual yield from this plantation was formerly between 300 and 400 quintals, but had fallen off until in some years not more than ten or twelve quintals were obtained. The 1916 crop amounted to forty-eight quintals, and that of 1917 to twenty-eight quintals. The soil and climate were suitable for coffee production, but the trees were in an extremely poor condition owing to continuous defoliation, the leaves being covered with *Stilbella* spots and prematurely shed green leaves being visible on all sides. The part selected for treatment was situated about 3,500 ft. above sea-level. All the trees were cut back to stumps about six to nine inches high, and the plot thoroughly cleaned up, shade trees being also cleared of vines and epiphytes. The area was naturally isolated to some extent, and three rows of banana trees were planted all round the edges to act as a barrier against the adjacent diseased coffee trees.

It was found that a large number of other plants in the plantation acted as hosts for *Stilbella flavida*, including *Bryophyllum calycinum*, *Andira inermis*, *Inga vera*, orange, and others of which the local names are given. It was found advisable to destroy every green plant in the plot except the shade trees, old coffee, and bananas, the young coffee seedlings being particularly dangerous. After about six months the coffee stumps bore shoots from one to three feet high and quite free from leaf spot. Coffee seed was planted a little later, and about a year from the first clearing up less than 1 per cent. of the trees showed any infection. Subsequent results were vitiated by the introduction of diseased seedlings by the occupiers, but the original trees remained practically free from the disease during most of the second year, and the removal of diseased leaves when few in number or the cutting out of more seriously affected plants maintained satisfactory control during the third year.

These results indicate that it should be easy to control the disease by destroying the host plants of the parasite and afterwards maintaining a local quarantine.

After thorough eradication of weeds and grass, the coffee trees should be cut away to six inches above ground, the stump being left with a clean diagonal cut which will allow rain to run off. This should be done immediately after the removal of the crop while the dry season lasts. Whenever possible the entire infected area of a plantation should be cleared at once, but when this is impracticable the most isolated and elevated sections should be attended to first. Any natural barriers present should be utilized; otherwise rows of bananas should be planted close to the edge of the cleared section. Reinfection should immediately be arrested by destroying the affected leaves and branches, or if necessary the whole tree.

Ajrekar (S. L.) & Bal (D. V.). **Observations on the wilt disease of Cotton in the Central Provinces.**—*Agric. Journ. of India*, xvi, 6, pp. 598–617, 1921.

Cotton wilt may result from the action of the stem-borer *Sphenoptera gossypii*, or it may be due to a species of *Fusarium*. The two forms of the disease are easily distinguished: the first by the ease with which affected plants are uprooted, by the swollen condition of the roots, and by the tunnels produced by the insect; the second by a blackish or brownish discoloration of the woody tissues of the root, this being otherwise intact and not swollen. Another distinctive feature of the insect-produced wilt is the suddenness with which it affects the whole plant at once, this process being usually gradual in the case of the fungous disease which spreads successively from one part of the plant to another. The present paper deals with the last form only, and the scope of the work undertaken by the authors was restricted to attempts to establish the parasitism of the fungus, to determine the influence of soil conditions on its growth, and to test the alleged immunity of Buri cotton to the disease. Previous research by other workers had already established a marked difference between the American cotton wilt (due to *Fusarium vasinfectum* Atk.) and the Indian disease, and both American and Indian workers have failed to find any direct remedial or preventive measures. The only means, therefore, of checking the disease is to grow resistant varieties, and of these there are a number in the United States, while Buri is said to be immune in India. The Indian cotton wilt *Fusarium* has not hitherto been described or identified.

It is suggested that the wilting of the host plant is brought about through the secretion of a toxin by the parasite, since it does not seem to be altogether accounted for by the mechanical blocking up of the vessels, and a close examination of sections indicated that the majority of the vessels do not contain any hyphae. Attempts to establish the existence of a toxin failed.

For the inoculation experiments four strains of the wilt *Fusarium* were isolated, two from the internal tissues of diseased plants, one from the surface of a wilted plant, and one from infected soil. Three of these strains had easily distinguishable cultural characters, while that from the surface of a wilted plant seemed to be identical with one of those from the internal tissues. Eight series of inoculations on seedlings or seed in pots were carried out, only two of which gave successful results with susceptible varieties of cotton, six plants growing in two pots dying of wilt out of twenty seedlings in one case and one plant out of five in another, the strains of the fungus used being the two obtained from the internal tissues. The remaining inoculations on susceptible varieties (fifty-six plants in ten pots) failed. Buri cotton was inoculated in ten pots (fifty-six plants) without attack, but the irregular results obtained with susceptible varieties prevents a definite conclusion being drawn as to its true immunity. The fungus used for the inoculation was recovered from four of the seven successfully induced cases of wilt, and it is believed that both the internal strains are parasitic. They are described at some length and figured. In spore characters they are alike, but in pigmentation and in the characters of certain sclerotium-like bodies that were developed in culture they differed.

Experiments to test the effect of different antiseptics and other substances added to the soil have been in progress for some time. The results seem to indicate that control of the disease by this means is impossible. No evidence was obtained that any particular manurial treatment of the soil was likely to be effective in checking wilt, the growth of the fungus in the soil solution from different plots of the permanent manurial series on the Nagpur Experimental Farm being uniformly poor in all cases. On the other hand, steaming the soil or subjecting it to dry heat had some effect in reducing the disease.

The authors describe an experiment in which Buri was grown with susceptible varieties in pots of soil known to contain the wilt-inducing organism in a highly virulent form. Only the Buri plants, but all of these, survived, thus tending to confirm the reported complete immunity of this variety.

VINCENS (F.). **Une maladie du collet des Crotalaires au Tonkin.** [A collar-disease of *Crotalaria* in Tonkin].—*Bull. Agric. de l'Inst. Scient. de Saigon*, iii, 12, pp. 381–384, 1921.

A wilt disease of *Crotalaria juncea* from Tonkin is described and considered to be due in all probability to a *Fusarium* allied to *F. udum* Butl. which the author isolated from the diseased tissues. Other fungi found less regularly associated with the disease (*Neocosmospora vasinfecta*, (?) *Diplodia theobromae*, and species of *Melanospora* and *Cucurbitaria*) are regarded as followers.

The disease begins at the base of the plant, then invades the stem and causes withering and death.

The *Fusarium* isolated forms white or pale rose sporiferous cushions on the surface of the medium in a moist atmosphere, the conidia being 20 to 50 by 2 to 4 μ in diameter, falcate, and with 3 to 5 septa (mostly 3). A *Cephalosporium* form with cylindroid conidia, 5 to 12 by 2 to 3 μ, also occurs.

COCKAYNE (A. H.). **Discussion on the Flax industry.**—*New Zealand Journ. of Sci. and Techn.*, iv, 1, pp. 34–35, 1921.

Speaking at a general session of the New Zealand Science Congress, Mr. Cockayne stated that the Manawatu swamps had been greatly improved by drainage, 23,000 out of 50,000 acres of *Phormium* flax in New Zealand being situated in that region. The gross returns per acre were larger than for any other form of agriculture except fruit-growing. Yellow-leaf disease, however, was causing serious damage, 6,000 acres having been rendered unproductive. The outer leaves of the fans assumed a yellow colour and finally shrivelled up, and the next inner leaves were then attacked. Six species of bacteria were isolated from the roots, none of which gave rise to any pathogenic symptoms on inoculation. Nematodes and insects were also investigated, but they did not occur in sufficient numbers to account for the disease. A fungus, *Ramularia phormii*, was finally isolated and considered to be the cause of the disease. It is not described.

Field experiments showed that only the water-absorbing portion of the root could be primarily infected, i. e. only the secondary or tertiary branches, not the primary root. The fungus, however, spreads to the latter once it has gained a foothold. By destroying the water-absorbing roots the fungus prevents the taking up of water by the plants, so that the disease becomes especially serious during periods of drought. The fungus was isolated, developed in pure cultures, and reintroduced into healthy plants, in which it produced yellow-leaf disease.

Unless the disease can be eradicated, the flax industry will be ruined. The selection of disease-resistant strains is regarded as a more promising method of control than soil treatment.

ATKINSON (E. H.). **Phormium tenax. Diseases and insect pests.**—*New Zealand Journ. of Agric.*, xxiii, 5, pp. 298–302, 1921.

A preliminary study of yellow-leaf disease of *Phormium* ['New Zealand flax'] has already been carried out by Cockayne [see last abstract], who concluded that the disease was infectious and probably due to fungal or bacterial attack, aggravated by the presence of stagnant water round the plants. The diseased plants frequently recover, especially in the autumn and winter, and a general improvement follows the extension of the root-stock on to more favourable soil. Very few plants are killed outright, and recovered plants appear to be quite equal in production to those which have remained healthy throughout. Cases are quoted, however, where transplanted diseased *Phormium* roots recovered only temporarily and finally died. It has been observed that some varieties are more resistant than others, and their cultivation would probably be the best method of eradicating the disease. More recently Waters has isolated a fungus from the roots of affected plants, in the tissues of which it was fructifying, and this has been identified at Kew as a species of *Ramularia* [*Ramularia phormii*]. Inoculations on the roots of apparently healthy plants resulted in the formation of lesions which proved to contain the *Ramularia*. Experiments are in progress to determine whether the actual yellow-leaf disease can be induced by this parasite.

Little systematic work has hitherto been carried out on the fungi recorded as parasitic on *Phormium*, and their distribution in milling areas and relative economic importance is not known. A species of *Heterosporium* causes large, irregular, sooty blotches on the under surface of the leaves, the fibre underneath becoming red in colour and quite rotten. Badly affected leaves are quite useless for milling, and even a slight attack will cause a loss of many points in grading owing to the bad colour of the fibre. A *Fusarium* causes large, whitish, elliptical areas of dead tissue on young leaves, ruining them for milling purposes. A species of *Phaeoseptoria* is the cause of more or less severe leaf-spotting, accompanied by destruction of the fibre. Another fungus, a *Septoria*, causes longitudinal purple stripes on the leaf, ruining the fibre and killing the whole leaf.

WATERS (R.) & ATKINSON (E. H.). **Yellow-leaf disease in Phormium tenax.** Preliminary report on a current investigation.—*New Zealand Journ. of Agric.*, xxiv, 1, pp. 27–32, 1 fig., 1922.

This disease is marked by the development of an orange discoloration in the foliage, but the authors note that a similar condition may arise from a variety of causes. Search for other distinctive symptoms has failed. The presence of a root rot associated with a fungus in affected plants has been previously noted [see preceding abstracts], but further observations indicate that it can scarcely be regarded as a direct cause of the disease. Not only is the fungus found in the soil of infected *Phormium* flax swamps, but seedlings raised in disease-free swamps, as well as in nursery and garden soil, may contain it; it is equally common in adult healthy and diseased bushes; and it has been found in all parts of the Dominion in the roots of both *Phormium colensoi* and *P. tenax*, sometimes miles from the nearest area affected by the yellow-leaf disease. Healthy *Phormium* seedlings inoculated at the roots with pure cultures of the fungus sometimes showed lesions, but in no case was the typical yellowing of the foliage produced.

The writers therefore conclude that the presence of the fungus is not in itself an indication of yellow-leaf, but that suitable conditions may convert it into a parasite sufficiently destructive to cause the typical yellowing of the foliage. Experiments are in progress to ascertain what degree of parasitism may be exhibited by the fungus under various environmental conditions.

Meanwhile it is pointed out that no conclusive evidence has as yet been furnished that the disease is of parasitic origin. It has not been found possible as yet to reproduce the disease; seed from healthy and diseased plants sown in sterilized soil with and without subsequent inoculation with *Ramularia*, and even sown in bog soil which had had a diseased crop, has in all cases given healthy plants in the twelve months during which the experiments have continued. In isolations from the finer roots of affected plants which are often discoloured and rotted, six bacteria were obtained, but none was found able to reproduce the disease in healthy seedlings. The same has been the case with other organisms tested. A canker of the rhizome is commonly found in infected plants, and this condition is now under investigation.

The work carried out so far is held to indicate that even if the disease is caused by a micro-organism, the latter must require very special conditions to become pathogenic.

TONNESON (G. A.). **Gummosis of the Cherry.**—*Better Fruit*, xvi, 9, pp. 14–15, 22, 1922.

Field observations have led to the conclusion that autumn growing, with an 'unripened' condition of cambium and sap-wood, is a prevalent cause of gummosis, though bacterial and other factors may be involved. In the State of Washington there are numerous valleys with a rich sandy loam soil, containing ample moisture to keep the trees growing during July and August, and the leaves on such trees frequently provide nutriment as late as December. A sudden drop in the temperature injures the cambium in these cases, with the result that tissues are broken at weak places in the bark and an exudation of gum appears in the following spring. Trees planted on hillside clay soils seldom grow as late as August, and by reason of their earlier maturity they are less liable to gummosis.

Every effort should therefore be made to hasten the process of maturation before the winter season. The sources of nutriment must be reduced and continuous autumn growth checked by pruning from the middle to the end of August, taking off 15 to 25 per cent. or more of limbs and foliage.

After the trees reach the bearing stage there is less liability to gummosis, the surplus nourishment being required for the fruit.

CUNNINGHAM (G. H.). **A fungus disease attacking Blackberry.**—*New Zealand Journ. of Agric.*, xxiv, 1, pp. 23–26, 1922.

Cane-wilt, the most serious disease of raspberries in New Zealand, has apparently begun to attack blackberries in various parts of the North Island. The disease seems to have been first reported in 1921, and a visit to the principal affected areas, with the subsequent examination of diseased specimens, showed the causative organism to be the same as that of cane-wilt, namely, *Leptosphaeria coniothyrium* (Fcl) Sacc. This fungus has two stages in its life-cycle, of which the first, *Coniothyrium fuckelii* Sacc., is actively parasitic and responsible for the destruction of the canes, while later in the season the perfect or ascigerous stage appears on the dead parts.

The effects of the fungus vary somewhat according to the host. On the raspberry (*Rubus idaeus* L.) the infection is more severe than on the blackberry. It is usually confined to fruiting canes, but may also occur on growing shoots, and occasionally on the panicles. A reddish-brown discoloration is the first symptom of disease, rapidly followed by the wilting of some or all of the canes. This is due to the obstruction of the conducting vessels of the phloem and xylem by masses of fungous hyphae. If the cane is attacked at or near its base it dies completely, whereas infection near the apex results only in the death of those parts above the point of attack. Young growing shoots are killed outright, so that in severe cases the succeeding year's crop may be almost entirely lacking.

On the blackberry (*Rubus fruticosus* L.) the infection is relatively mild, occurring chiefly on the panicles. On the canes infection is not followed by wilting, but by the appearance of cankers which gradually result in death. The presence of the fungus may be detected by minute white blisters, formed by the separation of the epidermis from the tissues below on account of the dissolution of the latter by the action of the hyphae. Gradually these blisters expand and coalesce and the epidermis falls away, leaving small irregular cankers in which may be seen the fruiting bodies of the fungus.

Flower and fruit infection is the common condition on blackberry, the nearly mature fruits, their pedicels, and the main axis of the panicle being killed back to the cane. In severe cases the whole panicle, fruit included, turns a pale chestnut colour. When infection occurs in the fruits the hyphae send branches into the drupelets, which are soon drained of their contents. The fungus then works down the pedicel and up into other fruits, or it may attack the lower portion of the peduncle and cut off the food and water-supply of the fruit. The presence of numerous saprophytes, especially *Rhizopus* which forms a dense black mould, often complicates the recognition of the disease. Leaf infection results in the formation of minute dead areas, which fall away and leave small perforations.

Certain varieties of blackberry are more liable to attack than others. A small, semi-prostrate, profusely fruiting variety is invariably badly attacked, while a less common species, somewhat erect, large-leaved, vigorous in growth, but spare in fruiting, is usually free from disease. Prolific varieties are always small and stunted in growth, and their free fruiting habit is probably the reason of their greater susceptibility.

American experience has shown that spraying is practically useless against cane-wilt, the spore-containing receptacles being buried in the tissues. The disease being spread from fructifications embedded in drying canes, control measures should be directed rather towards the removal of all infected material. The fungus is much more severe on raspberries than on blackberries, so that its value as an exterminator of the latter, which are amongst the most troublesome of the noxious weeds of New Zealand, must not be over-estimated. Although many hundreds of diseased blackberry-bushes were seen during the visit of inspection referred to above, not one was observed to be destroyed outright. Its introduction into any locality with a view to the extermination of blackberries is therefore most undesirable, since it is more than probable that it would spread to the raspberries in the vicinity, and possibly also to other hosts known to be attacked in America and Europe, such as roses, apples, barberry, elderberry, and willow.

Zundel (P. L.). **The effects of treatment for bunt on the germination of Wheat.**—*Phytopath.*, xi, 12, pp. 469–484, 2 figs., 1921.

Peculiar climatic and soil conditions cause severe losses from bunt in the State of Washington. The treatment by dipping in solutions of copper sulphate, copper sulphate and sodium chloride, or formaldehyde, which are the methods adopted with 99 per cent. of all seed wheat planted in the state, usually results in injury to the seed. The cracking of the kernels, which are usually dry and brittle on account of hot, dry weather at threshing time, allows the fungicide to penetrate the embryo with injurious results.

An extensive series of greenhouse and field tests carried out by the author indicate that the practice of liming after steeping in copper sulphate, which has long been known to reduce seed injury, can be followed with equally good results after formaldehyde. Pre-soaking in water, before using a fungicide, followed by liming, overcame the injury practically completely, but is not adapted for use on a large scale. It is recommended therefore to dip the grain in lime water (1 lb. to 10 gals. for 10 minutes) after treating with copper sulphate or formaldehyde.

Blake (M. A.), Cook (M. T.), & Connors (C. H.). **Recent studies on Peach Yellows and Little Peach.**—*New Jersey Agric. Exper. Stat. Bull.* 356, 62 pp., 27 figs., 1921.

The present paper is an exhaustive compilation of the observations on 'peach yellows' and 'little peach' made by the authors during the period from 1912 to 1920 at the experimental orchards of Highbridge and Vineland, N. J. The results of the work on the same subject previous to 1912 were published in *N. J. Agric. Exper. Stat. Bull.* 226.

Peach yellows and little peach are American diseases of the peach which are said to occur also on nectarines, almonds, and apricots, and the same or very similar diseases attack the plum. Their cause is not known, but the authors believe them to be of the same general type as the mosaic and allied diseases of tobacco, tomato, pepper, potato, and other plants. A single tree may be affected with both diseases.

Since its first recorded appearance in the vicinity of Philadelphia in 1791 (it was still, apparently, confined to a small area in 1806) peach yellows has spread in the United States over a region extending from Massachusetts to South Carolina and west to Michigan, Illinois, Missouri, and Kansas. An isolated area in Southern Nevada is also reported. In Canada, the disease is confined to the peach-growing district of Ontario. It has never appeared in California. Little peach, which was not definitely recognized until 1898, occurs from New England as far south as Virginia and west to Michigan, and in some of the other western states in which yellows occurs. Peach rosette, which may be a southern allied or identical disease, does not occur in New Jersey, and is not dealt with.

The two outstanding symptoms of an advanced stage of yellows are: 1. Prematuring of the fruit, which may ripen from a few days to three weeks in advance of the normal time for the same variety. The diseased fruits are commonly more or less spotted and blotched with red instead of the normal 'blush', and in some cases the red pigment may extend through the flesh to the stone, around which the flesh is also of a more pronounced red colour than in healthy fruit; the flavour may vary from nearly normal to insipid or bitter. The premature fruit is very susceptible to brown rot, probably owing to its skin being less resistant. 2. The development of sickly, wiry, and finely branched shoots on the trunk and branches, bearing very narrow leaves and frequently continuing to grow late in the season after the rest of the tree has stopped growing. This symptom, usually considered of equal importance with the former for the identification of the disease, may sometimes appear several seasons after the first one, while in other cases the abnormal shoots may appear on young trees before the fruiting age, and also on bearing trees before prematuring becomes apparent. A yellowish-green discoloration of the foliage is also regarded as a symptom of yellows, but it can be very misleading as many other causes may produce the same appearance and, on the other hand, yellows trees may have a rich green foliage especially if given a good supply of nitrogen. Sometimes the only symptom on young trees and the first to appear on older ones is a rolling of the foliage from the margin inwards, giving the leaves a cylindrical shape. The lenticels of the bark are much enlarged in these cases. Little peach differs from yellows in that instead of prematuring, the fruit remains small and ripens from a few to ten days later than is normal for the variety; the diseased fruits are often flattened and somewhat rectangular in shape. This symptom is combined with a characteristic drooping of the foliage and curling and rolling of the leaves which are usually mottled yellow-green in colour. A similar drooping and rolling of the leaves is a constant feature of the early stages of yellows, especially in young trees. The authors consider that this is the most reliable symptom of the two diseases, though it does not necessarily permit of distinguishing one from the other. It is quite distinct from the drooping and flaccid condition of the leaves on trees suffering from drought. Young trees affected with yellows are usually checked in growth and assume a more upright and less spreading habit than healthy ones. Vigorous trees with either of the diseases are inclined to push into growth earlier and to bloom in advance of healthy trees, but the growth soon slows down. Practically every symptom of peach yellows and little peach is identical with one or other of the effects produced by other factors, such as girdling of the trees by borers or small rodents, winter injuries, label wires, traumatic wounds to the trunk and roots, other plant diseases, unfavourable soil, improper fertilization, and lack of cultivation. These are all conditions that impose a check on the growth of the tree. For instance, in seasons following cold or severe weather in late winter or early spring, many varieties of peaches may produce a number of small fruits or 'buttons' which cling to the tree throughout the season, but fail to develop to normal size: such cases should not be confused with little peach, from which they can be readily distinguished by the fact that usually some normal fruits are found among the 'buttons', and by the normal appearance of the foliage. A careful examination of each individual case is often necessary in order to avoid an incorrect diagnosis.

In view of the fact that the behaviour of yellows trees, especially the early ripening effect, is very similar to that of healthy trees that have been girdled or whose normal growth has been interfered with by weather, or by injuries, an investigation of the translocation of starch in normal and diseased trees was carried out. Comparative tests showed that in trees mechanically girdled or suffering from winter injury, or affected by yellows or little peach, the starch elaborated during the day by, and stored in, the leaves was not completely transferred at night, but that much remained in the midribs of the leaves at all times. This results in a check to the growth of the tree owing to shortage of food in the growing tissues. The amount of starch remaining in the leaves was found to be in direct proportion to the severity of the disease or the completeness of the girdling or winter injury, but the leaves from trees affected with yellows showed a greater starch content in the early morning than the leaves from girdled trees that had a corresponding rate of growth. Thus the prematuring of the fruits on both yellows and girdled trees is apparently connected with an interference with the process of translocation of the food supply. No explanation has, however, been obtained of the opposite behaviour of little peach trees; in this disease, starch accumulations are also found in the leaves, but the fruit is delayed in ripening instead of ripening prematurely. The peaches on some branches of a yellows tree frequently mature considerably in advance of those on other branches, and starch tests made with leaves from carefully selected twigs clearly indicated that prematuring is in proportion to the severity of the check to growth as measured by the inability to translocate starch. The more advanced the disease in any one branch, the greater is the starch residue found in the leaves in the early morning. The tips of lateral branches of diseased trees often appear quite normal and make a freer growth than those in the centre of the tree: tests made in the early morning showed much less starch in the growing tips than in the older parts of the twigs.

It was observed at the New Jersey Station that peaches of the same variety and coming from a single nursery differed greatly in susceptibility to the diseases when divided and planted on two different pieces of land, although only a quarter of a mile apart: one lot suffered considerable losses from yellows and little peach, while the other was only slightly affected. On the other hand, no influence was found to be exercised by the use of different fertilizers in the orchards, though the experimental plots received widely different treatment in this respect. The writers were also unable to observe that variety exerts any influence upon resistance or susceptibility to these diseases.

Pits from fruits which premature much in advance of the normal usually fail to germinate, but pits from slightly diseased branches may develop and produce seedlings: all the trees produced at the Station from such pits have proved to be healthy. Pollination experiments with pollen from diseased trees indicate that pollen is not a carrier of the infection. Inoculation experiments with the juices from leaves of yellows and little peach trees, and also from premature yellows fruits inserted into healthy trees, gave negative results, while, as is well known, the buds from trees diseased with yellows invariably convey the disease when budded upon healthy stock. A series of experiments was carried out in order to determine the incubation period of yellows. This was found to differ according to the virulence of the disease in the tree from which the buds were taken. The shortest period noted was from August of one year to spring of the next. This was with buds from a tree which suddenly developed acute symptoms in a large number of branches without any preliminary symptoms. In other cases the first wiry shoots began to develop two years after budding. In general the observations indicate that the disease may be present in a tree sometimes for as much as four or five seasons before even suspicious symptoms appear. Buds taken from apparently healthy parts of a diseased tree usually transmit the disease. In one case buds were taken from the healthy and diseased parts of a tree that had only a single small branch affected. Those from this branch gave the disease the following year while none of the others did so that year, and it was not until after five years that all the budded trees were affected.

Where diseased trees are left growing in an orchard they become centres of infection, surrounding trees gradually becoming diseased. It is not known, however, whether this is due to direct infection in some unknown manner or to environmental conditions favouring the disease in particular areas, but there is strong evidence against the spread of infection through the soil. Trees replanted where diseased trees have been removed are not more liable to become affected than any others. Infection through the agency of pruning tools is also considered to be very doubtful.

The number of new cases each year was recorded in certain orchards from the first planting. In general the increase was progressive, but it was much more rapid in some years than in others. [Apparently the diseased trees were removed each year.]

Little peach was the more common of the two diseases in these cases. Epidemics of yellows or of little peach have occurred in the Vineland orchards about every ten or fifteen years. In 1907 there was an epidemic of yellows, in 1920 one of little peach. From this and other observations the authors are inclined to regard the two diseases (and also rosette) as forms of a single disorder. In the periods between epidemics very few trees become attacked until at least the fourth or fifth season after planting, but during epidemics trees of all ages are affected.

Many of the estimates of the losses due to yellows or little peach that have been made are unreliable, as there is little doubt that in many supposed cases of yellows the symptoms were due to other causes and the losses were over-estimated. Even making allowance for such errors, however, the losses are very considerable. According to the authors' observations, in districts where the diseases prevail, from 1 to 3 per cent. of the trees are liable to develop unmistakable symptoms annually in quiescent periods, while during epidemics the proportion of trees infected can reach 25 per cent. or more in a single year.

A brief summary of measures recommended for minimizing the losses due to yellows and little peach is appended. Apart from ordinary sanitary precautions and the use of good stock, the chief recommendation is the immediate removal of all diseased and suspicious trees.

[An abstract of the investigations on the dissemination of these diseases reported in this Bulletin is contained in *Phytopathology*, xii, 3, pp. 140–142, 1922].

FROMME (F. D.), RALSTON (G. S.), and EHEART (J. F.). **Dusting experiments in Peach and Apple orchards in 1920.**—*Virginia Agric. Exper. Stat. Bull.* 224, pp. 1–12, 1921.

Tests were made with Bordeaux mixture; with a sulphur dust containing 80 parts dusting sulphur, 10 parts lead arsenate, and 10 parts hydrated lime; with copper-lime dust 10–10–80 (10 parts dehydrated copper sulphate, 10 parts lead arsenate, and 80 parts hydrated lime); with a similar dust except in the proportion 5–10–85; with Bordeaux dust; and with lime sulphur sprays.

A fruit-crack was quite serious on peaches dusted with the sulphur dusts, probably induced by the dust and excessive moisture. The 1920 results, supplementing those obtained in 1919, indicate that sulphur-dust is satisfactory for the control of peach scab. The data with respect to the control of brown rot and curculio of the peach are considered insufficient for drawing conclusions.

From the apple-dusting experiments, neither copper-lime dust nor Bordeaux dust gave sufficiently good control of scab to warrant their use. None of the dust mixtures was found to be effective enough against bitter-rot to warrant its use in Virginia.

A preliminary list of the diseases of cultivated plants in Ceylon.—*Dept. of Agric., Ceylon, Bull.* 52, 24 pp., 1922.

This list has been compiled by the staff of the Division of Botany and Mycology of the Ceylon Agricultural Department primarily with the object of furnishing information which will enable other countries to know what are the chief diseases of plants of economic importance in Ceylon. It is pointed out that most countries have adopted legislative measures to protect their crops from the ravages of introduced diseases, but that these measures are not always based on a sufficiently accurate knowledge of the diseases that can be introduced from any particular area. Obviously the first requirement of a country which wishes to protect itself from foreign diseases is to know what it should guard against in each area, otherwise the restrictions may be arbitrary or useless.

The diseases recorded total 415, and are arranged under 174 host plants, including, in addition to those of agricultural and planting interest, a number of forest trees and ornamental plants. The list is invaluable as an addition to knowledge of the distribution of a large number of the fungous parasites of tropical plants.

PARISI (ROSA). **Di alcuni parassiti delle piante medicinali e da essenze.** [Notes on some parasites of medicinal and aromatic plants.]—*Bull. Orto. Bot. Napoli*, vi, pp. 285–296, 1921.

Several parasites of medicinal and aromatic plants cultivated in the Royal Botanic Gardens, Naples, are described.

Physoderma debeauxii Bubák is responsible for serious damage to *Scilla maritima*. The disease generally develops in the rainy season, forming elliptical spots on the leaves, with the long axis parallel to the veins. These spots have a raised, pad-like, greyish-green, and shiny margin, and are sharply defined from the already yellowed leaf surface by a light green halo. The chlorophyll in the centre of the spot is destroyed, but persists longer than in any other part of the leaf in the light green zone, no doubt as a result of the stimulating action of the fungus. The latter occupies chiefly a dark violet or reddish-grey area in the centre of the spots, producing fine intracellular hyphae with ganglionic swellings and numerous round, yellowish-brown, finely warty spores, of which there may be six or seven in a single cell and which are from 14 to 28 μ in diameter.

Uromyces rumicis (Schum.) Wint. attacks the foliage of *Rumex patientia* in the spring, causing discoloration and premature shedding of the leaves.

Thielavia basicola Zopf. was found as a parasite on *Atropa belladonna*, apparently a new host. Its attacks are favoured by excessive humidity, lack of aeration in the soil, and abundant manuring, conditions which are generally found in hothouse cultivation. Seedlings transplanted in the open and freed from animal parasites were able to throw off the disease. Others that were taken from the greenhouse and planted near a wall which sheltered them from the sun's rays and from winds showed a loss of 90 per cent. from *Thielavia* infection.

Ramularia variabilis Fcl is a widely-distributed parasite of *Digitalis purpurea*. The most resistant variety so far encountered is *tomentosa* of Sardinia. Cavara is quoted as stating that *Digitalis* plants attacked by this fungus are considerably reduced in physiological activity, and are therefore inferior medicinally to healthy plants. *Heterosporium gracile* (Wallr.) Sacc. appeared on the leaves of *Iris pallida* in the spring, and the disease spread during the summer and autumn, all neighbouring plants being rapidly infected. Two new species of *Macrosporium* are described, *M. papaveris* and *M. cavarae.* The former was found on *Papaver somniferum*, causing large velvety black spots, especially on the green capsules. It differs from *Alternaria brassicae* var. *somniferi* Hart. & Br. in having long and pluriseptate fertile hyphae as compared with the short, torulose, 1- to 2-septate hyphae of the *Alternaria*, the conidia being rounded at the apex, 5- to 7-septate, 34 to 51 by 10 to 12 μ in diameter, and with a short pedicel, instead of being constricted at the apex, 5- to 9-septate, 52 to 80 by 13 to 40 μ, and with a long pedicel. *M. cavarae* attacks several species of *Ricinus*, including *R. borboniensis*, *R. gibsoni*, and *R. viridis*, causing round, brown or yellow, slightly zoned spots, with a dark coating of conidiophores, on the leaves, which ultimately dry up and are shed. The cotyledons and first leaves of seedlings were also attacked with considerable virulence. It is said to have developed especially on plants fertilized with calcium cyanamide. *Macrosporium solani* Ell. and Mart. (*Alternaria solani* Sorauer) was found on *Datura stramonium*, *D. metel*, *D. fastuosa*, *Hyoscyamus albus*, *H. niger*, and *Atropa belladonna.* The damage done to the leaves, and in the case of the species of *Datura* to the calyx and corolla as well, may assume serious proportions on account of the fact that the yellow-green colour of diseased parts is not confined to the spots actually invaded by the mycelium, but extends to the whole of the attacked organ, which ultimately dries up and falls off. From this it is concluded that the fungus exercises a toxic action on the cells outside the limits of its growth.

A fungus which is identified with *Septoria melissae* Desm. occurs commonly on the leaves of *Melissa officinalis* in the medicinal garden, forming numerous small brown spots dotted with the pycnidia. The affected leaves become shrunken, dry, and fall off, leading to considerable damage. From its characters it is transferred to the genus *Phleospora* as *P. melissae* (Desm.) Parisi.

Peyronel (B.). **Nuovi casi di rapporti micorizici tra Basidiomiceti e Fanerogame arboree.** [New cases of mycorrhyzic association between Basidiomycetes and arborescent Phanerogams.]—*Bull. Soc. Bot. Ital.*, Anno 1922, i, pp. 7–14, 1922.

The following is a list of the new cases of mycorrhizal association between four species of trees and thirteen species of Basidiomycetes observed by the author at Riclaretto in the Valli Valdesi in 1920.

On *Fagus silvatica*: *Cortinarius proteus*, *Boletus cyanescens*, *B. chrysenteron*, *Hypochnus cyanescens* n. sp., *Scleroderma vulgare.* On *Corylus avellana*: *Lactarius coryli* n. sp., *Boletus chrysenteron*, *Strobilomyces strobilaceus*, *Hypochnus cyanescens.* On *Betula alba*: *Amanita muscaria*, *Lactarius necator*, *Boletus scaber* f. *betulae*, *Scleroderma vulgare.* On *Larix decidua*: *Amanita muscaria*, *Russula laricina* n. sp., *Hygrophorus bresadolae*, *H. lucorum*, *Scleroderma vulgare.*

The new species in this list will be described elsewhere. The present paper is a brief record of the more striking features noted by the author in his study of these associations. Most conspicuous of all is the fact that both the form and dimensions of the mycorrhiza seem to depend chiefly, if not exclusively, on the phanerogam symbiont. Larch mycorrhiza, for instance, although produced by many different Basidiomycetes, are all of more or less the same type and dimensions; the slight differences observed are attributed rather to the varying nature of the soil than to specific differences in the symbiotic fungi. These mycorrhiza are conspicuous by their large dimensions in comparison to those of broad-leaved trees. In the latter also the mycorrhiza are very similar to each other, though some differences can be detected on close examination. *Scleroderma vulgare* forms, on the larch, mycorrhiza which macroscopically differ but little, if at all, from those of *Boletus elegans* or *B. laricinus*, while on the beech it produces much smaller mycorrhiza very much like those formed on this tree by *Boletus cyanescens* and *B. chrysenteron*. On the other hand, the fungal mycelium is naturally the principal factor in determining the structure, thickness, colour, &c., of the mycorrhizal covering, or, as the author calls it, 'mycoclena' (fungous mantle). In the author's opinion, the differences in these points are so conspicuous that it will eventually be possible to compile an analytical key which will allow of the immediate identification of the fungus producing the mycorrhiza by simply examining the mycoclena; for the most part they are of a microscopical nature, but generally they are accompanied by morphological characteristics which, with some experience, are noticeable to the naked eye. Thus the mycorrhiza formed on *Larix decidua* by *Boletus elegans* generally differ from those produced by *B. cavipes* in that while the latter are of a pure white colour, smooth, and have mycelial strands which mostly start only from their base, the former are milky or greyish-white in colour owing to the lesser thickness and laxer texture of the mycoclena (which forms a semi-transparent veil, especially over the tips of the rootlets), and the mycelium radiates from all parts of the surface of the mycorrhiza like a delicate cobweb, usually without forming definite strands. Still more prominent macroscopic distinctive features are supplied in some species by the colour of the mycelium. Thus the mycorrhiza formed by *Hypochnus cyanescens* on *Fagus silvatica* can be immediately recognized by the fine blue colour, and that of *Strobilomyces strobilaceus* on *Corylus avellana* by the fuliginous colour of the mycelium. Of peculiar interest, from the point of view of pigmentation, is *Scleroderma*, which, under conditions not quite elucidated as yet, sometimes forms mycorrhiza of a bright canary yellow on the larch and on the beech besides its usual white ones; this colour is perhaps due to a greater thickness of the mycoclena, since the thicker mycelial strands are yellow, while the thinner ones are white.

Although a mycorrhizal association with a particular species of tree can be formed by several species of fungi, two or more fungi very seldom combine in forming a single mycorrhiza or even a bunch of mycorrhiza on the same tree. Sometimes, however, mycorrhizal groups produced by one species of fungus can be observed on the same root as bunches of mycorrhiza formed by another species, though these are rather exceptional cases.

In general there is a close connexion between the environment in which the mycorrhiza develop and the specific nature of the fungi producing them. Each species of fungus grows by preference under certain oecological conditions determined by the greater or lesser compactness of the soil, the greater or lesser richness of the latter in organic matter and moisture, the presence or absence and the constitution of the grass turf, the situation and configuration of the ground, and the like.

The author's observations lead him to be almost certain of the following mycorrhizal associations, in addition to those already reported. On *Larix decidua*: *Amanitopsis vaginata*, *Lactarius rufus*, *Gomphidius gracilis*. On *Fagus silvatica*: *Lactarius blennius*, *L. volemus*. On *Corylus avellana*: *Boletus scaber*, *Cortinarius proteus*. On *Betula alba*: *Boletus subtomentosus*, *Amanitopsis vaginata*. On *Castanea sativa*: *Lactarius volemus*, *Boletus subtomentosus*. On *Quercus robur*: *Lactarius volemus*, *Scleroderma vulgare*, *Boletus scaber*. On *Populus tremula*: *Russula virescens*, *Cortinarius collinitus*.

It is stated that each species of Basidiomyceteae normally assumes a different aspect and size according to the species of tree with which it stands in mycorrhizal association; thus *Boletus scaber* in association with *Betula alba* is generally larger and has a thicker set stalk and a lighter coloured pileus than the forms associated with the hazel nut, oak, and chestnut. *Boletus rufus*, so different by its size and colour from the preceding species, is perhaps nothing else but a specialized form of it resulting from its association with *Populus tremula*. If greater attention were paid to these relations between fungi and particular species of trees, a guide might be found to some of the problems in the systematic study of the Hymenomycetes.

MURPHY (P. A.). **Some recent work on leaf-roll and mosaic.** *Royal Hort. Soc. London, Rep. Internat. Potato Conference of 1921*, pp. 145–152. [Received March 1922.]

Leaf-roll and mosaic of potatoes occur to some extent in Ireland, but certain varieties (of which a list is given) appear to be resistant to one or the other disease, and Great Scot appears to be resistant to both. Further evidence is given of the transmissibility of leaf-roll between adjacent plants. The effect of leaf-roll on starch translocation is shown by iodine tests on leaves from diseased and healthy plants. In the case of secondary leaf-roll, starch is to be found in lower leaves taken in the morning (up until 11 a.m.), whereas similar healthy leaves do not stain black with iodine. This test cannot always be relied on in primary leaf-roll, but in such plants the upper leaves may also show starch accumulation. This is a convenient method of diagnosing leaf-roll, and may be applied to plants sent through the post.

Under warm and dry climatic conditions mosaic symptoms in potatoes may not appear, but the infectious principle is nevertheless often present in a latent condition.

'Rust' is a name given by growers in certain parts of England (particulary the south) to a condition covering many types of diseased plants, including (1) spotting and colouring of leaves, plants dwarfed, leaf-roll present; (2) browning and bronzing of leaves, similar to 'potash hunger'; (3) 'physiological leaf spot' with sharply defined, black, angular spots; (4) plants resembling 'streak' of America and also similar to one phase of the bacterial ring disease of Appel, and to the author's 'leaf-drop'; (5) plants showing symptoms of the author's 'crinkle'. Of these the most destructive seem to be leaf-roll, bronzing, and crinkle, in this order.

The author discusses crinkle briefly, and considers that the evidence indicates that it is distinct from mosaic.

The value of some system of inspection of potatoes in the field is urged, in order that a grower may know the character of the plants from which he takes his seed tubers.

SALAMAN (R. N.) & LESLEY (J. W.). **Some information on the heredity of immunity from wart disease.** *Royal Hort. Soc. London, Rep. Internat. Potato Conference of 1921*, pp. 105–111. [Received March 1922.]

The authors present a preliminary report of experiments devised to test the mode of inheritance of immunity to wart disease in potatoes. Selfed families were grown from two immune varieties, Leinster Wonder and Edzell Blue, of which the former gave 14 immune and 4 susceptible, while the latter gave 22 immune and 6 susceptible. In a cross between two immune varieties, Golden Wonder and Leinster Wonder, 14 seedlings were immune and 7 susceptible. This suggests that all three are heterozygous for a single immunity factor. immunity being dominant. Another cross between immunes, Kerr's Pink and Champion II, gave 76 immune and 3 susceptible, and here there is clearly more than one factor concerned, the results corresponding fairly closely with the presence of two factors, either of which confers immunity. Crosses between certain susceptibles and immunes gave about half and half susceptible and immune, as would happen if the immune parent had one of the immunity factors and the susceptible had neither. A selfed susceptible gave results that require further testing, but combined with the results of other crosses, which are described, they suggest that certain susceptibles contain a factor which inhibits an immunity factor. It would appear, therefore, that immunity is of two kinds each due to a distinct factor, though both may occur together, and that susceptibility is also of two kinds, one merely due to an absence of both the immunity factors, and the other due to the presence of one of these factors with at the same time a factor which inhibits it.

Some varieties are preferable as susceptible parents on account of their factorial composition, and the same is true of the immunes; both parents must be considered in breeding immune varieties. No correlation has been observed between behaviour to wart disease and flower colour or tuber colour. The authors have not yet found a homozygous immune.

LAVERAN (A.) & FRANCHINI (G.). **Contribution à l'étude des insectes propagateurs de la flagellose des Euphorbes.** [Contribution to the study of insect propagators of flagellosis in Euphorbias.]—*Bull. Soc. Path. exot.*, xiv, 3, pp. 148–151, 1921.

Since insects are frequently attacked by flagellates of the genus

Herpetomonas it was natural that latex-sucking insects should be regarded as probably responsible for the presence of flagellates in the latex of species of *Euphorbia* when this condition was discovered. In 1910 Lafont observed the occurrence of flagellates in *Nysius euphorbiae* (Hemiptera of the family Lygaeidae) feeding on *E. pilulifera* in Mauritius. Using fifty insects he succeeded in transmitting flagellosis from an infected to a non-infected *Euphorbia* of the same species. In Dahomey Bouet and Roubaud found that *E. pilulifera*, which is very liable to flagellosis, was the food plant of numerous Hemiptera, especially *Dieuches humilis* of the family Lygaeidae. Flagellates were found in large numbers in a nymph of this species, but an examination of the proboscis and salivary glands gave negative results. Of ten *Dieuches* nourished for a week on infected *Euphorbia* two had flagellates, and a transmission experiment was also successful.

According to Patton and Cragg in India, *Lygaeus pandarus* (*militaris*) is common on *Calotropis gigantea*, a latex-bearing plant, and is almost always infected by *Herpetomonas lygaei*, which also attacks *L. hospes*; *Nysius minor*, which feeds on the latex of *E. pilulifera*, is in all probability the invertebrate host of *Herpetomonas davidi* which occurs in the latex of *Euphorbia*.

In 1914 C. França pointed out that the presence of flagellates had only been observed in the digestive tract of different Lygaeidae, not in the proboscis or salivary glands, and that these insects could not be regarded as the animal hosts of *Herpetomonas davidi*. In 1920 the same writer, studying flagellosis in *E. segetalis* in Portugal, came to the conclusion that *Stenocephalus agilis* was the primary animal host of the flagellates of *Euphorbia*, and the agent transmitting the infection from one plant to another. Flagellates were found in the intestine, proboscis, and salivary glands, while encysted forms occurred in the rectum.

The present writers, having noticed frequent instances of flagellosis of *Euphorbia* in and near Bologna, wished to ascertain whether *Stenocephalus agilis* occurred on these plants in Italy. They collected about 200 insects which were sucking the latex from *E. falcata* and *E. dulcis*. Flagellates were found twice in ? *Nysius* sp. and twice in Lygaeidae, genus undetermined, while Leishmaniform elements were twice observed in the digestive tract of *Calocoris*. In the digestive tract of one of the Lygaeidae (probably *Nysius*) were large numbers of spirochaetes, 14 to 24 by 0·5 μ, with four spirals. Flagellates of the *Herpetomonas* type occurred frequently in the digestive tract of *Anopheles bifurcatus* and *Culex penicillaris*. *Stenocephalus* was in no case observed either in the larval or adult stage. The latex-sucking insects collected at Bologna were of two families and four species: (1) Lygaeidae: ? *Nysius* sp. and ? *Lygaeus* sp.; (2) Cimicidae: *Calocoris chenopodii* and *Megalocerea ruficornis*.

It would seem that the *Nysius* referred to above as occurring on *Euphorbia* in Mauritius and elsewhere was rightly suspected of transmitting the flagellosis of these plants. Should further researches show infection of the proboscis and salivary glands of these insects, their role as the primary animal host of *Herpetomonas davidi* in certain regions will be established. The absence of

Stenocephalus from the insects collected at Bologna suggests at least that other species may equally well act as hosts of *Herpetomonas davidi*.

[This and the following abstracts, though dealing with the protozoa found in plants, are included because of their obvious interest to phytopathologists, especially to those working on mosaic and allied diseases].

MESNIL (F.). **La 'Flagellose' ou 'Leptomoniase' des Euphorbes et des Asclépiadacées.** ['Flagellosis' or 'Leptomoniasis' of Euphorbias and Asclepiadaceae.]—*Ann. Sci. Nat.*, Sér. X, iii, 5–6, pp. xlii–lvii, 4 figs., 1921.

The subject is discussed under the following headings: 1. History of the subject [see last abstract]. 2. Species of *Euphorbia* infested and geographical distribution. 3. Effect on the *Euphorbia*, describing the views of Lafont and França, both of whom insist on the pathological nature of the phenomenon. França states that although the invading organisms are restricted to the laticiferous apparatus, they exercise an influence on the cellular tissue, depleting the starch content and eliminating the chlorophyll. He has also observed the atrophy of heavily infected branches, and agrees with Lafont in holding that infection may result in etiolation and wilting. 4. Morphology of *Leptomonas davidi* in the *Euphorbia*. 5. Methods of transmission and evolution of *Leptomonas* in Hemiptera of the genus *Stenocephalus*. The life cycle of the parasite in the latex and in *Stenocephalus agilis* is figured after França. 6. Leptomonads of the *Asclepiadaceae*. 7. Affinities of the vegetable leptomonads, which are stated to belong to the family Trypanosomidae. The generic name *Leptomonas*, used by Lafont and França, is retained, though the author points out that the correctness of this name as against *Herpetomonas* is still under discussion, and that Donovan has proposed that the plant-inhabiting forms should be named *Phytomonas*. The resemblance of certain stages of *Leishmania* recently described by Mrs. Adie in the bed-bug to similar forms in *Stenocephalus* is noted. A bibliography is appended.

FRANCHINI (G.). **Sur un trypanosome du latex de deux espèces d'Euphorbe.** [On a trypanosome of the latex of two species of *Euphorbia*.]—*Bull. Soc. Path. exot.*, xv, 1, pp. 18–23, 1 fig., 1922.

For a considerable time the latex of *Euphorbia nereifolia* and *E. coerulescens* in the Botanical Garden at Florence has been under observation on account of the presence in it of an unknown organism. The latter was sometimes round, sometimes oval or elongated, with a nucleus and granulations in the protoplasm, but no flagellum. Genuine trypanosomes and a series of other forms were eventually found in the latex. The trypanosomes are of two kinds, large and small, the former measuring 8 to 10 by 1 to 2 μ and the latter 4 to 8 by 1 to 1·5 μ. They are U-shaped, the two branches gradually converging. The organism remains in the latex during the winter, when the temperature sometimes falls to zero C. It is thought that besides the free forms found in the latex there are other forms enclosed in the tissues of the plant.

This trypanosome presents closer analogies of development with certain trypanosomes of vertebrates than with those of insects, and is regarded as a new species, *Trypanosoma euphorbiae.*

Among the obligate phytophagous insects of the Botanical Garden at Florence, the following harboured flagellates in their digestive tract: Pentatomidae: *Pentatoma ornata, P. ornata* var. *pectoralis, P. juniperina, Psacasta cerinthi,* and *Graphosoma lineatum* var. *italicum* (flagellosis, caused by *Crithidia* n. sp., was less frequent in the two last named.) Pyrrhocoridae: *Pyrrhocoris apterus* (*Herpetomonas* was present in 50 per cent. of the specimens examined, the coelomic fluid, salivary glands, and proboscis being infected). Lygaeidae: *Lygaeus saxatilis* (*Herpetomonas* n. sp., in the digestive tract), *Oxycarenus lavaterae* (these insects are particularly numerous on *Althea syriaca* (Malvaceae), and 20 per cent. contained numerous *Crithidia* in their digestive tract.)

Among occasionally phytophagous insects the following contained flagellates in their digestive tract: Muscidae: *Musca domestica, Calliphora erythrocephala, Sarcophaga haemorrhoidalis,* and *Lucilia sericata* (all of which harboured *Herpetomonas* and more rarely *Trypanosoma*). Culicidae: *Anopheles maculipennis, A. bifurcatus, Culex pipiens,* &c. (*Herpetomonas, Crithidia,* and sometimes *Trypanosoma* in *A. maculipennis*). Psychodidae: *Phlebotomus papatasi* (*Herpetomonas* rather rare in the digestive tract).

Franchini (G.). **Sur un flagellé nouveau du latex de deux Apocynées.** [On a new flagellate of the latex of two Apocynaceae.]—*Bull. Soc. Path. exot.*, xv, 2, pp. 109–113, 1 fig., 1922.

Two species of Apocynaceae, *Funtumia elastica* and *Thevetia nereifolia,* cultivated at the Agricultural College in Florence, were examined for the presence of protozoa in the latex. The same organism was found twice in the latex of the trunk, the young branches, and the leaves of one of the four specimens examined, a *Funtumia.* The protozoon was generally elongated, and the flagellum frequently absent, or very short. In exceptional cases the flagellum was longer than the protozoon. The nucleus was medially placed, generally spherical, and often surrounded by a rounded or oval clear space. There was a small rod-shaped blepharoplast in the front of the body, but very rarely a rhizoplast. Divided and U-shaped forms were frequent, small Leishmaniform bodies rare. Besides the elongated or flagellate forms there were round or oval forms of varying dimensions, sometimes with several chromatic masses in the protoplasm. Some of the divided forms with two nuclei and two centrosomes were more or less constricted in the middle, and in these cases the centrosome was situated near the centre of each half, not at the periphery.

Large spherical or oval organisms with pale protoplasm, containing several chromatic masses and vacuoles, were also observed and thought to be in process of degeneration. Thick-walled, nucleated, encysted forms, without a centrosome, were present.

Besides the free forms, there were also oval elongated bodies enclosed in special formations (cells ?). These enclosed bodies were somewhat smaller than the free forms, but otherwise similar. Two, three, or more were enclosed in a single cell, the dimensions of which ranged from 7 to 15 μ in length and 4 to 10 μ in width.

A protozoon similar to the foregoing was observed in the latex of a *Thevetia nereifolia* situated in close proximity to the infected *Funtumia*. Flagellate forms, however, were absent, and elongated forms less frequent. The large spherical or oval forms with several chromatic masses in the protoplasm predominated. The *Thevetia* was much less heavily infested than the *Funtumia*. Probably the same insect inoculated the organism into both plants, which did not seem to be adversely affected by its presence. The protozoon is probably a flagellate of the genus *Herpetomonas* or a similar form, any divergence from the normal being explained by the unaccustomed medium.

França (C.). **Encore quelques considérations sur la flagellose des Euphorbes.** [Some further observations on flagellosis of *Euphorbia*.]—*Bull. Soc. Path. exot.*, xv, 3, pp. 166–168, 1922.

The writer maintains his conclusion, challenged by Laveran and Franchini [see abstract above, p. 307] that *Stenocephalus agilis* is the primary host of *Leptomonas* [*Herpetomonas*] *davidi*. The connexion between the presence of infected *Stenocephalus* and the flagellosis of *Euphorbia* has recently been demonstrated by Prof. Galli-Valerio (*Schweizer. Mediz. Wochenschr.*, L, 1921) on *Euphorbia gerardiana* Jacq. (=*E. seguieriana* Necker).

Attention is drawn to the discovery by Mrs. Helen Adie (*Indian Journ. Med. Res.*, Oct. 1921) of the life-cycle of *Leptomonas donovani* in *Cimex lectularius*.

Franchini (G.). **Flagellose du Chou et des punaises du Chou.** [Flagellosis of the Cabbage and of Cabbage bugs.]—*Bull. Soc. Path. exot.*, xv, 3, pp. 163–165, 1 fig., 1922.

Bugs of the family Pentatomidae were found on cabbages near Bologna, the species most frequently being *Pentatoma ornatum*, *P. ornatum* var. *pectorale*, *P. oleraceum*, and *Ælia acuminata*. With the exception of the last named, these species frequently harboured flagellates (*Crithidia* and *Herpetomonas*) in their digestive tract, and occasionally in their salivary glands and proboscis. The excreta of these insects contained many flagellates and Leishmaniform bodies with thick walls (cysts). The larvae were also infected. Clusters of greyish eggs adhered to the under surface of some of the cabbage leaves, causing them to turn yellow and die.

The flagellates referred to above contained granular protoplasm (*Herpetomonas* type), but were sometimes provided with a small membrane. The long flagellum originated from the centrosome, which was generally situated at some distance from the nucleus, but occasionally adjoined it. Elongated forms without flagella (Leishmaniform) were not infrequent. Elongated, helicoidal bodies without flagella, distributed in clusters, and other small slender bodies in bundles, with or without centrosomes, were also observed. Encysted forms were not infrequent. The dimensions of the flagellates were 7 to 15 (occasionally 22) by 1 to 1·5 μ, the flagellum generally being very long. The Leishmaniform oval bodies were

2 to 6 by 1 to 2 μ or 2 to 3 μ in diameter. The round cysts were 2 to 3 μ in diameter, and the oval 2 by 1 to 1·5 μ.

On the upper surface of the cabbage leaves the presence was frequently observed of Leishmaniform or elongated thick-walled bodies, without a flagellum, doubtless expelled with the excreta of the insects. The leaves should be well washed before examination. The presence of the bacillus *Pseudomonas campestris* could not be detected.

Flagellosis of the cabbage bugs is infrequent, that of the cabbage itself much less so. The organism perhaps penetrates the tissues of the plants as a result of the insect punctures, and may possibly pass from their excreta into the leaves.

LAVERAN (A.) & FRANCHINI (G.). **Spirochétose de punaises des Euphorbes et du latex.** [Spirochaetosis of *Euphorbia* bugs and latex.]—*Bull. Soc. Path. exot.*, xiv, 4, pp. 205–207, 2 figs., 1921.

Numerous spirochaetes were found in the digestive tract of Lygaeideae captured on *Euphorbia* near Bologna. On a bug of the genus *Nysius* the spirochaetes measured 14 to 24 by 0·5 μ. *Lygaeus pratensis* and *Anthocoris sylvestris*, found on *Sambucus nigra* in Paris, harboured numerous spirochaetes with no admixture of flagellates. These spirochaetes measured 14 to 20 by 0·33 μ, and were apparently identical in both insects.

Six samples of latex of *Euphorbia peplus* from Syracuse were examined in the summer of 1920. A few flagellates (*Herpetomonas*) were found in one specimen and numerous spirochaetes in two others. The latter resembled the spirochaetes of the bugs described above, except that they were shorter, measuring 6 to 8·5 by 0·5 μ. It is uncertain whether these divergences indicate a separate species or if they are merely the result of a different environment.

The writers have observed that the latex of *Euphorbia* varies greatly as regards the number of bacteria. Sometimes it is almost devoid of bacteria, especially when flagellates are present, while in other cases it contains numerous bacteria of various species and few or no flagellates.

It seems probable from these observations that there is a spirochaetosis of *Euphorbia*, which is propagated, like flagellosis, by certain species of bugs.

FAWCETT (H. S.). **The temperature relations of growth in certain parasitic fungi.**—*Univ. Calif. Publ. in Agric. Sci.*, iv, 8, pp. 183–232, 11 figs., 1921.

Pythiacystis citrophthora, *Phytophthora terrestria*, *Phomopsis citri*, and *Diplodia natalensis*, all obtained from citrus trees, were used. These fungi were grown on corn meal agar, uniformity in the medium being obtained by mixing the entire lot of medium before the start of the experiment. All conditions except the temperature were kept as constant as possible. None of the fungi produced anything but vegetative hyphae during the culture periods.

The cultures of fungi were kept under uniform conditions for nine months or more before the tests of temperature relations were started. Uniform discs of medium bearing hyphae of the fungi were placed in the centre of Petri dishes containing hardened corn meal agar, and these cultures were kept in incubators at constant temperatures, except for short periods at twenty-four hour intervals when the cultures were removed and measurement made of the diameter of the colonies. The incubators were run at various temperatures from 7·5° to 45° C.

The optimum temperature for the average rate of growth of a fungus on the medium used was found to vary with the length of the period of growth, and with the age of the culture. In general the optimum temperature for growth shifted to a lower temperature with each successive day after the first day. Comparing the growth during the second twenty-four hour period, it was found that the total range of temperature within which growth rate values were one-tenth or more of the maximum rate, included 32·5° to 37° C.; 70 to 80 per cent. of this temperature range is below the optimum temperature.

The author points out that the ten degree temperature coefficient, obtained by dividing the diameter of the colony at any temperature by the diameter of a colony grown at a temperature ten degrees lower, varied with the temperature. This coefficient would be infinity for ranges just below the lowest temperature at which the fungus would grow, would become unity at some range, which would include the optimum temperature of the fungus, and would become zero at points including and reaching above the maximum temperature for growth.

All the fungi used made some growth at 7·5° C. The optimum temperatures during the second twenty-four hour period were as follows: *Pythiacystis citrophthora* 27°; *Phytophthora terrestria* 30°; *Phomopsis citri* 27·5°; *Diplodia natalensis* 27·5°. The maximum temperatures for this period were respectively 32°, 36·5°, 32°, and 36·5°.

MATZ (J.). **La enfermedad de la raíz de la caña de azúcar.** [Root disease of Sugar-cane.]—*Est. Exper. Ins. Porto Rico, Circ.* 56, 12 pp., 1921.

This is a semi-popular account of the causes of root disease of sugar-cane in Porto Rico, with a chapter dealing with methods for its prevention. There are various causes which produce diseased roots, some of them being cultural and others associated with definite organisms. In the former group may be included purely physiological causes, as for instance when the development of the root system is arrested through wet, hard, or unventilated soils, in which the formation of rootlets and root hairs is prevented. These same conditions, however, are favourable to the organisms responsible for root rot and other diseases affecting sugar-cane, such as species of *Pythium* and *Rhizoctonia*, as the increased acidity of the soils described tends to keep down competing bacteria. Root disease is not a specific disease like mosaic, gummosis, or top-rot, for it may be due to more than one organism living in the soil, and be dependent on other factors for its appearance.

The chief symptoms of this disease are the stunted growth of the cane and the poor development of the leaves. Generally the lower leaves show these symptoms earlier than the more tender leaves higher up, and instead of falling normally when mature they turn yellow and adhere to the stalks. Adhesion of the leaves, base to base, follows. The tender leaves at the top also turn yellow and dry up from the margin towards the centre. This is followed by decay of the internal tissues of the plant, resulting in top-rot.

Another disease, which differs in some respects from the form above described, is due to *Plasmodiophora vascularum* Matz. This organism does not confine itself to the root but travels upwards into the main stem through the tracheids of the fibro-vascular bundles. The production of abundant spores in these channels soon blocks them, with the result that nutritive substances cannot reach the aerial parts of the plant. The progress of the parasite is, however, slow, and the plant may reach its full development before any symptoms are discernible. Nevertheless, in a great number of cases of the disease, plants were found to be so severely affected that at cutting time many of them were only three feet high, and all their top leaves were dead and dry. Only two or three nodes were normal, the rest being shrivelled and of a dead white colour. An examination of these plants revealed the presence of *P. vascularum* in many, if not most, of the fibro-vascular bundles. Where the organism was present the bundles had a bright yellow to orange or sometimes even reddish colour. This latter colour is sometimes produced also by other causes such as lesions inflicted by insects, or rot of the tissues in consequence of gummosis, rind disease, or heart-rot, but in these cases the tissues covering the fibres have a waxy or fatty aspect, thus differing from the disease caused by *P. vascularum*, where the covering layer of tissue retains its transparency, the characteristic coloration being derived entirely from the parasite itself.

This important disease is distributed over nearly the whole of Porto Rico affecting the varieties Cavengerie ('Caña negra'), Rayada, Crystalina, Otaheite ('Caña blanca'), and Demerara 109. Of these the variety Rayada has so far shown the greatest susceptibility, but no data are available regarding the comparative degree of resistance possessed by the other varieties. The disease is not new (though its real nature was only recently discovered), in contrast with mosaic and gummosis which appear to have been introduced recently, as no account of them exists in the older records. It is readily understandable that a disease like that caused by *Plasmodiophora*, the nature of which is not easily appreciated on account of the absence of any striking external symptoms, has in the past been put down to general debility. Though it cannot be regarded as epidemic, the disease must be considered severe because of its general distribution, the susceptibility of the varieties now most frequently grown, and the serious effect on the yield which may be reduced by more than 75 per cent.

In dealing with root disease proper, local conditions must be taken into account and the treatment adapted to suit them. Generally speaking, care must be taken to aerate the soil as much as possible by frequent cultivation, and to secure proper drainage. The chief difficulties are encountered in stump land which easily hardens on the surface, and in sandy soils in which the plant nutrients are liable to be washed out, thus rendering the development of young roots almost impossible. As the organisms responsible for root disease live in the soil, treatment of the setts with Bordeaux mixture would appear to be superfluous, though it is applied to prevent other diseases. In the case of *Plasmodiophora* the choice of sound setts is of great importance as the parasite can extend into the aerial parts of the plant, and cuttings from affected cane generally carry it, though seed pieces from the top can be used with impunity. Stumps of diseased cane left in the ground transmit the disease to the ratoons, and these constitute veritable foci of infection.

MATZ (J.). **Annual Report for the Division of Plant Pathology and Botany for the year 1920–21.**—*Ann. Rep. Ins. Exp. Sta. Porto Rico*, pp. 51–58, 1921.

In reviewing the work done by the Department, the author points out that many plant diseases in Porto Rico present features which differentiate them from those studied elsewhere under the same name. In sugar-cane, for instance, the Porto Rico gum disease is in all probability entirely distinct from that so fully studied in Java, while the root disease was found to be unlike that usually described in other countries. The *Plasmodiophora* disease of the fibro-vascular bundles of sugar-cane and the *Rhizoctonia* blights and root diseases of many other plants in Porto Rico have not been found elsewhere.

Further investigations into the yellow-stripe [mosaic] disease of sugar-cane brought out the fact that the granular plasma-like substance filling certain parenchyma cells, which constantly occurs in the more or less cankered stalks and leaf sheaths of cane affected with this disease, is also found in the central pithy regions of healthy but over-ripe Yellow Caledonia and G. C. 1313 cane. The mere presence of these plasma-filled cells does not, therefore, necessarily indicate yellow-stripe disease, but the writer believes that the latter, through its deleterious action upon the vital activities of the parenchyma cells, produces an effect analogous to the over-ripening or drying-out of cell sap in such cases as those mentioned, when grown in arid but irrigated fields. Field observations showed that the disease is carried sometimes over considerable distances and that infection may occur through the inner leaves. Whether the disease occurs on maize in Porto Rico is doubtful. So far no trace of it has been found, nor have maize plants growing close to diseased sugar-cane been infected.

The gumming disease of sugar-cane has spread very rapidly and is a menace to the sugar industry in Porto Rico. A detailed study of the relative susceptibility of different cane varieties has been undertaken. So far the variety Otaheite has been found most susceptible. The author states that the bacterium which causes the disease grows slowly or not at all on the more acid media. Inoculation tests showed that susceptible varieties such as Otaheite, B. 376, and Rayada can easily be infected by applying a small mass of bacteria to injured surfaces of growing leaves and tops of cane stalks, that the mature portions of the cane stalks or their roots do not offer likely points of entry to the organism, and that the disease is not transmitted from plant to plant through the soil. It is believed to be transmitted in the field by direct inoculation with the cutting tools, or by insects or driving rain. Infected ratoons having two or three small infected buds constitute dangerous foci of infection, propagating the disease until the tops of full-grown canes are reached. As the latter do not succumb as easily as the younger shoots, they remain a standing menace to neighbouring healthy fields.

White-root disease and black root-rot of coffee [the latter caused by *Rosellinia* sp.] were found on plantations having large and crowded shade trees and a heavy and moist surface mulch. Under these conditions *Pellicularia* is also frequent. *Stilbella* leaf spot, *Cephalosporium* sp., and *Cercospora* sp. are met with in a greater or lesser degree on coffee plants in nearly all the districts named. Root disease and leaf spot yield to some extent to rational soil treatment, but *Pellicularia* requires spraying and thinning out for its control.

Banana wilt was reported from many districts, and amongst specimens received by the department were *Phyllosticta sacchari* on sugar-cane leaf and *Phytophthora infestans* on tomato. A *Phytophthora* was isolated from the bud of a young coco-nut palm and a *Fusarium* was found constantly present in a root-disease of grape-fruit which has killed several trees in two groves in recent years. This last disease is distinct from the citrus foot-rot, the lesions occurring on the finer roots instead of near the base of the trunk. A serious root disease of onions due to a *Fusarium* was reported, while Avocado roots were attacked by a species of *Diplodia*.

KILLIAN (K.). **Ueber die Ursachen der Spezialisierung bei den Askomyceten. I. Die Monilia cinerea der Kirschen.** [Causes of specialization in the Ascomycetes. I. *Monilia cinerea* of Cherries.]—*Centralbl. für Bakt.*, Ab. 2, liii, 22–24, pp. 560–597, 1921.

The author chose *Monilia cinerea* of cherries for his experiments because of the ease with which it can be cultivated on artificial nutrient media, and also because it is to be found in almost pure culture on the fruit. Besides, there are two distinct forms of this fungus, namely, that of sweet cherries which brings about chiefly the rotting of the fruit and appears therefore to be of a somewhat saprophytic nature, and that of sour cherries which is found as a parasite on the flowers, whence it passes over on to the twigs, although it can also cause the mummification of the fruit in the same way as the other form. Cultivated on different nutrient media, both forms show constant and characteristic differences in the growth and disposition of their mycelium, the *Monilia* of sweet cherries showing its saprophytic tendencies by being less discriminating than the other form in the choice of its food, while the latter perished readily in media not adapted to it. By adding different organic and inorganic salts and acids to the cultures the author sought to bring about a unification of both types of the fungus. He found the *Monilia* of sweet cherries much more amenable to modification than the other. He succeeded, by the admixture of 3 per cent. of malic acid to a culture on potato-agar, in causing the former to assume all the characteristics of the latter. These characteristics, however, do not seem to become hereditary, as after a few generations, or even in some cases in the next generation, the fungus resumes its specific characteristics when returned to normal conditions. On the other hand, the presence of different organic acids in the nutrient media remained without any appreciable effect on the *Monilia* of sour cherries, which proved to be a very constant type. In one case only, out of a large number of experiments, did the author observe a few cultures of this form (in KNO_3 0·5 per cent., $MgSO_4$ and K_2HPO_4 0·2 per cent., dextrose 2 per cent.) come very near in structure and development to that of sweet cherries.

From these experiments the author comes to the conclusion that the *Monilia* of sweet cherries is a modified form of that of sour cherries, which progressively adapted itself to new conditions of food as the sour cherry tree was gradually being cultivated into the sweet fruit variety, and that the specialization of fungi depends largely on the chemical nature of the substratum on which they live. He seeks confirmation of his hypothesis first in his observation of the fact that the *Monilia* of sweet cherries, if forced to grow on a twig of some sour cherry species, assumes all the characters of the other form and maintains these characters if then transplanted on to sweet fruit-bearing kinds [thus differing from the modifications produced in culture on artificial media described above], and secondly, in the observations of Wormald (1920) on *Monilia cinerea*, Miss A. Hänicke (1916) on *Penicillium* and *Aspergillus*, and especially of Anderson (1912) on *Endothia parasitica* of chestnuts, the latter showing a great analogy with the results obtained by himself. There is an extensive bibliography attached, and the cultural characters of the two strains dealt with are illustrated.

Arnaud (G.). **Sur les affinités des Erysiphées et des Parodiopsidées.** [On the affinities of the Erysipheae and Parodiopsideae.]—*Comptes Rendus Acad. des Sciences*, clxxiii, 25, pp. 1394–1396, 1921.

The author considers that the Parodiopsideae and the Erysipheae form two parallel groups of the same family of the Parodiellinaceae (cf. Arnaud, 'Les Astérinées. II. Études sur les champignons parasites,' *Ann. des Épiphyties*, vii, 1921). The Erysipheae have usually no internal mycelium except their epidermal haustoria, while in the Parodiopsideae there is usually an abundant internal growth.

Perisporina truncata (Stev.) Arn. (*Perisporium truncatum* Stev.) is therefore of interest as showing this parallel development carried to the extent that the internal mycelium is reduced to the same degree as in *Phyllactinia corylea* (Pers.) Karsten amongst the Erysipheae. Its external mycelium produces short branches resembling stigmopodia which, when they pass over a stoma, may form a swelling completely covering both stomatic cells. The fungus then sends through the ostiole a simple, unicellular (rarely septate) hypha which passes through the intercellular spaces directly towards a cell in the neighbourhood of a vein, where its extremity expands into a bilobed swelling—a kind of appressorium—from which a haustorium is sent into the cell. The haustorium is ovoid, never spiral. In very rare instances two threads may penetrate through the same stoma, but each of them bears only a single haustorium. There are other minor resemblances to the Erysipheae, and the fungus is liable to be parasitized by *Cicinnobella parodiellicola* P. Henn.

DOIDGE (ETHEL M.). **South African Perisporiaceae, VI. The haustoria of the genera Meliola and Irene.**—*Trans. Roy. Soc. S. Africa*, ix, 2, pp. 117–127, 7 figs., 1921.

In corroboration of the work of Maire, the author finds that *Meliola* and *Irene* are true parasites. All the species examined send haustoria into the cells of the host. The penetrating filament is exceedingly fine, but stains well with cotton blue or methyl blue, Sudan III being used as a contrasting cuticular stain and the two stains being combined in lactic acid. The haustoria may develop in the epidermal cells or in palisade or other outermost chlorophyll-containing cells of the mesophyll, and they sometimes pass through one or more sclerenchyma fibres to reach the latter. They are spherical, usually small, thin-walled vesicles not greatly differing in the different species. The character of the penetrating filament is, however, of diagnostic value, and is apparently constant in a given species. The haustoria cause a considerable disorganization of the cells into which they penetrate, and their prejudicial effect may sometimes be seen in the discoloration of the leaf around the infected area; for instance, in *Schinus* purple spots radiate from the point covered by the *Meliola* mycelium, and no other cause has been found for the discoloration. It is not uncommon in South Africa to find the leaves of young seedling trees so covered with the dark mycelium that their normal colour can only be seen when just unfolded.

Similar haustoria were found to occur in *Baladyna velutina* and *Dimerium psilostomatis.*

TANAKA (T.). **New Japanese fungi. Notes and translations. X.**—*Mycologia*, xiii, 6, pp. 323–328, 1921.

Descriptions of a number of new species named by K. Hara in *Chagyôkai* (Tea Journal) in 1918–1919 are translated from the Japanese, and notes are given. All are from tea (*Thea sinensis*) in Japan. The fungi are: *Hypodermopsis theae, Stagonospora theae, Leptosphaeria hottai, Sillia theae, Ascochyta theae, Diatrype theae,* and *Hendersonia theae.* All are parasites except the *Stagonospora* and *Diatrype,* and most have been illustrated by Hara, who has been publishing a series of papers in *Chagyôkai* on diseases of the tea plant, in Japanese.

FAWCETT (G. L.). **Notas preliminares sobre una enfermedad del tabaco.** [A preliminary note on a Tobacco disease.]—*Rev. Indust. y Agric. de Tucuman,* xii, 1–2, pp. 5–17, 14 figs., 1921.

The most destructive disease of tobacco plants, apart from insect troubles, occurring in the Tucumán province (Argentina), is popularly known as 'corcova' (warping or distortion). Its cause has so far not been determined, but the author believes that he has eliminated the possibility of fungous origin, nor has evidence been forthcoming pointing to insect intervention.

The most characteristic symptom is the formation of dark lines on one or both sides of the veins of the leaf, in appearance like the tunnellings of small grubs, but differing from these in that they are more numerous and shorter, being only from 1 to 3 mm. long. Later, the lines situated near the principal veins may unite and form longer markings, or definite spots. On the largest leaves secondary lines, a few mm. distant from the main veins, are sometimes found, the intervening leaf-tissue turning a light or yellowish colour. Affected leaves end by turning yellow and withering. During cool or dry weather the spread of the affection is arrested, the dark lines take on a light colour, and the leaves show no further signs of ill health. On the stems of diseased plants stripes of various forms are frequently found. They generally run longitudinally, measuring 2 to 10 cm. by 1 to 6 mm., and sometimes are at first double. Less frequently small spots or short, bent, or circular stripes are formed, resembling, as in the case of the leaf, the effects of insect attack. The spots, originally yellow, subsequently grow larger, become sunken, and turn black.

Markings in every respect analogous with the black lines on the stem appear also on the principal vein of the leaf. The pith is sometimes affected, the tissues turning black and contracting, and small cavities being formed at regular intervals. Finally it dries up, leaving the stem hollow.

Infection is never uniform. While the healthy parts of the plant continue their growth, that of the diseased portions is arrested, with the result that the upper part of the stem droops and the young leaves are distorted.

The disease attacks plants in all stages of development, from seedlings to fully mature plants, and is favoured by high temperature and abundant moisture. The losses due to it are important in some seasons, almost total failure of the crop having been reported from some plantations.

Wilt caused by *Bacillus solanacearum* Smith has superficially a similar effect, but the slow onset, the absence of any gummy secretion in the vessels, the fact that the leaf veins do not turn black, the scarcity of bacteria in the vascular tissues, and the dry rot instead of a semi-fluid decay of the pith, serve to distinguish the present disease. It has been impossible to reproduce the disease by inoculating with bacteria isolated from diseased plants, or with infusions made from affected leaves (as can be done in the case of tobacco mosaic). Moreover, bacterial infection is almost constantly absent in the first stages of the disease, and the more abundant presence of bacteria in the later stages is probably due to secondary infection. But the possibility of a bacterial origin is not definitely excluded.

Of the control measures tried, neither spraying with Bordeaux mixture or lime sulphur, nor manuring with nitrate of sodium and bone meal, have had the slightest beneficial effect. Pulling up and removing all attacked plants also produced no effect, the disease spreading just as freely as where no measures were taken. The only means of control that can be suggested at present is the planting of resistant varieties. Of the varieties under cultivation in the province (Habano, Habano de vuelta abajo, Florida Cuban, Habano de Connecticut, Criollo, Florida, Sumatra, Orinoco, Little Orinoco, Zimmer, Yellow Pryor, Pennsylvania Broadleaf, and Turco) only Turco and Criollo have shown a certain resistance. Of the hybrids tried, a cross between Turco and Criollo has given satisfactory results on a small scale. More extensive trials are projected. Other crosses between common tobacco and the wild species *Nicotiana longiflora* Cav. and *N. sylvestris* Speg. & Comes resulted in sterile hybrids. *N. sylvestris*, when cultivated, is very subject to 'corcova', and *N. longiflora* is not completely immune.

SMITH (E. F.) & MCKENNEY (R. E. B.). **A dangerous Tobacco disease appears in the United States.**—*U.S. Dept. of Agric. Circ.* 174, 4 pp., 1921.

A severe outbreak of a mildew, due to a fungus provisionally identified as *Peronospora hyoscyami* de Bary, occurred in tobacco seed-beds in Florida in March 1921. It spread rapidly, and in a month had infected probably all the seed-beds in the cigar-wrapper growing area of Florida and Georgia.

The parasite is stated to have done no damage to tobacco in Europe, where it was first described on *Hyoscyamus niger*, but it has been known for many years as a destructive parasite of seedling tobacco in Australia, where it is called blue-mould. In the United States it has been recorded on a wild tobacco (*Nicotiana glauca*) in California, and specimens of what is apparently the same fungus were received from seedling cultivated tobacco in 1906. The origin of the present outbreak is obscure, several alternative possibilities being discussed.

Immediately on the appearance of this disease, the destruction of the first few severely affected beds was recommended as well as the spraying of other beds not yet, or only slightly, attacked, with Bordeaux mixture. This is believed to have had a good effect. It is further recommended that for the current year the shaded fields in which the expensive wrapper leaf is grown should not be planted unless seedlings known to be healthy are available. A separate publication (Circular 176) has been issued giving these recommendations in greater detail.

COOK (M. T.). **Wilting caused by Walnut trees.**—*Phytopath.*, xi, p. 346, 1921.

Potato and tomato plants within the area of the root system of *Juglans nigra* were frequently found wilted. Investigation showed that the walnut trees were the cause, the areas in which wilting occurred corresponding with the distribution of the root system. Other crops were not found wilted, nor did other trees cause a wilting of crop or wild plants. No explanation of this phenomenon is offered.

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JOHNSON (J.). **Fusarium-wilt of Tobacco.**—*Journ. Agric. Res.*, xx, 7, pp. 515–535, 5 pl., 1 fig., 1921.

The author observed a typical wilt disease of tobacco in Maryland in 1916. A similar disease occurred in Ohio in 1919, and it is possible that it will be found elsewhere as it is liable to be confused with the 'Granville' tobacco wilt caused by *Bacillus solanacearum*. The tobacco wilts associated with *Fusarium* recorded from the Cape of Good Hope and Ceylon, and the tobacco disease attributed to *Fusarium tabacivorum* Delacroix in France are regarded as doubtful in origin.

The present disease is characterized by a yellowing and wilting of the leaves of the plant, usually followed by death. The fibro-vascular system is turned brown or black. Under field conditions the attack may appear at any stage in the growth of the plants, but it is probable that it usually begins when they are young and remains latent unless conditions are favourable for further development. In contrast to the 'Granville' wilt the vascular lesions are distinctly dry. There is no rotting of the living parenchyma, the parasite being a typical vascular one. Death is believed to result not so much from clogging of the vessels as from toxic substances formed by the parasite or formed by the action of the parasite on the host.

A *Fusarium*, closely related to *F. oxysporum* (Schlect.) Wr. and regarded as a variety (var. *nicotianae* John. n. var.) of this species, was regularly present in the affected tissues, and was readily isolated. Infection was secured with pure cultures through the soil, and was greatly enhanced by wounding below the surface of the soil. Wounds in the stalk above ground do not seem to permit successful infection. A relatively high soil temperature (28° to 31° C.) was found to favour infection, but there is a wide range of temperature through which the disease can occur. An acid soil was also found to favour the disease. High soil moisture is not regarded as assisting infection, and the Maryland attack was on high, sandy land.

The susceptibility of the varieties of tobacco tested differs considerably. None tried was absolutely immune, but Connecticut Havana, Cuban, and Sumatra showed 98 per cent. resistance, while Pennsylvania Broadleaf and Wisconsin binder selection H 12074 were nearly as good. The least resistant was the ordinary White Burley amongst the *N. tabacum* varieties, though *N. glauca* was still more susceptible. A strain of White Burley that had been selected for resistance to *Thielavia basicola* was also found to be markedly resistant to the wilt, and this indicates that, should the disease become severe, selection amongst the susceptible commercial varieties may be entirely feasible.

The morphology and cultural characters of the organism are described in detail. Infection has been secured with two strains of *F. oxysporum* from potato on tobacco, but attempts to infect potatoes with the fungus from tobacco failed. The latter retained its virulence on its proper host unimpaired after four years in culture.

SMITH (E. F.) & MCKENNEY (R. E. B.). **The present status of the Tobacco blue-mold (Peronospora) in the Georgia-Florida district.**—*U.S. Dept. of Agric. Circ.* 181, 2 pp., 1921.

The statement that the Georgia-Florida industry has been destroyed by blue-mould disease [see this *Review*, i, 9, p. 320] is without foundation. The infection in the seed-beds was very severe, but growing conditions were favourable to the development of the crop and adverse to the spread of the disease. The attacks were therefore substantially confined to the lower leaves, and are estimated not to exceed 5 per cent. of the crop in the infected areas, i. e. an average of about one leaf per plant. The hot dry period during the first ten days of May appears to have been instrumental in checking further development of the disease.

Equally baseless are the statements to the effect that the disease will spread on tobacco in storage, and that even leaves maturing without visible infection are unsuitable for use. The infection does not spread on harvested and cured tobacco, and clean leaves are in all respects adapted for wrapping purposes.

The use of the term 'mould' in connexion with this fungus is somewhat misleading unless properly qualified, *Peronospora* having nothing in common either with the ordinary green or white mildew of damp weather or with the white mould of cigar tobacco.

The disease has not appeared in Connecticut, North Carolina, southern Alabama, or the Madison or Dade City districts of Florida.

BURGER (O. F.) & PARHAM (H. C.). **Peronospora disease of Tobacco.**—*Quart. Bull. State Plant Board Florida*, v, 4, pp. 163–167, 1 fig., 1921.

The authors are not inclined to believe that this [see preceding abstract and this *Review*, i, 9, p, 320] is a recently introduced disease, its simultaneous appearance under the favourable weather conditions of the spring of 1921 in every seed-bed in Gadsden County, even those that were isolated and not exposed to outside infection, suggesting that it must have been present throughout in previous years. Tobacco grown under 'combination shade' made of slats and cheese cloth was the most severely attacked, then that grown under slats only, while there was little in the sun-grown crop, and artificial infections failed once the weather became hot. Of late years more shade-grown tobacco is planted, and sowing is done earlier while the weather is still cool. These conditions are believed to be largely responsible for the present outbreak. The disease was so completely checked by the hot weather in May and June that the damage is only estimated at about 1 per cent. of the season's crop. It is believed that the disease may be controlled by spraying the seed-beds with 2–2–50 Bordeaux mixture.

PRITCHARD (F. J.) & PORTE (W. S.). **Effect of fertilizers and lime on control of Tomato leaf spot (Septoria lycopersici).**—*Phytopath.*, xi, 11, pp. 433–441, 16 figs., 1921.

After an introductory review dealing with current interpretations of fertilizer effects on disease resistance, a series of experiments to test the behaviour of the tomato leaf spot fungus (*Septoria lycopersici*) with different substances is described. The plants, of which there were twenty-five in each group, were grown in pots or glass jars in fertile, friable loam soil. Sodium nitrate (15·65 per cent. N), potassium sulphate (48 per cent. K_2O), acid phosphate (16 per cent. available P_2O_5), and lime were used in varying quantities with and without other fertilizer ingredients. Copper sulphate was also used in two sets of experiments. The plants were inoculated with *Septoria lycopersici*, kept in a moist chamber for 48 to 60 hours, and then transferred to greenhouse benches. The initial infections were counted the eleventh day after inoculation. The records included measurement of average leaf area on the plants, number of infections per plant, and number of infections per unit area of leaf surface. The treated plants received the nitrate, phosphate, or potash at the rates of 50, 150, 300, and 500 parts per million parts of soil, lime at 200, 400, and 1,000, and copper sulphate at 5, 10, and 40 parts per million parts of soil. The controls received either no fertilizer or uniform quantities of certain fertilizers which were also used for the treated plants.

Nitrate increased both the leaf area and the number of infections per plant, the former by 77 per cent. and the latter by 55 per cent. There was a reduction of 13 per cent. in the number of infections per square inch of leaf surface.

Acid phosphate increased the leaf area and number of infections per plant in three sets of experiments and decreased them in another. The average increase in these experiments was 14 per cent. for the leaf area and 50 per cent. for the number of infections per plant, while there was an increase of 32 per cent. in the number of infections per square inch of the leaf surface.

Lime reduced the leaf area by 2 per cent. and the number of infections per plant by 8 per cent., giving also a reduction of 7 per cent. in the number of infections per square inch of the leaf surface.

Potash gave conflicting results in two separate experiments. In the first there was a reduction of 19 per cent. in the leaf area, of 46 per cent. in the number of infections per plant, and of 33 per cent. in the number of infections per square inch of leaf surface.

In the second there was an increase of 6 per cent. in the leaf area, 77 per cent. in the number of infections per plant, and 68 per cent. in the number of infections per square inch of leaf surface.

Copper sulphate reduced the leaf area by 20 per cent., and the number of infections by 17 per cent., but the number of infections per square inch of leaf surface was increased by 4 per cent.

The results of the experiments indicate that the fertilizers only indirectly influenced the susceptibility to leaf spot through their effects on growth or the internal conditions accompanying development. This was true also of the different ratios and quantities used. The enlargement of the leaf area was correlated with an increase in the number of infections per unit area of the leaf surface. Favourable conditions for growth therefore increased susceptibility, while unfavourable conditions decreased it. Owing to the ideal conditions for infection, the percentage of disease was much higher than would normally be the case.

Truog and Meacham (*Soil Science*, vii, 1919) found that high acidity (hydrogen-ion concentration) of the cell sap often restricts the growth of plants, while the latter is promoted by a lower acidity, and it might, therefore, be assumed that the relationship between growth and infection really corresponds to that between acidity and resistance. Haas (*Bot. Gaz.*, lxiii, 1917), however, has shown that the total undissociated and dissociated acidity of plant cells is usually much greater than the dissociated acidity (hydrogen-ion concentration). It would seem, then, that the neutralization of acid in the cell by lime or other substances would have very little effect on the hydrogen-ion concentration since immediate dissociation would follow precipitation of the free acid. If, however, the dissociation of acids in plant cells is not so rapid a process as is assumed, hydrogen-ion concentration may have an important bearing on susceptibility to disease. Though probably not the plant's sole means of defence against parasites, it may be comparable to the serum of the blood in preventing animal disease.

Fertilizers apparently affect the susceptibility of plants to disease in the same general direction as they affect growth and they may, therefore, be used in such a way as to avoid conditions favourable for excessive infection, but they do not seem to provide a sufficient means for the control of tomato leaf spot.

JIVANNA RAO (P. S.). **The physiological anatomy of the spiked leaf in Sandal (Santalum album L.).**—*Indian Forester*, xlvii, 9, pp. 351–360, 2 pl., 1921.

In a previous article ('The cause of spike in Sandal', *ibid.*, xlvi, 9, pp. 469–487, 1920) the writer expressed the view that spike is due to an insufficient supply of water to the plant owing to relations with unfavourable hosts. The present investigation is confined to the starch content of the leaf of sandal, as the accumulation of starch constitutes the most essential feature of spike. The distribution of starch in the mesophyll was carefully studied, attention also being paid to the enlargement of cells and their number in a definite area. Sections were taken in the same way from (1) the leaves of a normal plant, (2) leaves in an advanced stage of spike, and (3) leaves of an apparently normal plant which suffered from drought owing to the removal or absence of hosts.

The internal structure of the spiked leaf reveals an interesting condition. The six to seven lines of mesophyll are packed so closely as to leave no air cavities towards the lower surface. In the young leaves the cells forming the sheath round the vascular bundles or their ultimate tracheidal ramifications are the first to be filled with starch. In older leaves this precipitation of starch is noticeable in the central cells throughout the cross-section of the leaf, and after extending to the lower mesophyll cells it is finally observed in the layer of cells beneath the upper epidermis. In the later stages the cells of the lower epidermis also become filled with starch.

From the examination of a large number of cases the following conclusions were drawn: (*a*) In the earlier stages of spike little or no starch is present in the younger leaves; (*b*) starch is present in all the leaves of the spike in the older stages; (*c*) starch disappears when the disease is so advanced that the plant is in a dying condition; (*d*) leaves from an absolutely unspiked plant sometimes contain a large supply of starch; (*e*) in all cases there is a progressive increase in the quantity of starch from the youngest to the oldest leaves remaining on the twig.

There is a low ash-content in spiked as compared with normal leaves. In its physiological anatomy the changes in the spiked tree are such as would be due to a reduced water-supply. The maximum deposit of starch in spiked leaves is round the vascular bundles, but it gradually extends to the periphery until the whole leaf is crammed. This centrifugal increase of starch agrees with the view that the sugar concentration in leaves is generally highest in the palisade layer, producing the maximum osmotic pressure at this point, a downward gradient being apparent from the epidermis to the vascular bundles.

In the spiked twigs of sandal the medullary cells are among the first to form starch, the vascular sheaths next, and the palisade cells last. Measurements of the leaf-cells from cross-sections of normal and spiked leaves in the later stages reveal no appreciable difference in size, but their division is retarded owing to lack of full turgidity. The cause of spike must therefore be traced to those factors which limit the turgidity of the cells and thereby check their powers of growth.

Continuous and rapid growth is one of the striking characteristics of spiked twigs. Owing to the condensation of starch, the older leaves soon lose their maximum osmotic pressure, and turgidity, which is so intimately connected with growth, becomes greatest at the topmost point of the shoot. The scanty available water-supply is directed to the younger leaves until these repeat the process. It is interesting to note the tenacity of the plant under these conditions. Even when the trunk and branches are completely desiccated, the twigs continue to bear tufts of the smallest pigmented leaves, which die and fall off very quickly. An examination of these leaves showed that the cells were in a plasmolysed condition, there being only a few starch grains in the bundle sheaths. Evidently these minute leaves receive an extremely low amount of moisture from the soil through the trunk and desiccated branches.

While agreeing in the main with the 'unbalanced circulation of sap' theory advanced by Hole (*ibid.*, xliii), the writer maintains that the difficulty of obtaining an adequate water-supply referred to above constitutes the primary cause of spike.

PETRAK (F.). **Mykologische Notizen, ii, 42. Über Septoria apii Chester.** [Mycological Notes, ii, 42. Notes on *Septoria apii* Chester.]—*Ann. Myc.*, xix, 1–2, pp. 31–32, 1921.

Septoria apii occurs in various forms, which differ greatly in the leaf spots they produce. The first—very rare—form is distinguished by having somewhat large, irregularly roundish, yellow-ochre or light brown spots, up to 5 mm. in diameter, with a raised circumference, the surrounding area being scarcely darker; these spots occur at considerable intervals from each other or even singly; they are either wholly sterile or else have a few pycnidia in the centre. Another form produces small, light yellow-ochre to brownish spots, 1 to 3 mm. in diameter, spread somewhat densely over the whole leaf surface and often so close together that they coalesce; they have raised edges and are either totally sterile or bear a few pycnidia on the upper or lower surface. In the third type the formation of true spots is absent, and the pycnidia appear on both surfaces of the leaf, at first in small, somewhat dense conglomerations which later spread gradually until the pycnidia seem to cover both surfaces of the leaf with their black dots, causing it to wither and dry up rapidly. This form also occurs on the leaf-stalks and stems of the host plant.

During the summer of 1920 the author grew in the open three varieties of knob-celery (celeriac), namely 'Erfurter frühester Markt', 'Riesen-Alabaster', and 'Prager Riesen'. The two last named were attacked by the *Septoria* directly after transplanting, and were so retarded in their development that by the autumn the resulting knobs hardly exceeded the size of a walnut. 'Erfurter frühester Markt', which was grown in the same bed as the other two, showed only a slight attack on a few leaves up to the middle of August, and it was not until the end of the month that infection became severe. Little damage was done at this late stage, and the harvest was excellent. The variety 'Prager Riesen' was attacked by the third form of the disease described above; 'Riesen-Alabaster' suffered in its early stages from the first, later from the second form; and 'Erfurter frühester Markt' was susceptible to the third form almost exclusively.

As preventive measures the author recommends that celery should be planted in beds which have been heavily manured in the previous season, and that a few weeks after transplanting sulphate of ammonia should be spread on the soil, an operation which can be repeated with advantage one month or six weeks later. It is also important to keep the beds watered during dry weather, as otherwise the fungus is liable to get the upper hand.

The author's attempts to inoculate parsley with *S. apii* failed.

JONES (L. R.) & DOOLITTLE (S. P.). **Angular leaf-spot of Cucumber.** —*Phytopath.*, xi, 7, p. 297, 1921.

Cucumber seed was planted at Ellison Bay, Wisconsin, in soil which, so far as known, had never before grown cucumbers. The seed used was from plants showing both mosaic and angular leaf spot (*Bacterium lachrymans*). No mosaic developed in the progeny, but angular leaf spot appeared on two plants in one hill, and spread over the half-acre field, the subsequent infection of the young fruit proving very serious. This supplements the previous observations of Carsner and of Gilbert and Gardner in showing that angular leaf spot can overwinter on the seed and is very destructive to the young fruit.

GARDNER (M. W.) & GILBERT (W. W.). **Field tests with Cucumber angular leaf-spot and anthracnose.**—*Phytopath.*, xi, 7, p. 298, 1921.

Field tests indicated that seed treatment with $HgCl_2$ (1–1,000 for five minutes) is effective as a control for angular leaf spot (*Bact. lachrymans*), although it does not eliminate all the infection. This treatment was also found to reduce anthracnose (*Colletotrichum lagenarium*) to a trace. *Bact. lachrymans* survived twenty months but not thirty-two months on the seed and did not appear to persist over winter in the soil. The *Colletotrichum* was found (as had been previously noted) to persist one winter in the field, but not twenty months, so that a two-year rotation should eliminate soil infestation with this fungus.

DOOLITTLE (S. P.). **Overwintering of the bacterial wilt of Cucurbits.**—*Phytopath.*, xi, 7, p. 299, 1921.

Previous evidence by Rand and his colleagues that the beetle *Diabrotica vittata* is concerned in the overwintering of wilt caused by *Bacillus tracheiphilus* is supplemented by the author's findings. These beetles were collected in the field in 1917 and 1919 before cultivated cucurbits had appeared, and placed on healthy cucumbers in the greenhouse. Several of the plants thus treated developed wilt and were the only ones to get this disease in the greenhouse during the past four years. Although the beetle feeds in early spring on *Micrampelis lobata* and *Sicyos angulatus*, these plants were never found showing wilt. No evidence was secured indicating that *Diabrotica* is concerned in mosaic overwintering, though *Micrampelis* is known to be an agency in carrying the cucurbit mosaic through the winter.

PALM (B. T.). **Aanteekeningen over slijmziekte in Arachis hypogaea.** [Observations on the slime disease of *Arachis hypogaea*.]—*Meded. Inst. voor Plantenziekten*, 52, 41 pp., 2 figs., 1922. [English summary.]

The slime disease or bacterial wilt of ground-nut (*Arachis hypogaea*), caused by *Bacillus solanacearum*, was first observed in the Dutch East Indies in 1905, and is now known to occur in many districts of Java, Sumatra, and other islands, causing an estimated annual loss of at least 25 per cent. of the crop. In severe attacks the plant dries up so quickly that the leaves may remain green, but slight early infections involving only a part of the plant are sometimes overcome, the host recovering completely. The root system of affected plants shows a number of dead roots, those first attacked being dark in colour, while those further from the centre of infection are brown. Some of the nuts remain small, the shell often being brown-veined in consequence of the presence of bacteria in the vascular system. The characteristic bacterial slime that exudes from the vessels of the cut stem and roots is first readily detected in the later stages of the disease.

The appearance of the plant is not an index to the number of bacteria present. Healthy-looking parts are frequently filled with bacteria without even any discoloration of the affected vessels, and it is from these regions of the plant that the organism may most easily be isolated. The shell of well-developed fruits often contains bacteria, which penetrate also into the funiculus and even into the seed-coat, but they have never been found in the embryo.

The cultural characters of the organism are described. Gelatine is liquefied very slowly. On boiled potato a very characteristic colour change occurs, the culture gradually taking a deep grey to jet black colour. The change of colour appears after five to fifteen days at a temperature of 23° to 30° C. The different strains vary somewhat in their cultural characters; two, for instance, showed no growth when nitrogen was given as nitrate of potassium and carbon as laevulose, while another did.

Inoculations were carried out on the roots of pot plants of ground-nut, tomato, and tobacco. Typical disease symptoms developed in all cases, the controls remaining healthy. A number of new host-plants of *Bacillus solanacearum* in the Dutch East Indies have been discovered, viz. *Chenopodium ambrosioides*, *Beta vulgaris*, *Talinum racemosum*, *Rumex abyssinicus*, *Galphinia gracilis*, *Hibiscus sabdariffa*, *Linum usitatissimum*, *Daucus carota*, *Petroselinum sativum*, *Barleria lupulina*, *Coreopsis speciosus*, *Eleutheranthera ruderalis*, *Helianthus annuus*, *Senecio sonchifolius*, *Tagetes signatus*, *Verbesina alata*, and *Zinnia elegans*.

The disease appears to be favoured by humidity of the soil and is reported to be more prevalent on heavy clay. The planting of *Arachis* for several years in succession on the same land also increases the incidence of the disease. The whole question of the influence of the soil in relation to this disease is by no means clear. There is some prospect of improvement through selection, de Jong's experiments on these lines having already given satisfactory results. As the shells of nuts from diseased plants sometimes contain large quantities of bacteria they should be burnt after planting, not left heaped on the fields as is the custom. Where possible only seed from healthy plants should be planted.

GABEL (W.). **Ueber die Verwendung von Quecksilbersalzen zur Saatgutbeize.** [On the use of salts of mercury for the disinfection of seed.]—*Zeitschr. für angew. Chemie*, xxxiv, pp. 587–588, 1921.

Inorganic salts of mercury have been employed for the disinfection of seed in Germany since 1906, when they were introduced by Hiltner. The use of organic salts of mercury is of more recent date, the first mention of it occurring in 1913. The simplest organic mercury compound is cyanide of mercury, which is said to be completely effective in preventing stripe disease of barley when used as a steep for the grain. Mercury chlorophenol, introduced by Remy for the steeping of cereals attacked by *Fusarium*, is the chief component of 'Uspulun'. Another organic salt of mercury is mercury cresol sodium cyanide, which is the chief ingredient of the new fungicide 'Germisan'. A third proprietary seed disinfectant containing mercury is known as 'Fusafine', which consists mainly of corrosive sublimate in association with common salt, sodium sulphate, and an azo colouring substance. 'Fusafine' contains about 20 per cent. of sublimate.

SHARPLES (A.). **Treatment of mouldy rot disease by application of 'Agrisol'.**—*Agric. Bull. Fed. Malay States*, ix, 3, pp. 184–191, 1921.

Field tests made with the proprietary fungicide 'Agrisol'—a coal-tar product—showed that under local conditions and used in the form of a 20 per cent. solution, at twelve-day intervals, it is a reliable preparation for the control of mouldy rot (*Sphaeronema* sp.) of *Hevea*. The conditions in some of the experiments were such as to test the fungicide very severely, previous treatment by the methods ordinarily used having failed, and the author believes that it would be equally successful under any conditions likely to occur on plantations run on progressive lines, though this point will require to be tested further by experiments in different localities. In lightly infected areas one application is seldom sufficient, two usually clear up the diseased bark, but in difficult cases three paintings are often necessary. In badly infected areas the treatment should be continued until the final eradication of the disease. Strict supervision is necessary, and a system of marking treated trees, such as the addition of colouring matter to the solution, must be employed to aid this. The fungicide is easily miscible with water, and strong solutions do not harm the tender cortical tissues of the tapped surface. The only precaution required is to stir the solution before applying, as some of the constituents have a tendency to settle.

GADD (C. H.). **The efficacy of formaldehyde vapour as a disinfectant of Tea seed.**—*Dept. of Agric. Ceylon, Bull.* 51, 8 pp., 1921.

In Ceylon the process of disinfection of tea seed imported from India, with a view to preventing the introduction of blister blight (*Exobasidium vexans*), is carried out by means of formaldehyde vapour. The tea seeds are placed in trays with wire gauze bottoms, which are kept on racks in an air-tight compartment. Formalin is then poured on to permanganate of potash, thus effecting the liberation and diffusion of formaldehyde vapour. After forty-five minutes the gas is allowed to escape and the seeds are removed.

Laboratory experiments to test the efficacy of this method of disinfection were conducted as follows: A large enamelled box with a capacity of $3\frac{1}{2}$ cubic ft. was used as a fumigation chamber, the seeds and spores being placed in sterile Petri dishes on the bottom of the box. Permanganate of potash (1 gm.) was placed in a small basin within the box, 2 c.c. of formalin being added immediately before closing the lid. The spores of eight different fungi were used, viz. *Penicillium glaucum, Aspergillus* sp., *Mucor* sp., *Pestalozzia palmarum, Botryodiplodia theobromae, Tricothecium roseum*, and two species of *Fusarium*, one cultured from rice and the other from tea seed. The spores of *Exobasidium vexans* were not tested, as the fungus is not known to occur in Ceylon, and it was considered inadvisable to import it even for experimental purposes. The following treatments were applied: (1) Dry Film. Four drops of water containing fungus spores in suspension were placed on the bottom of a sterile Petri dish with a sterile platinum loop and dried before fumigating. (2) Wet Film. As in (1) but fumigated before drying. (3) Masses of spores. Spores from cultures were placed in clumps on the bottom of the sterile dishes.

After fumigation sterile bean agar was poured into each dish. Controls were made as in (1) and (2), but were not fumigated. It was found that fumigation for forty-five minutes was sufficient to kill the spores of all species used when these were exposed as thin films. The masses of spores of all species except *Fusarium* were also killed. The latter developed even after two hours' fumigation.

Experiments were further undertaken to determine the effect of the treatment on spores present on tea seed. Twenty seeds were placed in a layer at the bottom of a sterile Petri dish and fumigated for forty-five minutes. Each seed was then placed in a sterile test-tube containing melted bean agar. Five other seeds were used as controls. The latter developed fungi and bacteria after the second day, while by the tenth day fungi had developed in all the tubes, but they were considerably fewer in those that had been disinfected than in the controls. In the treated tubes, *Fusarium* spp. predominated, but *Pestalozzia, Penicillium, Aspergillus*, and other fungi also occurred. The growth of the three last-named forms can only be explained, in view of the earlier experiments, by a failure of the gas to reach the spores, or by insufficient duration of treatment, or insufficient intensity of the gas concentration. In the treated tubes, growth began in many cases in the region of the hilum, and it was concluded that the spores on the surface of disinfected seeds had been killed, but not those that might occur in the micropyle or within the seed. No appreciable improvement in the results was obtained by increasing the time of fumigation or by preliminary soaking. Further experiments showed that spores do actually occur at times within the seed coat, and these were naturally not destroyed by the gas In experiments to test the effect of the treatment on the germination of tea seed, it was found that slightly more treated than untreated seeds had germinated at the end of six weeks.

Seeds of other species were next tested, cucumber, pea, chilli [*Capsicum* sp.], melon, onion, maize, cow-pea, rice, bandakkai [*Hibiscus esculentus*], and Lima bean seeds being used. Petri dishes were employed instead of test-tubes. In all the controls bacteria and fungi were apparent on the third day. On the seventh day there were no fungi in the dishes containing treated seeds of cucumber, pea, chilli, melon, onion, and Lima bean; they had, however, developed from one seed of maize, one of cow-pea (damaged by weevil), three seeds of rice, and two of bandakkai. Very few bacterial colonies were present in the treated dishes. Formaldehyde vapour is an excellent disinfectant of peas, beans, &c., but less efficacious with cereals and tea, owing to its inability to penetrate the glumes and seed coat respectively.

Previous experiments have shown that when tea seeds are exposed in four layers to the gas, it fails to penetrate to the middle layers in sufficient concentration to kill the fungus spores on the seed coats. An inspection of the disinfection process at the Government fumigatorium at Colombo showed that the formaldehyde vapour in some cases even failed to penetrate to the bottom of the seed in the top layer, while the lower layers were quite unaffected by it. This is no doubt due to some extent to the presence of powdered charcoal, used for packing, in the interstices between the seeds.

This method of disinfection must therefore be pronounced economically unsound. The results are not commensurate with the expenditure of labour and material, and there is no adequate safeguard against the introduction of fungous pests with the tea seed.

PETCH (T.). **Report of the Botanist and Mycologist for the 3rd quarter 1921.**—*Trop. Agric.*, lvii, 5, pp. 318–319, 1921.

Several cases of the leaf disease of tea caused by *Cercosporella theae* were recorded during the rains. In practically all cases this leaf disease begins on acacia and then spreads to the tea by means of wind-borne spores. *Acacia decurrens*, *A. dealbata*, and *A. melanoxylon* are all liable to this disease. There are several cases on record in which it has occurred in firewood reserves on *Acacia decurrens* and spread from that plant to interplanted *Eucalyptus robusta* (red gum), *E. diversicolor* (Karri), &c.

New diseases recorded during the quarter include black rot (*Corticium theae* Bern.) on coca (*Erythroxylon coca*). Root diseases of cacao and 'bunchy top' disease of plantains are under investigation.

On a rubber estate an orchid, *Dendrobium macarthiae*, was attacked by *Phytophthora faberi* at the same time as the pod disease, caused by the same fungus, was prevalent on *Hevea*.

SOUTH (F. W.). **Work of the inspection staff, July-September, 1921.**—*Agric. Bull. Fed. Malay States*, ix, 3, pp. 200–203, 1921.

DISEASES OF RUBBER.—Pink disease (*Corticium salmonicolor*) was for the most part under effective control during the quarter, the drier weather prevalent acting as a check. Two isolated cases were found at Chaban, this being the first authentic record from Malacca. Mouldy rot (*Sphaeronema* sp.) is still spreading and has appeared on an estate in Malacca. In Negri Sembilan a long spell of dry weather much reduced the severity of the disease in all districts except on holdings where the undergrowth was thick. In Temerloh district in Pahang the attack was severe in a small area owned by Chinese. In Johore a few cases were found in the Johore Bahru district, but prompt measures resulted in checking the spread. In this State by far the most important outbreak is the recent one near Muar. This district is low-lying and damp, and the trees are closely planted, with a remarkable amount of undergrowth. A large majority have become infected with mouldy rot. The amount of infection is gradually being reduced, but the eradication of the disease is not even in view. Attention is being paid to clearing the undergrowth and to painting affected trees, but unless the former is attended to, the latter is of little use. Black stripe [*Phytophthora*] appeared again in Jelebu district, Negri Sembilan, in spite of the dry weather. Patch canker [*Phytophthora*] is reported to have attacked a few trees on an estate in Malacca. The trees were cut out and burnt.

Coco-nut Pests and Diseases. A serious attack of the moth *Brachartona catoxantha* in Province Wellesley is decreasing in severity mainly owing to parasitation by the fungus [*Botrytis necans* Massee] which commonly attacks the caterpillars. Very few moths appeared at the last emergence. Leaves with infected caterpillars were tied to infected trees elsewhere with a view to disseminating the fungus.

A[shby] (S. F.). **A fungous decay of Nutmegs in Grenada.**—*Agric. News* [*Barbados*], xxi, 519, p. 93, 1922.

A species of *Phomopsis*, apparently not previously described on this host, has been isolated from light, internally decayed nutmeg [*Myristica fragrans*] seeds, which are always present in the cured product and are removed by the graders before the seeds are bagged for shipment. In pure culture a white growth was formed, from which, after some weeks, arose black pycnidia extruding yellowish tendrils of *Phoma*- and *Phlyctaena*-like [A- and B-] spores. The fungus in question resembles *P. citri* Fawc., the cause of stem end rot and melanose of citrus fruits in Florida, except that the spores are smaller. Investigations into the losses caused by this fungus and as to whether it attacks the fruit on the tree or after falling are in progress.

Liese (J.). **Neue Beobachtungen über Cenangium abietis Pers.** [New observations on *Cenangium abietis* Pers.]—*Zeitschr. für Forst- und Jagdwesen*, xliv, 4, pp. 227–229, 1 fig., 1922.

One-year old pines sent for examination from Pomerania were found to be attacked by *Brunchorstia destruens* Eriks. (= *Br. pini* Allesch.), the conidial stage of *Cenangium abietis* Pers. The primary needles below the terminal bud turned yellow and died, while the apex gradually withered. Microscopic inspection revealed the presence of a mycelium in the bud and the discoloured portion of the cortex. Slightly above the dividing line between the diseased and healthy part black pycnidia, 1 to 3 by 1 mm., protruded from the cortex. The cavities of the pycnidia were filled with a large number of slightly crescent-shaped, hyaline conidia, mostly quadricellular, 30–40 by 3 μ.

The fungus is a facultative parasite, attacking the buds only under particular climatic conditions, such as alternations of humidity and drought. It has hitherto only been observed on pines above five years of age.

FAULL (J. H.). **Some problems of forest pathology in Ontario. Needle blight of White Pine.**—*Journ. of Forestry*, xx, 1, pp. 67–70, 1922.

The forests of Ontario present a number of problems in pathology, many of which are of fundamental importance in relation to fire, productivity, stumpage values, and type succession. Pathological work now in progress includes a tabulation of the timber diseases of Ontario with respect to causal agents, host relationships, and distribution, foundation studies on the butt rots, and the investigation of various problems in response to special demands.

Butt rots are the principal destructive agencies at work in the Ontario forests, none of which is exempt. With increasing age the trees become more susceptible, and the final deterioration causes a serious loss in stumpage values. Butt rots are also responsible for the windfalls and their resulting débris which litter the forest with combustible material and increase the danger of fire. Butt rots are fortunately almost entirely restricted to mature or suppressed timber, young trees being immune.

One serious difficulty encountered in these investigations has been the absence of information on the identity of causal organisms. For instance, as far as the literature shows, no definite connexion has been established between balsam rot and any specific causal agent.

Other problems requiring solution are the rate of progress of butt-rot infestations and their relation to the age of the host species, to the specific resistance of the host, and to environmental factors. Skilled and patient investigation, which will greatly simplify the present and future administration of the forests, is also necessary in such matters as soil characters, crowding, mixed stands, and climate.

Particular attention has been paid to the needle blight of the white pine (*Pinus strobus*) which is specially prevalent in the northern Ontario stands. The first record of the disease dates from 1905, when it was observed in the Timagami Forest Reserve. The greater part of the subsequent researches were carried out in this locality.

The most noticeable symptom of the blight consists in a yellowing or reddening of the new needles shortly after their emergence from the buds at or about midsummer. The discoloration continues progressively from the tips of the affected needles downwards during a period of about a fortnight. As a rule the upper part of the tree is most severely attacked, and the extent of the blighting is generally uniform for all the needles of any single fascicle.

It was soon ascertained that the injury was neither a winter killing of the foliage, nor an enzymic disease, nor due to fungi or insects. It was, moreover, impossible to induce the disease in healthy branches by fusing them at freshly abraded spots with diseased branches of affected trees. It was discovered in 1919 that the source of the trouble was in the absorbing roots, which were dead in greater or lesser numbers in blighted trees, and were thus unable to provide the extensive supply of water necessary for the expansion of the new needles. The young needles consequently turn pale and then redden from the tips downwards. The foliage of trees recovering from blight may be short, tufted, and pale, but other factors are involved in that connexion. The cause of the death of the absorbing roots has not been fully explained, but certain evidence suggests a drying out in periods of drought in shallow or leachy soils. White pine, though probably the most severely attacked, is not the only sufferer. Investigations are proceeding as to the other species of timber involved.

Another problem associated with needle blight is the difficulty of distinguishing it from the discolorations due to the sulphur fumes in areas within range of sulphur dioxide emanations. The two disturbances can only be differentiated with certainty at the growing season, Observations on both phenomena have shown that burning of the leaves from sulphur fumes occurs rapidly whenever temperature and humidity conditions are favourable, the injuries not being necessarily restricted to needles of the current season. Needle blight, on the other hand, takes place at a definite period in relation to the emergence of the needles from the buds.

Observations on the needle blight have now been carried on consecutively since 1918, and of 633 white pines whose histories have been followed 358 were blighted. Two of the remaining healthy trees became blighted in 1919 as a result of the partial lifting of the thin soil cover and its permanent displacement from its bed of broken rock. These trees died in 1921. The total percentage of deaths was 29·15, and there were 149 apparent recoveries. The results of these investigations indicate that young stands are not likely to be seriously depleted by needle blight, the percentage of deaths among trees with trunks 6 inches or less in diameter being only 6·8. In heavily blighted mature stands, however, the injury may be a deciding factor in the determination of the time of harvesting.

Guyot (M.). **Notes de pathologie végétale.** [Notes on plant pathology.]—*Bull. Soc. de Path. Vég. de France,* viii, pp. 132–136, 1921.

Notes are given on certain diseases of plants observed during the summer of 1921 in the Somme district.

Cladosporium herbarum was common on wheat in spite of the dry season, especially in the less vigorous fields and those suffering most from the drought (chiefly calcareous soils). Not only the glumes but the enclosed grain was infected. *Fusarium culmorum* was fairly frequent on barley and oats but was not seen on wheat. Affected plants lodge readily. *Urophlyctis alfalfae* is often prevalent in old lucerne fields.

For some years past there has been a considerable amount of withering, with many deaths, amongst the elm trees in Picardy. The condition appears to have been observed in 1918 for the first time in young plantations in which the leaves suddenly turned yellow and fell off at the height of the vegetative season, leaf-fall being complete within ten days. Recovery did not take place subsequently. Older trees were also attacked but were more resistant and were not so often killed. The attack may be confined to certain branches which wither and die, the rest of the crown remaining healthy. The topmost branches seem to be more liable to this partial attack than those at the base. After 1918 no further cases of new attack seem to have occurred. Naturally the condition described was attributed by the residents to the effects of the war, either to the use of searchlights and the like, or to poisoning with war gases. But this is negatived by the fact that areas far from the front line were affected, and also that many individual trees escaped injury throughout. No other tree but the elm has suffered. Trees on road-sides as well as those in fields and woods are equally damaged. The wood of affected branches shows a brown zone corresponding with the annual rings of the last few years, the colour being due to browning of the cell-walls and a deposit of brown or black granules in the cell cavities. The roots appear to be perfectly healthy. Attention is called to the similarity between this pathological condition and the walnut disease described by Gard [see this *Review* i, 3, p. 77], the cause of which is equally unknown. [See also this *Review* i, 8, p. 277.]

KLIKA (J.). **Einige Bemerkungen über die Biologie des Mehltaues.** [Some observations on the biology of mildew.]—*Ann. Mycol.*, xx, 1–2, pp. 74–80, 1922.

With the exception of the genus *Phyllactinia*, the mildews may be generally classified as ectoparasites. The external mycelium sends into the cells of the host-plant only haustoria, which penetrate by chemotaxis. It is generally believed that these haustoria only enter the cells of the epidermis, but the author has found that in several species, including *Erysiphe polygoni, E. cichoracearum, Uncinula aceris, Trichocladia astragali,* and *Sphaerotheca humuli,* they sometimes pass through the epidermal cells and penetrate into the cells of the palisade or spongy tissue, or even into the vascular bundles. This process occurs chiefly in older leaves in the autumn.

Dimorphism is a frequent phenomenon in mildews, and may be attributable partly to the degree of nutriment in the substratum and partly to the difference in the illumination of the upper and under side of the leaf. Thus, in *Myosotis silvestris,* the oidia of *Erysiphe cichoracearum* were spherical on the upper side and 14·5 μ in diameter, while on the under side they were oblong and 26 by 11·6 by 13 μ.

Zopf's fibrosin bodies have been observed by the author in the oidia of *Podosphaera leucotricha, Sphaerotheca humuli, Microsphaera alni, Oidium quercinum, Uncinula prunastri, U. aceris, Trichocladia astragali, Erysiphe polygoni,* and *E. cichoracearum.* They doubtless constitute an important reserve material, dissolving at germination.

The development of the perithecia is believed to be occasioned by a decline in the nutrient value of the substratum, the atmospheric influences which often coincide with this stage being of secondary importance. This view is supported by the extensive occurrence of the perithecial stage of oak mildew during the last two years, during which the abnormal drought has caused a deterioration in the nutrient value of the host-plant. Numerous perithecia were found by the author in 1921 on *Quercus pedunculata* and *Q. sessiliflora* in Bohemia, and they were also abundant on *Q. laurifolia* in a locality where Vlach has observed them regularly in smaller numbers since 1916. They have always been found on leaves exposed to the sun and quite dried up, the oidia on these leaves having a relatively low power of germination.

A comparative examination of the perithecia occurring on the two first-named oaks, which are Bohemian species, with those of *Q. laurifolia*, which is American, revealed marked differences in the shape and length of the appendages. The specimens from the latter are characterized by long and elastic appendages which in their ramification resemble the American forms, while the perithecia of the native oaks, with their stiff, short appendages, are more like the typical form of *Microsphaera alni*. The difference in the hosts apparently accounts for this variation.

Inoculation experiments with *Oidium quercinum* [full details of which are given] showed that different forms of *Quercus pedunculata* vary in their degree of susceptibility to infection, the var. *pectinata* being susceptible, and var. *fastigiata* resistant. The latter may escape attack even when growing in close proximity to infected trees of other varieties. An attempt to transmit oak mildew from *Q. pedunculata* to *Q. rubra* failed. Mildew on the latter species has been very seldom reported and the author has failed to find any case in the trees he has examined.

Other inoculation experiments dealing with the specialization of forms of *Uncinula aceris*, *Trichocladia astragali*, *Sphaerotheca castagnei*, and *Erysiphe polygoni* are reported.

Division of Botany, Department of Agriculture [Canada]. Survey of the prevalence of common plant diseases in the Dominion of Canada, 1920.—*First Annual Report*, pp. v + 55 [Mimeographed, 1921].

This is the first plant disease survey report for the Dominion of Canada. It was prepared from reports made by collaborators in the different Provinces, and edited by W. H. Rankin and W. P. Fraser. The plant diseases of economic crop plants are listed, with notes as to their prevalence, seriousness, &c. The following summary covers some of the more important points.

CEREAL CROPS. Stem rust (*Puccinia graminis*) was widely distributed on wheat, oats, barley, rye, timothy, and other grasses. On wheat some damage was caused in Prince Edward Island and in Quebec, but, as usual, the greatest damage occurred in the western Provinces. In Manitoba, open aecidia were found first on June 11, and the first rust on wheat was found at Winnipeg on June 30; at later dates, rust caused much injury to wheat throughout the Province. In Saskatchewan, *P. graminis* was first found on wheat in the southern part of the Province on July 9, but was not collected from the northern agricultural areas until about the first of August, and on the whole the injury to wheat in Saskatchewan was not serious. In Alberta, damage was negligible; the rust was not collected at Edmonton until August 12, and no cereal rusts were found in the Peace River district. On the other cereals damage from stem rust was not, in general, serious. *P. coronata*, *P. dispersa*, and *P. simplex* are recorded for the Dominion, but were not very prevalent in 1920. *P. glumarum* was found on *Hordeum jubatum* in Alberta.

The common cereal smuts were prevalent, and produced injury in greater or lesser amounts. The bunt of wheat in Manitoba and Saskatchewan was caused principally by *Tilletia tritici*. *Helminthosporium*, especially *H. gramineum*, was injurious to barley in certain areas. Some root-rots of cereals were attributed to this fungus. Wheat scab (*Gibberella saubinetii*), ergot, and other cereal diseases were reported but were not severe.

FLAX. *Melampsora lini* was common in western Canada on flax. *Fusarium lini* caused some wilt in Saskatchewan.

SUNFLOWERS. *Puccinia helianthi* and *Sclerotinia* sp. caused some injury.

FRUIT CROPS. *Venturia inaequalis* was not so serious as usual on apple. *Bacillus amylovorus* caused some damage to apples and pears. *Exoascus deformans* and *Sclerotinia cinerea* were not destructive. A number of other fruit diseases were found.

VEGETABLES AND POTATOES. A number of diseases are recorded. *Phytophthora infestans* did not occur in western Canada, except a small amount in British Columbia, but caused damage to potatoes in the eastern sea-board. *Rhizoctonia solani* was severe in Ontario and westward.

WEINZIRL (J.). **The resistance of mold spores to the action of sunlight.**—*Papers on Bacteriology and allied subjects. Univ. of Wisconsin Studies in Science*, 2, pp. 55–59, 1921.

Spores of the following moulds were exposed to direct sunlight on paper slips in glass Petri dishes: *Mucor* sp., *Aspergillus niger*, *A. fumigatus*, *A. nidulans*, *Oidium lactis*, and *Penicillium glaucum*. It was found that they were almost all able to withstand exposure of fifty-eight hours (or five days of continuous exposure) to the intense rays of a summer sun. This result contrasts greatly with the power of resistance exhibited by bacterial spores, which the author has previously shown (*Amer. Journ. Publ. Health*, iv, 11, p. 969, 1914) do not usually withstand more than five hours' exposure. This fact undoubtedly helps to explain the preponderance of viable mould spores in the atmosphere, as compared with bacterial spores.

As a partial explanation of this resistance the author suggests that the pigment in coloured spores exerts a protecting influence, though *Oidium lactis*, which has colourless spores, is equally resistant and forms an apparent exception. The relative lightness of mould, as compared with other, spores points to their having been more successful in eliminating water from their protoplasm, and this may possibly have a share in enabling them to resist adverse agents.

RAINES (M. A.). **Vegetative vigour of the host as a factor influencing susceptibility and resistance to certain rust diseases of the higher plants.**—*Amer. Journ. of Bot.*, ix, 5, pp. 183–203, 6, pp. 215–238, 2 pl., 1922.

An extensive review of the literature is presented as indicating that, contrary to the general theory that vigorous organisms are less liable to disease, in the case of the rusts factors which tend towards greater host vigour also increase the vigour of the rust attack on these hosts.

In order to test any possible influence of the seed upon the attack of rust on the progeny, twenty-five plots of wheat, eight of barley, and one each of oats and rye were planted, in an isolated area, with seed from various sources, ages, and conditions. Natural rust infection appeared simultaneously on all the plots of wheat on the same day, and likewise on all the plots of barley simultaneously.

Plots of wheat, rye, oats, and barley were sown on June 10, June 23, July 6, July 20, August 5, and August 25, and observations were made during the growing season as to the amount of rust on plants of different ages. In the case of wheat, rust [species not mentioned] invariably appeared when the plants were putting out their third leaf, then increased steadily until the leaves bore the maximum amount, after which the leaf sheaths became affected, and a few pustules developed on the stem. Thus on any date there was in general a greater amount of rust on the older than on the younger plants. The rust on rye followed much the same course as that on wheat. The oats differed in that no rust appeared on any plot until August 12, when four plots were up. It then appeared in about the same abundance on the four plots, and in its subsequent development, the older the plant, the greater the abundance of rust on it, and the larger the proportion in the teleuto stage. Little rust appeared on the barley.

Puccinia coronifera Kleb., *P. secalina* Grove, *P. triticina* Eriks., and *P. sorghi* Schw. were grown under aseptic conditions on seedlings in test-tubes. Seeds were treated with chlorine water, then allowed to germinate in Petri dishes, then transferred to plugged tubes containing a little water. The reserve food of the endosperm allowed the plants to reach the third leaf stage, and to produce a generation of rust. The inoculations were made with a small sterile platinum spatula. The four rusts mentioned were thus grown aseptically for 10, 6, 8, and 8 generations respectively, and that they remained free from external contamination was demonstrated by the fact that no bacterial or fungous growth took place when a rust-infected seedling was deposited on sterile agar.

In fifty-eight inoculations with one uredospore of *P. sorghi* upon *Zea mays*, infections were obtained twice. It was found necessary, however, to inoculate with more than one hundred spores in order to be certain that infection would result.

Variation was found, under similar greenhouse conditions, in the amount of teleutospore production by *P. coronifera* from different sources. From cultures showing variation in the amount of teleuto stage produced, selections were made from cultures producing teleutospores abundantly, and from other cultures of the rust showing few or no teleutospores. It was found that this tendency of spore production continued in succeeding generations, and that the factor of fungous constitution must be given consideration in work on the conditions of teleutospore production.

A susceptible sugar corn (maize) was used for tests in water cultures, and the plants produced under different conditions of nutrition were inoculated with *P. sorghi*. An increase in the incubation period of the rust occurred with the depression in vigour and rate of growth of the host, and the pustules produced were smaller and produced decidedly fewer spores. The incubation period was shorter on the younger than on the older leaves of the same plant. Abundant rust infection was produced on chlorotic leaves of the corn grown in an iron-free nutrient. Chlorophyll is, therefore, not necessary for rust development.

A considerable series of soil culture experiments was carried through, using oat plants and *P. coronifera*. Here again, in general, the more vigorous host tissue supported a more luxuriant parasitic mycelium. Under a given soil treatment, however, the largest plants were found to have the least infection per unit area of most severely infected leaf, indicating that the selection of rapidly growing and early maturing varieties may mean not only the escape of the plants from rust, but a less severe attack. The writer concludes from his nutrition studies and from a review of the literature that it is questionable whether there is any direct relation between any environmental factor either physical or chemical, of the nature of a nutrient or stimulus, and susceptibility to rusts of the cereals.

A discussion is presented calling attention to the fact that there are various host-parasite relations; these relations may be those of symbiosis, of commensalism, or of more or less destructive parasitism. In the case of the rusts and various other parasitic fungi, the relation to the host is at first predominantly one of symbiosis, and only later does it reach one of destruction.

STEPHENS (D. E.) & WOOLMAN (H. M.). **The Wheat bunt problem in Oregon.**—*Oregon Agric. Coll. Exper. Stat. Bull.* 188, 42 pp., 5 figs., 1922.

Both *Tilletia tritici* and *T. levis* cause bunt of wheat in western Oregon, and are of approximately equal virulence. In the rest of the State *T. tritici* alone occurs. In Oregon wind-borne spores are the chief cause of infection.

Experiments in seed treatment have been carried out during a period of ten years. They show that solutions of formaldehyde and copper sulphate sufficiently strong to kill the spores may destroy or retard germination or give weakly plants unless the seed is rinsed in clear water after treatment with formaldehyde or in lime water after copper sulphate.

Formaldehyde solutions of 1 pint of commercial formalin to 45 gallons of water, and copper sulphate solutions of 1 lb. to 10 gallons of water were equally effective in controlling bunt. Seed treated with formaldehyde should be sown while the seed is still damp and only in moist soil, the copper sulphate treatment being preferable if the seed is to be stored or sown in dry soil. An important factor which causes reduced germination in treatment with fungicides, especially copper sulphate, is the injury sustained by the seed-coat in threshing. Grain threshed by hand under moist conditions is less liable to injury than that threshed in dry weather and by machinery.

Experiments are in progress to ascertain whether dusting with dry copper carbonate, which has successfully controlled bunt in

Australia and California without injury to the seed, is equally effective in Oregon.

Nearly twenty varieties of wheat, out of hundreds tested, were found to be so highly resistant to bunt that they may safely be sown without treatment. The following varieties combine resistance to bunt with a high yield: Turkey C. I. 1558 A; Turkey C. I. 1558 B: Crimean C. I. 2903–5; Turkey C. I. 3055; Crimean C. I. 4430: Turkey C. I. 1571 C: White Odessa C. I. 4655; Martin Amber C. I. 4463; Red Hussar C. I. 4843; and Turkey × Florence.

HOPKINS (E. F.). **Hydrogen-ion concentration in its relation to Wheat scab.**—*Amer. Journ. of Bot.*, ix, 4, pp. 159–179, 18 figs., 1922.

A study was made of the growth of *Gibberella saubinetii* in media at different hydrogen-ion concentrations, and of the growth of wheat seedlings and the production of seedling infection in soils at various hydrogen-ion concentrations.

The fungus will grow in culture at a wide range of P_H concentration, but a minimum was found to occur at P_H 5·5 to 6·0, the curve rising both on the acid and alkaline sides of this point. For the soil tests a soil having an original reaction of P_H 5·9 was used, and $N/1$ H_2SO_4 and $N/1$ NaOH were added to give ranges from P_H 3·4 to P_H 9·0. The seed of Fultz wheat was inoculated with spores of *G. saubinettii* from a single spore culture, and planted in the different soils in flats, and the surface of the soil was then sprayed with spore suspensions of the fungus. Here also there was apparently a P_H effect upon the fungus, for a minimum infection occurred in two series of tests at P_H 5·5. There is also apparently an acidity effect upon the germination of the seeds, resulting in a lessened germination at about P_H 5·5. The phenomena of infection doubtless depend on the reactions of both the fungus and the host to the hydrogen-ion concentrations. In highly acid and highly alkaline soils seedling infection was great; at and near P_H 9·0 all the seedlings were rotted before they reached the surface of the soil.

A soil reaction of P_H 5·5, at which the minimum in the infection curve occurs, is not an unusual one, and it would not be difficult to adjust the soil to this reaction.

HAMBLIN (C. O.). **Foot rot of Wheat caused by the fungus Helminthosporium.**—*Agric. Gaz. New South Wales*, xxxiii, 1, pp. 13–19, 5 figs., 1922.

A *Helminthosporium* which is not described, but is illustrated, was found to cause probably greater damage than *Ophiobolus graminis* in 1921 in New South Wales. The *Helminthosporium* attack is not necessarily in patches in the field, but may be scattered throughout the crop. Sometimes plants are attacked when nearly mature, or seedlings may be affected. The stooling is poor, the root system not properly developed, and the base of the plant is browned. In Take-all (*Ophiobolus*) the base is more blackened than browned, and the two diseases can usually be distinguished in the field. The yield of plants attacked by foot rot is reduced, and the grains are often shrivelled. Affected plants seemed also usually to be more susceptible to *Septoria*, *Erysiphe*, and rusts. The *Hel-*

minthosporium was found on wheat in Australia as early as 1913. All standard varieties are attacked, but late-sown, rapidly maturing wheats escaped heavy infection. It is not known whether the fungus may be seed-borne, but affected plants may produce clean seed.

A review of the literature regarding similar troubles elsewhere is given, and crop rotation, fallow, proper preparation of seed-bed, the use of good seed and of superphosphate, are recommended as control measures.

MOLZ (E.). **Ueber eine weitverbreitete Roggenerkrankung.** [On a widely distributed Rye disease.]—*Deutsche landwirtsch. Presse*, xlix, 41, p. 284, 1 fig., 1922.

During the first fortnight of May, 1922, a large number of specimens of rye plants from different parts of Saxony were submitted for examination to the Phytopathological Experiment Station at Halle. The accompanying reports stated that the damage started in relatively small areas, spreading later over a number of acres. The first symptoms of the disease were arrested growth, and a pale yellowish-grey anthocyanic discoloration of the leaves, accompanied by brown spots. Other pale spots, evidently due to frost, occurred on the leaves, the tissues being brittle at these points. Some of the leaves were curled, the heart-leaf frequently being twisted like a corkscrew. Finally the plants withered and died. Remarkable powers of resistance to this disease were displayed by the Petkus variety, while Himmel appeared very susceptible.

Insect and fungous parasites were absent, but soil samples from the affected localities were found to be strongly acid, the lime content being so small (0·035 – 0·05 per cent. CaO) as to be absolutely inadequate for the requirements of the plants. The disease is directly traceable to this deficiency of lime in the soil, owing to which the oxalic acid formed in the course of the metabolic processes of the plant could not be neutralized, and far-reaching disorganization, and finally death of the cells resulted. It was ascertained that the soils in question had for many years past been fertilized exclusively with green manures, sulphate of ammonia, and potassium, all of which increased the acid content out of all proportion to the scanty supply of lime present in the subsoil in these cases. The appearance of the symptoms in the late spring was doubtless due to the fact that the requirements of the seedlings in their early stages are largely covered by the reserves contained in the grain. It was only when the vigorous spring growth made further demands on the soil supplies that the deficiency of the latter became apparent.

Experiments in treating some of the dying plants with a lime solution having proved successful, it is believed that the immediate top dressing of the diseased rye fields with 2 or 3 cwt. of slaked quicklime per acre will effect the necessary control. In the autumn the fields should again be treated with carbonate of lime at the rate of 35 cwt. per acre. If the top dressing in the spring has been omitted for any reason, a mixture of 3 cwt. of caustic lime and 25 cwt. of ground uncalcined carbonate of lime per acre should be strewn over the fields, and ploughed in during the autumn. In soils such as those under discussion, nitrogen should never be given in the form of sulphate of ammonia, but in that of Chile saltpetre or calcium cyanamide.

VEVE (R. A.). **The efficiency of the 'roguing' method for the eradication of the mottling disease.**—*Louisiana Planter*, lxix, 2, p. 30, 1922.

Since October 1917, when the first cases of mottling [mosaic] in sugar-cane were observed in Porto Rico, the Fajardo Sugar Company has been conducting experiments to ascertain the seat of the disease and to devise measures for its control. For one year all chemical compounds directly or indirectly affecting the vitality of the cane were tried: sulphate of ammonia, sodium nitrate, sodium chloride, calcium carbonate, potash, ashes, filterpress cake, ferric sulphate, magnesium nitrate, &c., all gave negative results. It was found that neither the soil nor manures, organic or inorganic, affected the development of the disease. Disinfection of the setts failed to check it when setts were taken from affected plants. All the Porto Rican varieties, of which there are over sixty, were found to be susceptible.

The adoption of 'roguing' (i. e. digging out all the diseased stools immediately they are found) in the Company's plantations immediately led to a great reduction in the incidence of disease. The decrease may be estimated as follows:—1918–1919, 0·5000 per cent. infection; 1919–1920, 0·1190 per cent.; 1920–1921, 0·0079 per cent.; and 1921–1922, 0·0020 per cent. It is concluded that roguing may safely be recommended in plantations where the infection does not exceed 15 per cent.

BRUNER (S. C.). **Sobre la transmisión de la enfermedad del 'mosaico' ó 'rayas amarillas' en la caña de azúcar.** [Notes on the transmission of 'mosaic' or 'yellow stripe' disease of Sugar-cane.]—*Rev. Agric. Com. y Trab.* [Cuba], v, 1, pp. 11–22, 5 figs., 1922.

This is the last of a series of articles by the author dealing with mosaic or yellow stripe disease of sugar-cane in Cuba. In the present section, after an account of the experiments of other workers to determine the mode of transmission of the disease, he describes those carried out by himself in Cuba. He was able to bring about infection of healthy plants in a low percentage of his trials by means of the aphid employed by Brandes in his trials (*Aphis maydis*), but states that as this insect does not normally attack sugar-cane under field conditions it cannot be taken seriously into account as an active agent in the spread of the disease. Of other insects regarded as possible carriers (*Kolla herbida* (*Tettigonia similis*); *Tettigonia* sp.; *Draeculacephala mollipes*; *D. reticulata*; *Myndus crudus*; *Stenocranus* (*Delfax*) *saccharivorus*; *Phaciocephalus* sp.; *Oliarus* sp.; *Monecphora bicincta*; *Pseudococcus calceolariae*; *P. sacchari*; *Sipha maydis*; *Thrips*; *Tarsonemus spinipes*; *Paratetranychus viridis*; *Euscelis bicolor*; *Liburnia* sp.; and *Aphis setariae*), only *Phaciocephalus* sp. is regarded as worthy of further investigation as it is suspected to be an active carrier of infection. The others are either proved non-carriers or else their activity as transmitters is thought to be negligible.

The author's inoculations with juice from diseased sugar-cane confirm the existence of this method of infection, but the remarkably low percentage of successes obtained shows that there are factors connected with the transmission of the disease which still await elucidation. In needle inoculations eight out of one hundred succeeded when the needle was rapidly inserted into the midrib of the leaf after passing through a living affected leaf. Inoculations of the growing point with the expressed juice of the top of the cane taken into a hypodermic syringe without exposure to air mostly failed, but two out of thirteen succeeded in one series and three out of ten in another. When no precautions were taken to exclude contact with air three out of fifteen succeeded in another series, which was exactly the same number of successes as in a set of fifteen inoculated simultaneously without exposing the juice to the air. Provided the inoculations are made rapidly there seems to be no advantage in excluding air. Several experiments were tried with juice that had been passed through a Chamberland-Pasteur filter, with negative results, but whether the failures were due to the exclusion of the infection agent, or simply to the oxidation of the liquid consequent upon the lengthy process of filtration, is not known.

FARNETI (R.). **Sopra il 'brusone' del Riso.** [On the 'blast' of Rice.]—*Att. Ist. Botan. dell' Univ. di Pavia,* Ser. II, xviii, pp. 109–115, 10 pl., 1921.

Prof. Montemartini, in publishing the following posthumous note of Farneti's, disclaims any desire to decide between the opposing views of the different authorities cited. As early as 1871 Garovaglio attributed rice blast to an ascomycete *Pleospora oryzae*; some years later, however, Cattaneo, who originally also held this view, discovered that a number of other fungi were present on affected plants, none of which could be regarded as the primary cause of the disease.

Briosi and Cavara found in 1892 that the fungus *Piricularia oryzae* was the most widely distributed parasite in the affected rice-fields, but were unable to trace any direct connexion between it and the disease. A special commission, nominated by the Ministry of Agriculture to inquire into the matter, also failed to secure conclusive proof that *Piricularia oryzae* was the immediate cause of blast. Exhaustive researches by this Commission into climatic and cultural conditions provided no clue to the origin of the disease. Voglino isolated bacteria from the roots of diseased plants and maintained, in papers published in 1897 and 1903, that blast was due to a bacterial rot of the roots. In 1902 Ferraris demonstrated by a series of accurate observations that the mycelium of *Piricularia oryzae* was distinctly parasitic in character, attacking the rice plants near the basal node of the ear and producing the typical symptoms of blast. The Japanese authorities, Miyabe, Hori, and Kawakami, studying diseases of the same general type as blast, attributed them in part to *Piricularia oryzae,* and in part to the *Helminthosporium oryzae* of the first two authors. But both they and Ferraris based their views on direct observation only and did not furnish experimental proof of the cause of the disease.

Subsequent workers in Japan and America have maintained that blast is caused by *Piricularia*, and Metcalf successfully induced the American form of the disease by artificial inoculations with this fungus. On the other hand, Brizi in a series of papers from 1905–1908 ascribed the disease to physiological disturbances induced by the effect on the root system of defective drainage and want of aeration, and this view was supported by Sorauer and others. Farneti took up the inquiry into the cause of brusone in 1904. After ascertaining that the Japanese and Italian diseases were identical, and that the various names for the disease referred merely to different aspects resulting from the more or less advanced stage of the diseased condition, he maintained that the various fungi associated with it were in great part only different forms of the one highly polymorphic species, which included *Piricularia oryzae*, *P. grisea*, *Helminthosporium oryzae*, *H. macrocarpum*, *H. sigmoideum*, *Cladosporium* sp., and *Hormodendron* sp. Farneti affirmed that rice blast is constantly associated with the fungus in question, and succeeded in reproducing all the typical symptoms of the disease by inoculations both from pure cultures and with spores taken directly from the plant. He has left a number of plates, &c., illustrating the behaviour of the parasite under different conditions, but these do not indicate his long and patient studies on the resistance of varieties, the characters of the attack on different parts of the plant and at different stages of its development, and the methods to be employed for the control of the disease.

The year 1909 brought the researches on rice blast in Italy to a close, since the disease, presumably owing to the introduction of resistant foreign varieties, ceased about that time to cause any anxiety. It is, however, characteristic of brusone that alternating periods of virulence and mildness occur, the disease temporarily disappearing as a result of new cultural methods or the introduction of improved strains, only to return with renewed severity. It is not impossible that renewed outbreaks may again revive the interest which it excited in the past.

The article is illustrated with excellent reproductions, some in colour, of Farneti's original plates.

KULKARNI (G. S.). **Smut (Ustilago paradoxa Syd. & Butl.) on Sawn (Panicum frumentaceum Roxb.)**—*Journ. of Indian Bot.*, iii, 1, pp. 10–11, 1922.

The author reports the occurrence of this smut on *Panicum frumentaceum* in Sind, and states that it has been previously recorded only from Pusa. The smut is stated to agree in every respect with the published description, except that germination is not exclusively by long, branched, septate hyphae. While this is the type obtained by sowing the spores in water, sowing in a nutrient solution (tomato broth) leads to the production of a true promycelium with sporidia which bud freely and produce secondary sporidia abundantly.

No treatment has previously been known, since the life-history of the smut had not been worked out. Experiments were carried out to test the effect of seed treatment with 2 per cent. copper sulphate solution in which the seed grain, previously dusted with smut spores, was steeped for ten minutes. The treated seed gave a crop quite free from smut, while in the plots from seed similarly dusted with spores, but not steeped in copper sulphate solution, about 90 per cent. of the plants were smutted. Hence the author concludes that infection occurs in the seedling stage from spores adhering to the grain coats, and can be readily prevented by a copper sulphate steep.

Ulbrich (E.). **Kulturkrankheiten der Kakteen.** [Diseases of Cacti in cultivation.]—*Monatsschr. für Kakteenkunde*, xxxi, 8, pp. 113–121, 1921.

Excessive humidity of the atmosphere is very harmful to cacti and is the main factor in the causation of two serious diseases: cork disease and glassiness. Cork disease consists in the occurrence of irregular spots, with a corky and rusty appearance, on the stems, or of depressions and even perforations in the shoots. *Cereaceae*, *Mamillariaceae* and *Phyllocactaceae*, especially the last, are liable to the disease. In severe cases the shoots may be covered with spots, the tip only remaining green. The first symptom is a faint yellowish-green to rusty discoloration of certain spots, which frequently appear somewhat translucent. The disease is generally most severe in the *Opuntiae*, *Phyllocacti*, and *Epiphylla*, in which it frequently causes the destruction of the shoots, but even in milder cases the flowering capacity of the plants may be greatly reduced. A mild attack of the disease is characterized by the formation of cork in the cortex or deeper cells of the epidermis (which consists of several layers of cells), which leads to the development of small wart-like excrescences. The epidermal cells outside the cork tissue gradually dry up and are ruptured by pressure from the developing cells below. The torn remains of the epidermis form a rough, cracked surface over the cork. In very mild attacks the epidermis does not tear but extends evenly over the cork tissue, the excrescences and callosities retaining a smooth, greyish-white surface. The disease is due to excessive humidity of the air and is increased by over-shading. It is found usually in plant houses in which other leafy plants are growing, but the author has observed it on shady balconies in damp weather. Dry air and free exposure to light are the best preventives.

Glassiness not only disfigures the plants but may even destroy them. On the softer *Cereaceae* and on *Phyllocactus*, *Opuntia*, and *Epiphyllum* dark green translucent spots appear. A slight pressure crushes the epidermis at the diseased points, and the soft tissue beneath turns black almost immediately. The latter process occurs gradually in any case, so that the diseased parts present a greenish-black to inky appearance. In severe cases the shoot may die above the affected part, but in milder attacks a wound cork is formed which separates the diseased from the healthy tissue. The diseased tissues shrivel up, the epidermis is torn, and the healed wound leaves discoloured depressions behind. The disease is frequently complicated by the occurrence of bacteria in the affected tissue, which then falls to pieces.

An examination of the diseased tissue shows that the abnormally elongated cells are full of glucose and poor in starch, the latter being entirely absent from the most severely affected parts, while the healthy cells contain an abundance of starch grains. The diseased tissues are very rich in crystals of calcium oxalate, occurring mostly as short octahedra, whereas in the healthy cells needle crystals (raphides) are chiefly found. The disease attacks cacti growing in very damp and warm greenhouses with other tropical leafy plants. The cacti recover when subjected to good ventilation and the removal of other plants. Excessive atmospheric humidity must therefore be regarded as the primary cause of glassiness, and, like the other disease, it can be checked by dry air and good lighting.

Though most cacti are typical light-loving plants, some species of *Phyllocactus* and *Epiphyllum* are injured by over exposure to the rays of the sun, the shoots turning red and becoming stunted in growth. This has been observed when the plants stand too near the glass. Excessive cold (temperatures near the freezing point) may cause a somewhat similar but less strongly marked coloration in *Phyllocactus*. Few cacti will stand temperatures below 5° C.

WELLES (C. G.). **Cercospora leaf spot of Coffee.**—*Philipp. Journ. of Science*, xix, 6, pp. 741–744, 1 pl., 1921.

The leaf spot of coffee caused by *Cercospora coffeicola* Berk. & Cke, which is now reported for the first time from the Philippine Islands, is commonly known in other countries as 'brown eye spot', 'brown eyed disease', or 'berry spot'. The disease is widely distributed in such important coffee-growing regions as Mexico, Cuba, Trinidad, Porto Rico, Java, Uganda, and India. The organism found in the Philippines agrees accurately with the descriptions of *C. coffeicola* furnished by previous investigators.

At present the attack in the Philippine Islands is confined to the leaves and occurs only on nursery stock. Of the five species of coffee grown at the Los Baños Experiment Station *Coffea bukobensis* is the only one affected, *C. liberica, robusta, congensis,* and *canephora* being immune.

The lesions are found mostly on the upper surface of the leaves and are light brown when young, the centre portion later turning greyish, with concentric striations and encircled by brown rings. Later they penetrate through the leaf and distinct spots are produced on the under surface. Sometimes the spots coalesce, and in severe cases the leaves turn brown and fall off. The typical *Cercospora* conidiophores and conidia are produced in the greyish central portion of the lesions. The formation of secondary conidia reported by Butler (*Fungi and disease in plants,* p. 485, 1918) has not been observed.

Spraying experiments with Bordeaux mixture prove conclusively that the 'brown eye spot' may easily be controlled and probably eradicated. Fortnightly applications are recommended.

Informazione.—*Boll. mensile della R. Staz. di Patologia vegetale,* iii, 1–3, p. 34, 1922.

In *Italia agricola* of 15th January 1922 Ciferri gives a short description of a disease on Reinette apples in the Italian Marches, which he calls 'white pustule'. The surface of the ripe fruit is covered with numerous rounded pustular crusts, averaging 3 to 4 mm. in diameter, slightly raised, with a blackish margin and a delicate whitish powdery scurf in the middle. This efflorescence is formed by the fructifications of *Trichothecium candidum* Wallr., the mycelium of which penetrates into the flesh up to the core, and brings about a gradual mummification of the fruit. This fungus behaves as an occasional parasite, penetrating through cracks in the rind. The diseased fruits have a bitter taste and are of no commercial value. It is believed that this disease is closely related to the bitter rot of apples due to *Trichothecium roseum*, and that these two forms are but different strains of the same species.

STEVENS (N. E.). **Rots of early Strawberries in Florida and southern California.**—*Amer. Journ. of Bot.*, ix, 4, pp. 204–211, 4 figs., 1922.

The most common cause of decay of ripe strawberries in Florida is *Rhizopus nigricans*, but this fungus is of minor importance on winter strawberries in California. *Botrytis cinerea* is the commonest fungus on strawberries in California, but occurs only under conditions of extreme moisture in Florida. The author made a comparison of weather records of the two regions, and concludes that the difference is to be explained partly by the fact that there are more favourable moisture conditions during the winter season in California, but more especially because the temperatures during the day are lower in California from January to April than in Florida, and therefore favour *B. cinerea*, which is known to have a lower optimum temperature than *R. nigricans*.

BROOKS (C.) & COOLEY (J. S.). **Temperature relations of stone fruit fungi.**—*Journ. Agric. Res.*, xxii, 9, pp. 451–465, 24 figs., 1921.

Tests were made with the *Monilia* stage of *Sclerotinia cinerea* and with *Rhizopus nigricans*. Naturally infected sweet cherries were placed at temperatures of 0°, 5°, 10°, 15°, and 20° C. After ten days all the fruit at 15° and 20° showed rot, and nearly all that at 10°. Two-thirds of the cherries at 5° were rotted and one-third of those at 0°. Prunes were inoculated with *Monilia* and *Rhizopus* and kept at temperatures of 0°, 5°, 7·5°, 10°, and 15° C. After five days rot was well developed from both fungi on those kept at 10° and 15°.

A number of tests were made with peaches. *Monilia* was found to grow on peaches at lower temperatures than it would grow on potato-dextrose agar, while the reverse was true with *Rhizopus*. Both fungi grew at lower temperatures on ripe fruit than on green fruit. After *Monilia* had a start, a temperature of $2\frac{1}{2}$° held it in check for six days. A temperature of 10° held *Monilia* in check for only one or two days, and *Rhizopus* for three days. The rots develop three to five days later if held at the lower temperatures immediately after inoculation, indicating the value of good refrigeration from the time the fruit is picked. *Rhizopus* is more readily checked by lower temperatures than is *Monilia*; at $7\frac{1}{2}$° it is practically eliminated.

Brooks (C.) & Fisher (D. F.). **Transportation rots of stone fruits as influenced by orchard spraying.**—*Journ. Agric. Res.*, xxii, 9, pp. 467–477, 6 figs., 1921.

Fruit from sprayed trees develops during transportation or storage much less rot caused by *Sclerotinia cinerea* than occurs on fruit from unsprayed trees. In the case of sweet cherries, fruit from orchards in which there was less than one per cent. of rot on either sprayed or unsprayed fruit at picking time developed later 24·3 per cent. rot on the fruit from unsprayed trees and only 6·4 per cent. on that from sprayed trees. With Italian prunes the figures for rot during storage and transportation were 28 per cent. from unsprayed trees and 7·1 per cent. from sprayed or dusted trees.

Spraying or dusting the trees exerts little influence on the development of *Penicillium* and *Rhizopus* rot in transportation and storage. The occurrence of bruises and skin punctures are important factors in the development of rots caused by these two fungi.

Welles (C. G.). **Cercospora leaf spot of Averrhoa carambola.**—*Philipp. Journ. of Science*, xix, 6, pp. 747–750, 2 pl., 1921.

A very serious leaf spot, causing partial or total defoliation of *Averrhoa carambola* L., has been observed at the Los Baños Experiment Station. *A. carambola* is a native of tropical America, and is now widely distributed in all tropical countries, but apparently this is the first instance of leaf spotting recorded on it. The spots were first noticed during the last week of June 1921, at the beginning of the wet season. At this time the attack was very slight, but by July 15 the trees were already partly defoliated, 100 per cent. of the larger leaves showing from one to ten lesions each. When young the lesions appear as irregular, yellow, chlorotic spots with a maximum diameter of 3 to 5 mm. The chlorotic areas may coalesce, giving the leaf a mottled appearance. Old and young leaves are similarly affected. Later the central tissue of the lesion dies and turns greyish-brown, surrounded with a band of chlorotic tissue 1 to 2 mm. in width. At a certain stage of development both dead and chlorotic tissues fall out, resulting in a shot-hole condition. In severe cases the leaves turn yellow, and this is followed by defoliation. It would appear that such complete defoliation will lead to the death of affected trees if not checked. Black lesions form on many fruits but cause no noticeable damage. Their connexion with the *Cercospora* leaf spot is probable, but not definitely established. The kindred species *A. bilimbi* L., which is extensively grown locally, appears to be immune.

The disease is caused by a *Cercospora* which the author names *C. averrhoi* n. sp. The conidiophores emerge through the stomata and are light brown, erect, simple, 5- to 7- septate, and average 52 by 5 μ. The conidia are hyaline, short, straight, or slightly curved, tapering above to a blunt point, and measuring about 28 to 67 by 3 to 5 μ. They have 4 to 7 septa. Isolation was readily accomplished by planting the diseased tissue directly on corn meal medium, but the cultures were not maintained long enough to produce spores.

The results of fortnightly applications of Bordeaux mixture were very satisfactory, the number of new infections being reduced by 80 per cent., notwithstanding the frequent heavy rains. Complete eradication of the disease should be possible by these means.

SPEGAZZINI (C.). **Sobre algunas enfermedades y hongos que afectan las plantas de 'agrios' en el Paraguay.** [Notes on some diseases and fungi affecting sour fruit trees in Paraguay.]—*Anales Soc. Cient. Argentina*, xc, pp. 155 et seq. [pp. 1–36 of the reprint], 1 pl., 1921.

In Paraguay, citrus fruits were formerly one of the staple products, but in all localities recently visited by the author, signs of great neglect were apparent in the plantations, the lack of profitable markets for these fruits having led growers to concentrate on the cultivation of more remunerative crops. As a result of this neglect the different diseases affecting Paraguay citrus trees were studied under particularly favourable conditions. The main injury was found to be caused by fungi and the present paper gives a survey of the fungous flora (including the saprophytes) found on citrus in this area.

Gummosis is very common, and besides damaging Aurantiaceae, from the most suceptible *Citrus aurantium* through *C. limetta*, *C. medica*, *C. limonum*, and *C. deliciosa* in a diminishing order of susceptibility to *Citrus bigaradia* which is highly resistant to the disease, it also attacks such different plants as *Mangifera indica*, *Rheedia brasiliensis*, *Santalum album*, *Eugenia jambos*, &c. The author considers the disease to be exclusively due to infection by *Bacillus gummis*, but it is often found associated with a non-parasitic rot apparently caused by unsuitable soil conditions. The latter is most severe on the mandarin (*C. deliciosa*).

Leaf wart or red scab is found on *C. limonum*, *C. medica*, and *C. aurantium*, rarely on *C. limetta*, and may cause considerable damage. Though the disease is generally ascribed to *Cladosporium citri* Massee, the author suggests that this fungus may only be secondary to some microzoal parasite. It is distinct from the 'white rust' described by Briosi and Farneti, of which specimens were received from Chile for comparison.

Lepra explosiva [eruptive leprosy] is a hitherto undescribed disease affecting *C. aurantium* and possibly endemic in Paraguay, where it is widely distributed, especially in the northern region. It is considered serious although its spread is slow. There are three distinct phases of the disease. The first is characterized by the sudden appearance of isolated, discoidal or elliptical spots, 5 to 10 mm. in diameter, about half-way up to the vigorous, juicy, green shoots of the current year. The spots are surrounded by a sharply defined furrow about 0·5 mm. wide, and are cinnamon or fawn-coloured, and smooth except in the centre where a small, round, greyish, sunken pit occurs. A little later black granules appear in the encircling furrow and these rapidly become hemispherical, being 1 mm. in diameter and in height, and somewhat flattened at the top. They are corky-carbonaceous, hard, smooth, not shiny, and of the same colour throughout; their number increases until they form a complete belt around the spot, though without coalescing. They constitute one of the sporing stages of the fungus which causes the disease and are made the type of a new genus, *Pseudhaplosporella* (a Dothideaceous form of *Haplosporella*), the species being named *P. aurantiorum*. The vascular bundles of affected shoots are blackened, and the cortex changed to a reddish, somewhat powdery mass. Thin, colourless or greyish hyphae are found in the diseased tissues, especially below the centre of the spots, in union with the stromatic fructifications.

In the second phase of the disease the spots gradually increase in number, and twigs of the second year become attacked. Eventually the spots coalesce, losing their typical form, and the whole of the affected surface is covered with a tan-coloured substance, much wrinkled and furrowed, in which are numerous regular or irregular stromatic nodules varying in size between 0·5 to 2 mm. in breadth and 0·25 to 0·5 mm. in height. The leaves on these diseased twigs turn yellowish and tend to roll upwards at their margins, becoming detached and falling readily. The medulla of the affected twigs is more or less dried up but without change in colouring; the woody tissues are almost normal though tinted grey; while the phloem shows marked signs of a more or less profound alteration, the reddish tissues being swollen and friable, and containing thin bundles of dark mycelium. This stage of the disease is associated with a second pycnidial form of the fungus, named by the author *Paradiplodia aurantiorum* n. g., n. sp. This is a Dothideaceous form of *Diplodia*.

At the same time a third stage, *Ephelidium aurantium* n. g., n. sp., is sometimes found at the older points of attack, forming stromata of slightly larger size than those above mentioned. These stromata bear on the surface a number of small depressions lined with spore-bearing hyphae and fringed with a circle of stout setae with short, blunt, obtusely bifurcate branches or processes near the tip. The acervuli are 0·1 to 0·2 mm. in diameter and the conidia straight or curved, hyaline, 3- to 5-septate, and 40 to 50 μ by 4 to 5 μ.

The third phase of the disease may take either of two forms. One is the further extension of the spots, which may spread down to the primary branches and the upper portion of the trunk and thence ascend to the remaining branches of the crown, the three peculiar metagenetic stromatic forms of the fungus appearing with more or less frequency as the disease spreads. The other consists of a restricted number of isolated eruptive lesions of fairly large size on the principal branches and trunk of the tree, extension being usually downwards. In this form neoplastic nodules are formed endogenously, producing first a swelling of the cortex and then, under constantly increasing pressure from within, finally rupturing the bark and causing three or four radial rents which may be up to 5 cm. in length. The lesions gradually increase in size, some reaching a diameter of 20 cm. and a height of 5 cm., but they remain whitish, hard, and fresh in appearance, with no exudation or secretion from them. It is possible to follow this extension of the disease from the smaller branches affected during the second stage, by greyish linear markings in the inner bark, which run down to he older branches and converge at the points where the neoplastic growths originate. Only a few dark hyphae can be detected along the course of the markings in the inner bark and in the centre of the nodules.

Finally, crowns of diseased trees lose their leaves and from the collar of the root arise numerous, more or less vigorous suckers, only to dry up very shortly without apparent cause. During this last period the stromatic eruptions on the branches and twigs continue to increase. In the interior of some of the *Ephelidium* stromata very small globose cavities develop in which asci are formed. To this perfect stage of the fungus the name *Amylirosa aurantiorum* n. g., n. sp., of the Dothideaceae is given. The loculi occur either in a single series or in two superimposed rows, without ostioles. The asci are cylindrical, $80–100 \times 10–14\,\mu$, obtusely rounded at the apex, and contain 8 elliptical, fuliginous spores, with 1 to 5 septa and often a vertical septum in one or other of the central cells, 15 to 20 by 6 to 8 μ, slightly constricted at the septa. Paraphyses are present.

The author recommends that a survey should be undertaken to determine the amount of damage caused by this disease and meanwhile advises the removal and burning of affected trees, the cleaning up of the plantations, especially as fallen twigs may bear the fungus, and spraying with Bordeaux mixture.

The paper terminates with a systematic list, copiously annotated, of all the fungi found by the author growing on living or dead citrus trees in Paraguay, twenty-nine species being enumerated, of which thirteen are new. The microscopic characters of *Amylirosa aurantiorum* in all its stages are illustrated.

CIFERRI (R.). **Notae mycologicae et phytopathologicae. 8. Sulla biologia e la sistematica di una n. sp. del genere Dothiorella.** [Mycological and phytopathological notes. 8. On the biology and systematic position of a new species of the genus *Dothiorella*.]—*Ann. Mycol.*, xx, 1–2, pp. 40–41, 6 figs., 1922.

A parasitic fungus occurring on the rind of pomegranates at Alba (Piedmont) is described as a new species, *Dothiorella sanninii* Cif., and a Latin diagnosis is given.

Minute black pustules completely covered the epidermis of the affected fruit, almost obscuring its natural colour. Scabs were formed, composed of from two to six of these pustules. The fungus was isolated and grown in pure culture, and was readily inoculated into healthy fruit. On these, orange-coloured excrescences quickly emerged from a dark brown basal stroma, attaining a maximum size of 8–12 μ [?]. The excrescences, which gradually turn brown, are piled one on top of the other, the mass sometimes bending under its own weight or bifurcating. In many cases the fungus fails to develop further. In others pycnidia arise as superficial pear-shaped bodies in small clusters. The pycnospores are expelled from the ostiole in a yellow gelatinous globule, and are hyaline, bacillar, cylindrical, straight or slightly curved, continuous, and 4·5 to 5 by 0·8 to 1 μ in diameter. Their germination was not observed. The form of the basidia, which usually have three sterigmata at the apex, may ultimately form the basis for a separate subgenus of *Dothiorella*. Similarly branched or verticillate basidia are known in *D. tulasnei* Sacc., *D. stromatica* (Preuss.) Sacc., and other species.

In the *Coltivatore* of 30th December 1921 (no. 36) the author gives a brief description of the effects of this disease under the title of 'La rogna della melagrana' [pomegranate scab]. It attacks only the rind of the fruit, but damages it to such an extent as to render it unfit for sale. In order to avoid the spread of the disease, particularly in storage, he recommends the immediate removal of all infected fruits and states that storage in heaps should be avoided, each fruit being placed separately, as infection occurs readily through contact when there is any slight injury to the rind.

Van Overeem-de Haas (C. & D.). **Verzeichnis der in Niederländisch Ost-Indien bis dem Jahre 1920 gefundenen Myxomycetes, Fungi und Lichenes.** [Catalogue of myxomycetes, fungi, and lichens found in the Dutch East Indies up to the year 1920.]—*Bull. Jard. Bot. Buitenzorg*, iv, 1, pp. 1–146, 1922.

Accompanying this comprehensive catalogue of the myxomycetes, fungi, and lichens of the Dutch East Indies is a brief list of the Dutch and foreign workers who have collected them. Most of the collections have been worked out in Europe and America, the types being scattered in various herbaria and not fully represented at Buitenzorg. References are given under each species to the record of its collection and the island or islands in which it has been found. The myxomycetes are stated to be the best known group, the fungi being chiefly known only as far as the parasites and some of the more conspicuous groups are concerned. Nevertheless, the fungi listed number 2,232, apart from 97 myxomycetes and 503 lichens. Some records from outside Dutch territory (e.g. from Sarawak and English and German New Guinea) are included. The list terminates with a complete bibliography.

Davis (D. J.). **The identity of American and French Sporotrichosis.**—*Papers on Bacteriology and allied subjects, Univ. of Wisconsin Studies in Science*, 2, pp. 104–130, 1921.

A disease found all over the world and known as 'sporotrichosis' affects both animals—notably rats and horses—and man. In the United States it occurs chiefly in the Missouri Valley, the number of human cases observed so far approximating to one hundred, though this figure is in practice probably greatly exceeded as not all cases are reported. In America, Schenck, in 1898, was the first to isolate the causal organism, a Hyphomycete, from chronic subcutaneous abscesses in a human patient, and Hektoen and Perkins, who observed a second case in 1900, named the fungus *Sporothrix schenckii*. After a comparison of the cultures both they and Schenck agreed that the fungus was the same in both cases. In France the disease is relatively common, and there, as well as in most continental countries, it is referred to *Sporotrichum beurmanni*, isolated by de Beurmann and Gougerot in 1903, and named in 1905 by Matruchot and Raymond. The French workers first learnt of the American cases in 1906. The French and American forms have hitherto usually been regarded as distinct species, though some American writers on the subject occasionally refer to the American organism as *S. beurmanni* or *S. schenckii-beurmanni*, but the author gives strong reasons for holding that they are identical or at the most only strains of the same species. Several other species have since been recorded from different countries as human parasites, the chief being *S. dori*, *S. indicum*, *S. gougeroti*, *S. jeanselmii*, and *S. councilmani*, but they are rare, and some seem scarcely to differ from the commoner form. In 1906 de Beurmann and Gougerot examined a culture from the original American strain of Hektoen and Perkins, and pointed out certain differences which, they contended, justified its separation as a distinct species, but the disease, clinically, pathologically, experimentally, and therapeutically, is admittedly identical in both countries.

The author emphasizes the pleomorphic changes [which are described in detail] observed in cultures of the fungus from both French and American isolations, some of these changes being transient and others of a permanent nature, and suggests that the differences alleged by the French workers are fully covered by this tendency. The proposal by Greco, concurred in by Meyer, to compromise by using the term *S. schenckii-beurmanni* is deprecated, not only because it further complicates an already ponderous nomenclature, but also because it is contrary to scientific usage. Precedence is clearly in favour of the name *S. schenckii*. It is admitted even by French workers that the subsequent isolations made from American cases are identical with the French fungus. The author is personally convinced that these subsequent American isolations are all the same fungus as that described by Hektoen and Perkins. Even if it is maintained, however, that the small differences observed between the pleomorphic forms of the original Schenck-Hektoen strain and the other Sporotricha justify its maintenance as a distinct species, the important fact remains that the hundreds of isolations since made in France and in North America are all alike and that sporotrichosis as it commonly occurs, not only in these countries but in most others, is caused by a single species of *Sporotrichum*.

GONZALEZ FRAGOSO (R.). **Esferopsidales nuevos ó poco conocidos de la micoflora española.** [New or little-known Sphaeropsidales of the Spanish fungous flora.]—*Asociación Española para el Progreso de las Ciencias. Congreso de Oporto, VI. Ciencias Naturales*, pp. 35–57, 6 figs., 1921.

This is an annotated list of new or little-known Sphaeropsidales in Spain.

Phyllosticta rabiaei (Pass.) Trotter causes the anthracnose of the chick pea or gram (*Cicer arietinum*), a disease usually attributed to *Ascochyta pisi* Lib. Previous Spanish records have included this disease with the anthracnose of peas and other leguminous plants as all caused by the last-named fungus. While the fungus described by Trotter is usually responsible for the disease on *Cicer arietinum*, the author thinks it not impossible that *A. pisi* may occasionally attack this host.

Notes are given on a number of other species, many of which are new or not previously recorded in Spain.

GONZALEZ FRAGOSO (R.). **Algunos Demaciaceos de la Flora española.** [Some Dematieae of the Spanish flora.]—*Bol. R. Soc. Esp. de Hist. Nat.* xxi, 1, pp. 93–99, 1 fig., 1921.

A list of 42 species of Dematieae found in Spain and the Balearic Islands is given, *Helminthosporium smilacinum* on withered tendrils of *Smilax aspera* and *Cercospora latens* Ellis & Everh. forma *europea* on leaves of *Psoralea bituminosa* being described as new. The list includes *Cycloconium oleaginum* Cast. on leaves of *Olea europea*; *Fusicladium depressum* (B. & Br.) Sacc. var. *petroselini* Sacc. on leaves of *Petroselinum sativum*; *Cladosporium compactum* Sacc. on leaves of *Citrus aurantium*; *Cladosporium pisi* Cug. & Macch. on pods of *Phaseolus vulgaris*; *Polythrincium trifolii* Kze on leaves of *Trifolium procumbens* and *T. arvense*; *Clasterosporium carpophilum* (Lév.) Aderh. on leaves of *Amygdalus communis*; *Cercospora bolleana* (Thüm.) Speg. on leaves of *Ficus carica*; and *Heterosporium variabilis* Cke on leaves of *Spinacia oleracea*.

PETCH (T.). **Studies in entomogenous fungi.**—*Trans. Brit. Mycol. Soc.*, vii, 1–2, pp. 89–132, and 3, pp. 133–166, 3 pl. (2 coloured), 1921.

This paper deals with the Nectriae parasitic on scale insects found in collections made for the most part in Ceylon but including also species from India, Japan, Formosa, Australia, Florida, the West Indies, and South America. The specimens preserved in the herbaria of the Royal Botanic Gardens, Kew, and of the British Museum (Natural History) have also been examined.

The genera treated are *Nectria* (with conidial stages belonging to *Tubercularia* and *Pseudomicrocera* n. g.), *Lisea*, *Sphaerostilbe* (with conidial stage belonging to *Microcera*), *Calonectria* (with conidial stage belonging to *Discofusarium* n. g.), *Podonectria* n. g. (with conidial stage *Tetracrium*), *Broomella*, *Patouillardiella*, and *Fusarium*.

Three new genera are described: *Pseudomicrocera*, to contain the conidial stage of *Nectria diploa* B. & C., previously described as *Aschersonia henningsii* by Koorders and as *Microcera* by Miyabe and Sawada, Sydow, and Petch; *Discofusarium* for the conidial stage of *Calonectria coccidophaga* Petch n. sp., previously known as *Microcera tasmaniensis* McAlp, and *M. mytilaspis* McAlp; and *Podonectria* for certain species parasitic on scale insects previously referred to *Ophionectria* and other genera, but agreeing amongst themselves in having thick-walled asci, long multiseptate ascospores, and a *Tetracrium* conidial stage.

On p. 95 there is a list of all the species of Nectriae and their probable conidial stages that have hitherto been recorded on scale insects, but many of the twenty-nine species therein mentioned have now been reduced as a result of the author's studies, and he has added six new species, besides one new conidial stage of an existing species. Full historical and taxonomic notes, based in many cases on the examination of type specimens, are given, and the distribution of the species is recorded.

It is proposed to emend the genus *Corallomyces* so as to include only those species that are co-generic with the type, *C. elegans*, namely those having *Nectria* perithecia, with a stilboid conidial stage and continuous conidia: *Sphaerostilbe* being at the same time emended to contain species with *Nectria* perithecia, a conidial stage belonging to *Microcera*, and elongated, septate conidia. It is pointed out that the *Microcera* stages of different species of *Sphaerostilbe* cannot be distinguished from one another in the absence of the perithecial stage.

The coloured plates, painted by Alwis, are of great beauty. A bibliography is appended.

LE MOULT (L.). **Le Hanneton et son parasite.** [The Cockchafer and its parasite.]—*Comptes rendus Acad. d'Agric. de France*, viii, 21, pp. 596–601, 1922.

Thirty years ago the author was entrusted with the formation of syndicates for the destruction of the cockchafers and their larvae all over France. In the course of this mission, which incidentally resulted in a saving of 600,000,000 francs, he discovered a fungus, *Isaria densa* Giard (*Botrytis tenella* Sacc. according to Prillieux & Delacroix), causing a disease of cockchafers (more especially of their larvae) analogous to the muscardine of silkworms. The fungus was cultivated and employed against the insects for several years on a very extensive scale, with the result that the cockchafer pest was completely exterminated on all the farms and estates into which *I. densa* was introduced. Owing to the author's prolonged absence from France subsequent to these experiments, the whole question of cockchafer extermination was allowed to drop. In 1911, however, the fungus was found still present in a field at Gorron (Mayenne) which had belonged to the former syndicate, and innumerable mummified larvae were obtained on digging the potato crop with which it had been planted. As recently as last March and April the author received some fifty or sixty more of these mummies, and cultures were immediately made from their interiors.

In the experiments mentioned above, 5 kg. of the cultures were generally mixed with a hectolitre of sand or soil and spread over the ground immediately before tilling. Cultures of other parasites were also used, including *Isaria destructor*, *I. farinosa*, and *Sporotrichum globuliferum*, in the hope of destroying other soil larvae, e.g. *Anisoplia austriaca*, *Elater segetis*, and *Agrotis segetum*. The author indeed believes, though he cannot produce direct evidence in support of his belief, that the method is universally applicable to insect pests, such as *Cochylis*, *Phylloxera*, and the like.

In 1914 a bacillus was accidentally discovered apparently living in symbiosis with *Isaria densa* in the larva of the cockchafer. The two parasites develop together in culture, the bacillus penetrating the substratum while the fungus grows on the surface. These mixed cultures were used in Vaucluse against the cockchafer larvae and in Ardèche against the peach aphis. The insects were rapidly killed and their bodies turned black, instead of white as in the case of *Isaria densa* used alone. The bacillus has not yet been identified, but is believed to be a new and extremely virulent parasite which destroys the insects in less than twenty-four hours.

VEITCH (R.). **A fungous parasite of the Hornet.**—*Agric. Circular* [*Dept. of Agric., Fiji*], ii, 5, pp. 114–115, 1921.

In May 1921 the writer noticed in the sugar-cane fields in the Nausori district large numbers of hornets (*Polistes hebraeus* F.) attacked by a fungus which was later identified at the British Museum as *Isaria crinata* Felton, a fungus first recorded from the West Indies. The number of hornets found dying or dead, a large proportion of which were females, was ample enough to justify the recognition of the fungus as an effective check on the propagation of the pests; this view is supported by the observations of the residents in the district, who state that the hornet has greatly decreased in numbers of late years. Indications go further to show that the fungus is active throughout the year and not at one season only. So far it has not been found on hornets in the dry districts of Fiji.

ROSS (H.). **Weitere Beiträge zur Kenntnis der verpilzten Mückengallen.**—[Further contributions to the knowledge of fungus-infested fly-galls.]—*Zeitschr. für Pflanzenkr.*, xxxii, 1–2, pp. 83–93, 1922.

This paper forms a continuation of the author's earlier publication (*Ber. deutsch. botan. Gesellsch.*, xxxii, p. 574, 1914). It gives an account of the distribution, systematic position, and biology of the galls. The fly-galls are very widely distributed in Central Europe, and occur also in South America. Fungous infection of the galls is the rule in most of those due to Asphondylariae and *Lasioptera*. Forty-three cases in all, on some seventy different plants, have been reported, and a list of these is given.

The nature and extent of the mycelia in the fly-galls differ widely, and it is evident that various species of fungi (*Macrophoma* and other forms) are involved. The manner in which the fungus gains access to the galls is not fully known. Direct observations on oviposition have been made only in the case of *Mikiola fagi*, in which the eggs are laid in early spring on the outside of the leaf buds or on the shoot stems. The resulting larvae penetrate the interior of the buds and the leaf primordia, producing the familiar conical galls. Probably the process is similar in the other cases under consideration. The larva presumably comes into contact with the conidia of various fungi, which adhere to its moist body and are thus carried passively to the place at which the gall formation begins.

Normally the fungus lives in the gall as a harmless saprophyte without injuring the larva. In exceptional cases, however, the latter may be smothered by an excessive growth of the mycelium. As soon as the larva vacates the gall, or if it dies from any cause, the fungus may become parasitic on the cells of the gall tissues, which usually begin to decay under such circumstances.

Neger's view that there is a symbiosis between the insect and the fungus is controverted by the author. The fungus no doubt benefits by the abundant food supply resulting from the effects of stimulation by the larva of the plant tissues. But it confers no corresponding benefits on the larva, and the relations between the two may even become definitely hostile.

FULMEK (L.) & STIFT (A.). **Ueber im Jahre 1920 erschienene bemerkenswerte Mitteilungen auf dem Gebiete der tierischen und pflanzlichen Feinde der Kartoffelpflanze.** [Noteworthy contributions published during 1920 to the study of insect and vegetable pests of the Potato.]—*Centralblatt für Bakt.*, Abs. 2, Lief. 20–24, pp. 492–529, 1921.

A summary of the work on potato diseases, especially in Central Europe, during 1920, with bibliographical references. A section is devoted to leaf roll, mosaic, and other diseases, the origin of which is obscure. Wart disease and scab are treated at considerable length.

WILSON (M.). **Armillaria mellea as a Potato disease.**—*Trans. Royal Scottish Arbor. Soc.*, xxxv, pp. 186–187, 1921.

The honey Agaric, *Armillaria mellea*, well known as a disease of conifers and broad-leaved trees, has not hitherto been recorded as attacking potatoes in Great Britain, but only in Japan, Australia, and N. America. Specimens have, however, recently been submitted for examination from Rosebery, Midlothian. The dark brown rhizomorphs of the fungus are at once apparent on examination. As usual they present the form of rounded, brown strands, becoming slightly flattened on coming into contact with the tuber. Penetration generally occurs rapidly, and this is shown by a darker coloured, sunken patch on the skin, below which the cells are killed and partially disorganized. Sections through the tubers reveal either small patches of dead, brown cells, or large cavities, according to the depth of penetration of the rhizomorphs. In the latter case the cavities become partially filled up with masses of white mycelium and rhizomorphs. These cavities are surrounded by a dark brown zone of dead tuber-tissue, and this in its turn by a region where the hyphae can be seen penetrating the still living cells. A cork cambium is formed round the diseased portions, the infected cells being more or less isolated by a layer of cork. In severe cases the tubers shrivel and dry up in storage.

An examination of the garden in which the potatoes were grown revealed large numbers of rhizomorphs in the soil, but no fructifications. The source from which the rhizomorphs were developed was found to be an old sycamore stump, severely infected by *A. mellea*, and situated about four yards from the edge of the potato plot. The heavy wet soil of the garden may be a contributory factor in the development of the disease, which has occurred for several years and cannot, therefore, be due to seasonal peculiarities.

MANN (H. H.), NAGPURKAR (S. D.), KULKARNI (G. S.), KASARGODE (R. S.), PARANJPYE (S. R.), & JOSHI (B. M.). **Investigations on Potato cultivation in Western India.**—*Dept. of Agric., Bombay, Bull.* 102, 145 pp., 9 pl., 1921.

This bulletin is a discussion of the various phases of potato cultivation, including insect pests and diseases, in the Bombay Presidency, India.

Under the title 'The ring disease of potato' (pp. 38–57) Mann and Nagpurkar report that the ring or 'bangdi' disease is probably the worst potato disease. It is caused by *Bacillus solanacearum*. The disease is carried by the seed, and after having been grown a few years in India most of the tubers of a stock of potatoes will carry it. New stock is usually obtained from Italy, and is generally, but not always entirely, free from the bacteria. The organism appears to die in the soil within six months. The bacteria are very virulent and may be spread with the knife used for cutting tubers. The results of a number of experiments are given.

'Other diseases found in the seed' (pp. 57–75) are discussed by Nagpurkar and Kulkarni. Tuber rots caused by *Fusarium* spp. cause much loss in storage. Affected tubers were found to germinate more quickly than sound tubers, but the crop produced is more likely to show rot. The soil also carries the *Fusaria*, but appears to lose its infectiveness after eight months dry weather without crop. *Fusarium* wilt also occurs in the Deccan area, and the brown ring in the tubers has sometimes been confused with the bacterial ring disease mentioned above. *Rhizoctonia* also appears to cause some damage. *Spongospora subterranea* was found in the hilly districts, and a limited attack of nematodes in various places.

Under 'the storage of potatoes' (pp. 84–97) Mann and Nagpurkar report that 'black heart' or 'heat rot' is common in storage in India because of the high temperatures, and recommend sorting the tubers, storing them under conditions which allow air circulation, and the maintenance of as cool conditions as possible.

Mann and Joshi report 'A chemical study of "heat rot" or "black heart" of potato' (pp. 112–142). They find that at temperatures above 30° C., especially in the absence of aeration, there is a considerable increase in the ammoniacal nitrogen in the tubers and an increase in the amount of gummy matter and dextrin in the potato juice. In air the sugars increase at high temperatures, but this increase is slight when respiration is prevented. Acidity or alkalinity of the juice is not materially affected in cases of black heart. Lessened respiration occurs as black heart develops, and the amount of catalase is reduced in affected tubers.

GOSS (R. W.). **Temperature and humidity studies of some Fusaria rots of the Irish Potato.**—*Journ. Agric. Res.*, xxii, 2, pp. 65–80, 2 pl., 1921.

The author tested the ability of *Fusarium oxysporum* *F. trichothecioides*, and *F. radicicola* to rot potato tubers under different conditions of temperature and humidity. The three species make about the same growth in pure culture at 25° C., and this temperature is favourable for the production of tuber rot by each species. *F. oxysporum* and *F. radicicola* increase in growth rate in culture up to 30°, whereas *F. trichothecioides* decreases in rate of growth above 25° C., and also produces a tuber rot at lower temperature than the other two species, causing a rot in some cases at 5° C. At temperatures of 16° and above *F. oxysporum* produces more extensive rot than the other species used. Old tubers rot more readily than new tubers from the three *Fusaria*.

With all three species the greater the relative humidity the greater the rot at any temperature; in fact, the rotting was always greater under conditions of high humidity at a given temperature than at a temperature 5° to 10° higher but with a low humidity.

The use of dry as well as cool storage is therefore important in reducing the loss from *Fusarium* rots of potatoes.

PATCH (EDITH M.). **Rose bushes in relation to Potato culture.**—*Maine Agric. Exper. Sta., Orono, Bull.* 303, pp. 321–344, 1 fig., 1921.

The pink and green potato aphid (*Macrosiphum solanifolii*) is known to be one of the most important factors in the dissemination of potato mosaic and leaf roll, and in 1921 the author was sent to Aroostook Farm, Presque-Isle, in northern Maine, for the purpose of studying its probable field relation to the spread of these diseases. Among other facts she established that, under Maine conditions, the rose is the only existing primary host of the insect, i.e. the only plant species on which it deposits its overwintering eggs, and on which develops the spring generation of stem-mothers, as she never found the first two spring generations developing on any other host than rose bushes. Although native wild roses are of very rare occurrence in northern Maine, there are large numbers of uncultivated escapes especially in old house yards and in neighbouring hedgerows, where the hardy wild stocks on which the more tender cultivated varieties had been grafted have survived. In one particular case, about 2,000 such rose stems were observed in two old yards within easy reach of Aroostook Farm.

In relation to the bearing of the presence of rose bushes on the spread of mosaic, it was found in general that the nearer the rose, the heavier the infestation of the potato plants, and this was so marked in certain localities that the site of the rose bushes could be traced by following a line of increasing infestation of the potato fields. In a series of fields at graduated distances from rose bushes infested with the spring forms of the aphid, the migrants and their summer progeny were found to be colonizing potato fields that were within a few rods, earlier than fields a quarter of a mile distant, while fields half a mile away were so much later in becoming infested that the indication was that such fields would suffer very slightly in comparison with those nearer the roses; it follows, therefore, that even so short a distance as a quarter of a mile may sometimes be great enough to make all the difference between a heavy and a slight attack of aphids.

The writer's conclusion is that the evidence would seem to be that the rose 'is a pernicious weed with reference to potato culture', and that it should not be tolerated at distances under one mile from commercial seed potato fields. The situation in regard to table potatoes is not so serious, and the expense and trouble involved in destroying the roses might not always be justifiable. Valuable or ornamental bushes that it is desired to preserve should be treated so as to prevent their infestation by aphids, preferably by fumigation.

KASAI (MIKIO). **Observations and experiments on the leaf-roll disease of the Irish Potato in Japan.**—*Berichte d. Ohara-Inst. f. Landwirtsch. Forsch.*, ii, 1, pp. 47–77, 1922.

Leaf roll of potatoes, which had been recorded previously for

Japan in papers in Japanese, was found to be serious in the Okayama prefecture. The author gives a review of the literature, and records a number of preliminary experiments made. These tests indicated that the disease is not transmitted through the soil, but may be transmitted by tuber grafting, and evidently also by insects.

The following experiment is considered to demonstrate transmission of the disease by juice from diseased plants: Leaflets from a leaf-roll plant were macerated in a mortar with a little water, and the juice thus prepared was soaked up with bits of cotton and applied to knife wounds on petioles or stems of four plants. After a week two plants showed no symptoms of leaf roll, but on one plant inoculated at the middle height of the stem the leaves adjacent to the wound showed some discoloration and tendency to upward rolling in the tips of terminal leaflets, and in the other plant, inoculated on a petiole, decided discoloration and upward rolling appeared on the tip of the terminal leaflet of the leaf inoculated.

TICE (C.). **Seed Potato inspection and certification in British Columbia.**—*Scient. Agric.* [*Canada*], ii, 8, pp. 249–251, 1922.

Each province of Canada had a seed potato inspection service in 1921. The inspection and certification of potatoes in British Columbia was begun in 1921, and carried out by the Provincial Department of Agriculture. Two field and two tuber inspections were adopted, with the following standards: First field inspection (at about blossoming time). Only those fields are passed which show less than 5 per cent. mixture of varieties, 5 per cent. combined leaf roll, mosaic, and curly dwarf, 3 per cent. wilt, and 2 per cent. blackleg [*Bacillus atrosepticus*]. Roguing must be done through the summer by the grower, and at the second field inspection (in late summer) only 2 per cent. mixture and 2 per cent. combined leaf roll, mosaic, and curly dwarf are allowed. A field of potatoes lacking vigour is rejected, and notes are made in the field of the amount of late blight [*Phytophthora*], *Rhizoctonia*, and early blight [*Alternaria*] present.

The first tuber inspection is made before the crop is graded, with the objects of ascertaining whether the potatoes are sufficiently free from disease and true to type to warrant a certificate after grading, and of showing the grower how to grade. At this inspection the following are the limits of disease allowed: *Rhizoctonia*: 10 per cent. tubers with slight scurf, and 3 per cent. with severe scurf. Stem end discoloration: 3 per cent. Late blight or dry rots: 2 per cent. Powdery scab [*Spongospora*]: No severe, 1 per cent. slight. Common scab [*Actinomyces*]: No severe, 5 per cent. slight. Net necrosis: 5 per cent. Internal brown spot: 3 per cent. Silver scurf [*Spondylocladium*]: 5 per cent. Not more than 10 per cent. total infection by all the above tuber diseases is allowed.

The crop must then be graded; where only one grade is being put up, the tubers must not be smaller than 3 ounces nor larger than 12 ounces. A second grade of potatoes of 2 ounces or more is allowed for small seed stock. Crops passing all the above standards are then given tags bearing name and address of grower, variety and size of seed, and date of final inspection; one such tag is attached and sealed to each sack of potatoes by the inspector at shipping time.

The 1921 inspections showed that leaf roll and mosaic exist in British Columbia, but apparently in limited amounts. The valuable features of seed potato certification are pointed out.

DUCOMET (V.). **Oïdium de la Pomme de terre et Oïdium de la Betterave.** [*Oidium* of the Potato and *Oidium* of Beetroot.]—*Bull. Soc. de Path. Vég. de France*, viii, 4, pp. 153–154, 1921.

The author, in a paper in the same *Bulletin*, vii, pp. 57–58, 1920, drew attention to an undetermined *Oidium* of the potato, observed in the Department of Lot-et-Garonne in 1917. Shortly afterwards the fungus was reported from Grignon, but no practical importance was attached to the disease. In 1921, however, it appeared with greater severity and has also been reported in the neighbourhood of Pontivy (Brittany) and at Vitry-sur-Seine. The fungus, in the affected areas in the Department of Lot-et-Garonne and at Grignon, commenced to invade the crop after the rains at the beginning of August had given a fresh stimulus to vegetation. The variety l'Industrie, as well as the English sorts, the Factor and Majestic, have proved extremely susceptible. Saucisse, though grown in the vicinity of l'Industrie, at first showed comparatively slight infection, but was virulently attacked later on. On the other hand, certain varieties, such as l'Institut de Beauvais, have remained apparently immune. It was noticed that copper solutions used in the treatment of blight appeared also to have the effect of checking the *Oidium*. Although the latter produced perithecia in 1921, the author has so far been unable to find matured asci. Hence it is still impossible to determine the species, though it is surmised that it may prove to be *Erysiphe cichoracearum* or an allied form. It is perhaps the same as *E. solani*, mentioned, but not described, by Vanha in 1902.

A second undetermined species of *Oidium* has been found on isolated plants of sugar beet at Grignon, and also observed by the author at Mormant (Seine-et-Marne). The damage caused was insignificant in both cases. As to the species concerned it is possibly *Microsphaera betae* Vanha (1902). The conidiophore characters indicate that it cannot be *Erysiphe polygoni*, which has been reported on this host from the Caucasus.

SCHOEVERS (T. A. C.). **Ziekten en Beschadigingen van Tomaten.** [Diseases and injuries of Tomatoes.]—*Tijdschr. over Plantenziekten*, xxviii, 5 and 6, pp. 67–93, 4 pl., 1922.

The observations of the writer and other officials of the Dutch Phytopathological Service, together with information collected from Dutch and foreign technical literature, are here presented in the form of a complete record of the tomato diseases known to occur in Holland. The fungous diseases described and illustrated are wilt (*Verticillium albo-atrum*), *Rhizoctonia* disease, canker (*Diplodina lycopersici* = *Didymella lycopersici*), *Sclerotium* disease (*Sclerotinia libertiana*), stripe (*Bacillus lathyri*), leaf mould and rust

(*Cladosporium fulvum*), potato blight (*Phytophthora infestans*), and nose rot (*Phytobacter lycopersicum*).

For *Verticillium* wilt there is a natural remedy in high temperatures (over 77° F.) to which the fungus is very susceptible. The glass should be lightly plastered and watered to prevent excessive evaporation, and the plants well banked up on the first symptoms of wilt. To prevent the reappearance of the disease in the following year, the remains of the infected plants, with the surrounding soil, must be carefully removed. The fungus can live on decaying organic refuse or on the remains of plants themselves, and overwinter there. Thus the soil easily becomes infected. In severe cases of soil infection the only radical cure is a renewal of the soil, care being taken not to procure the latter from potato fields, which are also likely to be infected. Steam treatment is efficacious for the disinfection of the soil, but not generally practicable in Holland. The use of cresol has not given satisfactory results in the destruction of soil fungi. A solution successfully applied to the soil in England consists of 5½ parts of ammonium carbonate and 1 part of copper sulphate, using 3 gm. of the mixture per litre of water. During the winter the soil may be saturated with a 2·5 per cent. solution of formalin, using 20 litres of water per square metre. This should be done ten days or more before planting. In England the variety 'Manx Marvel' is stated to be resistant to wilt, but it does not appear to be cultivated in Holland.

The measures recommended for the control of *Verticillium* are equally applicable to *Rhizoctonia*. It is not known, however, whether it is affected by high or low temperature.

The spread of canker may be prevented by burying or burning the remains of diseased plants, on which the spores of the fungus develop in the spring. Spores may also adhere to the framework and glass of the greenhouses, and are possibly also present in the soil. As a remedial measure spraying with Bordeaux mixture is recommended. The plants and the atmosphere should be maintained as dry as possible in order to prevent germination of the spores.

Sclerotium disease is incurable when once the plant is actually attacked, but may be prevented from occurring the following year if the infected plants are burnt before the sclerotia fall to the ground.

Stripe disease is transmissible by the seed, and may be prevented by seed disinfection. The bacillus may also remain in the soil, which should be sterilized by means of steam. The disease is best controlled by such cultural methods as retarding growth and keeping the houses cool. Plentiful fertilization with potassium is also recommended, but an excess of nitrogenous manure favours the disease. Diseased plants should be removed, together with the surrounding soil. If only the upper part is infected, this may be cut away and the suckers allowed to develop. The variety Ailsa Craig appears to be resistant to stripe disease. The more rapid and luxuriant the growth of a variety the greater its susceptibility to *B. lathyri*.

Leaf mould may also be prevented by keeping the plants cool, and spraying the woodwork, glass, &c. in winter with a 10 per cent.

Carbolineum solution. Spraying with Californian (lime-sulphur) mixture in preference to Bordeaux is recommended as a remedial measure. In sunny weather the mixture is diluted with 60 parts of water, and when overcast with 40 parts. Whenever possible the treatment should be carried out during fine weather on account of the greater efficacy of the sulphur under such conditions. As a rule the disease appears towards the middle of July, and it is advisable to apply a preliminary spray about the first of the month and another a fortnight later.

Potato disease (*Phytophthora infestans*) can be prevented from attacking tomatoes by spraying with Bordeaux mixture. The amount of copper sulphate and also of lime should on no account exceed 0·75 to 1 per cent. Outdoor tomatoes are generally more liable to the disease than those under glass. The latter should be kept as dry as possible.

Nose rot (*Phytobacter lycopersicum*) attacks principally the tomatoes hanging lowest on the plant, the bacteria being present in the soil. They are spattered on to the fruits with particles of earth, and penetrate the skin through any crevice or wound, causing the formation of brown spots. The wounds may be so minute that they are only visible under a microscope. It is not certain whether infection can also occur through the style or the intact skin. The diseased fruits should be burnt or buried, and not simply left on the ground to form centres of infection. The soil should be thoroughly turned up, so that the upper infected layer comes well underneath. Sterilization by steam is also advisable.

In the concluding section, devoted to general sanitary measures, the use of river sand for seed-beds is recommended. Directions are also given for the disinfection of the soil, pots, and the like.

In addition to the diseases caused by fungi, notes are given on mosaic disease, on the chief insect pests, and also on such abnormalities as fasciation and leaf curl. Mosaic disease is less injurious to tomatoes than to tobacco and potatoes. Mosaic plants should not be used for seed, since a predisposition to the disease may be hereditary. The intensity of the disease may sometimes be reduced by whitewashing the glass of the houses.

Ciferri (R.). **Una nuova malattia del Pomidoro: la carie.** [A new Tomato disease: caries.]—*Riv. di Patol. veg.*, xi, 5–6, pp. 65–69, 1921.

This is a preliminary account of a new tomato disease observed towards the end of June, 1921, in the environs of Alba, on an immature tomato fruit. The fruit was flaccid, soft, slightly discoloured, the skin being healthy except at one point where a brownish depression occurred. The pulp in the interior of the fruit was found to be rotted and almost black, the rotted area being divided from the exterior parenchyma, which had remained healthy and adhered to the skin, by a more or less well-defined, reddish zone. The rotted tissue bore numerous black pycnidia of a *Phoma* measuring about 0·2 mm. in diameter, and containing an abundance of elliptical or roundish, hyaline, continuous, apparently non-guttulate, small stylospores, 2·5 by 1·5 μ.

Inoculation experiments proved the pathogenicity of the fungus.

How infection occurs in nature is not yet known, but the subsequent invasion is very rapid, and under the most favourable conditions the whole of the pulp is rotted in five or six days, the fruit losing its form and becoming a putrid mass. The skin, however, remains unaltered, and generally also a small part of the adhering parenchyma which seems to be very resistant to the disease.

It is noteworthy that when the disease is not too far advanced, the maturation of affected green fruit is not only not interfered with but—at least in laboratory experiments *in vitro*—accelerated.

Alterations in fruit by a species of *Phoma* are rare compared with those produced in stems and leaves. The present fungus has some resemblance to *Phoma oleracea* Sacc., *Phyllosticta lycopersici* Peck, *Phoma eupyrena* Sacc., and *Phoma crocophila* (Mont.) Sacc. (*Perisporium crocophilum* Mont.), but the differences are regarded as sufficient to distinguish it as a new species which is named *Phoma ferrarisii*, a preliminary Latin diagnosis being given.

This tomato rot is somewhat rare, very few examples having been found in a garden where apical rot of tomato, due to *Bacterium briosii* Pav., was comparatively frequent, and where a drying up of the leaves, probably of physiological origin, was also present.

A species of *Ramularia* is generally associated with, and may be a stage of, *P. ferrarisii.*

DENAIFFE. **Mildiou des épinards.** [Mildew of spinach.]—*Journ. Soc. Nat. Hort. de France,* xxiii, pp. 38–39, 1922.

In October 1921 spinach at Carignan (Ardennes) was severely attacked by *Peronospora effusa.* The disease developed with astonishing rapidity, most of the outer leaves being partially discoloured after a few days, while isolated spots appeared on the heart-leaves. A powdery coating of lilac-grey colour was apparent on careful inspection on the under surface of the leaves.

The unprecedented intensity of the disease was probably due to abnormally high temperature. There was a general outbreak of diseases apparently caused by species of *Peronosporaceae* (but possibly by *Erysiphaceae*) at the same time on hosts which are usually immune in the autumn. The foliage of *Scorzonera,* purple clover, comfrey, &c., was literally coated with a floury powder.

Considerable losses were caused by the attack on spinach, the leaves of which were unfit for use. It is recommended that all affected leaves should be burnt and the planting of *Chenopodiaceae* in the affected places discontinued for one or two years.

BARRUS (M. F.). **Bean anthracnose.**—*Cornell Univ. Agr. Exper. Sta. Memoir* xlii, pp. 97–215, 8 pl. (5 coloured), 11 figs., 1921.

The author gives a full account of the disease, its importance, symptoms, and control, together with a discussion of the fungus (*Colletotrichum lindemuthianum*).

The fungus was found to attack *Phaseolus vulgaris* and, to some extent, *P. lunatus, P. multiflorus, P. acutifolius* var. *latifolius,* and *P. aureus,* but did not attack certain other species of *Phaseolus* inoculated. Of species belonging to other genera, only *Vigna sinensis* and *Dolichos biflorus* were infected in tests made by the author. There are at least two strains or biologic forms of the fungus, and certain varieties of bean are resistant to both these forms.

Coloured illustrations are given of the effect of the disease on the pods and seeds, and also of the symptoms of bacterial blight, *Rhizoctonia*, and rust on the pods. A bibliography of 170 titles is appended.

McRostie (G. P.). **Inheritance of disease resistance in the common Bean.**—*Journ. Amer. Soc. Agron.*, xiii, 1, pp. 15–32, 1921.

The investigations reported in this paper had for their objects the dual purpose of studying the method of inheritance of disease resistance, and of obtaining varieties of beans resistant to the three diseases: anthracnose (*Colletotrichum lindemuthianum*), mosaic, and root-rot (*Fusarium martii phaseoli*).

From the families previously reported as homozygous resistant to anthracnose a number of white-seeded strains have been isolated, some of them promising commercial types. Some of the selected types are also exhibiting resistance to mosaic. Most of the crosses made in connexion with the inheritance of susceptibility to both root-rot and mosaic were reciprocal crosses between the root-rot resistant Flat Marrow and the mosaic resistant Robust Pea bean. Both these strains are also resistant to the prevalent β strain of the anthracnose fungus. Some F_2 plants were also selected from reciprocal crosses between the Flat Marrow and the ordinary White Marrow, the latter being resistant to the α strain of the anthracnose fungus and tolerant to mosaic. From this combination of parents there is some chance of securing progeny resistant to all three diseases.

The investigations of the inheritance of resistance to *Colletotrichum lindemuthianum* indicate a single factor difference between resistance and susceptibility where only the α strain of the fungus is involved. Where both the α and β strains are concerned, a two-factor difference is shown and a 9·7 ratio in the F_2 obtained. In both cases resistance is dominant over susceptibility.

In the case of bean mosaic there is a partial dominance of susceptibility over resistance. To account for the inheritance of resistance and susceptibility a two-factor hypothesis is advanced and supported by the totals of the observed F_2 ratios between resistant and susceptible plants, and by the fact that about one-sixteenth of these F_2 plants were severely infected with mosaic and bred true for this character in the F_3.

In the case of root-rot susceptibility is dominant over resistance. A tentative two-factor hypothesis is advanced to explain this result. The fact that the susceptible plants were in the majority in the F_2 and that a large number of F_3 families from these plants did not breed true, unlike those derived from resistant F_2 plants, accords with this view.

Bud-rot in Coco-nut palms.—*Agric. Circular* [Dept. of Agric., Fiji], iii, 1, pp. 10–11, 1922.

By notification in the Royal Gazette No. 3 of 1922, p. 13, the disease of coco-nuts known as bud-rot is stated to exist in the Colony of Fiji, and orders are issued for the destruction and disposal of coco-nut palms affected with this disease under Regulation 20a of the Regulations under section 6 of the Diseases of Plants Ordinance, 1913. Regulation 20a states that the Governor may, at the time he declares any disease, 'order that trees or plants affected with such disease shall be immediately destroyed and disposed of in such a manner as shall be directed by the Superintendent of Agriculture or by an Inspector authorized in writing by him for that purpose, and if such directions are not immediately carried out by the owner of such trees or plants, such trees or plants may be destroyed forthwith by such Inspector at the expense of the owner and disposed of in such manner as the Inspector shall think fit'.

MARLATT (C. L.). **Report of the Federal Horticultural Board, United States Department of Agriculture,** 22 pp., 1921.

This report includes a list of the current quarantine and other restriction orders controlling the import of plants into the United States, brought up to October 1, 1921.

Quarantine No. 3 prohibits the importation of the common or Irish potato from Newfoundland, the islands of St. Pierre and Miquelon, Great Britain, Germany, and Austria-Hungary, on account of the potato wart disease [*Synchytrium endobioticum*]. Potatoes may be admitted from other foreign countries under permit and in accordance with the provisions of the regulations issued under the order of December 22, 1913, bringing the entry of potatoes under restrictions on account of injurious potato diseases and insect pests. Importation of potatoes is now authorized from the following countries: Denmark, Cuba, Bermuda, and the Dominion of Canada.

Wart disease is now limited to comparatively small areas in the States of Pennsylvania, West Virginia, and Maryland. The aggregate of new infections covers an area of less than one hundred acres. The three invaded States are enforcing effective quarantine measures. Important progress has been made in the research carried out in co-operation with the Bureau of Plant Industry and involving the following investigations: The development of successful methods of soil sterilization by heat, chemicals, or other means; the testing of both American and imported varieties of potatoes for reaction to the disease and adaptability to the climates and soils of the infested and adjacent regions; the study of the character of immunity in inheritance and the production by breeding of new immune varieties; the determination of the effect of climate and soil conditions on the distribution and development of the disease; and a careful study of the life-history of the organism.

Very important results have been obtained from these investigations, notably in respect of the determination of immune varieties. The outcome of the work has largely banished the fear that the disease might follow as destructive a course in the United States as in parts of Europe, but it is pointed out that there is none the less a continued necessity for thorough survey work and the strictest administration of local quarantine regulations.

Quarantine No. 7, as amended, prohibits the importation from each and every country of Europe and Asia, from the Dominion of Canada, and from Newfoundland, of all five-leafed pines and all species and varieties of the genera *Ribes* and *Grossularia* on account of the white pine blister rust [*Cronartium ribicola*].

Quarantine No. 15 prohibits the importation from all foreign countries of living canes of sugar-cane, or cuttings or parts thereof, on account of certain injurious insects and fungous diseases.

Quarantine No. 19 prohibits the importation from all foreign localities and countries of all citrus nursery stock including buds, scions, and seeds, on account of citrus canker [*Pseudomonas citri*] and other dangerous citrus diseases.

Quarantine No. 24, as amended, prohibits the importation from south-eastern Asia (including India, Siam, Indo-China, and China), the Malay Archipelago, Australia, New Zealand, Oceania, the Philippine Islands, Formosa, Japan, and adjacent islands, in the raw or unmanufactured state, of seed and all other portions of Indian corn or maize, and the closely-related plants including all species of Teosinte (*Euchlaena*), Job's Tears (*Coix*), *Polytoca*, *Chionachne* and *Sclerachne*, on account of the downy mildews [*Sclerospora* spp.] and *Physoderma* diseases of Indian corn, except that Indian corn or maize may be imported under permit and in compliance with the conditions prescribed in the regulations of the Secretary of Agriculture.

Quarantine No. 28 prohibits the importation from eastern and south-eastern Asia, the Malay Archipelago, the Philippine Islands, Oceania (except Australia, Tasmania, and New Zealand), Japan (including Formosa and other adjacent islands), and the Union of South Africa, of all species and varieties of citrus fruits, on account of the citrus canker, except that oranges of the mandarin class (including satsuma and tangerine varieties) may be imported under permit.

The canker disease of citrus fruit has been officially reported to the Board as occurring in Australia. It therefore seemed desirable to extend the existing quarantine to cover Australia, Tasmania, and New Zealand, but action has been deferred until certain additional information can be secured.

Quarantine No. 34 prohibits the importation for any purpose of any variety of bamboo seed, plants, or cuttings thereof capable of propagation, including all genera and species of the tribe Bambuseae from all foreign countries and localities, on account of dangerous plant diseases, including the bamboo smut (*Ustilago shiraiana*). This quarantine order does not apply to bamboo timber consisting of the mature dried culms or canes, or to any kind of article manufactured from bamboo, or to preserved bamboo shoots.

Quarantine No. 37, revised, with regulations, prohibits the importation of nursery stock and other plants and seeds from all foreign countries and localities, on account of certain injurious insects and fungous diseases, except as provided in the regulations. The following plants and plant products may be imported without restriction: Fruit, vegetables, cereals, and other plant products imported for medicinal, food, or manufacturing purposes; and field, vegetable, and flower seeds. The entry of the following plants is allowed under permit: Lily bulbs, lily of the valley, narcissus, hyacinths, tulips, and crocus; stocks, cuttings, scions, and buds of fruits; rose stocks, including manetti, multiflora, brier rose, and *Rosa rugosa*; nuts, including palm seeds; seeds of fruit, forest, ornamental, and shade trees; seeds of deciduous and evergreen ornamental shrubs; and seeds of hardy perennial plants.

Provision is also made for the issue of special permits under safeguards for the entry in limited quantities of nursery stock and other plants and seeds not covered in the preceding lists, for the purpose of keeping the country supplied with new varieties and necessary propagation stock.

[In a separate explanatory leaflet (H. B. 105, revised 1st January 1922), it is stated that nursery stock, &c., imported for propagation has been the source of 90 per cent. of the insect pests and plant diseases introduced from other countries, which occasion an annual loss to agriculture and forestry of about one billion dollars. A seven years' test of the possibility of safeguarding plant imports by inspection and disinfection has revealed the inadequacy of this method, and the necessity for excluding all plant stock not absolutely essential to the agricultural and silvicultural requirements of the United States. The procedure for obtaining special permits is described. The immediate sale of the imported plants is not permitted, but plants produced from them may be sold. The permits will chiefly be granted to commercial firms and scientific institutions. Importation must be made through the Federal Horticultural Board at Washington or San Francisco. Importation by mail through the Board is also permitted.]

Quarantine No. 39 prohibits the importation of seed or paddy rice from Australia, India, Japan, Italy, France, Germany, Belgium, Great Britain, Ireland, and Brazil on account of two dangerous plant diseases known as flag-smut (*Urocystis tritici*) and take-all (*Ophiobolus graminis*). Wheat, oats, barley, and rye may be imported from the countries named only under permit.

Quarantine No. 44 prohibits the importation of stocks, cuttings, scions, and buds of fruits from Asia, Japan, the Philippine Islands, and Oceania (including Australia and New Zealand) on account of dangerous plant diseases, including Japanese apple cankers, blister blight, and rusts, and injurious insect pests. Provision is made for the importation under special permit of limited quantities of stocks, cuttings, scions, and buds of fruits from the countries named, for propagation.

Legislazione fitopatologica. [Phytopathological legislation.]—*Boll. mensile della R. Staz. di Patologia vegetale,* iii, 1–3, pp. 25–26, 1922.

By circular dated 9th February 1922, the Italian Ministry of Agriculture authorized the importation into Italy, for the purpose of freeing from *Cuscuta* and re-exportation, of foreign pasture seeds, by responsible commercial firms, under special licences to be granted by the Regional Phytopathological Observatories [Stations]. In the applications for such licences, the country of origin of the seeds to be imported, the quantity and quality of the seed, and the place in which grading and freeing from *Cuscuta* will take place must be stated; guarantees must also be provided for the fulfilment of a number of conditions to which the importation is subjected, such as destruction of the refuse remaining after freeing from *Cuscuta*, re-exportation of the seed treated, supervision by the Phytopathological Stations, &c.

IMPERIAL BUREAU OF MYCOLOGY

REVIEW
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GRAM (E.) & ROSTRUP (SOFIE). **Oversigt over Sygdomme hos Landbrugets og Havebrugets Kulturplanter i 1921.** [Survey of the diseases of cultivated agricultural and horticultural plants in 1921.]—*Tidsskrift for Planteavl*, xxviii, 2, pp. 185–246, 1922. [English summary.]

The period under review (1st October, 1920, to 30th September, 1921) in Denmark had an unusual amount of sunshine, a mild winter being followed by an exceptionally warm spring and a cool June. The rainfall was very low, except in December and January. The fungous diseases are classified under the following headings, many other records being given besides those mentioned below:—

CEREALS. Root blight (*Pythium de Baryanum* and *Fusarium* spp.) occurred in conjunction with poor germination in some oat and barley fields; oats (especially grey) were severely attacked, particularly on newly-tilled, non-calcareous soil. Mildew (*Erysiphe graminis*) occurred on rye, wheat, and barley, the new wheat variety Trifolium 14 being badly damaged. Foot rot (*Fusarium culmorum* and other species) was very prevalent on rye, wheat, oats, and barley. The strawbreaker fungus (*Leptosphaeria herpotrichoides*) caused some cases of foot rot of rye. Stripe disease of barley (*Pleospora graminea*) occurred in a comparatively mild form, but was very widespread, especially on the varieties Karl, Tystofte Prentice, and Nord Slesvig Kaempe. Good results were obtained by seed disinfection with 0·25 per cent. uspulun (which also promotes germination), 0·2 per cent. formalin, and 0·5 per cent. copper sulphate. Leaf spot disease of barley (*Pleospora teres*) was injurious chiefly on cold soils. Oats were attacked by leaf spot disease (*Helminthosporium avenae*) and winter barley by *Marssonia secalis*. Bunt of wheat (*Tilletia caries*) was very prevalent, 75 per cent. and 78·6 per cent. of infection being counted in two instances where the seed was not treated. Smut of wheat (*Ustilago tritici*) occurred on Wilhelmina and on Argentine spring wheat. Loose smut of barley (*U. nuda*), covered smut of barley (*U. hordei*), and loose and covered smuts of oats (*U. avenae* and *U. levis*) were all reported, the last named being on the increase owing to the omission of seed treatment. Flag smut of rye (*Urocystis occulta*) was very common, but easily controlled by disinfecting with formalin. Black rust (*Puccinia graminis*) occurred on rye and oats in the vicinity of barberry bushes: the regulations concerning the eradication of the latter have now been extended to include the southern Jutland districts. Yellow rust (*Puccinia glumarum*) was very prevalent on wheat, especially Wilhelmina, Tystofte Small II, and Panser II.

LEGUMINOSAE. Mildew of peas (*Erysiphe pisi*) was very severe in August: marrowfats were mildly attacked by foot rot (*Fusarium*, etc.).

ROOT CROPS. Mosaic, rust (*Uromyces betae*), and downy mildew (*Peronospora schachtii*) on mangolds and beets are increasing, the reason given being that seedsmen's nurseries afford numerous opportunities of early infection. Crown gall (*Bacterium tumefaciens*), dry rot (*Phoma betae*), and *Hypochnus violaceus* all occurred on beets. Dry rot frequently appears as the result of fertilization with marl or lime, and *Hypochnus violaceus* is reported chiefly from low-lying swampy ground.

CRUCIFERAE. Black rot (*Pseudomonas campestris*) and *Mycosphaerella brassicicola* of cabbage and soft rot (*Bacillus carotovorus*) of turnips were prevalent. Records of several others common diseases of crucifers are given.

POTATOES. Leaf roll occurred very generally, Magnum Bonum being attacked to the extent of 75 per cent. in some cases. Mosaic was also very serious, especially on Up-to-Date. Blackleg (*Bacillus phytophthorus*) [*B. atrosepticus*] was severe on Sharpe's Victor and Richter's Imperator, and *Verticillium albo-atrum* on Up-to-Date.

FODDER CROPS. Clover stem rot (*Sclerotinia trifoliorum*) was adequately controlled by the application of lime or marl to the soil. Bacteriosis (*Aplanobacter rathayi*) of cock's-foot grass [*Dactylis glomerata*] was of some importance in the nursery districts, and there were a few insignificant attacks of *Epichloe typhina* on the same host. Smut of brome grass (*Ustilago bromivora*) was successfully controlled by formalin.

FRUIT. American gooseberry mildew (*Sphaerotheca mors-uvae*) can be controlled by cutting back the twigs and by delayed dormant spraying with copper sulphate 3 to 4 per cent. or formalin 2 per cent. A reduction in the use of nitrogenous fertilizers is also advisable. Tomatoes were attacked by streak (*Bacillus lathyri*) and a fusariose (*Fusarium culmorum*). Apple mildew (*Podosphaera leucotricha*) was widespread on the varieties Aakero, Baldwin, Bellefleur de France, Bismarck, Boiken, Cox's Orange, Signe Tillisch, Urania, and others. Canker (*Nectria galligena*) was most severe on Cox's Orange and White Transparent. Scab (*Venturia inaequalis*) occurred principally on Bismarck, Cellini, Cox's Orange, Cox's Pomona, Lord Suffield, etc. The trellis rust of pears (*Gymnosporangium sabinae*) was prevalent and more severe than usual.

CUCURBITACEAE. Mildew (*Erysiphe cichoracearum*) and blight (*Macrosporium melophthorum*) [*Cladosporium cucumerinum* Ell. & Art.] of cucumbers caused considerable losses.

ONIONS AND LEEKS. Onion mildew (*Peronospora schleideni*) may be controlled by the careful selection of setts, roguing of diseased plants, and spraying with Bordeaux mixture. Onion mildew is reported for the first time on leeks. Leek rust (*Puccinia porri*) was also recorded from the north of the country.

TREES, SHRUBS, AND ORNAMENTAL PLANTS. A *Phoma*, found previously on allied evergreens, is reported to occur on dying twig-ends of *Cupressus*. *Fusarium dianthi* was found on carnations, streak (*Bacillus lathyri*) on sweet peas, and bacteriosis (*Pseudomonas syringae*) on lilac. Heart rot (*Polyporus annosus*) spread from fence posts to hawthorn and other shrubs in the vicinity and killed them.

PHYSIOLOGICAL. Bitter-pit was rather common in apples after picking. The appearance of dry spots and withering of the margin of apple leaves appears to be connected with a deficiency of potassium. A bark-burn ('*Lohkrankheit*') of cherry twigs was reported for the first time. Spray injury from lime-sulphur 1 : 30 is recorded on the apple varieties Frogmore Prolific (serious) and Hawthornden (slight). Yellow Transparent gooseberries are also liable to spray injury.

FREEMAN (E. M.). **Division of Plant Pathology and Botany.**—*Ann. Rept. Agric. Exper. Stat. Univ. of Minnesota*, xxix (1st July 1920 to 30th June 1921), pp. 72–77, 1921.

The most destructive plant disease in the State during the period under review was the black stem rust of wheat [*Puccinia graminis*]. Scab [*Gibberella saubinetii*] was also fairly serious, but less prevalent than in some years. Apples were severely attacked by fireblight [*Bacillus amylovorus*] and apple scab [*Venturia inaequalis*]. Blackleg of potatoes [*Bacillus atrosepticus*] did considerable damage in the Red River Valley, while lettuce drop [*Sclerotinia libertiana*] was quite destructive in the head lettuce region near Duluth, and black rot of cabbage [*Pseudomonas campestris*] in the south-east.

The work of breeding cereals for rust resistance is making progress. Selections from crosses between Marquis and Iumillo wheats were extremely resistant in the field. Preliminary experiments on the relation between soil nutrients and the physiology of host plants indicate that different biologic forms vary in their reaction to environmental conditions. There seems to be strong evidence that the spring habit of Marquis can be combined with the rust-resistant properties of Kanred. The study of the biologic specialization of cereal rusts has shown that there are at least thirty-three distinct forms of stem rust. Considerable evidence has been collected to the effect that the summer spores of black stem rust do not live over winter and spring in Minnesota, and that the rust in spring originates chiefly on infected barberries. The barberry eradication campaign has been vigorously pursued, twelve counties now being practically free.

The superiority of flax selections 25–7 and 175–1 was again demonstrated, these varieties being resistant to wilt [*Fusarium lini*]. Contrary to the general opinion, the wilt-resistant flax has not forfeited any appreciable degree of immunity by growing on clean soil. Experiments indicate that early planting will aid in the prevention of wilt.

The foot and root rot and seedling blight of wheat, barley, and rye [*Helminthosporium* spp.] were further investigated, a marked difference in susceptibility being found in seed-clean varieties. Re-cropping of wheat grown in infected soil resulted in stunting of the plants. A strain of *Helminthosporium* isolated from rye infected 32 varieties of wheat, 10 of barley, 1 of rye, and 50 species of grasses, while 7 varieties of oats and 13 species of grasses proved immune.

Careful hand inoculations were made with a view to ascertaining the varietal susceptibility of wheats to loose smut [*Ustilago tritici*] and a high percentage of infection was obtained on Preston, Bluestem, Glyndon, and Marquis. Stanley was less susceptible and Mindum and Kubanka very resistant to this fungus. In the barleys Manchuria, Minnesota 388, and Wisconsin No. 9 were extremely susceptible to *U. nuda*, while Minnesota 184 was somewhat resistant.

Many differences in resistance to bean anthracnose [*Colletotrichum lindemuthianum*] have been demonstrated, and at least two biologic forms of the disease isolated.

Seed potatoes derived from sprayed plants gave higher yields than those from unsprayed plants. Probably this difference was largely due to the repellent action of Bordeaux mixture on aphids, thus preventing infection by mosaic. Better results in the control of black scurf [*Rhizoctonia solani*] were obtained by treatment with corrosive sublimate (1 : 1000 for $1\frac{1}{2}$ hours) than with formaldehyde or copper sulphate.

[BEWLEY (W. F.)]. **Report of the Mycologist.**—*Seventh Ann. Rept. Cheshunt Exper. and Res. Stat. Hertfordshire*, pp. 32–41, 1921. [1922].

The following is a list of hitherto unreported diseases observed during the year. Tomatoes were affected by mosaic disease, and by a root rot and a fruit rot caused by *Sclerotium* sp. and *Botrytis* sp. respectively. Cucumbers were attacked by *Cladosporium* sp., causing leaf spot, and by mosaic disease. Arums suffered from a soft rot of the corms due to *Bacillus aroideae*, carnations were attacked by rust (*Uromyces caryophyllinus*), while wilt (*Verticillium albo-atrum*) was recorded on antirrhinum and sweet peas. Broad beans, culinary peas, and clover were all affected by streak (*Bacillus lathyri*).

The main problem under investigation was the leaf spot of cucumber caused by *Colletotrichum oligochaetum*. The symptoms of the disease and the characters of the fungus are described.

An attack on the leaves only impairs the health of the plant indirectly by the reduction of the leaf area, but when the fungus invades the stem it kills the parts above the point of attack. The scorched appearance of the plants and the spotting of the leaves make the disease easily recognizable.

C. oligochaetum grows readily on artificial media and also on such substances as new and rotten wood, straw, and cotton wool, if kept damp. An examination of suspected materials definitely proved that the fungus may hibernate in decayed wooden structures and may also be carried in straw manure. Fumigation with sulphur and spraying with cresylic acids do not always entirely destroy the fungus in greenhouses owing to insufficient powers of penetration. It was found that the disease could be produced by artificial inoculations between temperatures of 45° and 86° F., but most easily at about 75° F., the optimum temperature for cucumber cultivation. The disease could be materially checked by keeping the temperatures abnormally high or low. There was a marked relation between the amount of moisture in the air and the rate of development of the disease. With an average percentage humidity of 92 or 88 the disease appeared in three days; at 82 it appeared in four days; at 78 in five days; at 69 to 63 in six days; while inoculated plants exposed to a percentage humidity of 54 remained healthy. Excessive moisture in the houses therefore hastens the spread of the leaf spot.

The disease may be controlled to some extent by cleansing the houses during the winter with an emulsion of cresylic acid and soft soap (1 gall. of straw-coloured cresylic acid (97–99 per cent. purity) to 8 lbs. of pure potash soft soap) used at the rate of about one part in fifty parts of water. During the growing season promising results were obtained by the use of liver of sulphur and lime-sulphur, flour paste or casein being added as 'spreaders'. The following formulae have proved most satisfactory: (*a*) 5 lb. flour, 4 lb. potassium sulphide, 100 galls. water; (*b*) 5 lb. flour, 2 pints lime-sulphur, 100 galls. of water. To ensure complete efficacy these sprays should be used before the succulent petiole and stem tissues are attacked, as the disease is very difficult to check afterwards. The disease is extremely virulent and should be combated immediately it appears. Spraying, followed by the removal of spotted leaves, should be repeated at weekly intervals if necessary. The spray occasionally burns a young leaf or tendril; but the damage done to the plant is negligible. Dusting with sulphur powder acts as a temporary check to the disease, but does not completely control it. The atmosphere of the houses should never be allowed to become stagnant or saturated with moisture, the beds should be kept warm, and the day and night temperatures maintained as nearly as possible equal.

'Damping off' and 'foot rot' of tomatoes, due to *Phytophthora cryptogea* and *P. parasitica*, were described in the fifth Annual Report. Sterilization, with 2 per cent. formaldehyde or heat, of the soil, seed boxes, pots, and water-supply, in all of which the causal organisms may be transmitted, has proved an effectual preventive of the disease. The so-called 'Cheshunt compound' consisting of a mixture of 2 oz. of copper sulphate and 11 oz. of ammonium used at the rate of 1 oz. to 2 galls. of water is effective in destroying the fungi in the soil without injuring the plant. It is very easy to use, being merely watered on the soil so as to wet it thoroughly. The compound has also been tested on tomato and other plants attacked by *Verticillium albo-atrum*, *Fusarium* sp., and *Rhizoctonia* with promising results.

Melon canker is a disease which generally appears when the plants are setting their first series of fruits, and the rotting of soft tissues near the ground is a typical symptom. The base of the plant should be kept as dry as possible, and the rot may be checked by dusting the affected parts and adjacent soil with a mixture of two parts of finely ground copper sulphate, two parts of flowers of sulphur, and ten parts of powdered, dry, slaked lime. A bacillus has been isolated which is capable of producing the disease under favourable conditions and further work with it is in progress.

Mosaic is stated to be rapidly becoming one of the most important tomato diseases in the Lea Valley.

DICKSON (B. T.). **Plant diseases of 1920–21.**—*Thirteenth Ann. Rept. Quebec Society for the Protection of Plants*, pp. 66–67. 1921.

ORCHARD. During the season there was little apple scab (*Venturia inaequalis*) but an abundance of black rot (*Physalospora cydoniae*). The latter appears to be consequent on excessive winter injury due to the severe winter of 1917–18. Winter injury and black rot are two of the most important orchard problems of Quebec. Sporadic cases of silver leaf (*Stereum purpureum*) occurred.

FIELD AND GARDEN. Pea beans (*Phaseolus vulgaris*) were severely attacked by blight (*Pseudomonas phaseoli*), while mosaic and anthracnose also occurred, the latter only to a slight degree. Broad beans (*Vicia faba*) suffered from mosaic to the extent of 50 per cent. Sweet peas were also attacked by mosaic, distinct mottling being noticeable in the flowers of the red-purple varieties.

Clovers in general were subject to mosaic, the red clover (*Trifolium pratense*) in the experimental plots showing over 50 per cent. diseased. In the field, yellow and white sweet clover (*Medicago officinalis* and *M. alba*) were severely affected, and black medick (*M. lupulina*) and Alsike clover (*T. hybridum*) were also attacked, but no percentage estimates were made. Alfalfa (*M. sativa*) exhibited a speckling similar to that of mosaic, but it cannot yet be definitely identified as a form of the latter.

Tomatoes, potatoes, and tobacco all developed mosaic, the first named to the extent of 52 per cent. Mottling of the fruit was common. The potato seed was carefully selected, but nevertheless there was approximately 3 per cent. of mosaic, 5 per cent. of true leaf roll, and 8 per cent. of leaf roll caused by *Fusarium* sp. Blackleg (*Bacillus phytophthorus*) [*B. atrosepticus*] was not serious. Late blight (*Phytophthora infestans*) did not appear till September, when there was a fortnight of heavy, warm rain. This resulted in a heavy loss of potatoes in storage, chiefly from *Fusarium* rots combined with some late blight. The author's explanation is that the tubers did not mature sufficiently before harvest owing to warm rains in the latter part of the season, and very slight injuries to the skin can cause trouble in storage under such conditions.

Raspberries, especially Cuthbert, were severely attacked by curl and yellows, many plants showing typical mosaic symptoms with no sign of curl. Symptomatically they are distinct diseases. The uredo and teleuto stages of *Cronartium ribicola* again developed on currants. This has occurred for the last six years, without any sign of a diseased *Pinus strobus* in the vicinity.

GREENHOUSE. As in the field, tomatoes, especially Livingstone Globe, and to a lesser degree John Baer, were attacked by mosaic. Leaf spot, caused by *Septoria lycopersici*, was not serious. Seedlings of *Chamaecyparis obtusa* and *Pinus koraiensis* were damped off by a *Fusarium*. Snapdragon rust (*Puccinia antirrhini*) became so serious that all old stock had to be discarded and new seed obtained.

STORAGE. Potato losses in storage have already been mentioned. Black rot in apples was fairly common, excellent mummies with pycnidia being obtained. Complaints were received from the Montreal market that apples were badly packed, with the result that the stalk of one apple pierced the skin of the one above, thus affording entrance to *Penicillium glaucum* which set up soft rot.

RAMIREZ (R.) **Plagas de la Agricultura en el distrito federal.** [Agricultural pests in the Federal District].—*La Revista Agricola* [Mexico], v, 9, pp. 662–663, 1921.

This is a list of the chief insect and vegetable parasites occurring in the Federal district, Mexico. The following are some of the records of parasitic fungi of interest. *Phytophthora infestans* on tomatoes; *Exoascus deformans* on apricots; *Pseudopeziza medicaginis* on alfalfa; *Thielavia* sp. on agaves; *Meliola camelliae* on limes and oranges; Erysiphaceae on vines, roses, begonias, dahlias, cucurbits, chillies, and beans; *Nectria* spp. on apple and pear trees; *Claviceps purpurea* on Gramineae; *Mycosphaerella fragariae* on strawberries; *Venturia pomi* [*inaequalis*] on apple; *V. pirina* on pear; another *Venturia* on figs; *Glomerella rufomaculans* on apple; *Oospora* [*Actinomyces*] *scabies* on sweet potatoes; *Botrytis* on vine; *Didymaria* sp. on agaves; *Dimerosporium agavectorum* on agaves; *Cercosporella* sp. on apple; *Coryneum beijerinckii* on apricots; *Cylindrosporium* sp. on apple; *Ustilago zeae* on Indian corn; *Ustilago tritici* on wheat; *U. nuda* on barley; *Tilletia foetans* and *T. tritici* on wheat; *Puccinia graminis* on wheat; *Phragmidium subcorticium* on roses; *Rhizoctonia* sp. on sugar beet and sweet potato; *Bacterium tumefaciens* on pear; *Bact. savastanoi* on olive; *Bacillus amylovorus* on pear, apple, and quince; *B. solanacearum* on sweet potato and tomato.

POLE EVANS (I. B.). **Botany and plant pathology: Annual Report Department of Agriculture for year ending June 30, 1921.**—*Journ. Dept. of Agric. S. Africa*, iv, 1, pp. 55–59, 1922.

The most important research work carried out by the Department was in connexion with the wastage in export citrus fruits [see this *Review*, i, 2, p. 58], citrus canker, and tobacco wildfire.

Steady progress has been made in the campaign against citrus canker, and the number of infected trees has dwindled from 11,702 in 1917–18 to 6 in 1920–21. The disease of tobacco known as wildfire [since found to be not true wildfire but angular spot: see next abstract] is very prevalent in the Pietersburg and Rustenburg districts, and this serious disease is the subject of investigations with special regard to means of prevention. Poplar trees in the Bedford district have been found to be affected by *Cytospora chrysosperma*. A noteworthy feature during the late summer rains was the prevalence of bacterial diseases, particularly of the potato and tomato. Numerous inquiries were received concerning mottled or concentrically-zoned citrus leaves, a condition which requires physiological investigation. Crown gall seems fairly prevalent and must be attributed in part to the carelessness of nurserymen in sending out diseased stocks. Other diseases reported as being very prevalent were internal brown fleck and scab in potatoes, peach freckle, blossom end rot in tomatoes, wilt in pine seedlings, die-back of pines, ripe rot in papaws, die-back in apples, bacterial wilt of beans, walnut blight, physiological troubles of quince, plum, peach, pines, and buchu [*Barosma*].

At Durban further investigations of the micro-organisms causing deterioration of sugar in storage were carried out, and work on the South African Polyporaceae and Thelephoraceae was continued. At Capetown the study of the causes of wastage in export citrus made good progress and disclosed a very satisfactory state of affairs as far as cold storage conditions at Capetown are concerned; control of pear scab, of 'vrotpootje' in wheat, and die-back of stone fruit trees caused by *Schizophyllum commune* also engaged attention.

Departmental Activities. Wildfire and angular spot in Tobacco. *Journ Dept. of Agric. S. Africa.* iv, 2, p. 117, 1922.

The disease popularly known as wildfire and angular spot in tobacco, which during the season 1920–21 was only reported from the Government Experiment Stations at Rustenburg and Piet Retief and from certain farms in these districts, seems to be spreading to Groot Marico and Swaziland, while it has also made headway in the two original districts. This extension is causing great anxiety to growers.

According to Schilz's recent work, the South African organism is *Bacterium angulatum*, the bacterium connected with angular leaf spot in the United States. While the lesions on tobacco leaves in the field and those produced by inoculation resemble wildfire, the organism concerned is not the wildfire organism, *B. tabacum*, which has not once been isolated. [This is possibly also the case in Rhodesia: see this *Review*, i, 3, p. 93.]

HASKELL (R. J.) & WOOD (J. I.). **Diseases of fruit and nut crops in the United States in 1921.**—*Plant Disease Bull. Supplement* 20, 135 pp., 26 figs., 1922. [Mimeographed.]

The authors have prepared this report from data sent in by the working pathologists of the United States, most of whom are collaborators or correspondents of the Plant Disease Survey. Reports were also obtained from the Bureau of Markets and Crop Estimates. References are given to many of the publications of 1921 relating to fruit diseases in the country. The report covers diseases of pome fruits, stone fruits, small fruits, sub-tropical fruits (including citrus, fig, date, pineapple, avocado, mango, papaw, and guava), and several nut crops.

The temperature during 1921 in the United States averaged above normal in all parts. The winter of 1920–21 was mild, and spring opened early, but was followed by damaging cold spells. Summer was characterized by unusual heat, with drought in many cases. The precipitation for the year was irregular, being below normal in many areas, but above normal in others. These weather conditions exerted considerable influence upon the occurrence and seriousness of various fruit diseases.

The diseases are listed under the name of the fruit affected, and for each disease there is a general survey of the prevalence and distribution during the year, followed by a more detailed survey by states.

These reports are invaluable to any one wishing to obtain a comprehensive picture of the injuries caused by plant diseases in the United States, and of the variation in these diseases from year to year.

Report of the College of Agriculture and the Agricultural Experiment Station of the University of California, 1st July, 1920 to 30th June, 1921. 191 pp., 1922.

This report contains a brief record of the work on phytopathology in progress at Berkeley, at the University Farm, Davis, and at Riverside, some of which has been separately noticed.

Field trials of large- and small-seeded Bayo beans for resistance and susceptibility to bean rust (*Uromyces appendiculatus*) showed that the large-seeded varieties are so far immune, while the small-seeded ones are susceptible with a single exception, which is extremely resistant if not entirely immune.

The following varieties of oats exposed to epidemic attacks of stem rust (*Puccinia graminis avenae*) were found to mature free from infection: Sixty Day (223a), Burt 253a, Nebraska 21, Richland (281a), White Russian (284a), North Black Finnish, Sixty Day Selections, C.I. 256, Wisconsin Pedigree Kherson 156, Iowa 25, Iowa 102½, and Iowa 96–3. Of these the three last named and White Russian all gave evidence of high resistance to stem rust under all conditions, while the character of early maturing was in some degree responsible for the immunity of the others. Greenhouse tests showed that, in addition to the varieties mentioned, the following were also highly resistant:—five strains of White Russian, Tartarian, Long Tartarian, Danish, and Ruakura. The results of inoculations with twelve strains of *P. graminis avenae* on a wide range of oat varieties gave no indication of the existence of more than one biologic strain on this host.

Observations were made on the factors influencing resistance to stem rust in wheat. In Kanred, a resistant variety, both morphological and physiological factors are apparently involved. The narrowness of the stomatal openings prevented the entry of all but 10 per cent. of the germ tubes, while the few which gained admission were immediately arrested by a reaction of the host resulting in the destruction both of the hyphae and the invaded host cells. The dead areas on the leaf cannot be seen without a lens. In slightly less resistant wheats larger flecks of dead tissue may form before the fungus is killed.

Copper sulphate applied at the usual concentrations causes losses in steeped seed wheat under local conditions varying from 40 to 50 per cent., which may be largely prevented by dipping the seed thus treated in a solution of lime. This method is now well established in the Pacific coast states. During the past year nearly a thousand varieties and selections of wheat were heavily inoculated with bunt spores, and were grouped according to the results as follows: 0·7 per cent. immune (0 per cent. of infection); 1·9 per cent. resistant (0 to 10 per cent. of infection); 1·6 per cent. susceptible (11 to 25 per cent. of infection); 10·6 per cent. very susceptible (26 to 75 per cent. of infection); and 84·9 per cent. extremely susceptible (75 to 100 per cent. of infection). The immune and highly resistant wheats offer a basis for the breeding of bunt-resistant varieties. A number of crosses between resistant and susceptible wheats were made for future study.

Sooty mould (*Hormodendron cladosporioides*) occurs on wheat, and to a lesser extent on oats. Though usually considered unimportant it causes serious losses in the coastal districts subject to spring and summer fogs. The spores are wind-borne, the attack occurring after the grain is in full head. There appears to be a certain amount of varietal resistance to the disease. No remedy is known.

Barley scald (*Rhynchosporium secalis*) has been under observation in California for two years. It attacks the plants, especially the early sown varieties, soon after germination at the beginning of autumn. Some of the best varieties are highly resistant, while selections from Mariout, Tennessee Winter, and '4000' excelled the original parents in this respect.

Apple cankers were prevalent along the coast from Humboldt to Monterey, possibly because of their connexion with frost injury. The north-western and European cankers (*Neofabraea malicorticis* and *Nectria galligena*) were found together in several orchards, being hardly distinguishable from one another in the early stages. Reports from Oregon indicate that the treatment for north-western canker (Bordeaux 6–6–50 after the fruit is off, and again in three weeks) may also control European canker. New York canker (*Physalospora cydoniae*) was also present in a lesser degree.

Extensive experiments in the control of brown rot of apricots (*Sclerotinia cinerea*) were carried on at the Deciduous Fruit Station with some fifty different spray treatments, including most of the known fungicides. The preliminary results show that spraying has a definite value in controlling the disease. Even trees which only received a dormant spray (usually considered worthless) averaged fewer dead twigs than the controls. Ten large control trees averaged 299 infections to the tree, while ten similar adjacent trees sprayed with lime sulphur while dormant had an average of 183 infections, and ten other trees sprayed while dormant with Bordeaux only 102 each.

It was found that the common ornamental Japanese quince (*Chaenomelas japonica*) was an excellent host for *S. cinerea*. The quince flowers, which are amongst the earliest to come into bloom, are readily attacked, the infected blossoms being densely covered with spore masses which serve to produce an early infection of susceptible fruit trees.

Bacterial gummosis (*Pseudomonas cerasus*) on the apricot is now reported to be present on the cherry also in California. The disease appears to be spreading rapidly. It is at times almost indistinguishable from brown rot.

The lemon brown rot fungus (*Pythiacystis citrophthora*) occasioned serious damage to deciduous nursery trees in the early winter. The heaviest losses occurred among June buds of peach and apricot, many trees being girdled by cankers just above the bud. Grafted stocks of pear, both Bartlett and Ussuriensis, were also affected. *P. citrophthora* is a soil fungus which attacks the bark only under conditions of extreme moisture, and no further spread is anticipated after planting out. There is some evidence, however, that the fungus may occur in bearing trees.

Fawcett's conclusion that *Bacterium citriputeale* Smith and *Bact. citrarefaciens* Lee, causing citrus black pit and citrus blast respectively, were identical, was confirmed by a number of experiments. The two diseases are merely two different effects produced by the same organism. It has also been ascertained that infections leading to the disease are usually due to slight surface injuries brought about by south winds with driving rain. This is the first satisfactory explanation of the well-known facts that the lesions are more numerous on the south than on the north side of the tree, and on long succulent shoots than on the shorter and more compact growth; and that the blast is slight on trees in sheltered places on the north side of buildings or thick hedges. Bordeaux mixture applied in the first few days of November reduced the number of blast lesions to about one-fourth of that on unsprayed trees.

Stem end rot and melanose (*Phomopsis citri*), not previously believed to occur in California, were found on lemons and pomelo respectively. The fungus has probably been present in the State for a long time but overlooked on account of its minor importance under Californian conditions.

WOLF (F. A.). **Additional hosts for Bacterium solanacearum.**—*Phytopath.*, xii, 2, pp. 98–99, 1922.

Some fifty species of host plants in nine families are known to be subject to attack by *B. solanacearum*. The author adds soy-beans (*Soja max*), dahlia (*Dahlia rosea*), and cosmos (*Cosmos bipinnatus*) to the list of hosts found naturally infected. The dahlia and cosmos showed sudden wilting, but the soy-beans, although less wilted, showed a dwarfing followed by premature drying and death of the foliage.

HEUSER (W.). **Versuche über den Einfluss äusserer Bedingungen auf die Stärke des Steinbrandbefalls des Weizens.** [Experiments on the influence of external conditions on the intensity of bunt attack on Wheat.]—*Fühlings landwirtsch. Zeit.*, lxxi, 5–6, pp. 81–99, 1922.

Various external factors are involved in the incidence of bunt on wheat, the most important of which are temperature at sowing time, and manurial treatment. Numerous investigations have shown that very high or very low temperatures favour the germination of the wheat at the expense of the bunt spores. On the other hand, the moderate temperatures usually prevalent in Germany at sowing time (6° to 10° C.) afford equal facilities of germination both to the grain and the spores. Laupert (*Deutsche landw. Presse*, lxii, 1920) states that in South Russia, wheat sown in the middle of August comes up in three to four days, before the spores have time to germinate. At very low temperatures again (3° to 4·5° C.), the spores are unable to germinate while the wheat can do so. The minimum temperature for the germination of wheat is 3° to 4·5° C. and for that of bunt spores 5° C., the optimum for wheat is 25° C. and for bunt spores 16° to 18° C., the maximum for wheat is 30° C. and for bunt spores 25° C. Rapid germination is also a varietal characteristic of Criewener 104, Siegerländer, and other varieties. Heine's Teverson is an example of a slow-germinating and slow-developing variety which is extremely liable to attack.

According to von Kirchner (*Fühlings landw. Zeit.*, 1916), the resistant varieties are enabled to withstand the progress of the mycelium, even after infection has taken place, by reason of certain acids, antitoxins, and ferments which they contain. The rapid development of the ears is a further means of protection against the disease, the mycelium being unable to penetrate all the newly-formed shoots. It is suggested that the anatomical structure of the hydrophytic varieties of the coastal districts is possibly better adapted to the requirements of the fungus than that of the xerophytic inland varieties. Small seeds used in an experiment gave a higher percentage of infection than large ones, but this is not of much importance in practice.

Fertilization with potassium and phosphoric acid increased the percentage of infection, while nitrogen reduced it by stimulating the development of ears. An experiment in 1921 showed that the use of seed from the 1919 crop led to a reduction of 20 per cent. in infection as compared with seed from the last harvest.

WEBER (G. F.). **Studies on Corn rust.**—*Phytopath.*, xii, 2, pp. 89–97, 3 figs., 1922.

Uredospores of *Puccinia sorghi* were found to germinate better when shaken from the sori than when removed with a scalpel. The minimum temperature for germination was 4° C., the optimum 17°, and the maximum 32°. The optimum temperature for infection was about 18° C.; a good deal occurred at 8°, but none at 32°. The germ-tubes enter the host through the stomata usually with, but sometimes without, the formation of appressoria. No attraction of the germ-tubes towards the stomata was found. The mycelium developed in the intercellular spaces in contact with the host parenchyma. Infection of the mesocotyl was obtained.

Uredospores from rusted maize leaves kept out of doors under various conditions at Madison, Wisconsin, in 1919, germinated freely until early November, after which a rapid decline in viability took place, and by 15th February, 1920, only two spores germinated in all the tests; after that none germinated. On 3rd and 11th January attempts to inoculate maize plants with these spores from outdoors failed. The spores therefore failed to over-winter under such conditions.

No evidence of specialization on the part of the rust was obtained. Sweet corn (*Zea saccharata*) was found to be most susceptible to rust, followed in order by flint, flour, dent, *Z. ramosa*, pod, and pop corn, the last named being only moderately affected.

FITZPATRICK (H. M.), THOMAS (H. E.), & KIRBY (R. S.). **The Ophiobolus causing take-all of Wheat.**—*Mycologia*, xiv, 1, pp. 30–37, 1 pl., 1 fig., 1922.

Perithecia of *Ophiobolus* were found on wheat showing take-all symptoms in New York in 1920. The fungus was compared with specimens labelled *O. graminis* from England, Japan, Italy, and France, and all were found to be identical. Specimens were sent from New York to McAlpine in Australia, who pronounced the American material to be the same species as that occurring in Australia.

Comparisons were made between the specimens usually called *O. graminis* Sacc. and specimens of *Sphaeria eucrypta* Berk. & Br. and *S. cariceti* Berk. & Br. obtained from Kew. The latter is considered to be identical with *Ophiobolus graminis*, and the name *O. cariceti* (Berk. & Br.) Sacc. should replace *O. graminis*. *Sphaeria eucrypta* and *O. herpotrichus* are considered to be different organisms, both of which have, in various ways, been associated with the name *O. graminis* or with the take-all disease. A full description of *O. cariceti* is given.

KIRBY (R. S.). **The take-all disease of Cereals and Grasses.**—*Phytopath.*, xii, 2, pp. 66–68, 3 figs., 3 pl., 1922.

Take-all caused by *Ophiobolus cariceti* (*O. graminis*) was first reported for the United States by Kirby and Thomas from New York in 1920 (*Science*, lii, p. 368), and has since been found in Oregon, Arkansas, and Indiana. A survey of New York State in 1921 indicated that the disease was confined to winter wheats and was absent from the eastern part of the State. The loss was at least 2 per cent. in infected fields.

The disease is usually found in more or less circular areas, in which the plants are stunted and yellowish to ashy-white in colour. Infected plants usually die early and seldom produce more than a single head. The diseased culms are browned or blackened, from one-half to two inches above ground, by mycelium in the leaf sheaths and between the culm and inner sheath. The roots break readily, and there is a marked reduction of tillers. Later in the season saprophytic fungi may blacken the leaves and culms of diseased plants. After (or rarely before) the plants die, the beaks of the perithecia may protrude through the outer leaf sheath.

In the field the only plants attacked besides wheat were rye (a single plant) and *Agropyron repens*.

The cultural characters of *O. cariceti* are given. The fungus was isolated from ascospores, and perithecia developed in culture on sterilized sweet clover and wheat stems. Tests were made in the greenhouse by planting sixty-two varieties of cereals and forty-eight species of grasses in soil inoculated with the fungus. All the fifty-four varieties of eight species of *Triticum* tested proved susceptible, nearly all the plants being stunted. Stunting of rye, oats, barley, maize, and most species of grass did not occur, although eventually the barley bore a pronounced mycelial plate with many perithecia at the base of the plants, and a few perithecia developed on rye. Of the wild grasses tested, very heavy infection occurred on *Agropyron repens*, heavy infection on *A. intermedium*, *Elymus canadensis*, *Hordeum jubatum* and *Hystrix patula*, moderate infection on eleven species, slight infection on eight species, and no infection on twenty-four species.

No conidial stage of the fungus was found. Ascospores are produced abundantly. They were found as early as 5th June, but during June and July the spores produced were shorter than normal, rarely septate, and failed to germinate. Ascospores kept under field conditions germinated during the period from October to March, but failed to germinate the following August.

Tests as to the method of dissemination of the fungus indicated that seeds from diseased plants do not carry the disease, that screened soil is infective for a time (less than eight months), and that bits of straw containing perithecia are most virulent, retaining their infective property for more than eight months. The soil is probably the principal source of the inoculum ; healthy plants grew beside diseased plants in pots without becoming infected.

The fungus grows better in an alkaline than in an acid medium. Tests showed that fewer plants were killed by it when sulphur or acid potassium phosphate was added to the soil than in the cases where lime or sodium nitrate was added.

In most fields examined, there was little or no difference in infection on high and low ground, although occasionally the disease appeared worse in wet soils.

Suggestions for control include rotation, the eradication of wild hosts from the fields, care in the use of manure containing infected straw, thorough cleaning of seed wheat, and the avoidance of liming the soil before planting wheat.

HORNE (W. T.). **A Phomopsis from the Isle of Pines.**—Abs. in *Phytopath.*, xii, 2, p. 105, 1922.

A *Phomopsis*, apparently more vigorous than *P. citri*, was obtained from a grapefruit from the Isle of Pines, West Indies, with stem end rot. The fungus was capable of producing typical stem end rot in oranges and grapefruit when inoculated from cultures.

BURGER (O. F.) & DE BUSK (E. F.). **Spraying to control melanose.** —*Univ. of Florida Agric. Exper. Stat. Press. Bull.* 335, 2 pp., 1922.

This is a preliminary report on the control of citrus melanose (*Phomopsis citri*). The disease is most prevalent in rainy and foggy seasons, when the spores of the fungus are washed from the dead twigs on to the leaves and fruit. The leaves and twigs can only be infected while very young, the disease being harmless to leaves of three to five weeks old or more. The leaves should therefore be sprayed very early. Recent experiments showed that the disease can be controlled by spraying the trees from ten to twenty days after two-thirds of the blossoms have dropped. Good results were obtained by the use of the following Bordeaux-oil spray: copper sulphate 3 lb., rock lime 3 lb., water 50 galls., and a good oil emulsion 3 qts., the latter being added after the Bordeaux has been prepared.

A power sprayer with a pressure of not less than 200 lb. must be used (or 250 lb. in the case of a spray gun). The use of spray rods is recommended.

LUDWIG (C. H.). **The control of angular leaf spot of Cotton.**—*Phytopath.*, xii, 1, pp. 20–22, 1922.

During 1921 a second test of Rolfs and Faulwetter's method for the control of angular leaf spot of cotton (*Bacterium malvacearum*) was carried out at the South Carolina Experiment Station. The treatment consists in stirring the seed in strong sulphuric acid until the lint is removed, washing, sterilizing for about ten minutes in 1 in 1,000 solution of mercuric chloride, washing again, and drying. The seed used in the trial was of the Cleveland Big Boll variety, and was severely attacked by leaf spot. It was found that the disease was excluded from the plots planted with treated seed until the parasite had had time to enter from outside. In the untreated control plots the percentage of infection ranged from 24·2 to 85·3. Recent Arkansas observations indicate that the disease may be transmitted from infected to healthy fields by labourers passing from the one to the other. In the absence of infection from outside the treatment of the seed with sulphuric acid and mercuric chloride appears to give absolute control of angular leaf spot.

COOK (O. F.). **Causes of shedding in Cotton.**—*Journ. of Heredity*, xii, 5, pp. 199–204, 4 figs., 1921.

The shedding of floral buds and bolls is a consequence of abortion, the danger of which must be recognized in the breeding of varieties, as well as in the choice of cultural methods. While any injury to the buds or young bolls, or any external condition that inhibits their development, may be a cause of shedding, there is no doubt the primary causes are genetic and physiological. The normal method of shedding is by disarticulation, i. e. unjointing of the socket where the base of the pedicel is inserted on the fruiting branch. Lloyd's studies (Environmental changes and their effect upon boll-shedding in Cotton, *New York Acad. Sci.*, xxix, pp. 1–131, 1920) show the lack of a structurally specialized abscission layer, but this does not justify the statement that 'the position of the abscission layer is not predetermined by any anatomical relations, but is an expression of a purely physiological phenomenon'. On the contrary, it appears that abscission has a very definite morphological position, occurring always at the same place in the socket or insertion of the pedicel.

Considering that pedicels represent internodes, the sockets are the nodal points, where unspecialized, embryonic tissues would be expected. The articulation is marked on the surface by a minute groove, and by the absence of oil-glands from a short ring of nodal tissue.

With sockets of the normal circular, or transversely elliptical form, the pedicels often begin to tear at the base while the buds and their enclosing involucres are still fresh and turgid. The buds may wilt on partial detachment or fall with scarcely any sign of withering. A gap is at once formed between the separating tissues of the pedicel and the socket, this relaxation of tension indicating that the socket was too large for the base of the pedicel. In such cases enlargement of the sockets, rather than shrinkage of the pedicels, would seem to give the mechanical stimulus for shedding. The inhibition of the growth of the floral buds or young bolls during the development of the vegetative framework would explain the enlargement of the sockets in proportion to the pedicels. The growth of the fruiting-branch internodes must continue in order to support more internodes, buds, and bolls further out on the branch. Shedding of buds is much less frequent with Egyptian than with Upland cotton, but over-luxuriant conditions may force abortion even in the Egyptian type.

In certain cases the pedicel is not inserted on a normal rounded socket, but runs down the internode of the fruiting branch by a decurrent base. In such cases shedding is replaced by a condition of 'blasting' in which the withered buds may remain attached to the plant, simulating a disease. It is not a true disease, however, but due to a hereditary malformation of the pedicel.

The above observations do not detract from the importance of other causes of shedding such as mechanical injury, pests, diseases, and unfavourable climatic and soil conditions. According to Lloyd, shedding follows more rapidly and regularly upon mechanical injury than upon weevil attack. Excessive shedding in brachytic varieties is explained by the same authority on the basis of 'competition between bolls for water', but a genetic factor is clearly indicated, since one may find plants aborting all their buds while their neighbours yield good crops.

Dowson (W. J.). **On the symptoms of wilting of Michaelmas Daisies produced by a toxin secreted by a Cephalosporium.**—*Trans. Brit. Mycol. Soc.*, vii, 4, pp. 283–286, 1922.

The present paper is an account of the experiments undertaken by the author at Wisley in the autumn of 1920 in the investigation of the secretion of a toxic substance by a fungus which causes a serious and widespread wilt disease of Michaelmas daisies, and which for the present is regarded as a species of *Cephalosporium*. The complete account of the investigation of the disease, including the morphology of the parasite, is left over for a further paper.

Distilled water containing aster stems was used for growing the fungus. After some weeks the liquid was filtered through a Berkefeld filter, and healthy shoots of Michaelmas daisy inserted in small glass bottles containing it. Controls of boiled tap-water were used. After three days the wilting was complete, the symptoms resembling those of the disease as induced by inoculating with the fungus. The controls remained unchanged for ten days.

In a second series the filtered fluid was dialysed through goldbeater's skin into boiled tap-water, and similar but even more rapid results were obtained.

In a third set of experiments mesophyll cells of healthy leaves were placed in hanging drops of the filtered liquid. Changes in the chloroplasts were noticed after twenty-four hours, and by the sixth or seventh day they were collected into an irregularly-shaped, bright yellow mass at one or both ends of the cells, while plasmolysis was setting in.

It is concluded that the symptoms of the disease are due to the action of a crystalloid toxin, secreted by the fungus, on the assimilating tissue. Resistant varieties were equally affected by the toxin, and are believed to owe their resistance to interference with the growth of the fungus.

WILTSHIRE (S. P.). **The Michaelmas Daisy disease.**—*Ann. Rept. Agric. & Hort. Res. Stat. Long Ashton, Bristol, for 1921*, pp. 74–76, 1 fig., 1922.

A number of inoculation experiments were carried out on stems of Michaelmas daisy plants in pots, the fungus used being in several cases the original strain first isolated from wilted plants at this station in 1920 (*Long Ashton Rep. for 1920*, pp. 84–85, 1921) The inoculations were done through stem wounds. The earliest symptom of infection was noticed from eighteen to thirty days after inoculating as a reddish-yellow discoloration of the leaves on the main stem of the inflorescence. This was followed by the withering of some leaves of the flowering shoots. The affected shoots were frequently confined to the side of the inflorescence above the inoculation. Ultimately the whole shoot died and young shoots sprang up from the base exactly as occurs in natural infections. A fungous mycelium similar to that used in the inoculations was recovered from the dead stems.

The fungus originally isolated is therefore the probable source of the disease, but it was decided fully to establish its pathogenicity before naming it. No differences between it and the fungus reported by Dowson in a similar disease [see last abstract] were apparent in an isolation of proved pathogenicity received from him.

CHABROLIN (M.). **Le dépérissement des Abricotiers dans la Vallée du Rhône.** [The dying off of Apricots in the Rhone Valley.]—*La Vie agric. et rurale*, xx, 24, pp. 415–416, 1922.

Various methods are being tested with a view to saving the apricot trees of the Rhone Valley, which have been dying in great numbers of recent years [see this *Review*, i, 6, p. 180]. The diseased condition is reported to be extending to fresh areas, which points to the spread of infection from affected trees. Dead trees should be removed immediately, and many growers recommend that any trees which shed their leaves prematurely or have yellow terminal shoots should also be cut out. The removal of affected branches is advantageous, provided the wounds are dressed with an antiseptic solution.

Attempts are in progress to raise trees from seed, but so far the results are not very encouraging. Treatment with a copper bouillie (Michel Perret 2 per cent.) gave good results in one case, but applications of a mixture made up with copper sulphate 2 kg., lime 1 kg., casein 50 gm., and water 100 litres, appear to have been useless against *Monilia*. Spraying with lime-sulphur is recommended.

BROOKS (C.), COOLEY (J. S.), & FISHER (D. F.). **Experiments on the use of oiled fruit wraps for the control of Apple scald.**—Abs. in *Phytopath.*, xii, 2, p. 103, 1922.

Further tests have confirmed previous results showing that scald can be controlled under the most unfavourable storage conditions by wrapping apples in paper infiltrated with oils which absorb the respiration gases. An odourless and tasteless type of oil has been found which does not cause any tainting of the fruit.

Scald can be arrested or reduced after several months' storage by substituting oiled paper for the common paper wraps, and it was also found that if the fruit was first stored in oiled paper, scald did not result when it was repacked in common paper after a month.

WILTSHIRE (S. P.). **Canker control trials.**—*Ann. Rept. Agric. & Hort. Res. Stat. Long Ashton, Bristol, for 1921*, pp. 70–73, 1922.

Further spraying trials were carried out in 1921 on a highly susceptible apple seedling, Kingston Black × Médaille d'Or. Owing to the abnormally dry summer, however, the amount of infection was very slight, which lessened the value of the tests. The first spraying, with copper stearate, was given on 3rd February, and a second, with Burgundy mixture, on 1st April. Ten shoots on each of five trees were sprayed, ten others being kept free from spray as controls. There were more cankers on the sprayed branches than on the controls (16 to 9), but the number in both cases was negligible as compared with 1920 (179 to 500 on a smaller number of larger branches). It is probable that a wet atmosphere is of even greater importance than wet soil conditions in the production of canker, though earlier experiments (of which details are given) have shown that the latter is an important factor, influencing both the number and the rate of growth of the cankers.

A further experiment was made on a large scale in a mixed plantation of young bush apples which were sprayed with Burgundy mixture in December 1920. The number of leaf-scar infections visible in November 1921 on both treated and control trees was small compared with that usual in a rainy year. One striking feature of this experiment was the number of cankers developing from old cankers imperfectly excised (seventeen in the sprayed trees and twelve in the controls). This emphasizes the necessity for thorough cutting out, the only really safe plan being to cut well into the healthy wood, in order to ensure complete removal of the fungus. Omitting cankers on the 1921 wood, there were 54 on the control trees (60 trees of 20 varieties) against 34 on the same number, of the same varieties, sprayed. Certain varieties were much more severely attacked than others.

WHITE (E. W.). **Apple tree anthracnose or black spot canker control.**—*Scient. Agricult.* (*Canada*), ii, 6, pp. 186–191, 3 pl., 1922.

This disease [fungus not named, but presumably *Neofabraea* *malicorticis* (Cord.) Jackson] is prevalent in the coastal regions of British Columbia. As a result of several years' experiments, the author finds that the disease can be controlled, and recommends pruning out all dead wood in July and August, and spraying early varieties with 3–4–40 [Imperial gallon] Bordeaux as soon as the fruit is picked. For medium late varieties, spraying with 1–1½-40 Burgundy in late August, and with 3–4–40 Bordeaux as soon as the fruit is picked, is recommended. For late varieties an application of 3–4–40 Bordeaux in late August is considered sufficient.

WORMALD (H.) & GRUBB (N. H.). **Notes on the control of nursery stock against crown gall.**—*Gard. Chron.*, lxxi, p. 198, 1922.

The results of experiments carried out at East Malling Research Station, on certain types of Paradise apple stocks known to be very susceptible to crown gall, may be summarized as follows: the galls occurring on the base of the stock were distinctly larger where the stocks had been roughly torn from the stools than where smoothly cut with a knife. Covering the wound, before planting, with Stockholm tar or grafting wax, especially the former, reduced the number and size of the galls but also appeared to injure the roots to some extent. Probably this was largely due to the poor rooting of these stocks. Stocks planted with their bark severely bruised showed after two years' growth a considerable proportion with galls on the main stem above the base, while uninjured stocks were practically free. Many of the cut roots bore small galls at the cut ends.

LEE (H. A.). **Banana freckle in the Philippine Islands.**—*Phytopath.*, xii, 2, pp. 101–102, 1 fig., 1922.

Green and mature banana fruits in public markets in the Philippines are commonly spotted with reddish-brown to black spots. The leaves may also show similar spots, and are often streaked and roughened by the disease. The spots bear pycnidia and the spores resemble those of *Phoma musae* Carpenter, as described from Hawaii. Attempts to culture the organism failed. The disease is much more abundant at the close of the wet than during the dry season. It is prevalent also in the Sulu Archipelago and in the island of Mindanao. It is considered probable that the disease reached Hawaii from the Philippines.

ZELLER (S. M.). **Die-back of Loganberry in the Northwest.**—Abs. in *Phytopath.*, xii, 2, p. 104, 1922.

Die-back was found where the canes were left hanging down during the winter, but not where they were trained up in the autumn. *Mycosphaerella rubina* is sometimes present, but it is considered that the canes are devitalized by the extremely moist conditions to which they are subjected during the winter, rather than by the effects of any parasitic organism or low temperatures.

SIEGLER (E. A.) & JENKINS (A. E.). **A new Sclerotinia on Mulberry.**—*Science*, N. S. lv, pp. 353–354, 1922.

Sclerotinia caruncuIoides n. sp. is described on fruits of cultivated *Morus alba* from Scranton, S. Car. The fungus produces a disease characterized by the enlargement of portions of the fruit.

MAFFEI (L.). **Una malattia della foglia del 'Kaki' dovuta al Colletotrichum kaki n. sp.** [A leaf disease of the 'Kaki' due to *Colletotrichum kaki* n. sp.]—*Riv. Patol. Veg.*, xi, 9–10, pp. 116–118, 1921.

For some years past, a hitherto undescribed leaf disease of the persimmon has been observed in the Botanic Garden at Pavia on specimens of *Diospyros kaki* L. var. *kiombo*. In 1921 the disease appeared with particular virulence, scarcely a leaf being free from it. The author thinks that this outbreak may have been favoured by a hailstorm which injured the leaves in July that year. Other varieties of persimmon in the vicinity were not affected.

The disease is characterized by hazel spots originating nearly always at the margin or at the apex of the leaves, and progressing towards the centre with the formation of concentric rings. The major portion of the leaf is invaded, dries up, and becomes brittle, and the whole leaf finally falls. The spots stand out very vividly on the intense green of the leaf. As they increase and coalesce they alter the shape of the leaf and give it a contorted, almost knotty, aspect. In association with the concentric markings, numerous acervuli, varying from 90 to 160 μ in diameter, burst through the epidermis and liberate a great number of cylindrical, hyaline, granular, sometimes guttulate spores, 18 to 21 μ long by 4 to 7 μ broad, borne on densely crowded basidia. From the stromata stand out numerous, pointed, brown, septate hairs, 100 to 180 by 4·5 μ, which traverse the hymenial stratum.

The author proposes to call the disease 'kaki leaf spot', and the causal organism *Colletotrichum kaki* n. sp., a Latin diagnosis being appended. He is, however, doubtful whether it is distinct from *Gloeosporium kaki* Seiya Ito, which he found on the same plants.

CERASOLI (E.). **Intorno alla solubilizzazione dei composti cuprici anticrittogamici sulla superficie degli organi verdi della Vite.** [On the solubility of fungicidal copper compounds on the surface of the green portions of the Vine.]—*Riv. Patol. Veg.*, xi, 5–6, pp. 70–72, 1921.

There is a very complete literature on the effect of Bordeaux mixture on *Plasmopara viticola*, but nothing definite is known concerning the solubility of the small quantities of copper contained in fungicides after being deposited on the green portions of the vine.

It is generally known that carbonic acid, ammonium carbonate, and nitric acid, in variable quantities, are always present in the atmosphere and in rain-water, and that these exert a solvent action on copper compounds. It is further generally admitted that some effect in dissolving the copper particles is exercised by special substances secreted by the leaves, such as ammonium compounds and organic acids, but Ruhland has demonstrated that in a healthy leaf the quantities available are so small as to be without practical effect.

The author's investigations with Bordeaux mixture and Bordeaux powder [see this *Review*, i, 3, p. 67] have led him to conclude that copper, under the influence of atmospheric factors, especially carbon dioxide, tends to become transformed into bicarbonate of copper, which would subsequently give rise to the formation of colloidal solutions of copper hydrate. Perhaps after a certain lapse of time and under favourable environmental conditions, the bicarbonates and the colloidal solutions of copper hydrate, combined in a certain chemical equilibrium, give rise to the formation of copper carbonates physically distinct from the ordinary carbonates, so that they cease to be influenced by the action of the carbon dioxide of the air, and colloidal solutions of copper hydrate are no longer generated. This would check the action of the fungicide on the development of the parasite.

On studying the action of copper in Bordeaux mixture and Bordeaux powder, the writer was able to establish the fact that leaves affected by mildew have an acid reaction. To prove this, leaves that were, respectively, healthy, slightly affected, completely withered, and covered with the characteristic white efflorescence of the fungus were immersed in glasses of distilled water, care being taken to cover the leaf blade only with the liquid. After some days of exposure to the air, it was found that only the water containing healthy leaves gave a neutral reaction, the reaction being more or less acid in the other cases. The acidity was most pronounced in the case of leaves covered with the white efflorescence. From this the conclusion is drawn that the solution of the copper salts is due to very weak acids or acid salts excreted by the parasite during its entry into the tissues. This pathological acidity would easily react on colloidal copper hydrates (but not so easily on copper carbonates formed as indicated above), giving rise to copper ions, to which the fungicidal action may be supposed to be due. When these acid substances do not find copper in the colloidal state on the green portions of the plant, they cause serious functional disturbances and alterations which upset the equilibrium of the physiological activity of the plant and bring about its death or at least the death of the leaves. It is perhaps for this reason that the green parts of plants require to be coated with a reserve of copper in the colloidal hydrate form, even before the spores germinate.

JØRSTAD (I.). **Oversikt over forsøkssprøitninger mot soppsykdommer i frukthaven i aret 1921.** [Survey of spraying experiments against fungous diseases of the orchard in the year 1921.]—*Norsk Havetidende*, xxxviii, 4, pp. 75–81, 5, pp. 108–112, 1922.

The experiments, which were carried out in different parts of the country, included tests with lime-sulphur and sulphur dust for the control of apple mildew. The dust contained a small quantity of calcium arsenate. The varieties treated were Gravenstein, White Astrachan, Virginian Rose, and Akerø. The results showed that dusting was only effectual when applied after the opening of the buds, and that it must on no account be substituted for winter spraying. A further disadvantage of dusting is that it requires absolutely calm weather. Apple mildew can be successfully controlled by three sprayings with lime-sulphur, one just before flowering, one immediately after flowering, and another later, preferably during the latter half of July. Apple rust [*Gymnosporangium juniperinum*] can be held in check simultaneously by these means.

Further experiments with 2 per cent. sodium chloride and lime, 1 per cent. formalin, lime-sulphur and gelatine, lime-sulphur alone, and lime-sulphur with nicotine-soap, showed that the best control of apple mildew was secured by the use of lime-sulphur with nicotine-soap. The sodium chloride solution seriously injured the foliage without arresting the development of the fungus.

Experiments in the control of *Monilia* on Morello and sweet cherries were carried out with lime-sulphur (winter strength), 2 per cent. copper sulphate, and 2 per cent. acid Bordeaux mixture. The results of these experiments were not very conclusive, but showed that a distinct increase in yield resulted from winter spraying.

LEDERLE (P.). **Gefällter Feinschwefel zur Bekämpfung des Mehltaues und anderer verwandter Pilze.** [Precipitated finely divided sulphur for the control of mildew and other allied fungi.]—*Mitt. der staatl. landwirtschaft. Versuchsanst. Augustenberg in Baden, Allg. Weinzeit.*, xxxix, 23, pp. 89–90, 1922.

The many drawbacks incidental to the use of powdered sulphur may be avoided by the following cheap and simple treatment:—Solution 1. 250 gm. hyposulphite of soda dissolved in $\frac{3}{4}$ litre hot tap-water. Solution 2. 250 gm. sodium bisulphate dissolved in $\frac{3}{4}$ litre hot tap-water. Solution 3. 10 gm. of glue dissolved in $\frac{1}{4}$ litre hot water. Solution 3 should be stirred while hot into solution 1. After diluting solutions 1 and 2 each with 4 litres of water, they should be mixed and allowed to stand for 3 to 18 hours, when they are ready for use. By this time the sulphur is precipitated in the form of milk of sulphur. The slightly alkaline mixture may be kept for a few days, but should if possible be used in the morning following the mixing of solutions 1 and 2. It has been successfully applied to vine mildew (*Oidium tuckeri*), rose mildew (*Sphaerotheca pannosa*), gooseberry, apple, and *Euonymus* mildews, and peach leaf curl (*Exoascus deformans*).

KUHL (H.). **De Haens kolloidaler flüssiger Schwefel als Spritzmittel gegen Pflanzenschädlinge.** [De Haen's colloidal liquid sulphur as a spray for plant diseases.]—*Chemiker-Zeit.*, xlv, pp. 479–481, 1921.

At the request of the German Pomological Society the author made an examination of the properties of the colloidal soluble sulphur mixture prepared by the firm of De Haen at Seelze. He found that in consequence of its fine dispersion the adhesiveness of the mixture was very great; milk of sulphur distributed over a slab formed a crust which did not agglomerate either in running or trickling water. Shrubs treated with the mixture withstood a fortnight of incessant rain.

Owing to the intensity of the oxidation promoted by this fine dispersion, leaf-burning was feared, but experiments proved that only in one case (that of the dog-rose) was this of any significance.

Other plants, e.g. vine, gooseberry, cherry, elder, and lilac, were not affected, or only very slightly. At the same time this rapid oxidation of colloidal sulphur should be borne in mind, as very careful handling is necessary. Colloidal sulphur bears the same relation to atmospheric oxygen as pyrophoric iron, which is self-inflammable.

The excellent biological effects of colloidal sulphur and its superiority to other preparations are due both to its great adhesiveness and increased chemical activity. The purely mechanical aspect is explained by the observations of Chrétien (1856), who found that exclusion of air killed the mycelium of the mildew fungus. This was illustrated by the behaviour of certain shrubs in a plantation attacked by mildew, those on the side adjoining the street being practically free from disease. The thick coating of dust which settled on them effectually excluded the air and destroyed the mycelium, without necessitating any kind of treatment. An analogous effect is produced by the dispersion of excessively fine particles of sulphur in the mixture under discussion.

From the chemical standpoint the action of the sulphur is intensified by heat, an increase of which in the case in point is produced by the rapidity of the reaction. The resulting formation of sulphur dioxide contributes to the fungicidal action of the mixture.

De Haen's colloidal sulphur may therefore be regarded as an instance of biological and practical co-operation, its efficacy depending on an increase of chemical activity as well as on its mechanical properties.

SKAIFE (S. H.). **Notes on some South African Entomophthoraceae.** *Trans. Roy. Soc. S. Africa*, ix, 1, pp. 77–86, 3 pl., 1921.

The material on which these notes are based was collected at Cedara, Natal, during 1919–20. The following species were observed: *Empusa muscae* Cohn on muscid flies. *Empusa conglomerata* Sorokin on imago of *Nephrotoma umbripennis* (Alex.). *Empusa grylli* Fresenius was first noticed on 10th January, 1920, on grasshoppers, and was extremely common until the end of March, impartially attacking several different species of Acridiids. *Entomophthora aphidis* Hoffman was first noticed at Cedara on 11th November, 1919, on a large green aphis on peas. It was common on certain species of aphids found on sweet peas, roses, maize, and *Datura stramonium* throughout the summer, serving as a very effective check on these pests. No specimens of the common cabbage aphis or of a black aphis frequent on chrysanthemums were found to be infected. *Entomophthora apiculata* Thaxter on Lepidoptera, imagines of *Lycophotia muscosa* Geyer (Noctuid), of an undetermined Geometrid, and of a Lycaenid, larvae of *Pachypasa capensis*; Diptera, imagines of a large Anthyomid fly and of *Nephrotoma unicingulata* Alex.; Coleoptera, imagines of *Trocalus fulgidus* Fabr. and of *Adoretus ictericus* Burm.; Hemiptera, adults of *Locris arithmetica*. During February and March 1920 this fungus killed large numbers of the beetles named above, the victims being found mostly on the trunks of wattle trees, fixed by means of rhizoids, with their wings partially spread. The fact that various hemipterous insects are liable to attack by Entomophthoraceae indicates that the host is infected by contact with the conidia, not by their ingestion as maintained by Hesse and others. *Entomophthora megasperma* Cohn on larvae of *Euxoa segetis* Schiff. The author thinks that in all probability Thaxter's *Entomophthora virescens* is identical with *Tarichium megaspermum* Cohn, in which case Cohn's name takes precedence of Thaxter's.

PETCH (C. E.). **Spraying** *versus* **Dusting.**—*Thirteenth Ann. Rept. Quebec Society for the Protection of Plants,* pp. 68–72, 1921.

Dusting has many advantages over spraying, one of the foremost being the rapidity with which it can be carried out. It is also most effective when applied in the early morning or in the evening, i.e. at times which do not interfere with the ordinary work of the farm. Spraying, on the other hand, requires the best of weather and the most important part of the day. The initial expense of purchasing a dusting outfit is about one-half that of a sprayer, and the upkeep is considerably less. Sprayer parts soon become corroded and worn out, but the chemicals in a dry state have little effect upon the duster.

The two outstanding advantages of dusting lie in the fact that fungous diseases develop most rapidly in weather that is suitable for dusting but not for spraying, and in the greater speed, which permits the rapid treatment of large areas. Another important consideration is the injury to foliage and fruit due to burning, which has so far been absent from the experiments with dusting, even with preparations containing as much as 15 per cent. arsenate of lead or 10 per cent. arsenate of calcium. The results of experimental work in New York, Michigan, Illinois, Nova Scotia, and Quebec show that dusting is as efficient as spraying in the control of apple scab and biting insects. Further trials will be necessary before a final decision can be arrived at with regard to the limitations of the two systems.

DICKSON (B. T.). **Studies concerning mosaic diseases.**—*Macdonald College, Canada, Tech. Bull.* 2, 125 pp., 8 pl. 1922.

The plants so far found recorded in the literature as subject to mosaic disease number 96, including mosaic recorded for the first time by the author on *Pisum sativum*, *Trifolium hybridum*, *Medicago lupulina*, and probably on *M. sativa*. Of these plants, 30 belong to the Solanaceae, 20 to the Cucurbitaceae, 18 to the Leguminosae, and 7 to the Gramineae, the other 21 plants being distributed through 17 families.

The symptoms shown by plants with mosaic are discussed in detail. Conditions which affect the growth rate of the plants modify the symptoms of the disease; temperature plays an important part, and under certain temperature conditions the symptoms may be masked. Diseased plants may show a great reduction, not only in the amount of seed produced, but also in the germinating power of such seed as is developed.

The histology of the tissues of healthy and affected tobacco, tomato, petunia, potato, black henbane (*Hyoscyamus niger*), pepper, sweet pea, kidney bean (*Phaseolus vulgaris*), broad bean (*Vicia faba*), clovers, Canada field pea (*Pisum sativum*), and raspberry is described. It was found that in all cases the following histologic modifications occur in affected leaf tissues: (1) Hypoplasia in the lighter green areas, manifest especially in the palisade tissue, but present also in the spongy mesophyll cells, and making such areas about one-third less in thickness than the darker green areas. (2) Reduction in intercellular space volume of these lighter areas. (3) Reduction of chlorophyll content of these cells because of fewer chloroplasts, less chlorophyll per plastid, or breaking down of plastids. (4) The presence in these cells of secondary contents derived from degenerated plastids and, possibly, cytoplasm. (5) Small hyaline bodies, apparently derived from fragmented plastids, are often found in the diseased chlorenchyma. These bodies are in a state of rapid motion, possibly as a result of the presence of invisible, rapidly moving bodies. (6) Reduction in area covered by each epidermal cell over hypoplastic chlorenchyma, but by growth these epidermal cells become either deeper than normal, or develop more trichomes than normal. (7) The transition from hypoplastic to non-hypoplastic tissue is sudden except in slightly affected leaves, and occupies a lineal space of only three or four palisade cells. (8) Under adverse conditions the most hypoplastic tissues may die and thus give rise to brown flecks. (9) The darker green areas are more or less hypertrophied, with more intercellular space, and greater chlorophyll content, than in normal leaves, and such areas are covered with epidermal cells that are larger in area than normal.

Such modifications as result from mosaic in plant parts other than leaves (for example, in the fruits of tomato, pepper, or bean, or sometimes in the stem of tobacco) occur in the chlorenchyma and are similar in nature to the changes in the leaf. Hypoplastic areas may occur in the floral parts of diseased tobacco, petunia, and sweet pea, but in general mosaic affects chlorenchymatous tissues, and the plants become more or less dwarfed in correlation with the duration and severity of infection. In the mosaic diseases studied by the author, no modifications of vascular tissues comparable with those described for leaf roll of potatoes and for sugar-cane and maize mosaic were found.

In considering the aetiology of mosaic, the bacterial, enzymic, virus, and 'amoeba' theories are reviewed. The author has not found amoeboid bodies such as Kunkel described [see this *Review*, i, 6, p. 194], but has found, in free-hand sections of leaves in advanced stages of mosaic, small bodies having an erratic movement and suggesting flagellates, among the hyaline bodies in spongy mesophyll cells and in trichomes. No definite proof that they were flagellates was obtained from non-living sections, nor could protozoan organisms be isolated. A bacterial flora is almost invariably present in diseased leaves. In sections of tobacco killed in a concentrated alcoholic solution of mercuric chloride and stained by the Giemsa method, minute dark-staining bodies, 0·3 μ long and slightly less in width, were found, sometimes in great numbers, in the border parenchyma of the vascular tissues of diseased leaves; these bodies were not found in healthy leaves. They were also observed in close contact with the walls of the chlorenchyma cells, and in some cases surrounded the chloroplasts.

These are apparently the same bodies observed by Ivanovski and others, and while they may be secondary, it is possible that they may be akin to the Chlamydozoa described in virus diseases of animals and man. Attempts to isolate and culture these bodies on gelatine or agar failed, but in bouillon there developed from bits of hypoplastic tissue of tobacco, after surface sterilization, minute organisms, sometimes in zoogloeae and sometimes in *Streptococcus*-like chains. Inoculations with 0·5 c.c. of this bouillon were made, and in twelve of fifteen plants typical mosaic developed after eighteen to twenty-one days. The author recognizes, however, that some 'virus' as well as the *Streptococcus*-like organism may have been present. Similar bouillon cultures were made from 0·1 c.c. of plant juice diluted 100 times and passed through a Chamberland F filter; slight turbidity was apparent after four days at room temperature, and infection occurred in all plants inoculated.

The experiments of Lodewijks concerning the relation of coloured light to mosaic were repeated under more exact conditions. Lights of different wave-length were found to exert some influence, by enhancing (green light) or masking (blue light) the symptoms, but the effects are probably caused by alterations in the growth rate, etc., of the plants, rather than by an effect upon the causative agent of the disease. Extracted sap from diseased tobacco plants remained virulent after exposure to lights of different colour. Extended freezing, however, reduced the virulence of the filtered juice from diseased plants.

The aphid *Macrosiphum pisi* Kalt. was shown to transmit mosaic between *Trifolium pratense*, *T. hybridum*, *T. repens*, *T. incarnatum*, and *Medicago lupulina*, and cross-inoculations with expressed juice from diseased plants were also successful between these hosts. In one case, mosaic was transferred by the above aphid from *Trifolium pratense* to *Medicago sativa*. Raspberry mosaic is also transmitted by aphids, probably *Aphis rubiphila*. Cross-inoculations between the clovers and *Pisum sativum* or *Phaseolus vulgaris* were unsuccessful, except in the case of one plant of *T. hybridum* which was infected from *P. sativum*.

Seed inheritance of mosaic was found to occur in *Pisum sativum*, *Trifolium pratense*, *T. hybridum*, *Melilotus alba*, and probably in *Hippeastrum*, but was not found to occur in raspberry.

A discussion of mosaic of raspberry is included, the disease being differentiated from 'yellows' or 'curl'. Streak and leaf drop of potatoes are noted as regards the possible relation of these diseases to potato mosaic.

The literature (153 titles) is summarized under the various topics discussed. The plates were made from contact photographs of mosaic leaves and from drawings to show the histological details of diseased and normal tissue.

PALM (B. T.). **De Mozaiekziekte van de Tabak een Chlamydozoonose? (Voorloopige mededeeling.)** [Is the mosaic disease of Tobacco a Chlamydozoonose? (Preliminary note.)]—*Bull. Deliproefstat. te Medan-Sumatra*, 15, pp. 1–16, 1922. [With English translation.]

The results of previous work by other investigators in connexion with the cause of mosaic are briefly referred to. While it has been classed amongst 'degeneration diseases' by some, and ascribed to enzymic action by others, a third group has adhered to the view that the disease is due to an ultramicroscopic organism, or at least to one not rendered visible by the usual staining agents. Since 1903, when Ivanovski found a very small bacterium, which could be filtered from tissues of tobacco affected with mosaic, no work undertaken in accordance with modern cytological methods is known to the author; the present paper gives the result of some investigations carried out by such methods. The material studied was taken from diseased plants of the Deli variety, grown at Medan; the fixing fluids employed were Flemming's mixture in various concentrations, hot alcoholic sublimate, and Zenker's fluid; while Heidenhain's haematoxylin, eosin, and Loeffler's methylene blue were used for staining.

In many of the cells of the mosaic tissue, fairly large, peculiarly shaped, frequently amoebiform, less frequently round to spherical corpuscles were found either in intimate contact with the nucleus or in its immediate vicinity. Sometimes more than one such body is present in a cell. Other very small granules of varying size may also occur, either alone or in association with the larger bodies described. The larger corpuscles are generally reticulate, but sometimes appear to be almost without definite structure; one or more spaces resembling vacuoles are now and then visible. In well-stained sections it is generally possible to see a small number of granules in the corpuscles. A membrane does not appear to be formed. Seeing that these cell inclusions are entirely absent from the cells of the healthy tissues, it is natural to connect them with the disease.

The larger corpuscles stain grey with haematoxylin, and are light red with eosin; they are also very clearly seen in unstained preparations of living material (especially in the hairs on the diseased portions of the leaves), and have much the same appearance as in the fixed preparations. They are denser and more opaque than the surrounding cell plasma. They do not seem to possess automotive power, though the normal movement of the plasma may displace them at times.

The smaller granules, which have a maximum size of $0\cdot5\ \mu$, occur chiefly during the later stages of the disease. They stain blackish with haematoxylin after fixation in Zenker's fluid, and light blue with Loeffler's methylene blue. They frequently lie in irregularly-shaped groups in the cell plasma, sometimes completely filling the lumen. While sometimes rounded in shape, they are generally of greater length than breadth, and some, evidently in a process of division, are drawn out in the centre. Larger granules—up to about $1\cdot5\ \mu$—were seen in other cells, but the author was unable to determine whether these were normal cell constituents, or products of reaction of diseased cells, or stages in the development of the smaller bodies. The nucleus in diseased cells is often hypertrophied, and may show symptoms of degeneration.

The author's observations agree on the whole with those of Ivanovski. The latter believed that the diminutive granules found in the cells of tobacco plants affected with mosaic were bacteria, and that the larger corpuscles were products of the reaction of the cell plasma to infection. Palm, however, points out that the small bodies agree in every respect with the so-called Chlamydozoon-Strongyloplasma or 'elementary corpuscles' of von Prowazek and Lipschütz, found in certain of the filterable virus diseases of animals and man. The larger amoebiform bodies are considered as homologous with the so-called corpuscles of Guarnieri associated with variola. It is, therefore, suggested that mosaic disease of tobacco belongs aetiologically to the Chlamydozoonoses, and the author proposes the name *Strongyloplasma ivanovskii* n. sp. for the presumed organism described above.

McDougall (W. B.). **Mycorrhizas of Coniferous trees.**—*Journ. of Forestry*, xx, 3, pp. 255–260, 3 figs., 1922.

The present paper is based on materials collected by Dr. Barrington Moore at Bar Harbour, Mount Desert Island, Maine, in October 1921. The collections included mycorrhiza from *Picea rubra*, *Abies balsamea*, and *Pinus strobus*, together with fruit bodies of the mycorrhizal fungi of the first two.

The fruit bodies in both cases were species of *Cortinarius* which are described but not named. According to the collector, that from *Picea rubra* also forms mycorrhiza on balsam fir, yellow birch, and possibly other trees. Several species of *Cortinarius* have already been reported as forming mycorrhiza, e. g. *C. callisteus* on pine, *C. caerulescens* on beech, and *C. fulmineus* on oak (Noack), *C. rubipes* on *Quercus rubra*, *Acer saccharum*, and *Celastrus scandens* (Kauffman), and *Cortinarius* sp. on *Betula alba* var. *papyrifera* (McDougall). The present report, however, is believed to be the first authentic determination of a mycorrhizal fungus on *Picea*.

The mycorrhiza of this tree are bright yellow owing to the colour of the mycelium. They are very small and do not form coral clusters as a rule. The fungus mantle appears to be rather loose; the fungus layer thin and not very compact. Microscopic examination showed that the fungus had penetrated between the first, and often also the second, row of cortical root cells, but the latter were not elongated.

The fungus of *Abies balsamea* is believed by the collector to form mycorrhiza also on spruce and white pine. The *Abies* mycorrhiza are very similar to those of *Picea rubra* except in colour, which is white. The relatively thin and loosely constructed mantle appears to be somewhat characteristic of mycorrhiza caused by species of *Cortinarius*.

The material from *Pinus strobus* consisted of two seedlings with several peculiar nodules on their roots, resembling the tubercles on the roots of leguminous plants. The nodules were pale yellowish or buff colour, 1 to 4 mm. in diameter. They are apparently very uncommon, since the collector examined numbers of *P. strobus* roots from which they were absent.

The author believes that no such structures have been described in previous literature. 'Coral' clusters of mycorrhiza, containing large numbers of rootlets, are familiar on the roots of spruce, oak, and hickory. In the present instance, however, the rootlets are bound together by the mycelium into a compact tubercle. The character of the fungous tissue is similar to that of many other ectotrophic mycorrhiza. The formation of the tubercles, therefore, may have been due to an unusually luxuriant growth of the mycelium, possibly characteristic of the species of fungus concerned, or due to exceptionally favourable vegetative conditions. No sporophores were found, so the identity of the fungus symbiont remains uncertain.

The author considers that there is no evidence to support the old theory that the ectotrophic mycorrhizal fungi assist the host plants in the absorption of nutriment from the soil, and states that the consensus of opinion among recent workers is that the higher plants receive no benefit whatever from the association, which represents an instance of 'antagonistic nutritive conjunctive symbiosis'. Though in ordinary cases the host plant is not seriously injured by the association, any unusual abundance of the mycorrhiza may interfere to a considerable degree with the functions of the root system. It is now believed that the mycorrhizal fungi produce their fruit bodies soon after they have fully established relations with the host plant. It seems probable, therefore, that the mycorrhiza is, in a sense, a substitute for the sclerotium. Possibly the tubercles described in this paper are due to a greater tendency to sclerotium formation in the fungus concerned than is usual with mycorrhizal fungi.

SMITH (C. O.). **Some studies relating to infection and resistance to Walnut blight.**—*Monthly Bull. Dept. Agric. California*, x, 9, pp. 367–371, 1 fig., 1921.

Walnut blight is caused by the yellow chromogenic organism *Pseudomonas juglandis* Pierce, which attacks the leaves, nuts, catkins, and tender shoots of *Juglans regia*. The only known sources of infection are the old blight lesions, where the organism hibernates and under favourable conditions appears on the surface in a bacterial exudate. It may then be transported by different agencies to the foliage, where it causes new infections. It was recently demonstrated that the walnut blight organism may occur on the surface of both the leaf and catkin buds before the beginning of their spring growth. The old lesions on the trees were the only sources from which the organism could have come in these cases.

Inoculation experiments showed that dormant buds do not often become infected until visible new growth has appeared. Fog, dew, and late rains are important factors in the spread of the disease, which is probably also disseminated to some extent by insects and pollen. The diseased catkin shows a mass of blackened, watery, flower clusters, usually not expanded, while the rachis is also often blackened, and may be bent or twisted. The organism has been isolated from diseased catkins and pollen from such catkins in spring.

Careful experiments have been undertaken to ascertain whether or not the soil may be a source of blight infection. Tests were made in sterilized and unsterilized soil, and the observations are in close agreement with those of Lee and Fulton in their study of the relationship of soil to the citrus-canker organism (*Journ. Agric. Res.*, xix, 5, pp. 189–204 and 207–234, 1920). Both in sterilized and unsterilized soils the number of colonies in the dilution-plates begins to decrease after twenty-four hours' incubation of the soil at 20° C., and at the end of six to nine days the organism was not isolated from unsterilized inoculated soil, while in the sterilized soils it was isolated after eighteen but not after twenty-five days. These preliminary results indicate that the soil is not a medium of infection.

Tests of several commercial varieties of walnuts, as well as orchard observations, show that Ehrhardt is less susceptible than Placentia and Seedlings.

ARMSTRONG (G. M.). **Studies in the physiology of the fungi. XIV. Sulphur nutrition: the use of thiosulphate as influenced by hydrogen-ion concentration.**—*Ann. Mo. Bot. Gard.*, viii, 3, pp. 237–281, 21 figs., 1922.

The author used *Aspergillus niger*, *Penicillium glaucum*, *P. cyclopium*, and *Botrytis cinerea* in cultures at various hydrogen-ion concentrations in order to determine certain phases of sulphur metabolism of these fungi.

The following compounds proved, in general, favourable sources of sulphur, in the order named: $MgSO_4$, $Na_2S_2O_3$, $MnSO_4$, KSH, $KHSO_3$, $K_2S_2O_8$, KCNS, NH_4CNS, K_2S. The fungi produced H_2S except when $MnSO_4$, $MgSO_4$, or $K_2S_2O_8$ was used, and regardless of the hydrogen-ion concentration, concentration of the salt, or relative degree of growth. When $Na_2S_2O_3$ was used, sulphates were the chief end products of its decomposition, although H_2S and tetrathionate also may occur, and sometimes molecular sulphur, or globules of sulphur in the hyphae, were found.

The reaction of the medium may change during the growth of the fungi. With *Aspergillus niger* the acidity increases (and may reach P_H 1·5), but when the sugar in the medium is used up the reaction reverses. *Penicillium cyclopium* may cause a reversion of the reaction with sugar present in the solution. The course of the changes occurring in the medium cannot be determined merely from a determination of the initial and final hydrogen-ion concentrations.

WEBB (R. W.). **Studies in the physiology of the fungi. XV. Germination of the spores of certain fungi in relation to hydrogen-ion concentration.**—*Ann. Mo. Bot. Gard.*, viii, 3, pp. 283–341, 39 figs., 1922.

The author tested the germination of the spores of *Aspergillus niger*, *Botrytis cinerea*, *Colletotrichum gossypii*, *Fusarium* sp. (from a cotton boll), *Lenzites saepiaria*, *Penicillium cyclopium*, *P. italicum*, and *Puccinia graminis* in various nutrient solutions at different hydrogen- and hydroxyl-ion concentrations.

C. gossypii spores germinated best in an alkaline medium, and *Fusarium* sp. showed as great or greater germination on the alkaline side as on the acid side, but the other fungi tested gave the best spore germination under conditions of active acidity, usually exhibiting a maximum at P_H 3·0 to 4·0, sometimes with a secondary maximum in the vicinity of P_H 7·0. Spore germination with all the fungi occurred over a wide range of hydrogen-ion concentration;

with most of the fungi the percentage of germination did not fall off greatly on the acid side until P_H 2·5 to 1·5 was reached, when the decrease in germination was abrupt. There was a more gradual and diverse relation on the alkaline side, but most of the fungi showed germination up to P_H 9·0, and in several cases germination occurred at P_H 10·0. *C. gossypii* germinated but poorly at greater acidity than P_H 3·0 to 4·0, while *L. saepiaria* showed little germination on the alkaline side, i. e. little or no germination usually occurred in greater alkalinity than P_H 7·0 to 8·0. The medium in which the spores are placed sometimes markedly affects their germination in relation to hydrogen-ion concentration: sugar-beet decoction, for example, seems to possess some substance or set of conditions which stimulates germination. The method of germination was also affected by the medium: *C. gossypii* germinated by the production of secondary spores instead of germ-tubes in peptone solution; this does not appear to depend upon the hydrogen-ion concentration.

A change in the reaction of the medium may or may not occur during germination. A medium in which some spore germination will occur is not necessarily a good medium for mycelial growth; thus the germ-tubes of *B. cinerea* disintegrated at P_H 2·1. The germ-tubes in other cases were often irregular or abnormal in strongly acid or alkaline solutions.

Neither an extension of the time during which germination was allowed to proceed nor a temperature range of 4 to 5° C. above or below a provisional optimum affected the curve of percentage of spore germination in the various solutions.

A few tests were made with spores of *Ustilago avenae*. In mannite solutions germination occurred at concentrations from P_H 2·4 to 8·2 with a maximum at P_H 6·2. Sporidia were formed most abundantly from P_H 5·4 to 7·0.

Conidia of *Sphaerotheca pannosa* failed to germinate in any of the solutions tested, whether the trials were made with fresh conidia or with conidia subjected first to low or freezing temperatures.

De Bruyn (Helena L. G.). **The saprophytic life of Phytophthora in the soil.**—*Meded. van de Landbouwhoogeschool, Wageningen*, xxiv, Paper 4, pp. 1–38, 2 pl., 1922. [English, with Dutch summary.]

From a survey of the literature the author concludes that most species of *Phytophthora* can develop as saprophytes in the soil. Amongst the species of which the life-history is more or less fully known, *P. fagi, cactorum, nicotianae, syringae, parasitica. terrestria, cryptogea, erythroseptica,* and *arecae* have been proved by other workers to be present in some form in soil, while this has not been established in the case of *phaseoli, colocasiae, infestans, faberi,* and *meadii*. Reasons are given for the statement that previous work does not exclude the possibility that the latter (except *meadii*) may be present in the soil, or at least that their life-histories may at times include a soil stage.

The author worked with *Phytophthora syringae, erythroseptica,* and *infestans*, which were grown in culture on different types of sterilized soil in test-tubes. *P. syringae* infected lilac after having lived as long as two years on bog-soil. Conidia and a few oospores were formed in the various types of soil inoculated. *P. erythroseptica* formed many oospores and considerable aerial mycelium in soil culture, but produced conidia only when drops of water were present. Pink rot of potato tubers was produced upon inoculating from cultures which had grown continuously on soil for one and a half years. With both these species the fungus was still viable in soil in test-tubes after having grown without transfer for one year. On the soils tested *P. infestans* grew best on clay and bog soil, less well on leaf-mould, and rather poorly on sand. This experience may be correlated with the fact that potato blight is more severe in clay than in sandy soil. Considerable aerial mycelium and many conidia may be produced during the saprophytic growth of this fungus in soil. If a culture on raw potato be covered with sterilized soil, the mycelium can grow through the soil and reach the surface. Water which had been poured over fruiting cultures of *P. infestans*, and consequently contained conidia and some hyphae, was poured over sterilized soil: conidiophores were subsequently found arising from the soil, and sometimes a luxuriant mycelial growth appeared. Thus the common conception that potato tubers are infected in the soil by conidia that have percolated down to them with a current of water need not be maintained; the fungus can reach the tubers by growing through the soil. The fungus was still able to infect living pieces of potato tuber after having lived on clay alone for eleven months.

P. syringae and *P. erythroseptica* overwintered on soil and other media in tubes left out of doors during the winter both in 1920–21 and 1921–22, the former species in mycelial condition, the latter apparently only as oospores. During these winters the cultures were subjected to temperatures occasionally as low as $-12°$ C., and sometimes for considerable periods below 0° C. *P. infestans* withstood an exposure of nine days during which the temperature reached $-9°$ C., and an exposure out of doors from 15th January, 1921, until the following spring, during which the temperature fell below 0° C. on eight nights; but cultures on various media placed outside in October 1921 could not be revived in December or thereafter, having perhaps been killed by severe frosts from 27th November to 6th December. It is therefore uncertain whether this fungus can overwinter in the soil, especially in regions where frosts are common or severe.

P. syringae and *P. erythroseptica* were found to develop also in unsterilized soil, and to produce infection after having grown in such soil out of doors for about five months during the winter.

It will be apparent from the results of these experiments that at least three species of *Phytophthora*, and probably more, can live as saprophytes in the soil for considerable periods. The fact that no oospores of certain species have been found in nature does not preclude the possibility of the saprophytic existence of such species. The occurrence of a saprophytic stage in certain species of *Phytophthora* renders it impossible to control these diseases by means of crop rotation. There are references in phytopathological literature to the continued existence in the soil of *Phytophthora fagi* after four years, *P. nicotianae* after three years, and *P. cactorum* after two years. Control measures must be directed to defending the plants against the attacks of the fungus, such as spraying with fungicides or cultivating resistant varieties. [See also this *Review*, i, 8, p. 253.]

NOWOTNY (R.) **Ueber praktische Erfahrungen mit Holzimprägniermitteln.** [Practical experiments with wood preservatives.] —*Zeitschr. angew. Chemie*, xxxv, 37, pp. 217–219, 1922.

Observations and experiments extending over a number of years have shown that the treatment with a strong preservative of all poles and other structural timber used in mines is necessary to combat the attacks of the various wood-destroying fungi. Untreated pine wood used in the mines near Dortmund lasted on an average only a year and a quarter, the severity of the fungous attacks being far greater in the mines than in the open. It was ascertained by means of a number of experiments that only very strong preservatives were effective in controlling the decay. The best results were obtained by the use of 'Basilite' (88·89 per cent. sodium fluoride and 11·11 per cent. of dinitrophenol aniline), the wood treated with 3 kg. of Basilite per cb. m. remaining immune during the seven years over which the experiments extended. Weak antiseptics such as sodium silicate with or without lime proved totally ineffectual. Good results were also obtained by the use of 'Glückauf' (nitrated phenol), 'Viczsa' (ammoniacal solution of metallic salts (Cu, Zn), phenol, and cresol), and the Rüping tar oil process, applied respectively in the proportions of 12·5 kg., 15·3 kg., and 58·3 kg. per cb. m.

WOLF (F. A.). **A leaf spot disease of Tobacco caused by Phyllosticta nicotiana E. & E.**—*Phytopath.*, xii, 2, pp. 99–101, 1922.

This fungus causes a minor spotting of the foliage of tobacco seedlings or more mature plants. The conidia were found to be 6 to 10 by 3 to 3·5 μ. The fungus does not altogether agree with Ellis and Everhart's brief description, and the type specimens of *P. nicotiana* are missing, but it is considered advisable to accept the above identification.

GARDNER (M. W.) & KENDRICK (J. B.). **Tomato mosaic.**—*Purdue Univ. Agric. Exper. Stat. Bull.* 261, 24 pp., 13 figs., 1922.

This is a semi-popular account. No variety of tomato has been found resistant among sixty-three seedsman's varieties, and the mosaic has been transferred to currant tomato (*Lycopersicum pimpinnellifolium*), cherry tomato (*L. esculentum* var. *cerasiforme*), and Chinese scarlet eggplant (*Solanum integrifolium*).

The symptoms of mosaic on tomato plants are variable and, besides the mottling, there may be stunting, malformation, crumpling, curling, crinkling, or spotting of the leaflets; blighting of shoots; brown, dead spots and streaks on the petioles and stems; and elevated greasy areas or streaks, becoming dryish, brown, and sunken, on the fruits. The 'winter-blight' and certain other 'blights' of the older literature probably referred to mosaic.

Mosaic may be spread by insects and evidently by handling the plants during cultural operations. There is no evidence that the disease persists in the soil. Mosaic is especially severe when the plants become infected early, i. e. in the seed beds. The relation of weeds to the disease is discussed.

ANDERSON (M. L.). **Soil conditions affecting the prevalence of Fomes annosus [Trametes radiciperda].**—*Trans. Roy. Scot. Arbor. Soc.*, xxxv, pp. 112–117, 1921.

Fomes annosus, one of the most serious fungous diseases of conifers in Scotland, occurs most commonly in the drier parts of the country, i. e. the north and north-east. It attacks the roots, causing heart rot and root rot. It rarely produces fructifications on sandy open soil, but on stiff clay the sporophores are usually conspicuous. It must not be supposed, however, that the fungus is more common on stiff soils, as it occurs at least equally often on light sand. The texture of the soil appears to influence greatly the mode of attack. Thus in open, porous soils a slight extension of the fungus may bring the hyphae into contact with a weakened rootlet, which is quite sufficient to cause infection. The hyphae are apparently able to extend for short distances through open soil, but in impermeable soils the fungus may be tied down to one tree, and in such cases sporophores are more readily produced. The fungus may easily be overlooked in the former case, owing to the absence of sporophores, while all the time doing considerable damage underground.

Fomes annosus seldom or never attacks living and healthy hardwoods [broad-leaved trees], even when the latter are grown with badly-damaged conifers under similar conditions. This seems to indicate some special protective tissue in the roots of hardwoods, which is able to counteract a destructive agency in the soil acting adversely upon conifers.

The writer believes this injurious soil factor to be acidity, which weakens the roots of the conifers and exposes them to attack by the ferments or enzymes of the fungus. Most Scottish forest soils tend to acidity, but some species of conifers seem to be less liable than others to the resultant effects. This excess of acidity may be due either to the nature of the soil or to the over-accumulation of humus.

The view that soil acidity is the dominant predisposing cause of attack is supported by a number of facts.

Fomes annosus is very common in all parts where one crop of conifers is succeeded by another, especially in impermeable soil; this may be due to acidity caused by the non-decomposition of the humus of the first crop. It is also frequent in first plantations on old agricultural soil, where the subsoil drainage conditions are usually very bad, producing acidity in the upper layer.

The natural distribution of the trees is of interest in this connexion. Hardwoods replace conifers naturally on the boulder tills [glacial clays] all over the country, which, owing to poor drainage, are usually of an acid nature. Spruce and larch are normally restricted to well-drained soils formed from the decay of rock *in situ*, where the easily soluble bases are most concentrated. Douglas fir in America and Scots pine in Scotland occur normally on glacial sands and gravels where both species utilize mycorrhiza to a great extent. Possibly this symbiosis enables the trees to withstand the acids. Both these species are liable to severe attack on the more fertile clays and clay-loams. In these badly-aerated soils mycorrhiza do not thrive, and the trees are thus more or less dependent on their own root-hairs.

Groups of trees surrounding old stumps of a former crop are frequently attacked on more or less impermeable soils. This appears to be due not only to direct infection from the old stumps, but also to a local acidity produced in the soil by their decay. The removal of the acids is prevented by the nature of the soil. *Fomes annosus* is apt to occur on all types of soil where there is an excess of dead vegetable matter. This applies also to soils from acid igneous rocks, such as granite, where the bases have been leached out, as in the glacial sand and gravels of north-east Scotland. There the Scots pine seems less liable to attack than larch or spruce, especially on poorer soils where assistance from mycorrhiza may be expected.

Heart rot appears in young and middle-aged woods some time after the canopy has been closed. No doubt the practice of close planting, combined with neglect of thinning, has resulted in an excess of raw humus. The latter, by the formation of acidity in the soil, damages the rootlets and renders them liable to attack.

Conifers, especially Douglas firs, attacked by heart rot are very apt to succumb to wind and snow-storms. In nearly every instance careful inspection of the roots of fallen trees will reveal the presence of *F. annosus*. Attempts at eradication in a growing wood are hopeless, and the difficulty must be solved by the proper selection of species adapted to the several types of soil. Assuming soil acidity to be the primary cause of attack, the following rules, with the necessary modifications for economic reasons, should be applied to sylvicultural practice:

1. Stumps and other dead material should be removed from prospective sites for planting.

2. Bracken, heather, blaeberry, etc., should be burnt before planting. These plants tend to form an accumulation of raw humus, especially in dry sandy soils.

3. The degree of soil acidity should be ascertained. Conifers can safely be planted in basic, neutral, or slightly acid soils. All or most of these soils are residual or approaching that type, and are well suited for larch, Japanese larch, spruce, Douglas fir, etc.

4. A high degree of acidity in the soil may be due to excess of raw humus, and a number of years should elapse to allow of its decomposition. This condition is frequently the result of clear felling a wood which has been grown as dense as possible.

5. In soils with a high degree of natural acidity, such as usually exists over boulder tills, either pure hardwood or a large percentage of it is probably best. Scots pine, however, grows very well on some boulder tills, as also do certain firs, notably *Abies grandis*. It is a mistake to neglect the cultivation of hardwoods, which are

not only resistant to the root fungus but also tend to counteract soil acidity.

6. Scots pine is probably the tree best suited to very impoverished or unfertile soils such as peat, while the possibilities of birch should not be overlooked.

The virulence of *F. annosus* would certainly be reduced by attention to the above rules. Damage in a growing wood may be mitigated by drastic thinning, which enables the accumulated humic acid of the upper soil layers to be removed by oxidation. If no improvement follows, the wood should be clear felled and planted with suitable trees.

The fungus appears to live only in the upper soil layers, into which the spores may be carried by rabbits and other animals, or washed by rain-water from the bases of the standing trees. It is in these upper soil layers that the greatest concentration of acid takes place, with the consequent damage to the rootlets.

HILEY (W. E.). **The Larch needle-cast fungus, Meria laricis Vuill.** —*Quart. Journ. of Forestry*, xv, 1, pp. 57–62, 2 figs., 1921.

The brown discoloration and shedding of young larch needles during the summer, commonly attributed to frost, was found to be due to *Meria laricis* Vuill. Numerous large hyphae up to 10 μ broad, and with thick gelatinous walls, are visible under the microscope in sections of the brown needles. These coarse hyphae give off finer ones, some of which penetrate the mesophyll cells of the leaf.

Fructifications are formed only in a humid atmosphere. Specimens of *Larix europaea* and *L. occidentalis* received from Argyllshire showed characteristic conidiophores growing out in bundles, 60 to 100 μ in diameter, through the stomata. These bundles only appear on the brown portion of the needle, and usually emerge on the lower surface near the midrib, but occasionally also on the upper surface. The individual hyphae composing the bundle are colourless and septate. From the apex of each segment a conidium, $8–10 \times 2{\cdot}6–2{\cdot}7\ \mu$, may be abstricted, secondary conidia also being produced. These conidia, which are liberated in a damp atmosphere, infect other larch needles in a manner not yet exactly determined.

The attack observed by the writer became noticeable on six to seven year old trees in June 1920. The needles on the long shoots began to turn yellowish-brown at or near their apices. The discoloration then spread towards the bases and became darker in tone, the maximum severity of attack occurring two or three inches from the apices. The mycelium did not penetrate to the stem, so the young needles must have been infected individually. In September only small tufts of green needles were left at the tops of the shoots. Infection probably took place in older trees through wounds caused by the larch needle moth (*Coleophora laricella*). There is little doubt that the fungus hibernates in the needles, reinfecting trees from the ground in the spring.

The disease may be distinguished from frost injury by the facts that the youngest needles are not affected, and that each needle does not die throughout its whole length at once. It is most destructive in nursery lines and young plantations, the heavy loss of needles during the growing season reducing the increment both of height and volume. Hartig showed that *Sphaerella laricina* was most destructive in larch woods mixed with spruce, the diseased larch needles catching in the spruce twigs and remaining there till the spring, when the ascospores reinfected the larch. Underplanting with beech as a substitute for spruce gave excellent results, and this method might also prove successful in the case of *Meria laricis*.

The larch needle-cast appears to be very widespread in Britain. The western American larch is also attacked, but the Japanese variety seems to be immune.

A brief account of the history of the disease is given, and a bibliography appended.

TAUBENHAUS (J. J.) & MALLY (F. W.). **Pink root disease of Onions and its control in Texas.**—*Texas Agric. Exper. Stat. Bull.* 273, 42 pp., 3 figs., 1921.

Since 1906 considerable damage has been caused to this important crop in Texas by a disease popularly known as pink root. Losses up to 43 per cent. have been observed, representing nearly $350 per acre. To this must be added the increased susceptibility of affected onions, in transit or in storage, to black mould decay (*Aspergillus niger*) and soft rot (*Bacillus carotovorus*), though pink root in itself does not cause any decay of the bulb.

The disease is widely distributed, having been noted in California, Wisconsin, Iowa, New York, and in the Bermuda Islands (whence, according to the authors, it undoubtedly emanated). Of Liliaceous plants tested, only species of *Allium* (the onion, shallot, and garlic) are subject to pink root disease, Narcissus, Tulip, Funkia, Iris, Freesia, Lily and Calla being immune. Amongst onion varieties, the true Bermuda Crystal White Wax, White (Yellow) Bermuda, Red Bermuda, and Extra Early Red are more or less resistant, while Denia (and other Spanish strains), Yellow Dutch, Strasburg, Yellow Denvers, Australian Brown, Large Red Globe, Large Red Wethersfield, Large White Globe, White Portugal (Philadelphia), and White Silverskin are highly susceptible. In the latter category must also be placed practically all the 'multiplier' varieties of onions, in addition to shallots. Amongst garlic varieties, several strains of the Mexican and Italian, especially the pink type, are more subject to the disease than the large white varieties known as the Chinese.

Pink root has been proved by the authors to be caused by a *Fusarium* which is tentatively named *F. malli* Taub. n. sp. It resembles *F. oxysporum*, differing chiefly in forming pionnotes instead of pseudopionnotes. *F. malli* is generally found associated with another species of *Fusarium*, which is apparently non-parasitic by itself, but seems to increase the virulence of *F. malli*. The above-ground symptoms of the disease are not always easily recognizable, except in the case of severe infections, when the plants have a stunted appearance. The trouble is confined to the growing roots, bulb plate, and crown, and does not affect the onion or garlic bulb, except to reduce its size owing to the expenditure of most of the available energy in replacing diseased roots. The latter are dry, dead, and yellow, later frequently turning pink. Plants are subject to attack during all stages of their development, from the seed-bed onwards, but the inhibitory effect on growth is more marked when the bulbs begin to form and when they approach maturity. In severe cases new roots become pink as fast as they are formed, and a projecting nipple is formed at the bottom plate of the bulb marking the site of this repeated production of new roots.

The popular belief that the disease is due to alkali in the soil has been proved erroneous by the authors' tests, but, in excess, alkaline substances in the soil may become contributory causes by lowering the resistance of the plants. Adverse climatic conditions and careless cultural methods have the same effect. Even distribution of moisture through proper levelling of the ground, frequent waterings, and abundant humus in the soil, encourage vigorous growth and thus reduce the loss. The disease is favoured by any check in the growth of the plants, either through frost or through delay in ripening until the very hot weather sets in. Thrips and eelworms also encourage infection by weakening the plants.

The seed is, however, often sown in infected seed-beds and the green setts taken from these for planting out will carry the disease. Attempts to reduce soil infection by treating the soil with lime or sulphur failed. Formaldehyde and steam were used in attempts to disinfect the seed-bed soil, with considerable success. Treatment with a solution of one pint of formaldehyde in twenty gallons of water applied at the rate of one gallon per square foot reduced the attack from over 80 to 0·6 per cent. in field tests. Steaming at 15 lb. pressure for two hours killed the fungus. Setts grown in infected seed-beds were dipped in formaldehyde or copper sulphate before planting out, but effective strengths were found to be dangerous to the setts.

A three or four years' rotation is advisable in infected fields. Where, however, onions have to be grown more often on such land, heavy artificial manuring should be resorted to, as this may give the plants enough vigour to outgrow the disease; the authors recommend the use of 1,000 lb. per acre of a compound analysing about 7 per cent. acid phosphate, 5 per cent. nitrate of soda, and 2 per cent. potash.

EDGERTON (C. W.). **Onion diseases and Onion seed production.**—*Louisiana Agric. Exper. Stat. Bull.* 182, 20 pp., 9 figs., 1921.

Onion diseases, especially black stalk rot (*Macrosporium parasiticum*), have been very prevalent for some years in the Bayou Lafourche region, the most important onion-growing district of Louisiana. Almost every year the seed crop has been reduced at a moderate estimate by at least 50 per cent., chiefly from *M. parasiticum*, while considerable damage is done to the bulb crop by various diseases. The seed almost exclusively used is a local variety known as the Creole onion. During the war investigations were undertaken to test the possibility of control by means of spraying. The work, which was restricted to observations on the diseases and some preliminary experiments, has now been discontinued, as there is no longer any shortage of seed.

The stems of the diseased seed onions become covered with a black, smutty layer composed of the spores and mycelium of *M. parasiticum*. Many stems either rot away or become so weakened that they are blown over, or collapse under their own weight. Very few of the broken or bent stalks produce much seed, while the yield of the standing stalks is also greatly reduced.

Climatic and soil conditions appear to influence considerably the development of this and other onion diseases. Thus at Bayou Lafourche the rainfall is heavy and humidity high, thick fogs being common during the early spring. The soil is heavy, and not well drained. Baton Rouge, where part of the investigations were carried on, is further from the Gulf, and situated on higher ground. The fogs are less frequent, humidity is somewhat lower, and the general incidence of disease is much less.

Besides *M. parasiticum,* the following fungi are frequently present on onion plants: *Peronospora schleideni*, *Colletotrichum circinans*, a species of *Botrytis*, *Fusarium malli*, and another species of *Fusarium*. The first named is, however, almost the only disease recognized by the growers, and it alone is found on old plants. A heavy development of the black stalk rot frequently succeeds a severe outbreak of onion mildew (*Peronospora schleideni*). The latter has never been seen on the high land at Baton Rouge, even on plants grown from bulbs from the infested regions. *Colletotrichum circinans* is often found on the plants and bulbs, causing onion smudge on the latter. Neither this nor the species of *Botrytis* responsible for neck rot in other regions is of any great economic importance. Pink root disease (*Fusarium malli*) occurs in various parts of Louisiana, where it has been known since 1909 both on the bulbs and seed crops. Another species of *Fusarium* produces a rot of the roots which sometimes affects the base of the stalk. Arrested growth and partial sterility follow.

Evidently *M. parasiticum* is more definitely parasitic than is commonly believed, and will develop rapidly on any slightly weakened tissue. It may even attack the uninjured plant, and spread rapidly after once gaining entrance to the stalk, especially under conditions of great humidity.

A white spot disease of undetermined origin also predisposes to severe attack by *M. parasiticum*. It first appears in the form of chlorotic spots on the stem, usually on the enlarged portion just above the ground. These perfectly white spots are more or less circular and gradually increase in size. Cultures from them have always given negative results, and the spots may be of physiological origin.

Spraying experiments were carried out at Baton Rouge and Bayou Lafourche with Bordeaux mixture 4–4–50, distillate 1–100 (used as a 'sticker'), and nicotine sulphate ('Blackleaf 40') 1–1000, applied in varying combinations at weekly intervals. At Baton Rouge the bulbs were imported from the regions subject to disease, but all the plants remained healthy throughout the season. The solutions containing distillate were better than Bordeaux mixture alone, being less easily washed off by rain.

In the Bayou Lafourche region a weekly spraying was not sufficient to protect the onions from black stalk rot and other diseases, and the extra yield obtained did not justify the expense of the treatment.

A further series of tests with bulbs procured from different districts showed that the yield at Baton Rouge was nearly double that obtained in the alluvial region of Lafourche, and the author, therefore, recommends that seed for the market should be grown as much as possible outside the lower coast region.

Destructive Insect and Pest Act Advisory Board, Canada.

A Destructive Insect and Pest Act Advisory Board has recently been established in Canada to supervise the carrying out of the provisions of the Act, and to recommend to the Minister of Agriculture such changes or additions in the regulations as may be deemed necessary. The appointment of the following as members of the first Board was notified on 5th May, 1922:—Arthur Gibson, Dominion Entomologist, Chairman; E. S. Archibald, Director of Experimental Farms, Vice-Chairman; J. H. Grisdale, Deputy Minister of Agriculture; H. T. Güssow, Dominion Botanist; and L. S. McLaine, Chief, Division of Foreign Pests Suppression, Secretary.

Amendment No. 1 to regulations governing the importation of Potatoes into the United States.—*U.S. Dept. of Agric. Fed. Hort. Board*, June, 1922.

By this amendment, which is effective from 20th June, 1922, special provision is made for the importation of potatoes from foreign countries into Hawaii and Porto Rico; they are admitted for local use only, free of any restrictions.

Potatoes may be imported from the Dominion of Canada and from Bermuda into the United States free of any restrictions. Potatoes from certain districts of Mexico may be imported into the United States under certain conditions and restrictions, which are detailed.

Plant Pest and Disease Ordinance, 1921 (No. 38 of 1921): Regulations. Dar-es-Salaam, Tanganyika, 9th June, 1922.

The Plant Pest and Disease Destruction Regulations, 1922, provide for the destruction by fire of any plant in Tanganyika Territory declared to be a pest under the Plant Pest and Disease Ordinance, 1921. The following are declared to be pests within the meaning of the Ordinance: Mistletoe (*inter alia Loranthus* spp. and *Viscum* spp.); Dodder (*Cuscuta* sp.).

IMPERIAL BUREAU OF MYCOLOGY

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DUFRÉNOY (J.). **La gommose du bois de Châtaignier.** [Gummosis of Chestnut wood.]—*Comptes rendus Soc. de Biol.*, lxxxvi, 7, pp. 371–374, 4 figs., 1922.

The gum deposited in the wood of certain plants as a sequence to parasitic infection may originate in the degeneration of the tyloses. Woods like those of the chestnut, which normally contain tyloses, develop excessive numbers under parasitic stimulation: old chestnuts suddenly destroyed by ink-disease may show the lumina of their vessels completely blocked by more or less gummified tyloses.

Gum may be deposited in the vessels in the absence of tyloses. It is abundant in the wood of the rootlets formed by chestnuts affected with ink-disease, even when these rootlets terminate in luxuriant mycorrhizal growths. Wood exposed by stem or root cankers is especially subject to gummosis, but this wound gummosis is superficial and local, while that of the tyloses is deep and extensive. These two forms of gummosis should be distinguished from that proceeding from the jellification of the middle lamella of the cell membranes.

KUFFERATH (M.). **Bacterium puttemansi Kufferath nov. spec., microbe produisant des taches sur la Tomate (Lycopersicum esculentum) conservée.** [*Bacterium puttemansi* Kufferath nov. spec., a micro-organism producing spots on conserved Tomato (*Lycopersicum esculentum*).]—*Bull. Soc. Roy. Bot. de Belg.*, liv, 2nd ser. 4, pp. 190–194, 1921.

In this paper a disease of pickled tomatoes, which depreciates their value, is described. It causes rounded, yellowish, swollen spots on the surface of the fruit under the skin which is raised in boil-like swellings but is not ruptured. It is caused by a straight or slightly flexuous, non-motile bacterium, 4 to 15 by 1 μ, and with rounded ends. The bacteria may occur singly or in pairs or in more or less elongated chains in which it is difficult to make out the separate individuals. The organism is Gram-positive and readily stained. No spores have been observed. It is described as a new species to which the name *B. puttemansi*, after the author who first called attention to it, is given.

It is easily isolated and inoculations with pure cultures have demonstrated that it is the cause of the condition described. In culture development is slow and the colonies are small. In bouillon there is a slight whitish deposit but no turbidity or scum. The individual size is reduced in culture (3 to 5 by 0·8 μ) and chains are infrequent.

The point of invasion has been found to be ordinarily at the stalk end of the fruit, where its detachment from the plant produces ruptures in the epidermis. Inoculations by placing suspensions at this point and then immersing the fruit in the pickling fluid gave characteristic spots in from one to two months. The bacteria were found in the liquid in the interior of the fruit. Sound fruit immersed in pickling liquid which had contained diseased fruit became infected. The bacterium maintains its virulence for a considerable length of time in the pickle. Inoculations by piercing the epidermis with a capillary tube containing the bacteria also gave positive results, the controls in all these cases remaining unaffected.

The organism is stated to belong to the group of the lactic acid bacteria.

WELLES (C. G.). **Cercospora leaf spot of Eggplant.**—*Phytopath.*, xii, 2, pp. 61–65, 2 figs., 1922.

Solanum melongena at Los Baños, Philippine Islands, was found to be attacked by a leaf spot disease. At first the spots were chlorotic, then greyish-brown and concentrically marked, and finally a shot-hole condition resulted. The disease is quite different from the leaf spot caused by *Phyllosticta hortorum*.

Eggplants only are known to be attacked. A Siamese variety was less affected than the native Philippine kind. The photosynthetic area of leaves may be reduced by 75 per cent. The fruit was not found to be attacked.

The parasite is described as *Cercospora melongenae* n. sp. Bordeaux mixture was found to hold the disease in check, but did not appear to be commercially profitable.

NICOLOFF (T.) & STEFANOVA (M.). **Die Kohlhernie in ihren Beziehungen zur Wirtspflanze.** [Club-root of Cabbage in its relation to the host plant.]—Reprinted from *Rev. Inst. de recherches agron. en Bulgarie* in *Zentralbl. für Agrikulturchemie*, li, 4, pp. 101–102, 1922.

The senior author has shown in a previous article [1920] that the higher vegetable parasites *Viscum, Loranthus, Orobanche,* and *Cuscuta,* absorb large quantities of nitrogen, potassium, phosphorus, etc., from the tissues of their hosts. As *Plasmodiophora brassicae* ravaged the cabbage fields round Sofia during 1920 the opportunity was taken to investigate its effects from this standpoint.

The leaves and roots of healthy and diseased plants were examined and striking differences were found between their protein content. While the leaves of healthy plants contained 33·37 per cent. of protein in their dry substance, the protein content of those from diseased plants was only 28·65 per cent. In the roots a still greater difference, but in the inverse direction, was found, the healthy roots containing 11·19 per cent. of protein and the diseased 32·87 per cent. Phosphorus and potassium were also present in larger quantities in healthy than in diseased leaves, the reverse being the case in the roots.

HEDGES (FLORENCE). **A bacterial wilt of the Bean caused by Bacterium flaccumfaciens nov. sp.**—*Science*, N. S. lv, pp. 433–434, 1922.

Navy beans (*Phaseolus* sp.) in South Dakota were attacked by a bacterial disease. The plants may be killed in the seedling stage after wilting and sometimes showing dull green to reddish-brown discoloration of the stems, or some of the shoots of older plants may die. The wilt of seedlings resembles somewhat the 'systemic disease' ascribed by Burkholder to *Bact. phaseoli.*

The organism was isolated and found to be a rod with polar flagella, measuring 0·66 to 3 by 0·33 to 0·5 μ, producing yellow colonies; it is named *Bact. flaccumfaciens* n. sp. The disease was reproduced by inoculations. Differences between this organism and *Bact. phaseoli* are mentioned.

KROEMER (K.). **Untersuchungen über die Beziehungen zwischen dem Bau der Rebblätter und ihrer Erkrankung durch Plasmopara viticola.** [Inquiry into the connexion between the structure of Vine leaves and their liability to attack by *Plasmopara viticola.*]—*Ber. der höheren staatl. Lehranst. für Wein-, Obst- und Gartenbau zu Geisenheim-am-Rhein*, pp. 75–76, 1921. [Included in *Landw. Jahrb.*, lvi, Suppt. 1, 1921.]

The researches of Müller-Thurgau, Ruhland, and von Faber have indicated that *Plasmopara* infection is dependent on the distribution of the stomata, and therefore occurs as a rule through the under side of the leaf. A relation has also been established between the disease and the age of the leaf, young leaves being more virulently attacked than old ones when artificially inoculated. The youngest leaves of all, however, have completely resisted every attempt at artificial infection.

The author has particularly studied the dentate margin of the leaves and the development of the stomata and epidermal tissue. Special attention was paid to the structure, distribution, and functions of the water pores, which are situated on the upper side of the leaf teeth. They can only be clearly distinguished in young leaves, since the tissues of the leaf margin shrivel up completely with age. An exudate of water from these pores may be observed after cool nights in May and June.

The author concludes as a result of numerous observations on leaves from different localities that infection by *Plasmopara* takes place principally through the water pores, which supply the conidia with the necessary moisture for the development of their swarm-spores and enable the germ-tubes of the latter to penetrate the interior of the leaf.

HIGGINS (B. B.). **Notes on the morphology and systematic relationship of Sclerotium rolfsii Sacc.**—*Journ. Elisha Mitchell Sci. Soc.*, xxxvii, 3–4, pp. 167–172, 1 pl., 1922.

Investigations undertaken with a view to discovering a fruiting stage of *Sclerotium rolfsii*, which occurs very generally in the warmer parts of the United States, have failed. On fleshy plants, and such fruits as cantaloupe, the growth of this fungus is very vigorous and characteristic; the mycelium forms broad, white sheets and a number of sclerotia develop. On small or more woody stems, however, such as sweet potato slips or pepper plants, the growth is often scanty and indistinguishable macroscopically from several other fungi, and sclerotia often fail to develop even in a moist chamber.

The mycelium is rather coarse, with large cells (150 to 250 by 2 to 9 μ), the feeding branches being more slender (about 2 μ in diameter). Clamp-connexions occur in the broader threads, and branching may take place behind the cross wall. In the slender threads branches may arise from any point. The clamp-connexions often develop abnormally, giving the impression of budding of the mycelium (cf. Taubenhaus, *Journ. Agric. Res.*, xviii, p. 127, 1919). The branches often anastomose and hold the hyphae together in sheets or strands. The cells of the mycelium are binucleate.

The sclerotia first appear as small, white tufts of loosely intertwined branches, with an actively growing region near the periphery. The latter is about one-twentieth of a millimetre thick, rich in protoplasm, and more readily stained than the centre of the mass. Within twenty-four to forty-eight hours all the cells of the mass, except those of the downy covering surrounding the growing region, swell to about three times their former size and become vacuolate and usually multinucleate. The cell walls of the growing region coalesce and gelatinize, forming a pseudoparenchymatous tissue about one-seventh of a millimetre thick. The cells of an outer layer lose their protoplasm and the walls collapse, a corky covering being thus formed over the surface of the mature sclerotium. The outer downy covering sloughs off, leaving the surface dark brown, smooth, and shiny. The cells of the pseudoparenchyma are broad, hyaline, and without air spaces, in contrast to those of the centre of the sclerotium. The mature sclerotia are dark brown, globose to elliptical, and 0·5 to 1·5 mm. in diameter.

Several sclerotia of an old culture originating from a wilted pepper plant were planted on agar plates, and fifty filaments isolated and planted. Five only survived and produced new growth. These were transferred to tubes of steamed bean pods, and in a few days produced abundant sclerotia. Transfers were then planted on plates of peptone beef extract agar—three colonies to each plate, two of *A* and one of *B*, etc., throughout the series. The production of sclerotia in these plates was rather irregular, but no sign of 'mixing' was observed. This experiment does not prove the non-existence of plus and minus strains (suggested by Taubenhaus, *loc. cit.*), but it shows that the mixture of such strains is not essential to the production of sclerotia.

Mature sclerotia placed in contact with a suitable medium send out hyphae from all over their surfaces without any apparent break in the tissue. The new hyphae are slender and push or dissolve an opening between the cells of the compact outer tissues: their cells are binucleate. Kept in a dry place the sclerotia remain viable for a long time (more than two years in one instance). It is not probable that they last long under field conditions, being very susceptible to freezing when wet.

The presence of clamp-connexions and of the binucleate cells shows the fungus to be related to the Basidiomycetes. These characteristics, together with the formation of sclerotia, are common to nearly all families of Basidiomycetes, and it does not seem possible to determine any closer relationship until spore formation has been observed.

La Rue (C. D.) & Bartlett (H. H.). **A demonstration of numerous distinct strains within the nominal species Pestalozzia guepini Desm.**—*Amer. Journ. of Bot.*, ix, 2, pp. 79–92, 1922.

A comparison of several strains of *Pestalozzia* isolated from diseased tissues of *Hevea brasiliensis* in Sumatra showed that while all, broadly speaking, fell within the limits of *Pestalozzia guepini* Desm., they were quantitatively different in regard to spore measurements and maintained their distinct characteristics through successive generations. Only morphological criteria are available in weakly parasitic genera, the members of which are not confined to specific or closely related hosts, and in such cases the authors think that morphologically indistinguishable fungi, not known to be confined to particular hosts, should be called by the same name, though the strains may show a wide range of variations among themselves.

Apparently all the common diseases of Pará rubber in the East are due to more or less ubiquitous fungi, and generally speaking the forms pathogenic to *Hevea* are known to infect the most diverse cultivated plants. *Pestalozzia* is familiar in the East mainly as the cause of grey blight of tea and leaf spot of coco-nut. The name *P. guepini* was originally applied to a form isolated from camellia and magnolia, characterized by a spore length of about one-fiftieth millimetre, with 4-septate spores, the terminal and basal cells hyaline and the three interior cells dark; appendages longer than the spores and typically three in number.

More recently tea blight and a stem disease of rubber seedlings, *inter alia*, have been attributed to *P. palmarum* Cke. Apart from an irreconcilable discrepancy in the measurements, the latter fungus does not differ materially from *P. guepini*. Sawada's creation of the new species *P. theae* for the form on tea is not accepted by the authors, since according to them the fungus does not differ sufficiently from *P. guepini* to warrant the creation of a fresh species. An examination of the literature on *Pestalozzia* diseases shows that, in general, authors have preferred to use the name *P. guepini* for tea diseases and *P. palmarum* for those of the palm, but this usage has not been justified either by cross-inoculation studies or the discovery of reliable morphological distinctions.

The writers' experiments involved comparisons between thirty-five strains—twenty-two from rubber, seven from coco-nut, three from tea, two from oil palm, and one from areca palm. The strains were measured through from four to eight successive generations, spore production taking twice as long in some cases as in others. The cultures were all grown on *Hevea* leaf agar with native brown sugar, no attempt being made at maintaining a constant temperature. The physiological differences shown by the strains among themselves were not correlated with morphological characters.

A rough analysis shows that the thirty-f[illegible] strains fall into fourteen groups, as judged by a statistical examination of a series of measurements of spores and appendages, and that these groups are not confined to particular hosts.

TANAKA (T.). **Japanese fungi.—Notes and translations, XI.**—*Mycologia*, xiv, pp. 81–89, 1922.

The author continues his series of technical diagnoses in English of a number of important parasitic fungi from Japan which have previously only been described in Japanese. In each case, besides the technical description, references are given to the Japanese literature and figures, and there are critical notes in many instances.

Helminthosporium oryzae Miyabe and Hori [*Bull. Agric. Exper. Stat. Nishigahara*, No. 18, pp. 67–84, 1901] has been treated in western countries as a *nomen nudum*, as the original description, and also Hori's later emendation (*Discourse on diseases of agricultural crops*, pp. 106–107, 1911) were in Japanese. It causes scattered or grouped, fuliginous or soot-coloured, velvety spots on the culms, leaves, and glumes of rice. The conidiophores are grouped two or three together, brownish, 100–330 by 7·2 μ, more or less bent, 7- to 15-septate, the lowermost cells largest and rather rounded and swollen, the width of the cells gradually reduced towards the apex, terminated by a blunt, thin-walled, light coloured or almost colourless cell. The conidia are 6- to 11-septate, fuscous, lunate or obclavate, bending to one side, obtuse at the ends, only slightly constricted at the septa, 84 to 140 by 16 to 22 μ. They germinate by germ-tubes from both ends. Both swamp and upland rice are affected. The spots on the leaf are at first small, then elongated and coalesced. Discoloration and withering of the leaf from the tip backwards soon follows, often causing the death of the whole plant. Hara in 1918 stated that this may be identical with Breda de Haan's *Helminthosporium oryzae* [*Bull. Inst. Bot. Buitenzorg*, vi, p. 11, 1900], though the description of the latter is rather imperfect. It differs strikingly from *H. macrocarpum* Grev. in the shape of the conidia. Recently, prevention through seed treatment and spraying with various fungicides has proved effective in Japan.

Glomerella cinnamomi Yoshino [*Bot. Mag. Tokyo*, xxi, pp. 230–232, 1907 (Japanese)] causes a serious disease of camphor trees, especially in nursery plants and young plantations in Formosa. The Formosan fungus generally agrees with that described from Kyûshiû by Yoshino, with the exception of the smaller size of the ascospores. Hara (*Bot. Mag. Tokyo*, xxv[illegible], p. 272) suggests that the present species should be called *Guignardia cinnamomi* on account of the lack of the stroma characteristic of *Glomerella*.

Physoderma maydis Miyabe [in A. I[illegible], *[illegible]andbook of plant diseases of Japan*, [illegible] ed. Tokyo, p. 114, 1909 (Japanese). Synonyms:

Cladochytrium, sp. nov. K. Sengoku (*Journ. Agric. Soc. Ehime Prefecture*, xxxii, p. 58, 1901): *Cladochytrium maydis* Miyabe (in A. Ideta, *Handbook of plant diseases of Japan*, 3rd ed., Tokyo, p. 75, *nomen nudum*; J. Omori and G. Yamada, *Plant Pathology*, p. 202, 1904, *nomen nudum*)] causes numerous orbicular, elliptical, or linear spots on the culm, midrib of leaves, and lower part of the husk of *Zea mays*; the spots are mostly small, often confluent, brown or fuliginous, light coloured near the margin. Sporangia are ellipsoid-ovate or globose, deep brown, 24 to 26 μ by 22 to 24 μ. The disease does not usually prevent fruiting, but sometimes does so when it occurs abundantly in the early stage of growth of the host plant. It is not known to occur in Japanese territory outside the prefecture of Ehime, Shikoku Island. This fungus is, in many respects, identical with *Physoderma zeae-maydis* Shaw, first reported from India (*Ann. mycologici*, x, pp. 245–247, 1912), though no actual comparison of the organisms has yet been carried out; the latter is now known to be responsible for one of the worst diseases of maize in the United States, and plant quarantine against this fungus was decreed by the United States Department of Agriculture in 1916.

Colletotrichum boehmeriae K. Sawada [*Journ. Formosan Nat. Hist. Soc.*, No. 17, p. 2, 1914 (Japanese)], occurs on the leaves and on the stem of ramie (*Boehmeria nivea*); on the former the spots are scattered, cinereous, with a brown margin, orbicular, and 1 to 2 mm. in diameter; on the stem they are orbicular, elliptical, or fusiform, occasionally causing longitudinal ruptures of the host epidermis, and 1 to 6 by 0·8 to 2 mm. in size. The hyphae are colourless, 4 μ thick; acervuli small, with setae; conidiophores dense and short; conidia colourless, cylindrical, or occasionally clavate, straight, obtuse at ends, granular, 14 to 19 by 4 to 5 μ; setae dark brown, tapering towards the apex, 1- to 2-septate, 45 to 85 by 4 to 5 μ. The stem infection produces a bad staining of the bast fibres which can hardly be removed by bleaching.

Cercospora piricola K. Sawada [*Journ. Formosan Nat. Hist. Soc.*, No. 17, p. 3, 1914 (Japanese)], on *Pyrus communis* and *sinensis*, hypophyllous; the spots usually are 1 to 3 mm. in diameter, angular, occupying a definite area enclosed by veinlets; later they coalesce and often cover the entire surface of the leaf; colour cinereous, later changing to brown. The conidiophores are fascicled, several (ten or more) together, straight or curved, cinereous, 0- to 2-septate, and 15 to 27 by 3 to 4 μ; conidia linear, curved, 3- to 5-septate, greyish and almost colourless, and 28 to 57 by 2·5 to 3·5 μ. This fungus resembles *Cercospora minima* Tracy & Earle (*Bull. Torr. Bot. Club*, xxiii, p. 206, 1896) on pear from America, but differs in being hypopyhllous and in having longer conidiophores and shorter but thicker conidia of greyish colour. The extent of the injury caused by it is not known.

Detailed descriptions are also given of the following fungi: *Mycosphaerella bambusifolia* Miyake and Hara sp. nov. [*Bot. Mag. Tokyo*, xxiv, pp. 338–40, 1910 (Japanese)]; *Phaeosphaeria bambusae* Miyake and Hara sp. nov. [ibid., pp. 340–341]; *Ustilaginoidea sacchari-narengae* K. Sawada sp. nov. [*Journ. Formosan Nat. Hist. Soc.*, iv, pp. 4–5, 1914 (Japanese)]; *Plasmopara wildemaniana*

P. Henn. var. *macrospora* K. Sawada var. nov. [ibid., xvi, pp. 2–4, 1914 (Japanese)] and *Ustilago formosana* K. Sawada sp. nov. [ibid., xxxiv, pp. 6–8, 1918 (Japanese)].

RAMIREZ (R.). **Cyathus de la Vid.** [*Cyathus* on the Vine.]—*La Revista Agricola* [Mexico], v, 10, p. 720, 1 fig., 1921.

In 1919, a vine growing in the field attached to the chief agricultural station was invaded by a rare organism. The runners were covered with white, branched, and sometimes reticulated filaments, while on or near the nodes of the branches whitish bodies (which later turned brown) arose. These, on development, opened out at the free end and took on the form of trumpets, in the interior of which four dark tubercles were visible, resembling seeds, each held by a thin cord. These characters and the microscopical details enabled the author to identify the parasite as a species of *Cyathus*.

To check the disease the author recommends prompt incineration of the affected parts, followed by spraying with Bordeaux mixture.

GARD (M.). **L'apoplexie de la Vigne et les formes résupinées du Fomes igniarius.** [Apoplexy of the Vine and resupinate forms of *Fomes igniarius*.]—*Bull. Soc. de Path. Vég. de France*, ix, 1, pp. 22–28, 2 figs., 1922.

The term 'apoplexy' is applied to the sudden drying up of a vine in full growth which cannot be attributed to drought since it occurs with equal frequence in damp soil and during rainy seasons. An examination of affected vines shows that the wood is transformed into a soft, spongy mass, containing an abundant mycelium such as is characteristic of the Polyporaceae. The wine-growers of Smyrna have named this spongy wood 'iska', meaning tinder.

Pure cultures were obtained by Viala from this diseased wood, and fructifications from these were identified by Mangin and Patouillard as *Fomes igniarius*. The author has found resupinate fructifications on diseased vines and has compared them with other resupinate forms of *F. igniarius* on oak, acacia, and several kinds of fruit tree. On these hosts the sporophore bears numerous cystidia, but the latter were practically absent in the forms occurring on vines in the south-west of France. This scarcity of cystidia results in a different surface texture as compared with the ordinary forms, in which the surface is somewhat velvety. The form on the vine is also pale in colour. The author accordingly creates a new variety, *viticidus*, a diagnosis of which is given.

The mycelium extends beyond the spongy wood into that which appears normal. It has been found in two-year old branches and even in those of the current year. Probably grafts obtained from affected vines often bear within them the germ of the disease.

Infection is said to take place through large wounds such as those caused in pruning. The fructifications have been observed on vines in the Gironde, Charente, and Lot-et-Garonne. Often, however, their development is arrested, and they form only a yellow, downy mass. It is believed that growth of the parasite in infected wood continues during the winter. The symptoms are said to be due to obstruction of the vessels not only by hyphae but also by tyloses and wound gum.

[In the discussion on this paper (*loc. cit.*, pp. 18–19) Patouillard stated that he had found cystidia in normal quantities on a specimen received from Gard, and it would, therefore, appear that it is not a distinct variety of *F. igniarius*. Viala stated that the fungus is very susceptible to the action of arsenious acid, and the latter has been used in practice for its control for a number of years. *Stereum hirsutum* can also cause a form of apoplexy of the vine. *F. igniarius* is a vigorous destroyer of tannin by means of an oxydase which is excreted by the mycelium growing in the dead wood and acts on the tissues in advance of its growth. Active growth only occurs in tissues rich in tannin, and the attack occurs usually on vines after they are about fifteen years old, before which treatment with arsenious acid is not usually required. The disease is very common in parts of Italy, where it is known as 'esca' from the old Greek 'iska'. This is a preferable name to apoplexy. Similar effects are produced in olive trees, which are frequently attacked by *F. igniarius*.]

HENNING (E.). **Avdelning för landtbruks botanik.** [Division of Agricultural Botany.]—*Årsberättelse över verksamheten vid Centralanstalten för försöksväsendet på jordbruksområdet under år 1921.* Reprinted from *Kungl. Landtbruks-Akad. Handl. och Tidsk., år 1922*, pp. 26–32, 1922.

Immunity trials with various crops were continued at the Swedish Central Agricultural Research Station in 1921. Nearly all the autumn wheats were very susceptible to yellow rust [*Puccinia glumarum*]. Pansar, Svea, and Thule II, suffered somewhat less than the other varieties. The early American variety, Michigan Bronze, was as usual the most susceptible. Mildew [*Erysiphe graminis*] was very prevalent, especially in too closely sown crops; Pansar was again comparatively resistant.

Experiments with various fungicides in the control of smut and the snow fungus [*Fusarium nivale*] gave satisfactory results in the case of formalin and uspulun. Formalin also effectively controlled gooseberry mildew, one treatment in the early spring considerably reducing the incidence of the disease.

Grey speck disease of oats, generally associated with excessively alkaline soils, was reported from a number of localities in all parts of the country. Yellow tip disease occurred in Östergötland and Småland on oats and in West Bothnia on timothy. Chlorine gas from an electro-chemical factory was responsible for severe smoke injuries to crops in the vicinity. Bunt of wheat [*Tilletia tritici*] was widespread and virulent, and many complaints were received that seed treatment with copper sulphate or formalin was not effective. These were in all probability cases of after-infection from the floor, sacks, sowing implements, or the workers' shoes. Immersion is always preferable to sprinkling as being both cheaper and more reliable. Loose and covered smuts [*Ustilago nuda* and *U. hordei*] were both prevalent on barley. Severe damage from black rust [*Puccinia graminis*] occurred on late-sown seed in humus-rich soils and in low-lying, richly-fertilized fields. Yellow rust caused severe damage to wheat in South and Central Sweden, especially to the native varieties. Svea and Thule II exhibited a high degree of resistance, but Pansar was severely attacked. In some districts barley also suffered considerably from yellow rust. Mildew occurred on both wheat and barley, while ergot [*Claviceps purpurea*] was also prevalent on the latter. Stripe disease [*Helminthosporium gramineum*] was present in Värmland, on Primus, Yellow, and six-rowed barleys. The strawbreaker fungus [*Leptosphaeria herpotrichoides*] severely damaged wheat and rye in low-lying districts. Straw fusariose occurred on early-sown rye.

In the northern districts much damage was caused by *Phytophthora* on potatoes. Severe attacks of corky scab (*Spongospora*) were reported from a number of districts. Wilt due to *Verticillium* and stalk bacteriosis were also reported. Ordinary scab [*Actinomyces scabies*] was prevalent in South Värmland, especially on Up-to-Date. Club-root (*Plasmodiophora*) and brown bacteriosis occurred on cabbage, root blight (*Pythium*) and heart-rot (*Phoma betae*) on beet. A severe disease of lucerne in 1920, caused by a species of *Macrosporium*, appeared to have been eradicated by sanitary measures.

Apple mildew (*Podosphaera leucotricha*), *Monilia* (especially on the Signe Tillisch variety of apple), gooseberry mildew (*Sphaerotheca mors-uvae*), and currant rust (*Puccinia ribis*) were all very prevalent. A speckling of apples, thought to be due to climatic conditions, occurred on the varieties Gravenstein, Ribston, and Signe Tillisch.

Wart disease of potatoes (*Synchytrium endobioticum*) no longer occurs in Sweden, but there is considerable danger that it may be introduced with consignments of potatoes from foreign countries. In conjunction with the General Agricultural Society of Sweden, the Botanical Division of the Central Institute obtained the passage of legislative measures concerning the import of potatoes [see this *Review*, i, 4, p. 128]. In order to conform to the regulations concerning the export of potatoes to certain foreign countries, twelve inspectors have been specially trained to examine the consignments before dispatch from the various ports.

WELLES (C. G.). **Bacterial plant diseases in the Philippine Islands.**—*Science*, N.S. lvi, p. 18, 1922.

While fungous diseases of plants are common in the Philippines, bacterial diseases of plants have been found to be rare, at least in central and southern Luzon. The only bacterial diseases so far found there are *Bacterium solanacearum* on various plants, citrus canker [*Pseudomonas citri*], *Pseudomonas campestris* on cabbage, *Ps. phaseoli* on beans, *Ps. malvacearum* on cotton, and an undescribed organism on parsley. With the possible exceptions of the citrus canker and parsley disease, the organisms and hosts are not indigenous to the Philippines.

HEDGES (FLORENCE). **Bacterial pustule of Soy Bean.**—*Science*, N.S. lvi, pp. 111–112, 1922.

A leaf spot of soy-bean which differs in the earlier stages of attack from the disease caused by *Bacterium glycineum* Coerper, is noted from Washington, D.C., southwards. The spots show a slight raising of the centre of the area in young infections, whence the name 'pustule'. Water-soaking is not produced, and in later stages the spots become characteristically reddish-brown and angular.

The organism gives a yellow growth and resembles *Bacterium phaseoli* E. F. Smith, but though it will cause infection on *Phaseolus*, *B. phaseoli* from the latter will not normally infect soy-bean. There are also slight differences in growth characters between colonies of *B. phaseoli* and the organism from the soy-bean. The latter is therefore named *B. phaseoli* var. *sojense* n. var.

MANZONI (L.). **Una causa bacterica dell' incappucciamento del Trifoglio pratense.** [A bacterial cause of leaf curl of *Trifolium pratense*.]—*Le Staz. Sperim. Agrarie Ital.*, lv, 4–6, pp. 136–144, 2 pl., 1922.

In this paper the author describes a leaf curl ('incappucciamento') of clover (*Trifolium pratense*) observed in a field belonging to the Royal College of Viticulture and Oenology at Conegliano, Italy. The characteristic feature of the disease in the aerial portion of the plant is the formation of a large number of thin, short branches growing close together and bent inwards, covered with slightly deformed leaflets three or four times smaller than normal, the laminae of which are folded on the midrib. The affected plants are always of a lighter green than normal, the condition resembling chlorosis. There are apparently many gradations in the intensity of the disease between perfect health and full attack. The root system of all infected plants examined was free from any marks of insect injury, but an important pathological modification was found in the woody cylinder of the principal tap root. The centre of the disturbance is usually in the vicinity of the collar, not infrequently just below it, and it extends downwards in gradually diminishing intensity for a considerable distance, even involving some of the principal lateral roots. In this diseased area the affected tissues turn a dark brown colour, shading towards black. The discoloration is continuous in the region of maximum disturbance, but in the more distant parts becomes broken up into small brown patches in the healthy wood. It is due to narrow, brown strands running downwards in the woody bundles, and also, but only when the centre of infection is not immediately below the collar, extending upwards. Affected wood vessels are generally obstructed by dense masses of a dark brown or black substance, their walls being vivid yellow in colour. The wood fibres and parenchyma are similarly affected, their contents being also frequently brown. The cells surrounding these areas undergo an abnormal development, dividing in a plane tangential to the centre of the disturbance, so that the diseased areas are isolated from the remaining xylem by new tissues, which have the aspect of a secondary meristem. This process is not invariably clearly marked, and affected plants which lack the ring of protective tissue may be found occasionally. It is difficult to give a reason for this difference in behaviour, unless it may be due to the age of the vessels and cells at the moment of the initial attack.

In very thin sections (under 15 μ) it is possible to distinguish, even without staining, alongside the wood vessels filled with the dark brown, homogeneous, limpid, almost transparent substance already referred to, others, generally less numerous, the contents of which are of a slightly lighter colour, but opaque and finely granulated, resembling bacterial zoogloeae. The author was able to examine a vessel in which the isolated granulations could be distinguished, and their aspect and form was that of true bacteria. Technical difficulties prevented a satisfactory photo-micrograph being taken, but typical vessels containing these granulations are figured, and given side by side with a photo-micrograph (medium enlargement) of the section from which the drawing was made.

Methylene blue in borax was found to be the most effective stain for the bacteria in the vessels, acting in even very dilute solutions if left for two or more hours. Carbol-fuchsin and gentian violet also stained them satisfactorily, though the outline was somewhat less distinct. The bacteria are usually elongated, sometimes slightly elliptical, and measure 1 to 2 by $\frac{1}{2}\,\mu$. They are often in pairs joined end to end.

Pure cultures of these bacteria were obtained. On a medium composed of clover root extract, meat extract, saccharose, and agar the colonies were visible after 24 hours, and after 48 hours their development was very distinct. Their aspect was always the same: the superficial colonies were circular, glossy, watery, slightly raised, colourless at the borders, whitish and mother-of-pearl-like at the centre, and 2 to 5 mm. in diameter; the submerged ones were spheroidal or lenticular, greyish-white, and 1 or 2 millimetres in diameter. In old cultures the agar below the colonies darkened as if a brown pigment had been excreted. The colonies consisted of elliptical bacteria, generally isolated, measuring 1 to $2\frac{1}{2}$ by $\frac{1}{2}$ or rarely 1 μ and taking all the ordinary stains. Inoculation experiments are described which reproduced the alterations in the wood vessels of the root already mentioned, including the formation of bacterial zoogloeae, but the aerial symptoms had not become visible at the time the plants were pulled for examination, though the tops appeared somewhat less vigorous and paler than those of the controls. Possibly enough time was not given for the full development of the disease.

Though the author admits that his experiments have not proved the organism isolated to be the immediate cause of the leaf curl disease in clover, he thinks that the bacterial growth in the root system gradually brings about the death of the plant, which only develops leaf curl in the last period of its life, possibly in only a small number of cases and under special soil conditions. He believes that the growth of innumerable thin branches observed on diseased plants may represent their last effort at resistance, an effort which may or may not be made, according to circumstances. These opinions are based on the facts that the actual loss of clover plants in the field under observation was much more extensive than would be expected from the amount of leaf curl present, and that many plants without leaf curl were found to be suffering from the bacterial root disease. It is thought that infection occurs through wounds.

Lyspletsyge hos Havre. [Bright speck disease of Oats.]—*Statens Forsøgsvirksomhed i Plantekultur. Medd.* 94, 2 pp., 2 figs., 1922.

'Bright speck' disease of oats in Denmark, which occasionally is found also on other cereals, beetroot, potatoes, &c., is most conspicuous about the middle of June, when large, withered spots appear on the leaves. The affected leaves often bend sharply in the middle or at the base and hang down limply. In severe cases the crop is practically destroyed, and in any case the affected plants seldom recover full vigour.

This diseased condition is said to be due to unsuitable soil conditions, being found principally on soils containing a superfluity of humus (reclaimed swamps and the like), an excess of lime or marl, or ashes and building refuse. Such soils generally have a high degree of alkalinity, and the 'bright speck' is found year after year on them.

The disease may be controlled by the application of manganese sulphate at the rate of 5 gm. per sq. metre (50 kg. per hectare). This should be strewn in the early spring over the places where the disease habitually occurs, adding sand, when necessary, to ensure even distribution. In the case of later applications, 1 kg. of manganese sulphate should be dissolved in 10 kg. of water and sprayed over the plants. Certain varieties of oats, e. g. Grey and Moss, are resistant and can be grown with advantage. Acid fertilizers, such as sulphate of ammonia, superphosphate, and kainit are preferable to Chile saltpetre, basic slag, 37 per cent. potash, or organic manure. The use of lime and marl should be avoided.

LINDFORS (T.). **Erfarenheter från vintern 1921–22 beträffande betning mot snömögel.** [Experience of the winter 1921–22 as regards disinfection against the snow fungus.]—*Centralanst. för Jordbruksförsök. Circ.* 80, 7 pp., 1922.

During the winter of 1921–22 the damage caused by the snow fungus [*Fusarium nivale*] was unusually severe in Sweden, especially on rye. In previous pamphlets the Central Institute recommended the use of mercurial preparations, e. g. uspulun and corrosive sublimate, as disinfectants for the seed, and the reports of the results obtained in forty-two different localities, chiefly with rye, as wheat is only exceptionally attacked, can be summarized as follows:—In the great majority of cases the disease was completely held in check by the treatment (generally uspulun). The few failures were probably due to the substitution of sprinkling for immersion, so that infected light seed was sown, or the susceptibility to frost of the particular varieties of rye selected for planting. The complete eradication of infection can only be ensured by immersion, since the parasite is carried on the seed.

In an experiment conducted by the author it was found that 22·1 per cent. of untreated plants, 50·4 per cent. of plants treated with uspulun, and 57·7 per cent. of those disinfected with sublimate survived the winter. It was ascertained in the course of the experiment that the same solution can be used repeatedly (up to eight times) without reducing its efficacy.

STAPLEDON (R. G.), WILLIAMS (R. D.), SAMPSON (KATHLEEN), & JENKIN (T. J.). **Preliminary investigations with herbage plants.**—*Bull. Welsh Plant Breeding Stat. Aberystwyth.* Ser. 4. No. 1, 1922.

A general review of the incidence of fungous diseases on the wide range of grasses and forage crops grown at the Station in the seasons 1919 to 1921 is contributed by Miss Sampson. Thirty-four species of fungi are recorded, twenty-five on Gramineae and nine on Leguminosae. These include several rare forms and three species—*Septoria culmifida* on *Alopecurus pratensis, Poa trivialis, Dactylis glomerata, Phleum pratense,* and *Arrhenatherum avenaceum*; *Mycosphaerella carinthiaca* on *Trifolium pratense* (English Broad Red), and *Sphaerulina trifolii* on *Trifolium repens*—that are new for the British flora.

The abundance of parasitic fungi in the plots is correlated with the methods of growing the hosts in pure species. At least two, *Gloeosporium caulivorum* and *Puccinia phlei-pratense,* are noted as causing an appreciable amount of damage. The former caused much damage to the clovers in the wet season of 1920 and a separate section of the bulletin, written by Miss Sampson, is devoted to a short account of it. *Trifolium pratense* is by far the most susceptible host, but successful inoculations were obtained on *T. repens, T. suaveolens,* and *T. hybridum.* Inoculations on *T. medium, T. incarnatum, Medicago lupulina,* and *M. sativa* failed. *Pseudopeziza trifolii* also caused appreciable injury to *Trifolium pratense* and *Erysiphe polygoni* and some to *T. incarnatum.* Of the twelve grass rusts, recorded, *Puccinia phlei-pratense* was severe in 1920–21 on *Phleum pratense,* some strains being considerably more susceptible than others. In the same seasons *P. glumarum* caused injury to *Dactylis glomerata, P. lolii* and *P. dispersa* to *Lolium perenne* and other rye grasses, and *P. perplexans* to the aftermath of *Alopecurus pratensis. Mastigosporium album* was particularly severe on the last-named host in late autumn and early spring, especially on introduced commercial seed. *A. nigricans* was also badly attacked by this fungus.

The incidence of the various fungi is recorded in detail under each group of host plants by Miss Sampson.

MCFARLAND (F. T.). **Factors affecting the germination of the sclerotia of Claviceps (Ergot of Rye).**—Abs. in *Science,* N.S. lvi, p. 85, 1922.

Sclerotia of ergot [*Claviceps purpurea*] more than a year old failed to germinate. Sclerotia sown out of doors on the surface of the soil without covering germinated well, but the stalks were usually short. The sclerotia must go through a period of rest, the shortest so far found being eight weeks during which they were kept in moist sand. Removal of the cuticle of the sclerotia, or treatment of them with 5 per cent. or 30 per cent. NaCl solution followed by washing, did not prevent germination.

BONNS (W. W.). **A preliminary study of Claviceps purpurea in culture.**—*Amer. Journ. of Bot.,* ix, 7, pp. 339–353, 6 pl., 1922.

The characters of a series of cultures started in 1919 by the author with a view to ascertaining whether by growing *Claviceps purpurea* on artificial media the physiological principles extracted from the natural sclerotia of the fungus could be obtained, confirmed in great part the descriptions and observations of Brefeld, Meyer, and Engelke. Unlike them, however, he was successful in obtaining a stage, in cultures of advanced age, which distinctly resembled the pseudoparenchyma and epidermal layers of the natural sclerotium. He demonstrated also the development of the conidial stage directly from the sclerotium without germination of the latter and without the formation of ascospores.

In the light of tests made with extracts of the cultures, the best being those grown on corn meal, there is reason to believe that only one of the commonly recognized active principles of ergot, namely histamine, was present. Ergotoxin was apparently absent, but chemical analyses on a larger scale than those made are necessary before this fact can be established with certainty. The author believes, however, that very probably the presence of this alkaloid is directly associated with changes involving sclerotial formation, a stage not obtained in his cultures. He concludes that it is extremely doubtful whether the artificial cultivation of *Claviceps purpurea* possesses any practical application.

DUCELLIER (L.). **L'ergot de l'Avoine** [Ergot of Oats.]—*Bull. Soc. Hist. Nat. Afrique du Nord*, xiii, 4, pp. 98–99, 1922.

Claviceps purpurea is found in Algeria on many wild grasses, such as *Ampelodesmos*, *Festuca*, *Lolium*, &c., but amongst cultivated cereals it has so far only been observed on oats. Rye, which is grown here and there in Algeria and Morocco, appears to be free from the disease, though the seed has been imported from localities in Europe and America where ergot of rye is common.

Since 1886, when the parasite was reported to be very prevalent on oats grown in the Mekerra valley, *Claviceps* has been frequently observed on this cereal in several regions of Algeria. The most commonly affected variety is *Avena algeriensis* Trab. ('red and black oats of Algeria') but *A. sativa* L. and *A. fatua* L. var. *glabrescens* Coss. are also subject to the disease. The susceptibility of *A. sterilis* L. and *A. barbata* Brot. is being investigated. No ergot has hitherto been found on wheat, though affected oats have been found on several occasions growing amongst hard wheats in Algeria.

TANRET (G.). **L'ergot d'Avoine et l'ergot de Diss.** [Ergot of Oats and ergot of 'Diss' grass.]—*Bull. Agric. Algérie-Tunisie-Maroc*, 2nd Ser., xxviii, 4, pp. 108–109, 1922.

The author reports the results of an examination of *Claviceps purpurea* on the grass locally known as 'diss' in Algeria (*Ampelodesmos tenax*) and on oats, with a view to determining their content of ergotinin, the supplies of which are now scarce owing to the closure of the Russian market.

The ergot of diss grass was found to be relatively weak in crystallizable ergotinin and to contain approximately an equal quantity of amorphous ergotinin (hydroergotinin or ergotoxin), the two together giving only about 0·10 gm. per kg. of ergot.

The ergot from oats was found, on the other hand, to be richer than that ordinarily obtained from rye, containing 0·80 gm. crystallizable ergotinin as against 0·40 to 0·60 from the Spanish rye ergot at present chiefly used. The sclerotia on oats are small and squat, but are sometimes in sufficient quantity to have caused accidents to horses. This appears to be rare, however, the amount being usually not more than 150 gm. per quintal [100 kg. or 220 lb.] which is not enough to be harmful.

Hence, though the ergot of diss grass is not likely to repay exploiting except in periods of great scarcity, that of oats is well worth consideration, and might replace the Spanish product with advantage.

STAKMAN (E. C.). **Diseases of cereal and forage crops in the United States in 1921.**—*Plant Disease Bull. Supplement* 21, pp. 139–254, 1922. [Mimeographed.]

It is impossible to exaggerate the value to the working plant pathologist of the annual summaries regarding the diseases of the chief crops of the United States issued by the Plant Disease Survey of the U.S. Department of Agriculture. They are compilations prepared chiefly from the reports of collaborators throughout the various states, and therefore cannot be readily abstracted. Not only is the occurrence, distribution, and intensity of the various diseases reported, but considerable information is accumulating on the epidemiology of many of them. The present report deals chiefly with cereal diseases; that on fruit diseases has been already noticed [see this *Review*, i, 11, p. 376].

Of particular interest is the discussion on the incidence of the various rusts of wheat in 1921. The areas affected by the three rusts do not coincide. Stem rust (*Puccinia graminis*) was most severe in Ohio, Michigan, Wisconsin, Minnesota, the Dakotas, Montana, and California, while leaf rust (*P. triticina*) did little damage in the north and west, but was severe in Oklahoma, Tennessee, North Carolina, and other eastern and central states. Stripe rust (*P. glumarum*) was confined to Montana, Idaho, Washington, Oregon, and California, and appears to be spreading east slowly. The underlying causes of this irregular distribution, the relation of climate and weather to the different rusts, the influence of barberry, the effect of varietal susceptibility, and other similar questions of general interest are discussed.

Two diseases of wheat have appeared in the United States recently, flag smut (*Urocystis tritici*) and take-all (*Ophiobolus cariceti*). Their distribution is fully described, and useful notes furnished regarding the losses caused, methods of dissemination, and treatment.

There is a full discussion of the various root rots and scabs of cereals, some of which are reported to be very widely distributed and to cause considerable losses. It is stated that one of the big problems confronting cereal pathologists is that of the foot and root rots, which are caused by species of *Fusarium*, *Helminthosporium* and other imperfect fungi. Those on maize are regarded by Hoffer, in a note on pp. 226–229, as being for the most part secondary to the influence of unbalanced available nutrients in the soil, the most important deleterious agents which become available in the soil solution being probably aluminium and ferrous-iron salts.

In the section on bunt of wheat the excellent results obtained from seed-treatment with chemical dusts are reported. The best appear to be copper carbonate dust and a dust consisting of equal parts of anhydrous copper sulphate and calcium carbonate, either of these dusts being mixed with the grain at the rate of 2 oz. per bushel. Bunt control is stated to be complete and injury to germination nil.

The greater part of the report is devoted to wheat, rye, barley, oats, and maize, the diseases of rice, sorghum, flax, and various forage crops being less fully dealt with. References are given to the chief publications dealing with particular diseases during the year.

SAWYER (A. M.). **Result of investigations made by the Department of Agriculture, Burma, into the extent of the damage caused by a parasitic plant known in Burmese as 'Pwinbyu' (Striga lutea).**—*Dept. of Agric. Burma, Bull.* 18, 7 pp., 5 pl., 1921 [1922].

Almost throughout the Burmese dry zone the sorghum crop, which covers about 350,000 acres, is liable to attack by *Striga lutea,* a full description of which is given in this bulletin. The pest is most severe on poor and light soils, such as those of the uplands, which have become exhausted from over-cultivation. On the heavier, deeper, and more fertile soils of low-lying districts the sorghum crop gets an early start and out-distances the parasite. Sorghum is sown from June to September, while *Striga* is most conspicuous from August to November, when its white flowers may be seen in dense groups among the light green stalks of the crop.

Striga is propagated exclusively from seed, immense quantities of which are produced from September to April. Germination can only occur when the seed is in contact with the roots of the host; otherwise the seed can remain dormant for several years (at least three) with no loss of vigour. Germination can take place readily at 1 ft. below the surface of the soil, and at any season of the year. Wind is by far the most important agent concerned in the dissemination of the seeds, which are extremely minute and light. Other common agents of dissemination are moving water, grazing cattle, the carting of infested crops, and the use of infected manure, implements, &c.

Amongst the plants on which *Striga* was found to be parasitic were maize, various millets, teosinte, Sudan grass, and thirteen species of wild grasses. Only five non-gramineous plants are listed as hosts, none of which are cultivated. Tests and observations indicate that it will not grow on beans and other pulses, cotton, sesamum, tomato, chilli, or coriander. Parasitism begins with the germination of the seed, and is absolute during the whole of the plant's underground existence, which lasts for about a month. The host is therefore most seriously affected during this stage, parasitism being only partial after the *Striga* has appeared above ground. The effect on the plant was indicated in pot cultures by a reduction in transpiration, dry weight of plant, and dry weight produced per unit quantity of water transpired, the reduction in all cases being very considerable.

Owing to the variety of factors involved in the failure of sorghum crops in Burma it is impossible to estimate exactly the extent of the damage caused by this pest alone. The results of experiments conducted at Mandalay indicate the approximate loss as varying from 4 to 46 per cent. These figures represent the incidence on clay soil, and would probably be exceeded on the uplands.

Trials were made of common salt, saltpetre, nitrate of soda, nitrolime, superphosphate, copper sulphate, sulphate of ammonia, and potassium nitrate, applied to the soil in quantities varying from 50 to 200 lb. per acre with a view to killing the parasite, but all were unsuccessful, while the crop itself was injured in several cases. An attempt was also made to destroy the parasite by sowing a 'decoy' crop of sorghum, which, with the accompanying *Striga*, was ploughed under before the latter produced seed, and this was followed by another crop later in the season. The later crops. however, were as heavily infested as the 'decoys', the yield in all cases being less than that of the controls. On poor soil, besides, it is often difficult to establish even one crop, and a second opportunity seldom occurs.

The following practices are recommended with a view to lessening the damage:—The sowing of sorghum in rows 18 in. apart, followed by occasional intercultivation with a wheel-hoe. Thorough cultivation, drainage, manuring, and early sowing, with a view to establishing a strong stand early in the season. The burning of all stubble and rubbish on the field after the harvest. Rotation of crops.

CAMPANILE (G.). **Su di una malattia delle frutta di Mandarino (Cytosporina citriperda Camp.).** [On a disease of Mandarin Oranges (*Cytosporina citriperda* Camp.).]—*Le Staz. Sperim. Agrarie Ital.*, lv, 1–3, pp. 5–12, 4 figs., 1922.

The author describes a disease which this year destroyed large quantities of mandarins (*Citrus deliciosa*) in the markets at Rome, and which, so far as he is aware, has not previously been recorded. The cause is a fungus which is referred to *Cytosporina*, though differing from the typical forms of this genus (probably on account of its unusual habitat), and is named *C. citriperda* n. sp., a Latin diagnosis being given.

The first symptom is the appearance on the fruit of a rounded, generally slightly depressed, spot (rarely two or three), from 0·7 to 1·5 cm. in diameter, at first reddish-brown, and later black in colour. Under young spots the wall of the endocarp is strongly attached to the rind, and on the latter being removed, tears away with it, leaving the underlying pulp bare. Under older spots the rind with the attached endocarp wall is reduced to a black pulpy mass, 2 to 3 mm. thick, which extends into the flesh of the fruit; the latter shows a tendency to dry up. Eight or ten days later, secondary spots appear at different points of the epicarp, gradually assuming an appearance similar to that of the primary spot. The interior surface of the rind under these newly-formed secondary spots shows a light yellow discoloration, but is not attached to the endocarp wall which remains intact; the underlying flesh is strongly blackened, granular in aspect, and thicker in consistence than the normal. At a more advanced stage the discoloration of the inner side of the rind is dark yellow; a black, gristly, irregular, lamelliform stroma, sometimes involving the endocarp between two contiguous segments of the fruit, and densely covered with pycnidia on both sides, is found immersed in the flesh. In some cases the infection reaches to the centre of the fruit and may even, though this occurs rarely, involve the seeds, the seed-coats becoming transformed into a black, granular, and extremely hard stroma. While pycnidia are constantly formed on the stroma in the endocarp, they occur very rarely on the exterior of the fruit. Among the very abundant material examined the author met with pycnidia on the surface of the fruit in two cases only. The essential difference between the primary and the secondary spots is that in the first the infection starts from the exterior and progresses inwards, while the secondary spots arise from an internal mycelium derived from the primary spot.

Artificial inoculations were successfully carried out by introducing a small piece of the stroma with pycnidia from diseased fruits, into small wounds in the rind of healthy ones. It still remains doubtful whether the fungus can penetrate in the absence of lesions in the rind; a careful examination of the diseased fruit failed to show any trace of insect or other external injury.

LEE (H.) & SHINO (A.). **Citrus canker control experiments in Japan.**—*Philipp. Journ. of Science*, xx, 2, pp. 121–150, 4 pl., 1922.

Experiments on the control of citrus canker (*Pseudomonas citri*) in the Philippines were described in a previous progress report by the senior author [see this *Review*, i, 7, pp. 213–215]. It was considered advisable to try further control measures in an orchard planted exclusively with the Washington navel orange (*Citrus sinensis*) in order to ascertain whether the methods already found to be effective were also commercially feasible. A series of experiments was therefore conducted at the Saigomura orchard in the Nagasaki Prefecture in Japan. The following is an outline of the seasonal conditions in the district, with their effects on the canker organism. November to May: temperatures usually below 20° C.; rainfall and canker dissemination very slight; no foliage or fruit development of the host plants from November to March. June and July: temperatures and rainfall increased and favourable to canker development; fruit and foliage of the host growing rapidly and liable to infection. Late July and early August: rainfall slight; not a period of serious canker development under ordinary conditions. August and September: possible typhoons with high wind velocities and heavy rainfall, favourable for the development and dissemination of canker; the fruit tissues are in a susceptible stage for infection. October and November: abrupt fall of temperature and decrease of rainfall: the fruit is nearly mature and no longer susceptible; canker activity may be disregarded.

The control campaign was organized with a view to applying protective spray coatings during the critical seasons of the heavy rainfall in June and the probable typhoons in late August and September. The orchard was in good cultural condition but the owner had had serious trouble with citrus canker. A good windbreak on all sides was formed by a belt of coniferous trees. The tests were carried out in 1919 on eighteen-year old navel orange trees covering an area of about six hectares, and comprised applications of lime-sulphur (1 to 40, 32° Baumé concentration); Bordeaux mixture (4–4–50); neutral Bordeaux mixture; Burgundy mixture (3–3–50); and formalin (1 to 100). All the mixtures, except formalin, reduced the infection, especially both the Bordeaux mixtures. Lime-sulphur, though an excellent bactericide, was easily washed off by rain. Formalin was absolutely useless. Rough pruning slightly reduced the canker, while pruning and spraying combined resulted in a very fair measure of control.

The commercial aspect of the various treatments may be summarized as follows: copper sprays (without previous excision of cankers) cost 32·4 to 33·7 Japanese sen per tree, the number of affected fruits being reduced to 34·37, and 46 per cent. as compared with 80 to 96 per cent. on the untreated trees. Copper sprays accompanied by the removal of sources of infection before the period of canker activity cost 92 sen for Bordeaux 4–4–50, 90 sen for neutral Bordeaux, and 92 sen for Burgundy 3–3–50, while the canker was reduced to 9·25 per cent., 6·5 per cent., and 18·5 per cent. respectively. Excision of the sources of infection, without other treatment, cost 59·6 sen per tree, and reduced the cankered fruits to 45 per cent. Lime-sulphur by itself cost 31 sen and reduced canker, but not to such an extent as the copper sprays. Other observations showed that wind prevention alone may reduce the development of canker from 50 to 60 per cent. down to 6, 20, and 37 per cent. The cost of American and Japanese orchard labour is approximately equal, considering the greater efficiency of the former.

Considerable disadvantages accompanied the use of the copper sprays, the commercial value of the fruits being depreciated by the increased infestation of the red spider, sooty mould (*Meliola camelliae*), and a blemish identical in appearance with melanose (*Phomopsis citri*), to the extent of 100 per cent., 25 per cent., and 63 per cent. respectively. The two former may be avoided by the addition of oil emulsions to the copper precipitate sprays. The melanose injury was definitely correlated with the use of the neutral Bordeaux mixture. Lime-sulphur and formalin did not produce these effects. It is probable that the application of the copper sprays in June and July, and of lime-sulphur in August, would solve this difficulty. The luxuriant green of the foliage and the clear colour of the fruits in the lime-sulphur plots was particularly noticeable. The use of the sprays mentioned in these experiments caused no perceptible insipidity of the fruit such as is attributed to the action of lead arsenate (*Monthly Bull. Dept. Agric. California*, i, pp. 10–11, 1921).

The effects of citrus canker on Washington navels may be briefly summarized as follows:—(*a*) an indeterminable loss, due to a decrease in the functioning of infected leaves; (*b*) an insignificant loss due to the dropping of young fruits; (*c*) a commercial loss owing to the blemish on affected fruits; (*d*) a slight reduction in weight of the cankered fruits; and (*e*) occasional secondary infection by fruit rots. The results of their experiments have convinced the writers that feasible control can be effected upon citrus fruits of the general susceptibility of the Washington navel, which is less susceptible than limes or grape-fruit but more so than the Mediterranean sweet orange, Satsuma, mandarin, lemon, citron, kumquat, and calamondin.

SAMUEL (G.). **Brown rot of Citrus fruit.**—*Journ. Dept. Agric. South Australia*, xxvi, 2, pp. 112–118, 5 figs., 1922.

Brown rot of citrus (*Pythiacystis citrophthora*) is reported in South Australia for the first time, oranges affected with the disease having been found in two localities in August 1922. In its early stages brown rot is difficult to distinguish from blue mould (*Penicillium* spp.), so that the disease may have been present for some years before being recognized.

Serious damage from brown rot is unlikely in South Australia, except possibly in the wetter districts. The spread of the fungus can probably be prevented by removing infected fruit from the ground.

An account is given of the methods adopted to combat the disease in California, and the life-history of the causal organism is described and figured [see this *Review*, i, 7, p. 211].

BARKER (B. T. P.), LEES (A. H.), WALLACE (T.), & WILTSHIRE (S. P.). **Leaf scorch on fruit trees.**—*Ann. Rep. Agric. & Hort. Res. Stat., Long Ashton, Bristol, for 1921*, pp. 77–121, 1922.

Since 1913 the causation of leaf scorch in apple and other trees has been under investigation at this Station. A type due to the action of wind, and another associated with certain soils ('scorching' soils) have been mentioned in previous reports. The scorches due to salt spray injury from sea winds and to the toxic action of spray fluids are not referred to in the present work.

In the type associated with 'scorching' soils the plantations affected can usually be picked out at some distance because of their brownish tinge instead of the normal green. The disease occurs in patches of various sizes which are not sharply defined from the surrounding healthy trees. The most obvious symptom of the trouble is the scorched appearance of the leaf-margins. Affected trees are also stunted in growth, this condition varying in accordance with the severity of the attack, but sometimes reducing the size so that trees fifteen years old are no larger than normal trees of five. The trouble usually coincides with the advent of dry summer weather, from the end of May to the end of June, though it is not necessarily confined to this period. The fresh growth which frequently follows rain, later on shows no sign of scorch. A moist season may either prevent the development of scorch on typical scorch plantations or considerably reduce its intensity. The roots are also affected in trees suffering from scorch, being insufficiently developed to give the tree a firm hold in the soil. The disease is most frequent on trees grown in arable soil, apples growing in grass being rarely affected. In the majority of cases 'scorching' soils are of a light and sandy character and are often very stony, but a few, fairly light. loamy soils of less coarse texture, and even heavy loams of good depth which are decidedly 'sticky' in wet weather and difficult to work, may also bear scorched trees. Two non-typical forms of the disease, of which one occurs occasionally with comparative suddenness late in the summer, and the other in the autumn, just prior to leaf-fall, do not damage the trees seriously.

Another type of scorching associated with soil conditions has been under close observation and treatment at Long Ashton, and differs from the above in that the scorch, instead of affecting only the margin and tip of the leaf is irregularly distributed over the surface. Affected leaves are, as a rule, much undersized. The discoloration begins soon after the unfolding of the new foliage and growth almost ceases by midsummer. The appearance of the plants was strongly suggestive of defective nutrition, and the response to artificial fertilizers was rapid and most striking.

A further type of scorch, reproducing the typical marginal and tip discoloration of the leaves, occurs in gooseberry bushes, in association with the die-back disease of those plants caused by *Botrytis cinerea*. A well-defined marginal scorch has also been produced experimentally on peach trees by applying lithium carbonate to the soil. A chance observation of leaf scorch produced by fire makes it clear that when the foliage of a tree is exposed to temperatures just sufficiently high to cause some injury to it, the marginal areas of the leaves are the first parts to suffer.

Experiments are described in which the object was to reproduce leaf scorch artificially under controlled conditions. From these trials and observations it appears that the cases of leaf scorch recorded fall into a number of more or less distinct categories, according to whether the disease is due to soil conditions, wind, heat, or injury to the vascular system of the tree. In no case, except in a few belonging to the last of these groups, could parasitic action, even at a distance, be held responsible for the trouble. To arrive at conclusions regarding the manner in which these unhealthy conditions arise within the cells the evidence available for each of these four groups of cases is discussed separately.

In the first group, soil influence is of a varied character, but the main feature which the cases under test had in common was a relatively poorly developed or defective root system to which the symptoms of scorching could be directly traced. Fertilizer experiments and analyses of scorching soils indicate that these cases of scorch may possibly be referred exclusively to a lack of potash salts, though a lack of nitrogen may sometimes co-exist. The mechanical character of the soil also seems in some cases to be concerned in the production of scorch, lack of adequate aeration resulting in a poor development of the roots; the same effect may be caused by poor water-lifting or water-holding soils. The authors think that damage to the root system by insects or fungi during the early part of the growing season might produce scorching, provided it was extensive enough, but no such case was seen.

In the second group, drying winds may cause excessive transpiration, or the leaf tissues may be affected locally by the chafing of one leaf upon another when stirred by breezes, but it is not clear whether, in the latter case, unhealthy cell conditions are set up through mechanical irritation, or whether the cuticular surface is weakened and excessive transpiration follows.

In the third group must be included cases of scorching of foliage under glass and of spot scorching after watering in hot sun, but these are probably rightly regarded as burns pure and simple.

The fourth group includes an example of scorching preceded by bark-ringing in the case of a plum tree, and also the marginal scorch frequently seen on the foliage of trees attacked by a vascular parasite, such as *Botrytis cinerea.*

The general conclusion is reached that excessive transpiration, or more accurately, unbalanced water relations of the leaf tissues, are apparently involved in all the cases of scorch referred to, this resulting sometimes from direct action on the leaf and sometimes indirectly through the roots.

Whilst there are factors connected with leaf scorch which still await elucidation, the practical side of the present investigation gives hope of a considerable degree of control in many instances. The three outstanding factors in this connexion are potash effect, influence of grass, and root-stock action. The experiments have shown that a liberal application of potash manures constitutes one of the most certain remedial measures in many cases. The fact that trees growing in grass rarely suffer from scorch is still unexplained, but the evidence suggests that the trouble may be reduced or even eliminated by growing a cover-crop of grass. The importance of active root growth indicates that only trees worked on free growing types of root-stock should be planted on 'scorching' soils, and that cultural operations tending to encourage active root growth, and manurial treatment with the same object, must necessarily lead to greater resistance to the disease. Nitrogenous fertilizers should be used sparingly, as these encourage the production of a dangerously large leaf surface. In the treatment of scorch it will be found of advantage to withhold all nitrogenous dressings until an improvement by means of potash alone has been secured. In the case of wind scorch, where plantations are unavoidably situated in wind-swept localities, the establishment of wind-breaks should lessen the trouble.

BARNUM (C. C.). **Stem end rot of Apples.**—*Science,* N.S. lv, pp. 707–708, 1922.

Apples removed from cold storage in California were found in some cases to show rot at the stem end caused by *Penicillium expansum.* It appeared that the fungus had entered the fruit through the attached stem. Since this method of infection appeared not to have been noted previously, the author tested it experimentally by inoculations and found that *P. expansum* can readily enter the apple after it has been removed from the tree by growing down the stem into the fruit.

WORMALD (H.). **Observations on a Discomycete found on Medlar fruits.**—*Trans. Brit. Mycol. Soc.,* vii, 4 pp. 287–293, 2 figs. 1922.

The author describes the fructifications of a fungus which developed in the spring of 1921 on mummified medlar fruits collected a year earlier under trees affected with leaf blotch. The fungus, which is believed to be the cause of the leaf blotch disease, differed but slightly from *Sclerotinia mespili* as described by Schellenberg. The differences noticed consisted in the narrower ascospores and in the stalk of the apothecium developing from the apex of the primary protuberance, not from the base as stated by Schellenberg. The direct connexion between this Discomycete and a *Monilia* with disjunctors found on the diseased leaves was not traced, but the fact that the fungus isolated from the mummies showed the same habit when grown in plate cultures as that isolated from the leaves, is suggestive that the two forms are stages in the life cycle of the same fungus.

STEVENS (H. E.). **Avocado diseases.**—*Florida Agric. Exper. Stat. Bull.* 161, 23 pp., 6 figs., 1922.

Avocado scab (*Cladosporium citri* Massee) has developed to a considerable extent in Florida during the past few years. It is common on the foliage of seedlings of West Indian avocadoes, and is difficult to control on young plants in the nursery. Fruits of the Trapp, Taylor and Fuerta varieties seem to be especially susceptible to scab. The injury is usually superficial on the fruits, but their appearance is marred, and the disease probably results in the shedding of many young fruits. Cool, wet weather favours the development of scab, and only young and tender growth is attacked; the fruit may become infected from the time the bloom drops until six or eight weeks later, but the principal injury occurs during the week or two after the bloom drops.

The disease occurs on young leaves and shoots as definite spots or patches, and in severe infections the leaves may be curled or distorted. The small, purplish-brown or dark spots are usually more prominent on the upper surface of the leaf. Sometimes a shot-hole appearance is caused. The spots on the young shoots, twigs, and leaf petioles are oval, and darker and more elevated than on the leaves. The spots on the fruits resemble those on the twigs, and in severe infections they may be so numerous as to give a roughened, russet, or scabby appearance.

C. citri from avocado will cause typical infections on either avocado or citrus, but a few trials with the fungus from citrus failed to cause infection on avocado, indicating that certain strains of *C. citri* have adapted themselves to avocado.

Tests showed that scab on the fruits can be largely prevented by appplying 3-3-50 [3-3-40, Imperial gallon] Bordeaux when the trees are in bloom, then two later applications at three-weekly intervals. For nursery stock a 4-4-50 Bordeaux before the growth starts, followed by ammoniacal copper carbonate every seven to ten days until the new growth becomes hardened, is recommended.

Black spot occurs as round, brown to black spots, from one-eighth to one-half inch in diameter, which are composed of hard, dry, corky tissues extending through the skin of the fruit. The bark of young shoots and fruit stems may also show the spots. The disease is caused by a *Colletotrichum* which appears identical with *C. gloeosporioides* Penz. The fungus gains entrance to the living avocado tissues apparently only through injuries. Tests indicated that the disease can be controlled by two or three applications of Bordeaux (3–3–50 or 4–4–50) beginning three or four weeks after the bloom has disappeared and renewed at three-weekly intervals.

Avocado blotch occurs on the fruit, and is likely to be confused with black spot. The blotch spots appear first as pale green areas on the fruit, showing one or more minute brown or black dots. The spots darken and finally become irregular and sunken. A few cases of blotch were found on fruit stems. The disease is caused by an undetermined *Cercospora*. It usually occurs in association with black spot, and the same control methods are effective.

Rusty blight, caused by *Gloeosporium* sp., occurs chiefly on the foliage and young branches. The infected leaves turn rusty brown, and affected parts are often concentrically marked. The tree may be largely defoliated by the attack. The twigs may die back, and the blooms are often damaged. Bordeaux mixture (4–4–50) is recommended for control, together with removal of infected branches.

Powdery mildew (*Oidium* sp.) was found, but is probably not serious.

Russeting of the fruits is not uncommon, and may be caused by insects, by mechanical injuries, or by certain fungi. One type resembles melanose of citrus fruits in outward appearance, and is thought to be the effect of fungous injury.

HARTER (L. L.) & WEIMER (J. L.). **Decay of various vegetables and fruits by different species of Rhizopus.**—*Phytopath.*, xii, 5, pp. 205–212, 1922.

Decay of vegetables and fruit from the action of fungi of the genus *Rhizopus* is usually attributed to *R. nigricans*. The present study was undertaken to test the ability of other species of the genus to cause decay similar to *R. nigricans*. Eleven species of *Rhizopus* were tested on twenty-seven different hosts, all of which were susceptible to decay by some of the species. From the results of the inoculations, full details of which are given, the different species were arranged in three groups, according to the optimum temperature for infection; *R. chinensis* represents the high temperature group (35° C), *R. oryzae*, *maydis*, *tritici*, *delemar*, *nodosus*, and *arrhizus* the intermediate group (30° C), and *R. artocarpi*, *reflexus*, *microsporus*, and *nigricans* the low temperature group (20–22° C). *R. microsporus* and *R. chinensis* proved more or less non-parasitic, infecting only a few of the hosts and those comparatively slightly. On the whole, the species of the intermediate group, which are seldom found causing decay, exhibited a more vigorous parasitism under artificial conditions than those of the low temperature group. *R. nigricans*, however, produced less percentage infection than *R. artocarpi* or *reflexus*, although it seems to be responsible for most of the decay of fruits and vegetables in storage and on the markets.

The ease with which infection took place varied with the host, the method of inoculation required apparently depending on whether or not the host was juicy or relatively dry. None of the hosts could be infected without wounding, except ripe peaches, which became infected on being dipped into a spore suspension, sporangiophores finally growing outward through the skin and fruiting abundantly. It was found that a considerable percentage of the decay attributed to brown rot (*Sclerotinia cinerea*) of peaches and plums was apparently in reality due to *Rhizopus nigricans*.

ALLEN (W. J.). **Orchard experiments. Spraying trials at Glen Innes Experiment Farm.**—*Agric. Gaz. of New South Wales*, xxxiii, 2, pp. 113–119, 1922.

Trials of various fungicides were carried out at Glen Innes Experiment Farm during the season 1920–21 for the control of powdery mildew and of black spot [*Venturia inaequalis*] of the apple.

For powdery mildew 10 lb. 'atomic sulphur' to 83 galls. water gave the best control. The first spraying should be done at the spur-bursting stage and this should be followed by three sprayings with atomic sulphur combined with lead arsenate at the regular periods prescribed for the control of codlin moth.

Sulphuric acid at a strength of 1 part to 1,500 parts by volume of water controlled powdery mildew fairly well. As injury results when it comes in contact with lead arsenate this treatment is unsuitable where the latter has to be used.

Colloidal sulphur and colloidal sulphur paste, prepared by precipitating the sulphur in lime-sulphur solution, have given equal results to atomic sulphur in controlling powdery mildew during the two seasons. The paste was successfully used in combination with lead arsenate.

The present treatment recommended by the Department is to cut out and burn all mildewed twigs during winter pruning, and to remove as far as possible all mildewed terminal buds. Spray with atomic sulphur (10 lb. to 80 galls. water) from spur-bursting to pinking stage. Spray with atomic sulphur combined with lead arsenate at the periods prescribed for the application of the latter for the control of codlin moth.

No outbreak of black spot has occurred at the farm, and the effect of fungicides in its control could not be determined. Bordeaux mixture causes severe russeting of the fruit in the Glen Innes district. Lime-sulphur caused no damage and gave a slight control of powdery mildew.

Search for a combined spray to control both diseases was also ineffective on account of the absence of black spot. It was found however, that atomic sulphur combined with lime-sulphur, first at spur-bursting strength (10 lb. sulphur to 83 galls. total combined spray) and later with lime-sulphur at summer strength for apples and pears, these later sprayings being made in conjunction with applications of lead arsenate, caused no injury and controlled powdery mildew.

The russet injury from Bordeaux mixture does not occur if the spray is applied at early spur-bursting, when only the tips of the enclosed blossom buds are exposed. Bordeaux mixture gave slight control of mildew this season but has ordinarily failed to control this disease. Both it and lime-sulphur retard the growth of the apple and pear trees and fruit, when the full four applications are made. The same strengths of lime-sulphur as are recommended in departmental publications for apple spraying can be used on the varieties of cherries tested without causing injury. They cannot safely be used on peach, nectarine, apricot, and Japanese plum trees later than the pinking stage.

Full details of the experiments are given.

BRERETON (W. LE GAY), HAMBLIN (C. O.), & STOKES (W. B.). **Black spot of Pear and Apple. Some orchard experiments.**—*Agric. Gaz. of New South Wales*, xxxii, 2, pp. 123–130, 3 figs., 1922.

This is an account of experiments on the control of black spot or scab of pear and apple (*Venturia pirina* and *inaequalis*), in orchards at Turramurra and Towrang between 1917 and 1921, the apple trials taking place in 1920–1921. The perithecial stages of these fungi were found for the first time in New South Wales in 1920.

Lime-sulphur was tested on Williams pears but was found to cause burning of the leaves and was therefore discontinued. Of various strengths of Bordeaux mixture tried, the formula 6–4–80 gave the best results; the slight amount of russeting produced in no way depreciated the fruit value, while the treatment was successful in controlling scab. 'Pickering' Bordeaux also gave efficient control, though it marked the fruit rather more severely. The 1921–1922 season was very favourable to the disease and the control trees bore about 90 per cent. of badly spotted fruit, while the treated plots had less than 5 per cent.

Apple scab trials took place at Towrang in 1920–1921. Atomic sulphur, lime-sulphur, and Bordeaux mixture were used and 100 trees in all of several different varieties received treatment, but as the amount of black spot was very limited, no conclusions could be drawn as to the effectiveness of the sprays. Bordeaux mixture 6–4–50 resulted in serious russeting of the fruit, especially where two applications were made. This experience seems to have been general on the tablelands. Lime-sulphur solutions have not caused russeting, but cannot be said to have been proved as yet to be effective in the control of the disease.

The Department's recommendations for controlling black spot include the ploughing in of all fallen leaves in the autumn and the cutting out and burning of all dead wood. Working the ground in the spring at flowering time helps to spread the spores and is not advised. The following spraying programme is recommended as the most likely to give complete control:—Bordeaux (6–4–50) or lime-sulphur (spur-bursting strength) at from spur-bursting to pinking stage. Lime-sulphur or Bordeaux (summer strength) when the petals are falling; this second application to be combined with the first lead arsenate spray for codlin moth. If weather conditions favour the disease, the same spray should be used with the second and third applications of lead arsenate. Finally, an autumn spraying with winter strength Bordeaux (6–4–22), before the leaves have fallen, but after the picking of the fruit, is required when the disease has been severe during the season, and is valuable as an insurance for next season.

It is stated that Bordeaux mixture applied five weeks after the falling of the petals causes very little russeting. The spraying of Trevitt apples or Williams pears grown in the coast districts with lime-sulphur solutions after the spur-bursting stage is not recommended.

LINDFORS (T.). **Ett besprutnings försök mot äppleskorv sommaren 1921.** [A spraying experiment against Apple scab in the summer of 1921.]—*Medd. från Centralanst. för försöksväsendet på jordbruksområdet* 227, 10 pp., 3 diags., 1922.

Experiments were carried out at the Swedish Central Agricultural Research Station to test the action of 'solbar' (Bayer & Co., Leverkusen, Germany) and 'frisco' (Phylatterion Ltd., Trelleborg, Sweden) on apple scab [*Venturia inaequalis*]. Both preparations were made up according to the prescribed formulas (1:100 and 1:22 respectively). The trees were sprayed twice, at the beginning of June and early in July. Better results were obtained with frisco than with solbar, the concentration of which was presumably too low. An analysis of the preparations showed that frisco contained about three times as much polysulphide sulphur as solbar, when diluted according to the instructions for spraying. Varietal susceptibility was very marked, a considerable degree of resistance being exhibited by Keswick Codlin, Codlin's Spring Grove, Ribston, and Golden Noble, while Säfstaholms-äpple, Alexander, and Signe Tillisch had a high proportion of scab in all cases.

HOWITT (J. E.). **Results of four years' co-operative experiments with (dry) formaldehyde for the prevention of Oat smut.**—*Ann. Rept. for 1921 Agric. and Exper. Union, Ontario Dept. of Agric.*, pp. 27–30, 1922.

The average annual loss from oat smut [*Ustilago avenae*] in Ontario is stated to amount, at a conservative estimate, to $3,000,000. The so-called dry formaldehyde treatment of the seed is extremely effective in the prevention of the disease, and co-operative experiments under ordinary farm conditions have been carried on for the last four years to convince farmers of the advantage of the method. Thirty-five trials were made altogether and 2,122 bushels of oats treated. The varieties of oats included O.A.C. No. 72, Alaska, Banner, White Cluster, Mammoth Cluster, and Siberian. The average of the results for the four years showed no smut in the crop from treated seed and 4·23 per cent. of infection in the crop from untreated seed. The average germination of treated and untreated seed was found to be identical, viz. 97·5 per cent.

The results of the treatment were therefore uniformly satisfactory throughout, the vitality of the seed being unimpaired and the control of the smut complete. In no case was there more than a trace of infection present in any of the fields sown with treated seed, while in some of the checks there was over 15 per cent. of smut. This method of treatment combines simplicity with rapidity and ease of application. It was found that one hundred bushels of oats could be treated in fifty minutes, and there was no necessity to wait for the seed to dry afterwards. The grain did not sprout, get mouldy, or swell.

The oats to be treated should be placed in a pile and shovelled over into another heap, the spraying being done during this process. The solution should consist of one part of formalin (40 per cent. formaldehyde) and one part of water, to be used at the rate of one pint to twenty-five bushels of oats. The irritation to the eyes, nose, and throat caused by the formalin fumes can be prevented by holding the sprayer close to the grain and allowing the air to circulate freely through the granary. After the oats are all sprayed they should be piled in a heap and covered with sacks or blankets, which should be sprayed with the same solution inside and out before use. After five hours the seed should be uncovered and sown as soon as possible afterwards. A slight reduction in germination may result from any delay in sowing. There is no need to wait for the seed to dry as the moisture is so slight that it is imperceptible and will not affect drilling.

Barker (B. T. P.) & Wallace (T.). **A new method of sulphur fumigation.**—*Ann. Rept. Agric. and Hort. Res. Stat., Long Ashton, Bristol, for 1921*, pp. 122–124, 1922.

Investigations on the fungicidal action of sulphur have been in progress for some years at the Station. The present note is concerned with methods of vaporizing sulphur in a fungicidally active form.

The toxicity of a treated atmosphere depends upon the presence in it of sulphur particles of varying size, some so small as to be barely visible under the highest magnification, and even these may be aggregates of still smaller particles. The toxicity to fungi of such an atmosphere may be removed from it by filtration, thereby demonstrating that the effective sulphur is not in the form of vapour but of definite particles. When air containing particulate sulphur is passed into water, a suspension of colloidal sulphur is obtained. Sulphur distributed on growing plants through the atmosphere in this particulate form furnishes a much more complete superficial covering than can be secured by dusting or dry-spraying with flowers of sulphur, and also adheres so firmly as to withstand heavy rain or jets of water of considerable force. The usual method of applying it in this form is by coating the hot-water pipes of the greenhouse with a paste of sulphur or by placing shallow pans of flowers of sulphur in the houses.

An improvement in respect of control is offered by the so-called 'vaporization' method, utilized in fumigators such as 'Campbell's Vaporizer'. It consists in boiling sulphur under such conditions that the vapour evolved condenses to a cloud of very finely divided particles of sulphur. The temperature of the sulphur is, however, raised above its ignition point in this method, and there is a danger of its burning which would result in the production of sulphur dioxide and injury to the growing plants.

These drawbacks have been avoided in a new method worked out at Long Ashton. It consists in passing a current of air over or through molten sulphur. The melting point of sulphur is about 115° C., its ignition point in air about 260° C., and its boiling point about 440° C. The most satisfactory temperatures of molten sulphur for the air-blast treatment appear to lie between 170° and 230° C., so that there is no risk of ignition in this treatment. The best yield of particulate sulphur is got by passing air from a perforated nozzle in a series of fine streams through the molten sulphur. So far only forms of apparatus suitable for laboratory and small greenhouse work have been tested, but the method is believed to have considerable prospects of being adopted for field use.

The method recommended by Vogt [see this *Review*, i, 1, p. 29] appears to produce a cloud of particulate sulphur of substantially the same character as that described above, but the objections to it are that the temperature is raised above the ignition point of the sulphur and that appreciable quantities of sulphuretted hydrogen are likely to be formed.

BRAUN (H.). **Effect of delayed planting on germination of seed Wheat treated with formalin.**—*Phytopath.*, xii, 4, pp. 173–179, 3 figs., 1 pl., 1922.

Experiments carried out in December 1921, and repeated in January 1922, on five varieties of wheat, viz, Marquis, Fultz, Turkey, Purple Straw, and Fulcaster, showed that the ordinary formalin treatment of wheat reduced germination considerably, especially if the seeds were kept a week before planting. Seeds subjected to the pre-soak formalin treatment, however, were not appreciably injured, even if kept a week before planting, whilst those planted a day after treatment were somewhat stimulated.

The full discussion of the causes involved is reserved for a later paper. Attention is drawn, however, to the hardening effect of formalin on the pericarp, which may prevent or delay the primary root from pushing through it. The absorption of water vapour by seeds previous to treatment tends to counterbalance this hardening effect. Another possible cause of the injury is the persistence of paraformaldehyde on the surface, or a concentrated solution of formaldehyde within the pericarp, of treated seeds, pre-soaked seeds, however, retaining much less formaldehyde or paraformaldehyde in or on their coats than seeds treated by the usual formalin process.

KOMURO (H.). **Preliminary note on the cells of Vicia faba modified by Roentgen rays and their resemblance to tumour cells.**—*Botan. Mag., Tokyo*, xxxvi, 424, pp. 41–45, 1922.

In a new series of experiments on the effect of X-rays upon the mitoses in the cells of *Vicia faba*, the author found that on account of the abnormal development of mechanical tissues, the tips of the rootlets of seedlings grown from irradiated seeds were harder than those of the controls. The cells of the former showed very few mitoses; almost all the cases observed were anomalous, the chromosomes having become fragmented and scattered in the cytoplasm. Both nuclei and nucleoli were increased in size, but no definite transitional stages were seen. In every case vacuolization of the nucleoli was observed. In some cells the nucleolus had escaped from the nucleus, and in many others the protoplast was separated from the cell wall. In the periblem tissue many cells showed karyolysis, while some were in a condition of pycnosis; the writer does not believe this pycnosis to be an artifact, since the epidermis and the neighbouring tissues, both in longitudinal and transverse sections, were disturbed in comparison to those of the controls. Even in the tissue adjacent to the growing point pycnotic cells were found. A decrease of chromatic substance was noticed in the nuclei, more usually in those with more than two nucleoli (this agrees with Kimura's observations on tumour cells), a reticular chromatic structure being found in young cells only. Giant cells were very often met with; the nucleus was enlarged so as almost to fill an entire cell, and in such cases many nucleoli were found scattered in the cytoplasm.

The author is inclined to think that changes such as described above mean senescence of the cytoplasm and that the karyolytic and pycnotic conditions may, with a high degree of probability, be taken as outward expressions of the approaching end of cell life. Referring to his examination of Kimura's preparations of tumours (carcinoma of horse testis and polymorphic sarcoma of man), while the author is not prepared to compare the changes of cell elements in his case with the degenerative changes of tumour cells, he thinks that it may be safely said that a heavy irradiation of the seeds of *Vicia faba* with X-rays induces in the cells of the radicles a diseased or senescent condition resembling that of tumour cells.

RAND (F. V.), BALL (E. D.), CAESAR (L.), & GARDNER (M. W.). **Insects as disseminators of plant diseases.**—*Phytopath.*, xii, 5, pp. 225–228, 1922.

Under this heading are included four papers read at the joint session of the Phytopathological Society and the American Association of Economic Biologists on 31st December, 1921. The authors, in the order given above, spoke on the following aspects of the subject:—1. Results of past investigations; 2. Systematic relations of carriers; 3. Control problems; 4. Urgent problems of the future. A bibliography containing thirty-four entries is appended.

VALLEAU (W. D.). **Some seed-borne diseases of agricultural crops.** Abs. in *Science*, N. S. lvi, p. 16, 1922.

Fusarium moniliforme was found to be 'practically universal' in maize seeds. The fungus is carried between the seed-coat layers, and may extend to the aleurone layer. In very flinty corn the organism remains dormant for a longer period after the seed is planted than in the case of poorly filled, starchy kernels.

A preliminary study of wheat, oats, and barley seed-grain indicates that they are commonly infected with pathogenic organisms. Lettuce seed was often found to carry an organism believed to be the cause of lettuce root rot. The organism of root rot of clovers seems also to be transmitted by the seed.

TWORT (F. W.). **A theoretical study of the nature of ultramicroscopic viruses.**—*Veterinary Journ.*, lxxviii, 8, pp. 283–291, and 9, pp. 324–330, 1922.

Throughout this paper the view is taken that there is no proof that any true ultramicroscopic virus has been seen or grown. The turbidity obtained by many workers with certain of these viruses in Noguchi's medium is not accepted as definite proof that cultures have been obtained, as similar phenomena can be observed in sterile organic media and soil filtrates.

The author has cultivated a spirochaete from a mouse and certain delicate vibrio-spirilla from soil, which in fluid cultures passed through a Berkefeld filter but not a Doulton white porcelain filter. In yellow fever the causal agent, which is believed to be the leptospirillum described by Noguchi, will pass even a fine porcelain filter, though it is an organism of not inconsiderable size. The composition of the medium, temperature, pressure, the structure of the organism, and other factors are all capable of influencing filtration through porous porcelain. Filter passage is, therefore, not by itself evidence that the causal agent of a disease is ultramicroscopic.

The author's repeated attempts to establish cultures of saprophytic ultramicroscopic organisms (which one would expect to occur, and to be more readily cultivated than the pathogenic forms) were failures. He considers it unlikely that ultramicroscopic viruses are merely very small bacteria. He supposes that more primitive forms of life than the bacteria and protozoa must exist, and that among them may be included pathogenic forms. The filter-passing lysins associated with many bacteria have been regarded by some as ultramicroscopic viruses, and have been shown to be capable of transmission from culture to culture and to increase. Even the lysozyme obtained recently by Fleming from normal body fluids, &c., is stated to be capable of increase under certain conditions when isolated. It is regarded as improbable that the ultramicroscopic viruses can be simple chemical substances or simple enzymes, and though they may be more complex enzymes, they are probably still more highly organized bodies. Such bodies may be represented by the suggested pre-cellular forms of life and be situated, in a sense, between the simple enzymes and the bacteria.

POOLE (R. F.). **Celery mosaic.**—*Phytopath.*, xii, 3, pp. 151–154, 1 pl., 1922.

The symptoms of this disease, as found in New Jersey, are conspicuous. The foliage is sometimes drooping, wilting, or spreading, but more usually is erect. The leaves often become filiform and produce a bushy top, while blister-like spots may appear on them. The affected parts are very brittle but show no alteration in colour. Aphids from diseased plants were transferred to healthy plants of the Golden Self Blanching variety, and in two weeks the latter showed symptoms of mosaic. New leaves developing after the older leaves were affected also showed the disease, even when aphids were absent. Several varieties of celery were found to be susceptible.

The author can account for the appearance of the disease only on the assumption that it may have been transmitted to the celery from adjacent tomato plants which showed mosaic.

RAND (F. V.). **Pecan rosette: its histology, cytology and relation to other chlorotic diseases.**—*U. S. Dept. of Agric. Bull.* 1038, 42 pp., 12 pl. (1 col.), 1922.

After a brief introductory survey of the nature of chloroses, general and infectious, the previous work on pecan rosette is summarized. The disease was first recognized by fruit growers in 1900, but the earliest published full account appeared in 1914, when the independent investigations of Orton and Rand were collected in the form of a joint paper (*Journ. Agric. Res.*, iii, pp. 149–174).

Trees of all ages are affected by rosette, the most constant sign of which is the development of undersized, crinkled, and yellow-mottled leaves, especially at the ends of the branches. The chlorotic areas are situated between the principal veins, and in severe cases may be thinner than the normal. Along the midrib and principal veins the blade is often rather thicker than in healthy leaves. Affected leaves have an undulated appearance of the laminae, parts of which are often absent. In slight cases, or at an early stage, yellow mottling may be the only external sign of the disease. Later, when the branches also become affected, there is considerable reduction in growth, and the leaves are compressed into clusters, giving the typical bunched appearance. The nuts borne on such branches are usually small and misshapen. The symptoms may appear over the whole tree at once or be confined at first to one or a few branches. In severe cases the affected branches begin to die back from the tip during the latter half of the growing season. Brownish spots and streaks develop in the chlorophyllous inner bark, and increase in size until the bark and cambium are disorganized. This 'staghorn' phase is followed in the same and subsequent seasons by the development of abnormal numbers of shoots from dormant and adventitious buds. With each repeated sequence of premature abnormal growth and dying back, the new twigs and leaves tend to become more and more depauperate.

The disease is fairly well distributed over the pecan-growing districts in the south, but has not been reported from the northern limits of pecan culture. Previous investigations have shown that rosette is not restricted to any soil type, season, or topography. In the alluvial river bottoms of Texas, Louisiana, and Mississippi, however, it is comparatively rare, these environmental conditions being natural to the tree. In dry, sandy, upland soil the disease is much more prevalent. According to McMurran, 90 per cent. of the cases which he observed were found under conditions denoting lack of humus, plant food, and moisture. The transplantation of rosetted trees to better conditions almost always effects their recovery; on the other hand, healthy trees used to replace diseased ones generally contract rosette.

Tests with fertilizers showed that most plots to which lime was applied, especially those receiving lime and acid phosphate combined either with muriate of potash or nitrate of soda, developed cases of rosette, while none appeared in the untreated control plots or in plots receiving muriate of potash with acid phosphate or stable manure with and without ground bone. Chemical analysis of the soil indicated that the presence of lime alone was not sufficient to account for the disease, since the percentage of calcium was higher in parts of the orchard which were free from rosette. In ash analyses of normal and diseased leaves and twigs the percentage of potassium appeared to be greater in the latter, but no other clear differences could be distinguished.

The fluctuation in the disease from year to year and its appearance in patches suggest that climatic and soil conditions are in some degree responsible. The negative results of attempts to isolate a causal organism or to transmit the disease by inoculation or grafting, and also the success of transplantation in effecting a cure in many cases, indicate that the cause is not a parasite, though the evidence is not conclusive and, in particular, the possibility of insect transmission has not been examined. There is no evidence of varietal differences in resistance to the disease.

Internal abnormalities of structure and metabolism in the leaf correspond in degree with the external manifestations. They are, in general, similar to those that have been described in the infectious chlorosis group of diseases, including mosaic and yellows. The histological changes may differ greatly in a comparatively small area of the leaf, and the most varied types of tissue derangement are found in the same leaf. The number and size of the cells, the differentiation of the tissues, the amount of intercellular space, and the variations in leaf thickness are all liable to great modification. The assimilation and translocation of starch are also profoundly affected. In the centre of the yellow spots the plastids are almost wanting, while there appears to be practically complete inhibition of translocation of starch from mottled leaves.

All the histological and cytological data hitherto ascertained in regard to this disease point to a much greater similarity to the known infectious chloroses than to the types of chlorosis due to soil or other environmental influences. Whether the factors responsible for causing pecan rosette must be introduced into the plant from without or may originate within the plant itself is a question that cannot yet be answered.

MELIN (E.). **Boletus-Arten als Mykorrhizenpilze der Waldbäume.** [Species of *Boletus* as mycorrhizal fungi of forest trees.]—*Ber. deutsch. bot. Gesellsch.*, xi, 3, pp. 94–97, 1922.

In 1921 the author isolated three genuine mycorrhizal fungi from *Pinus sylvestris* and one from *Picea abies* [see this *Review*, i, 4, p. 122]. They failed to form fruit bodies in pure culture, but the presence of clamp-connexions suggested that they were Hymenomycetes or Gasteromycetes. The synthesis of a mycorrhiza by the inoculation of sterile plants with the mycelium of a known forest fungus is necessary to establish the identity of the fungus symbiont, and this has now been accomplished by the writer with species of *Boletus*.

It has recently been pointed out by Romell [see this *Review*, i, 7, p. 233] that symbiosis frequently occurs between *B. elegans* Schum. and different species of larch, and between *B. luteus* and the pine. In July, 1921, cultures were obtained of the following:—*B. edulis*, *B. luteus*, *B. variegatus*, *B. subtomentosus*, *B. piperatus*, and *B. scaber*. The colonies of *B. luteus* greatly resembled the fungus previously isolated from the pine mycorrhiza. Inoculations were made as noted below.

Three months old seedlings of *Pinus sylvestris* were inoculated on 25th August with the mycelium of *B. luteus*. By 2nd November the upper lateral roots had developed into typical mycorrhiza, hyphal strands 50 μ in thickness running into the substratum. The lower lateral roots were not infected at this date, and the root hairs were well developed. This synthetic pine mycorrhiza closely resembles that of *Mycelium radicis sylvestris* α as previously described by the author, but it is impossible to decide whether they are identical since other species of *Boletus* might present a similar appearance.

Experiments with *Boletus luteus* and *Picea abies* were similarly conducted. There were no typical mycorrhiza by 9th November, but the fungus had formed thick hyphal strands round the upper lateral roots. The formation of mycorrhiza can probably be induced with greater facility in the pine than in the fir.

Seedlings of *Larix europaea* were inoculated in the summer with mycelium of *B. elegans*. By November the upper lateral roots had all developed mycorrhiza. Hyphal strands about 50 μ in thickness extended some distance into the surrounding sand. The fungus had not penetrated the lower lateral roots. Root hairs were entirely absent, and the partially-divided epidermal cells had curved out from the root in the shape of a crescent. These cells can probably act as root hairs. *Boletus elegans* may form mycorrhiza in other species of larch, but apparently not in *Pinus sylvestris* or *Picea abies*. It occurs only in the immediate vicinity of larches, of which it is probably an obligate parasite.

These experiments conclusively prove that the so-called humus fungi of the forests take part in the formation of ectotrophic mycorrhiza. *Boletus* is not the only genus involved, at any rate in the case of *Pinus* and *Picea*, for it very seldom forms clamp-connexions, and these structures were found in certain of the fungi isolated from roots.

GARD (M.). **L'Hydnum erinaceus Bull. sur Noyers.** [*Hydnum erinaceus* Bull. on Walnut trees.]—*Bull. Soc. Path. Vég. de France*, ix, 1, p. 21, 1922.

The author found sporophores of *Hydnum erinaceus* growing on mechanical or frost wounds of walnut trees in two different localities in France. As far as he is aware, this is the first time that the fungus has been recorded on this host. It does not appear to be a dangerous parasite, but its action on the wood of the host has still to be investigated.

KAR (P. C.). **'Bud-rot' of Palmyra Palm.**—*Bengal Agric. Journ.*, i, 4, pp. 110–111, 1921 [1922].

Bud rot of Palmyra palm, due to *Phytophthora palmivora* Butl. (*Pythium palmivorum*), has broken out in Bengal. The writer has seen numerous cases in the Hoogly and Burdwan districts, where the disease has probably been present for the last five or six years. The Palmyra palm itself is not of much economic importance in Bengal, but the writer thinks that there is a great danger of the disease spreading to the valuable coco-nut and areca palms unless the affected material is immediately destroyed by burning the tops of all diseased palms.

Willaman (J. J.) & Sandstrom (W. M.). **Biochemistry of plant diseases. III. Effect of Sclerotinia cinerea on Plums.**—*Botan. Gaz.*, lxxiii, 4, pp. 287–307, 7 figs., 1922.

In previous papers the senior author dealt with the vitamine requirements and the relation to pectic substances of the brown rot organism of stone fruits, *Sclerotinia cinerea*. The present paper deals with the changes in composition of certain varieties of plums brought about during the process of rotting by this fungus.

Three of the varieties used in the experiments were markedly resistant to *S. cinerea*, while the two others were very susceptible. Samples of each were examined at three stages of growth, namely, when half-grown, when fully grown and just beginning to ripen, and when fully ripe but still on the tree. From each sample a portion was analysed immediately, another inoculated and left to rot in a moist chamber, and a third left without inoculation in a moist chamber for the same length of time as the last. The inoculations were made by injections into the pulp, so as to avoid the factor of mechanical or other resistance of the skin of the fruit.

The susceptible varieties were found to rot more quickly after inoculation than the others (9 to 13 days as against 13 to 18 days according to the stage of growth), and they also showed a more abundant aerial growth of mycelium. The rotted fruit of the resistant varieties was also decidedly firmer in texture than that of the susceptible varieties.

Chemical analyses showed that in most cases the specific gravity of the expressed juice decreased in the sound fruit during storage in the laboratory, and that there was a still further decrease in the rotting fruit. There were indications of varietal differences in juice density which may be correlated with resistance, the resistant varieties having a higher specific gravity than the susceptible, even when the fruit had rotted. In most samples the acidity was less in the rotted than in the sound fruit. The acidity in plums does not fluctuate to any appreciable extent during the ripening process. In the fresh samples the resistant varieties had a somewhat higher acid-content than the susceptible, but no difference was apparent in the stored and rotted samples. There was no conclusive evidence that acidity is an important factor in the resistance of plums to brown rot. The changes in titratable acidity were relatively greater than those in H-ion concentration, the average percentage decrease in the former from sound to rotted samples being 17. This would indicate a consumption of acid by the fungus.

There was a marked increase of tannin during the storage of the sound samples in the first stage of growth but this did not occur when the fruit was infected by the fungus. The tannin-content did not appear to have any bearing on resistance or susceptibility. In all cases there was a small amount of oxalic acid present in the juice of the fresh fruit, and there was usually more in the rotted samples than in the fresh or sound stored ones, which points to a production of oxalic acid during rotting. There were some indications that a high oxalic acid-content denoted resistance to the disease.

Owing to the great irregularity in the quantities of total nitrogen in the three groups of samples, no clear indications of the nitrogen relations were obtained. There was some evidence that the rotted samples contained a higher proportion of total nitrogen than the sound ones. The fungus converts a portion of the non-protein nitrogen of the host into protein nitrogen in its own mycelium. Nitrites could not be detected in any of the samples, and the disturbance of nitrogen nutrition cannot be a factor in this disease.

It is not yet possible to suggest a hypothesis for the chemical and physiological bases of resistance to the brown rot of stone fruits.

BOAS (F.) & MERKENSCHLAGER (F.). **Versuche über die Anwendung kolloidchemischer Methoden in der Pflanzenpathologie.** [Experiments in the application of colloid-chemical methods in plant pathology.] *Centralbl. für Bakt.* Abt. 2, lv, 21–24, pp. 508–515, 3 figs., 1922.

Modifications in the colloidal properties of the proteins are effected by neutral salts as well as by acids and alkalis. The neutral salts of the alkalis precipitate albumin only at high concentrations, while those of the alkaline earths do so at lower concentrations. The well-known tendency of the lupin (*Lupinus luteus*) to chlorosis when grown on soils rich in lime may be traceable to a direct action of the alkaline earth on the albumin or to denaturization or flocculation of the albumin in the cell on account of the absence of protective colloids. The structure of the cell constituents would be thereby disorganized, numerous active constituents of the protoplasm would be broken down, and the plant would suffer far-reaching damage.

An investigation of the expressed sap of ten to twelve days old seedlings of *Lupinus luteus* showed that the cations of the alkaline earths, especially calcium, produce immediate flocculation of the proteins. Even very small quantities of calcium chloride will produce this effect, magnesium chloride being somewhat less effective, while potassium chloride has practically no action. The calcifuge habit of the lupin is evidently therefore the result of this action of the calcium ion on its peculiarly susceptible proteins. The latter are present in unusually high proportion in comparison with the carbohydrates (45·07 to 10·02, whereas in peas the protein is 23·19 and carbohydrates 53·02).

Viscosity tests were carried out with extracts of the seeds of lupin and pea. Extracted with water the former filtered much more readily than the latter, but when extracted with 5 per cent. sodium chloride the position was reversed. This is due to the fact that conglutin, the albumin of lupin, is very slightly soluble in water but readily soluble in a solution of sodium chloride, while the legumin and vicilin of the pea are appreciably soluble in water and filter at about the same rate whether extracted with water or sodium chloride. When various salts were added in order to test the action of cations on the viscosity, it was found that the pea extract made with sodium chloride was not affected in its rate of filtration by calcium or magnesium chlorides, while that of lupin filtered more rapidly as a result of flocculation of the albumin.

The action of magnesium on the lupin has not usually been separated from that of calcium, but it is evident that it should be similarly deleterious, and this has already been stated to be the case by several observers. The low proportion of carbohydrate is probably an important factor since it is said to act as a protective substance to the protein bodies. The lupin differs fundamentally from most other plants in its metabolism and it is not suggested that the above explanation of its liability to chlorosis in calcareous soils would apply to other calcifuge plants.

DUCOMET (V.). **Observations et expériences sur les maladies de dégénérescence de la Pomme de terre.** [Observations and experiments in connexion with 'degeneration' diseases of the Potato.]—*Bull. Soc. Path. Vég. de France*, ix, 1, pp. 29–38, 1922.

The author has cultivated 52 lots of the variety Institut de Beauvais from various parts of France, information regarding conditions of soil, altitude, age of stock without renewal, &c., having been obtained in each case. As a result of these tests and inquiries he notes that both leaf roll and 'frisolée' [mosaic] are widespread in this variety in France, the former being, on the whole, the more prevalent. Their onset and subsequent increase has varied in different localities; neither soil conditions, nor altitude, nor long continued cultivation of varieties seems to be an important factor in their intensity, but rather the degree of infection in the seed tubers used. In only one case was leaf roll absent, and in this the plants had frisolée.

Varieties particularly subject to leaf roll are more likely to be attacked by frisolée than vice versa. None of 70 varieties tested at Grignon has proved really immune, though the degree of attack varies greatly. Some are equally susceptible to both diseases, others to one more than to the other. Within a variety perfectly healthy individuals sometimes are found.

These diseases are not the result of cultivation, since the author found that the wild species *Solanum maglia*, *S. commersoni*, and *S. caldasii* became infected at Grignon. The frisolée of *S. commersoni* corresponds with what Berthaut has called the 'mutation frisée' of this species.

At least two forms of leaf roll may be distinguished, the ordinary trumpet-shaped, and a second which is more spoon-shaped. The latter corresponds to the marginal leaf roll of Quanjer. The term frisolée is preferred by the author to mosaic since the leaf mottling implied by the latter word is usually not marked, and when distinct the disease is not true frisolée but the Aucuba mosaic of Quanjer [see this *Review*, i, 8, p. 255]. The old name frisolée dates from the time of Parmentier, and describes the usual undulated and goffered appearance of the leaves of diseased plants from the first period of attack, long before the 'curly dwarf' stage is reached. A form characterized by non-crinkled leaves, marked by ill-defined local discoloration, is possibly a distinct disease, and if so the term mosaic would be better applied to it.

Rain may cause leaf roll to disappear temporarily, but this is not the case with frisolée, which is generally more marked in wet weather, the curly dwarf form excepted.

The author has failed to confirm Quanjer's statement that in the first year leaf roll is marked by symptoms confined to the top of the plant. The leaf rolling has always appeared to him to commence towards the base. He states that Quanjer himself appears disposed to abandon his former distinction between primary and secondary leaf roll. The three true symptoms of leaf roll are the rolling and hardness of the leaves, the interference with translocation of starch, and phloem-necrosis. The accumulation of starch precedes the leaf rolling, and this in its turn precedes phloem-necrosis. Hence the primary cause acts by disturbing diastatic activity; there is hypernutrition leading to premature maturation of the leaves.

The diseases may not be as entirely systemic as is generally believed. Tubers from a diseased plant have been cut in half and the halves have given a diseased and a healthy plant respectively. So also healthy shoots are sometimes found in diseased plants, and even axillary shoots from the same shoot may show some diseased and some healthy. Transmission through the seed is usually stated not to occur, but the author's seedlings of certain varieties have been so heavily attacked, even when he could find no green fly, that he is forced to conclude either that the diseases (especially frisolée) are hereditary, or else that there is a very marked hereditary predisposition to them.

ARTSCHWAGER (E.). **Occurrence of phloem necrosis in leaf roll tubers.**—*Phytopath.*, xii, 4, pp. 193–194, 1922.

The writer has recently observed a wide distribution of phloem-necrosis in the stolons and tubers of potato plants affected by leaf roll. Plants of long leaf roll lineage show signs of necrosis in the stolon even before the new tubers have attained an appreciable size. The diseased groups commonly found in the inner cycle show progressive lignification and the severity of necrosis increases with age. Mature tubers are often borne on stolons, the phloem tissue of which is completely diseased; in the tuber itself, however, the advance of necrosis is slow, being confined primarily to the basal region. If tubers slightly affected with phloem-necrosis are used for seed, it will be found that the malady becomes greatly intensified in the seed tuber when the plants have reached an appreciable size, and seed pieces from lateral and terminal eyes which showed no necrosis before planting will have developed it at this stage.

Experiments conducted with whole and cut tubers to determine the relative development of necrosis in the seed pieces after the latter were planted showed that necrosis developed only in vascular tuber tissue connecting with actively growing sprouts, the phloem tissue in the region of the dormant buds being normal. Thus the development of necrosis in the seed piece is undoubtedly correlated with growth activities and the movement of food initiated in the sprouting eye. There is an increase in vascular tissue to accommodate the increased transfer of food substances. The relative severity of necrosis in stolons and tubers, and the earliness of its development appear to be an index to the length of existence of the disease in a tuber line.

HUNGERFORD (C. W.). **Leaf roll, mosaic, and certain other related diseases in Idaho.**—*Phytopath.*, xii, 3, pp. 133–139, 1 pl., 1922.

Leaf roll and mosaic appear to be on the increase in potatoes in Idaho. The mottling, in the case of mosaic, may not be evident in the field, but was found to appear under greenhouse conditions Field tests gave a marked decrease in the yield from crops grown from tubers of plants affected with leaf roll or mosaic. The author also describes more fully the disease which he had previously (*Proc. Wash. Hort. Assoc., 1920,* p. 266) named russet dwarf. Affected plants in the field resemble somewhat those affected with mosaic, and are smaller and lighter in colour than normal plants. The leaves, especially the lower ones, have a rusty appearance, the veins on the lower surface appearing first water-soaked, then turning brown. Later on these lower leaves may fall off progressively from the ground up. Dark brown streaks are present on the petioles and stems of the lower part of the plant. The disease is transmitted by the tubers, and when tubers are planted in the greenhouse the symptoms are striking. The disease is also evidently transmitted from plant to plant in the field. Its cause has not been determined.

Another condition, termed calico, is fairly common in irrigated sections of Idaho, Washington, and Utah. The leaves are variegated, sometimes as much as half the surface being almost completely chlorotic, although later these areas may develop chlorophyll. Otherwise the plants appear normal, and the yield is not materially reduced. Tubers from affected plants transmit the condition.

EYER (J. R.). **Notes on the etiology and specificity of the Potato tip burn produced by Empoasca mali Le Baron.**—*Phytopath.*, xii, 4, pp. 181–184, 1 fig., 1 pl., 1922.

Recent investigators consider that tip burn of potato is either of a physiological nature or caused by the feeding of the potato leaf hopper (*Empoasca mali*). Ball (*Wisconsin Dept. of Agric. Bull.* 23, 1919) concluded that some 'specific' was transmitted by the insect, and this circulating through the veins caused the death of the tissue supplied by them.

The object of the experiments described here was to determine the nature and transmissibility of the 'specific' injected. Inocula were prepared by macerating the nymphal and adult stages of the insect in sterile water or alcohol, and were forced into the leaf tissues through the midrib, injections into the leaf membrane giving no results. The inoculated plants were placed in direct sunlight, and all developed typical tip burn in twenty days in the open, the progress of the disease being slower (twenty-eight days) if the plants were kept under glass. The disease develops naturally (i. e. when caused by the feeding of the leaf hoppers) within 4 days of inoculation. All the check plants remained healthy. Inocula prepared from the nymphs produced tip burn more quickly than those of adults. The 'specific' of tip burn exists in diseased leaf tissue after infection by the leaf hopper, and may be transmitted to healthy plants by inoculating them with an alcoholic extract of diseased leaves. Inoculations with extracts of various other insects which normally feed on the potato, gave negative results with the exception of *Nysius ericae* Schill, which caused chlorosis and death of the tissues but not tip burn. Mechanical injury to the midrib sometimes resulted in a browning similar to tip burn, but this did not spread beyond the group of cells injured.

BARRUS (M. F.) & CHUPP (C. C.). **Yellow dwarf of Potatoes.**—*Phytopath.*, xii, 3, pp. 123–132, 2 pl., 1922.

This disease, which is probably a new one, has appeared in various parts of New York State. Eighteen varieties have been found affected, and none of these seemed to show resistance. The plants have a stocky, dwarfed appearance, and the stems are yellowish-green in colour. The growing apex dies early. The stems when split show rusty specks in the pith and cortex of the nodes, and sometimes also of the internodes, of the upper portion of the plant. The leaflets are generally rolled, but sometimes corrugated. The most characteristic symptoms are shown by the tubers. These are usually small, few, set close to the stem, and sometimes cracked. The flesh is often discoloured with rusty brown specks or areas in the pith and other internal tissues of the tuber, but this discoloration is seldom found in the fibro-vascular bundles. These discoloured areas are most pronounced in the middle or bud end of the potato as taken from the field, the stem end not being affected except during storage. The old seed piece is usually intact during the growing season.

The authors found evidence that the causal agent exists, or persists, in the soil over winter. The disease may perhaps be carried also by the seed, but usually when affected tubers were planted they produced either no plants or only dwarfed and spindly ones. The causal agent has not been determined.

FRANCHINI (G.). **Amibes et autres protozoaires de plantes à latex du Muséum de Paris.** [Amoebae and other protozoa of latex-bearing plants at the Paris Museum.]—*Bull. Soc. Path. exot.*, xv, 4, pp. 197–203, 1922.

In this paper the author describes the protozoa found in latex-bearing plants other than those previously recorded [see this *Review*, i, 9, pp. 307–312.]

EUPHORBIACEAE. Trypanosomes frequent in *Elaeophorbia drupifera*; less frequent in *E. calyculata.* These trypanosomes strongly resemble those found in the latex of *E. nereifolia* and *E. virosa* in Italy, except for their smaller dimensions and rounded instead of rod-shaped blepharoplasts. The flagellum was usually absent. U-shapes were frequent, and there were a few forms with two nuclei and a centrosome. In the latex of *Excoecaria emarginata* trypanosomes were frequently observed, the dimensions of which generally exceeded those of the foregoing. U-shapes were somewhat rare, and the latex also contained large bodies measuring 10 to 15 by 3·5 to 4 μ with several masses of chromatin in the protoplasm. These were probably stages of reproduction. Other forms showing a large vacuole in the centre were probably degenerating. Slow but distinct amoeboid movements were observed. *Euphorbia verticillata* contained no trypanosomes, but a few amoebae were present, measuring 10 to 12 μ, and having one or more masses of chromatin in the protoplasm. The latex of *Manihot dichotoma* contained small bodies similar to *Leishmania*.

ASCLEPIADACEAE. *Chlorocodon whiteii* was infested by small amoebae, and *Cryptostegia grandiflora* by numerous amoebae of different species and varying dimensions, and occasional crithidian forms.

APOCYNACEAE. Amoebae were frequent in the latex of four species of *Strophanthus*, in *Acokanthera*, *Thevetia*, and *Cerbera odollam*. The last-named contained infrequent *Herpetomonas*. The amoebae contained in the latex of Apocynaceae had a dense protoplasm with few vacuoles. The nuclei varied in number from one to eight or more.

MORACEAE. *Cudrania javanensis* contained numerous protozoa with marked amoeboid movements. There were one or two nuclei in the protoplasm and a dark, comma-shaped centrosome. The plant was in poor condition, yellow, and with a scarcity of latex. Amoebae and other protozoa were observed in the latex of *Ficus benjamina*, *F. pierrei*, *F. tholloni* (partially withered), and *F. carica*. The last-named were outdoor fig trees, examined in March, which suggests that the organisms can survive the winter. Amoebae were frequent in *Antiaris toxicaria* and *Artocarpus lakoocha*.

SAPOTACEAE. *Chrysophyllum*, *Labramia bojeri*, *Treculia africana*, and various species of *Mimusops* were the most heavily infested. The amoebae resembled those present in the latex of *Antiaris* and *Artocarpus*. Flagellates of the *Herpetomonas* type were observed in the latex of *Sideroxylon inerme*. Spherical or oval protozoa were seen in *Mimusops schimperi*, with a long flagellum 10 to 15 μ in length, and containing several chromatin masses. *Chrysophyllum glabrum* and another species of *Chrysophyllum* contained large trypanosomes resembling those of *Cudrania javanensis*.

MENISPERMACEAE. Small, spherical or oval bodies were present in *Stephania rotunda* var. *succirubra*.

ANACARDIACEAE. A small protozoon, usually spherical, with one or more nuclei, was observed in *Oenocarpus vitiensis*.

Some of these plants, especially those most heavily infested, were yellow and contained little latex. The mean temperature of the plant-houses in which they grew was 23° C.

Cultures of the amoebae were obtained on a solid medium containing blood. They are undoubtedly new species of which this is believed to be the first record.

BISBY (G. R.), CLAYTON (E. E.), MARTIN (W. H.), ROSA (J. T. Jr.), & STOKDYK (E. A.). **The co-operative Potato spraying project. Report for 1921.**—*Phytopath.*, xii, 5, pp. 241–248, 1922.

Intended to supplement the data already published [see this *Review* i, 2, p. 36], the present report brings the results of potato spraying and dusting experiments up to date. It appears that Ohio and Manitoba may be added to the list of regions where the use of Bordeaux for potatoes is profitable. These and additional data from New Jersey, West Virginia, Pennsylvania, and elsewhere, together with published results for Canada, gave further indications of the value of spraying even in the absence of *Phytophthora*. In

Kansas and Missouri the advantage of Bordeaux spraying is questionable, although in 1921 increased yields were obtained in each case. Further particulars as to the mode of application, technique, &c., are included in this report.

During 1921 dusting tests on potatoes in New Jersey, Ohio, and Manitoba gave results inferior to those obtained by spraying. This inferiority of dust may be partly due to the dry season and the absence of late blight [*Phytophthora infestans*] in the areas in question.

KLEBAHN (H.). **Wirtswechsel und Spezialisierung des Stachelbeerrostes.** [Heteroecism and specialization of Gooseberry rust.]—*Ber. deutsch. bot. Gesellsch.*, xl, 3, pp. 104–111, 1922.

Eriksson (*Arkiv för Bot.*, xvi, 1920) has called into question Klebahn's view relative to the biologic specialization of the *Carex* rusts with aecidia on *Ribes* and *Urtica*. The present article deals with an attempt on the part of Eriksson to demonstrate the existence of an intermediate form, which he calls *Puccinia caricis* f. *diffusa*, on the ground that in twelve out of fifty-two cases of inoculation with teleutospores from *Carex*, infection occurred both in *Urtica* and *Ribes grossularia*, and in thirty-five on *Urtica* alone. The author thinks that this can be explained by an accidental mixture of the spore material, and states that, after renewed experiments, he maintains his opinion that the rusts forming aecidia on *Ribes* and *Urtica* are biologically distinct.

RAWITSCHER (F.). **Beiträge zur Kenntnis von Ustilagineen. II.** [Contributions towards a knowledge of Ustilaginaceae. II.]—*Zeitschr. für Botanik*, xiv, 4, pp. 273–296, 2 figs., 2 pl., 1922.

The author states that the first nuclear divisions during the germination of the spores of *Tilletia tritici* take place within the spore and not in the promycelium as described by Paravicini and by Dastur [see this *Review*, i, 3, p. 88]. The process, which is fully described, results in the formation of four (? haploid) nuclei which seem to have two chromosomes, the diploid nucleus having apparently four chromosomes. By the third day most spores contain eight nuclei which are still dividing, so that when the promycelium appears on the third or fourth day up to sixteen nuclei may migrate into it. No divisions were observed to take place in the promycelium.

In *Cintractia montagnei* the first nuclear divisions occur in the promycelium as it is formed. The resulting four nuclei may be distributed in either of two different ways: if like nuclei are in the two upper cells of the promycelium, a process is put out which connects the terminal and basal cells while the second and third cells are united by a clamp-connexion; if the two types of nuclei alternate in the four cells, the two distal cells and the two basal ones are united by clamp-connexions.

Urocystis violae behaves like *U. anemones* as described by Kniep [see this *Review*, i, 3, p. 86], except that it usually produces 8 (sometimes 7) primary, and 4 secondary, 4-nucleate sporidia.

In *Doassansia sagittariae* there is no fusion of sporidia. Secondary, tertiary, and subsequently formed sporidia are all uninucleate, as are also the infecting hyphae. The paired-nuclei stage appears shortly before the formation of spores. The two nuclei fuse in the young spore.

The author notes that nuclear fusions have been found in all the smuts so far investigated but the process differs widely in different species. If the fusion of nuclei derived from the same fusion nucleus denotes a retrogression in sexuality, the degree of this retrogression varies. In the *Tilletiaceae* conjugation of sporidia from the same promycelium seems to be the rule and it is constant in species of *Urocystis* and in *Doassansia alismatis*. In *Ustilago*, however, sporidia from different promycelia may conjugate, although in no case, so far as is known, is this obligatory.

The reduction divisions take place at the time of germination of the spore but the haploid stage varies greatly in length, the extremes being cases such as *Ustilago maydis* and *Doassansia sagittariae*, where almost the whole vegetative life is haploid, on the one hand, and *Urocystis anemones*, which forms only four haploid cells, on the other.

La Rue (C. D.). **The results of selection within pure lines of Pestalozzia guepini Desm.**—*Genetics*, vii, 2, pp. 142-201, 10 figs., 1922.

The author has carried out an investigation of the effects of selection within pure vegetative lines on *Pestalozzia guepini* Desm. This fungus was selected because of the presence of numerous distinct strains within the species [see above, p. 413]; the ease with which it can be grown in culture; the rapidity with which consecutive generations are produced; the availability of at least two easily measurable independent characters (length of spore and length of appendages); the rapidity with which spores are produced and their enormous numbers; the dark colour of the central cells of the spores, which develops only at maturity and serves to eliminate mere growth stages; and the total absence of any sexual form of reproduction.

The cultures were kept under as constant conditions as possible in ordinary laboratory (not incubator) conditions in Sumatra, and were started from single spores of the strain studied. From this strain twenty single-spore cultures were made to provide material for selection. Measurements were made on 100 spores of each culture. The culture giving the greatest mean spore length was taken for plus selection, and that with least spore length for minus selection. A third culture, as near as possible midway between the two, was taken as an intermediate to be carried on without selection. From the plus and minus cultures ten single-spore cultures were made and again 100 spores were measured from each of these ten cultures, those giving the greatest and least spore lengths being taken for continued selection. The process was repeated through ten generations. The same procedure was followed for length of spore appendages, except that the selection was carried through twenty-five successive generations.

In neither case was any evidence obtained that selection had been effective in increasing or diminishing the two measured characters. In one case a mutation was observed, giving a greater length of spore appendages than any other met with in the whole series, and differing also in other spore characters. This mutation has remained constant for several generations and will be further studied.

Another set of experiments, in which selection was made by direct measurement of the spore length of the single spore taken to start the culture in each generation, gave similar results.

A discussion is added in which the results of other workers on similar lines are critically examined.

SACCARDO'S **Sylloge Fungorum.**

In a circular received from Prof. L. Montemartini, Director of the Cryptogamic Laboratory, Botanical Institute, Royal University of Pavia, Italy, it is stated that two volumes of the *Sylloge*, which were in preparation by Saccardo at the time of his death, are being completed by Traverso and Trotter and will contain the descriptions of fungi published between the years 1912 and 1917.

The further continuation of this great work has now been undertaken by the Cryptogamic Laboratory at Pavia and Dr. Montemartini asks that all information on mycology published after 1917 may be sent to the Laboratorio Crittogamico, R. Università di Pavia, Italy.

Mycologists throughout the world will be glad to know that the future of the *Sylloge* is assured and has been placed in such competent hands.

LAIBACH (F.). **Untersuchungen über einige Ramularia- und Ovularia-Arten und ihre Beziehungen zur Askomyzetengattung Mycosphaerella. II. Ovularia obliqua (Cooke) Oudem.** [Investigations of certain species of *Ramularia* and *Ovularia* and their relations to the Ascomycete genus *Mycosphaerella*. II. *Ovularia obliqua* (Cooke) Oudem.]—*Centralbl. für Bakt.*, Abt. 2, lv, 11–13, pp. 284–293, 6 figs., 1921.

The genus *Ovularia* closely resembles *Ramularia*, the chief difference being that its conidia are continuous. The author has succeeded in establishing that *Ovularia obliqua* has for its perfect stage a *Mycosphaerella* similar in many respects to the *Mycosphaerellas* which have *Ramularia* conidia. The fungus is common in its conidial form on many species of *Rumex* and the perithecial stage has been found on the under side of the *Ovularia* spots on fallen leaves of the previous year.

The conidia are formed singly at the tips of conidiophores which emerge in bundles through the stomata of the leaf. The conidiophore continues to grow, pushing the first conidium over to one side and forming a second one at the tip some distance further on. Spore chains are never formed. The perithecia are of the usual *Mycosphaerella* type, and like those of *Ramularia knautiae* give rise to a copious growth of conidiophores and conidia from their walls when placed in a moist atmosphere. Pure cultures of the ascospores gave rise to the *Ovularia* form and inoculations with ascopores on *Rumex obtusifolius* caused typical spots to appear, which subsequently bore conidia.

The author separates species of *Mycosphaerella* with a conidial stage belonging to the *Ovularia* type as a new genus *Ovosphaerella*, and names the present species *O. lapathi*. This is a further addition to the genera which he has previously [*Centralbl. für Bakt.*, Abt. 2, liii, p. 559, 1921] separated from the old genus *Mycosphaerella*.

BROOKS (R. St. J.). **The National Collection of Type Cultures.**—*Trans. Brit. Mycol. Soc.*, vii, 4, pp. 237–239, 1922.

Early in 1921 the Medical Research Council made arrangements, by the courtesy of the Governing Body of the Lister Institute of Preventive Medicine in London, to maintain a National Collection of Type Cultures at the Institute. Since the formation of the Collection some 1,200 strains of micro-organisms, chiefly bacteria, of medical, veterinary, and economic importance have been incorporated in the collection, and cultures have been distributed to workers at home and abroad at the rate of about 2,000 per annum. A catalogue of all the strains is being printed, and is expected to be available for distribution shortly. The Staff are prepared to give assistance in the identification and classification of strains sent in by correspondents.

During the early part of the current year it was proposed to extend the scope of the National Collection by including representative fungi derived from different sources, as the need of a Mycological Collection in this country had long been felt. The British Mycological Society were asked to appoint a fully representative standing committee to advise and assist in all questions appertaining to fungi, and this has been done. The scope of the Mycological Collection includes the collection and maintenance of cultures of fungi of importance in phytopathology, medicine, veterinary science, technology, and soil biology, types useful for teaching purposes, and interesting species. For the present the collection is restricted to fully identified species of fungi, and in sending these it should be stated by whom they were named, and also whether a special medium is required for their growth. Cultures will be supplied on demand, so far as possible, to workers at home and abroad and, as a rule, a small charge will be made to defray the cost of the media and postage. Annual lists of the fungi in the collection will be published in the *Transactions of the British Mycological Society*. A set of type slides of fungi will be kept in the Botanical Department of the British Museum (Natural History), in addition to a working set at the Lister Institute.

SAWADA (K.). **Can Exobasidium vexans Mass. bear conidia besides the basidiospores?** Reprinted from *Trans. Nat. Hist. Soc. Formosa*, lix, 7 pp., 1922.

Blister blight of tea, which has long been prevalent in the Indian tea plantations, is also found in those of Formosa and Japan, especially in the prefectures of Taihoku, Toen, Shinchiku, and Nanto. The most serious damage occurs in March and April, though the disease is present all the year round. A similar disease, caused by an allied fungus *Exobasidium reticulatum* Ito & Saw., is also widely distributed in Formosa, and was formerly confused with *E. vexans*. In 1911 Kawakami [*Formosan Agric. Rev.*, xxxviii, 1911 (Japanese)] reported the results of an investigation of blister blight in Shinchiku, where the tea plants appear to be exceedingly susceptible to this disease, and in 1912 and 1915 the author's own work on the tea diseases of Formosa was published [*Formosan Agric. Rev.*, lxx, 1912 (Japanese) and *Special Bull. Agric. Exper. Stat. Govt. of Formosa*, xi, 1915 (Japanese)].

The symptoms of the disease on Formosan specimens exactly resemble those described by Indian authors. The present writer believes, however, that the so-called conidia borne on the convex under surface of the blistered area are really bicellular basidiospores. He has failed to find any spores on the tips of simple condiophores as described by Massee and McRae. On following out the development of the basidiospores he found that the unicellular spores borne on the basidium may fall from the sterigmata when ripe or may remain attached until the basidia wither and collapse: in either case they ultimately develop a septum. The differences in measurement obtained by Massee were probably due to his having measured immature basidiospores as well as old bicellular ones. Similar conditions are found in *Exobasidium reticulatum* and *E. machili*, and the author is not satisfied that true conidia occur in any species of *Exobasidium*.

PRITCHARD (F. J.) & PORTE (W. S.). **Isaria rot of Tomato fruits.**—*Phytopath.*, xii, 4, pp. 167–172, 1 fig., 1 pl., 1922.

During the years 1919–21 a new rot of tomatoes has been observed in the vicinity of Washington, D. C. and Arlington, Virginia. The affected fruits are partly covered by a white, cottony, surface growth, which later becomes pink or pale orange and granular. The surface filaments are sometimes quite coarse and occasionally greenish-yellow in colour, but in a dry atmosphere they are inconspicuous or even absent. The fungus only infects fruits, which may be either green or ripe, and which need not be wounded. It penetrates all the tissues which, however, remain rather firm. The rot is caused by a hitherto undescribed species of *Isaria*, which is named *I. clonostachoides*. A large number of inoculation experiments were made and successful infections obtained in 40 to 90 per cent. The optimum temperature for infection is about 29° C. The morphology and cultural characters of the fungus are described.

List of specimens in the Mycological Herbarium.—*Agric. Res. Inst., Pusa*, May 1921 [1922].

This list, which is primarily intended for the convenience and assistance of mycological officers in the various departments of agriculture in India, is divided into two sections, a fungus and a host index. The former includes a column for the locality in which the fungus was collected. No attempt is made to decide critical points of nomenclature. Supplementary lists of new specimens added to the herbarium will be printed from time to time.

EASTHAM (J. W.). **White pine blister-rust in British Columbia.**—*Agric. Journ. Brit. Columbia*, vii, 2, pp. 29 and 41, 1922.

The presence of white pine blister rust (*Cronatium ribicola*) was first detected in British Columbia in September 1921. Investigation showed that the disease was present on cultivated black currants over a considerable area in the Lower Fraser Valley and in Vancouver Island.

The disease is described in detail and a short account given of its origin and geographical distribution.

Proect de lege pentru controlul semintelor, combaterea plantelor parazitare in agricultură şi incurajarea productiunii de seminte. [Bill introduced in Parliament for seed control, for the suppression of parasitic plants in agriculture and the encouragement of seed production.]—*Buletinul Agriculturii* [Bucharest], i, 1–6, pp. 45–55, 1921. [French Summary.]

All persons in Roumania desirous of trading in seed of lucerne, clover, grass, and other fodder plants, vegetables, drug plants, fruit and ornamental trees, &c., must obtain a licence from the Ministry of Agriculture. Samples of all seeds must be tested at one of the agronomic stations of the country before being placed on the market. The importation of lucerne, clover, timothy, and flax seed containing *Cuscuta, Orobanche,* or other injurious parasitic plants is prohibited. Seed produced in the country is subject to testing in exactly the same way as imported seed.

Décret du 26 Janvier 1922 concernant la lutte contre les parasites végétaux et animaux des plantes cultivées, dans la Régence de Tunis. [Decree of 26th January, 1922, concerning the control of vegetable and animal parasites of cultivated plants in the Regency of Tunis.]—*Journ. offic. tunisien*, xx, 11th March, 1922. [Abs. in *Bull. mens. des Renseignements agricoles et des Maladies des Plantes*, xiii, 5–6, pp. 809–810, 1922.]

When the damage caused to cultivated plants by any vegetable or animal parasites assumes, or appears likely to assume, the dimensions of an epidemic or disaster, the Director-General of Agriculture, Commerce, and Colonization shall proclaim the affected areas and define the necessary measures for destruction and for regulation of the transport of plants or parts of plants liable to propagate the parasites in question.

All owners—the State, parishes, and public administrative bodies included—or occupiers, in whatever capacity, of urban or rural landed property are obliged to carry out the rules laid down in the above-mentioned orders. Co-operative protection societies may be formed under certain conditions for the execution of the prescribed measures of control.

In cases where the owners or occupiers fail to conform to the regulations in force, the work of destruction shall be officially carried out at their expense. Responsibility for infringement of the rules laid down for the transport of plants falls equally on the sender and conveyor. Plants fraudulently transported will be seized and destroyed, together with their packings. If they have been planted they will be uprooted and destroyed at the expense of the consignee, who is liable to the same penalties as the sender and conveyor.

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GENERAL INDEX

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