Report of Work on Seed-borne Diseases

carried out at the

Mycology Department, University of Edinburgh,

under

Dr. Malcolm Wilson.

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ary J.M. Noble.
B.Sc. 1933.
Ph. D.1935.

Submitted with Ph.D. thesis for
the Hutton- Balfour Prize in
Botany.
March 1936.

Gunning Victoria Jubilee Prize
in Botany 1936

See Ph.D. thesis 1935 for part of Prize Essay

Work on Seed-borne Diseases.

During the last three years research work has been carried out on certain plant diseases which are carried by seed. The lines followed in this work were;

Seed testing with a view to the detection of the presence of parasitic fungi.

The testing of fungicides which are used in the control of seed-borne diseases.

The preparation of descriptions, illustrated by photographs, of the appearance of these diseases on the seed and seedlings.

The first line of work has been studied on account of the fact that seed testers in this country do not generally take into consideration the sanitary condition of the seed while this is a routine practise on the Continent. The methods employed in each case have been studied and also, to a certain extent, practised. The seeds used in these tests were supplied by various growers in England and Scotland to whom reports on the condition of the seed were sent. In many of the tests the technique employed was that devised by Wilson (1). Seeds were sterilised superficially in a solution of bleaching powder, then planted in Petri dishes of oat agar medium such as is commonly used for the cultivation of fungi. Any fungi which were present either in or on the seed grew out into the medium, then they were easily subcultured and identified. Figures 4+5 Pl. 4 illustrate the use of this technique. The fungus Ascochyta Pisi, the cause of the disease known as "Spot" has grown out into the agar from almost every seed.

Seeds were also germinated on damp filter paper in Petri dishes, a method similar to that commonly practised in seed-testing stations, but although it is often possible to identify seed-borne fungi in such tests, the previous method is much more efficient in this respect.

Wilson. J.K. Calcium hypochlorite as a seed steriliser. Amer. Jour. Bot. 1915. Vol. 2. p. 420.

2.

A considerable number of sterilisers, between thirty and forty, have been tested with regard to their efficiency in controlling seed-borne diseases. These sterilisers were tested first in the Laboratory and then the most efficient were further tested under more natural conditions, e.g. two sterilisers "A" and "B" were found to be very efficient in laboratory tests so they were further tested in the following manner. Three samples of pea seed known to be heavily infected with Ascochyta Pisi were used, each sample consisting of 50 seeds. One sample was treated with "A", one with "B" and the third remained untreated as a control, the seeds were then sown singly in pots of sterile sand, and put into a greenhouse until they had germinated. The percentage which germinated in each sample was; "A", 86% germinated of which 76% were healthy, in "B" 68% germinated of which 58% were healthy, and in the untreated sample 68% germinated of which 28% were healthy.

When the seedlings were about three inches high they were transplanted into open soil, the diseased seedlings at this stage showing typical lesions on the stalks and leaves. The final result of this test showed that from the 50 untreated seeds only 14 healthy plants were obtained, from the 50 seeds treated with "A" 36 healthy plants were obtained and from the 50 seeds treated with "B", 30 were obtained Photographs illustrating this experiment are given in Plates 5 & 6. On the assumption that the only source of infection was the seed then it may be concluded from this experiment that such diseases as that caused by Ascochyta Pisi may be controlled by seed dressings.

Experiments on artificial infection of peas and beans have also been carried out in order to discover all the possible methods of transmission of the fungus from the parent plant to the seed and also to build up a stock of seed known to be heavily infected with certain diseases for use in testing sterilisers.

In one of these experiments, young flowers of culinary peas were infected with Ascochyta Pisi by placing spores on the stigmas. The pods developed from the infected flowers bore the typical lesions of the disease (Pl. 3. fig. 3). Other flowers infected in this way were fixed, embedded in paraffin, and microtomed.

he sections were then stained and examined microscopically for the resence of the fungus. So far, it has not been possible to trace he entire path of the fungus in this way but the experiments are eing continued.

In another experiment on artificial infection healthy seeds were oaked in a suspension of fungal spores and sown immediately in soil. he seedlings which subsequently appeared bore quite typical lesions s is shown in Pl.3. fig. 1. Infection of more mature plants was rought about by watering them with a suspension of spores and also y injecting spores into the plants by means of a hypodermic syringe.

Experiments are also being carried out with a view to determining he possibilities of insects carrying infection to the seed. Seeds hich have been attacked by the larvae of insects are also often nfected by a fungus. In Pl. 7, fig. 2 a pea seed is illustrated hich had been attacked by the larva of some insect, probably the pea idge. It was sterilised superficially and planted on oat agar. At the pycnidia of Ascochyta Pisi are shown, this fungus having grown ut from the seed. Such seeds are being sectioned in order to etermine the correlation, if any, between the insect attack and the ungal infection.

An important point which has emerged from experiments with peas , aturally and artificially infected, is that while many infected seeds ear an obvious lesion (Pl.1 fig.4) many show no external symptoms of he presence of such fungi as Ascochyta. Such lesions as those llustrated in Pl.1 fig. 4, are caused by the presence of deep cankers n the pod immediately above the seeds which become infected by direct ontact. In seeds which are infected without showing external ymptoms, however, the fungus is found in the tissues of the hilum and t appears reasonable to suppose that the fungus has grown downthe unicle from the pod and so into the seed. This supposition has been artially verified by isolating the fungus from the funicle of such eeds. The occurrence of seeds which are infected while showing no xternal symptom is of economic importance to seed growers as well as

to seed testers , since both depend almost entirely on the presence of external symptoms for the detection of diseases.

A considerable number of papers have been written on seed-borne diseases but they are scattered through various scientific publications and are mostly written in very technical language. Information gained from this literature, augmented and confirmed by personal observation, is to provide the basis for an account of some of the common seed-borne diseases illustrated by photographs such as are given in plates 1-12. The effect of certain methods of seed growing on the occurrence of diseases would also be considered as it appears that information on this point, written in non-technical language, would be of interest to seed growers and seed testers.

Some of the diseases which have so far been investigated are the following;

Peas. The diseases caused by Ascochyta Pisi, Mycosphaerella pinodes Ascochyta pinodella.

Beans. The diseases caused by Ascochyta Fabae, Uromyces Fabae, and Bacillus medicaginis var. Phaseoli.

Celery. The diseases caused by Septoria Apii, Phoma apiicola.

Beet. The diseases caused by Phoma Betae, Uromyces Betae.

Plate 1.

Plate 1.

The disease of peas caused by *Ascochyta Pisi* and known as "Spot".

Fig. 1. Pod opened to show badly infected seeds.

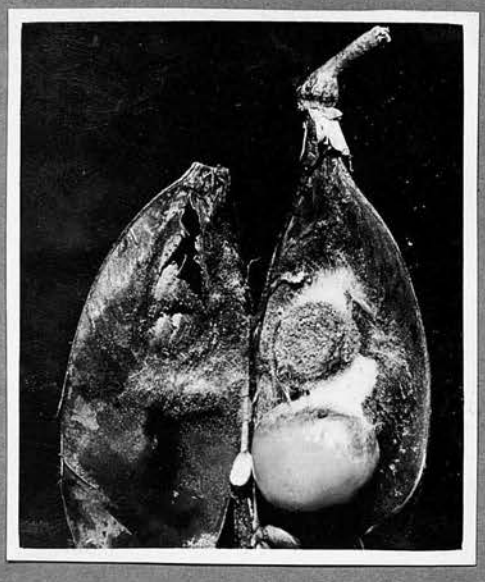
Fig. 2. At A, pod showing typical lesions, caused by *Ascochy*
At B, pod infected by *Mycosphaerella pinodes* , the d
caused by these two fungi are often confused.

Fig. 3. Pod containing one seed which is badly diseased (d),
two others which are apparently uninfected (S) but m
carry the fungus internally.

Fig. 4. Seeds showing typical lesions such as are caused by
infection from a canker on the pod .

Plate 1.

1.



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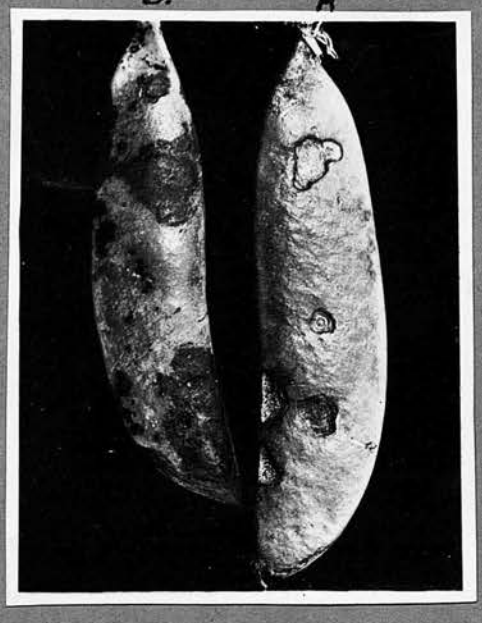

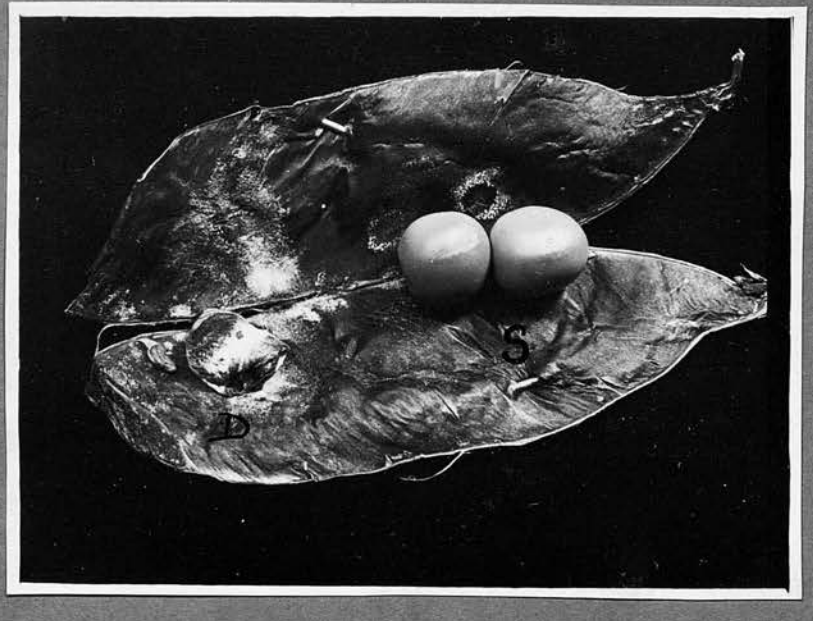

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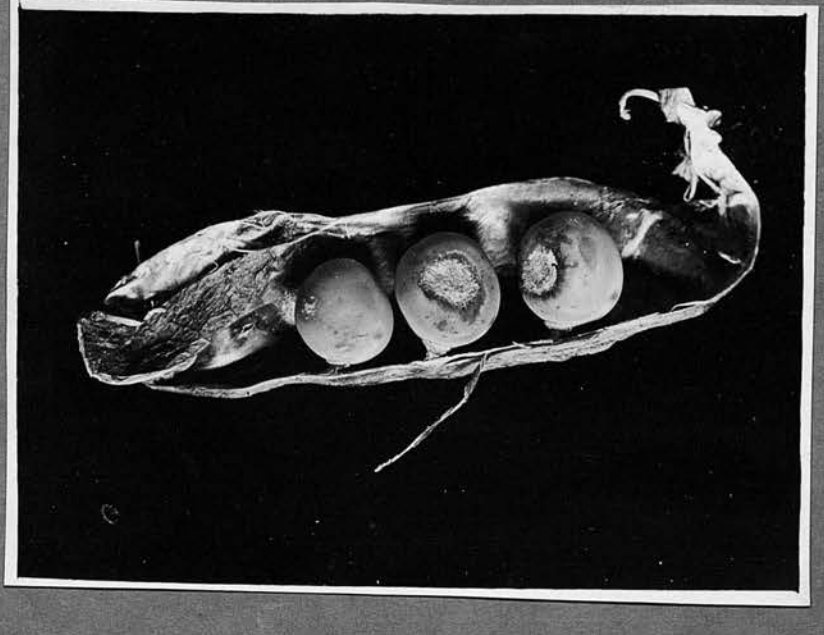


4.

Plate 2.

Plate 2.

Ascochyta Pisi.

Fig. 1. Infected seeds.

Fig. 2. At L, a lesion caused by artificial infection. The po was inoculated with mycelium from culture, at C contr inoculation.

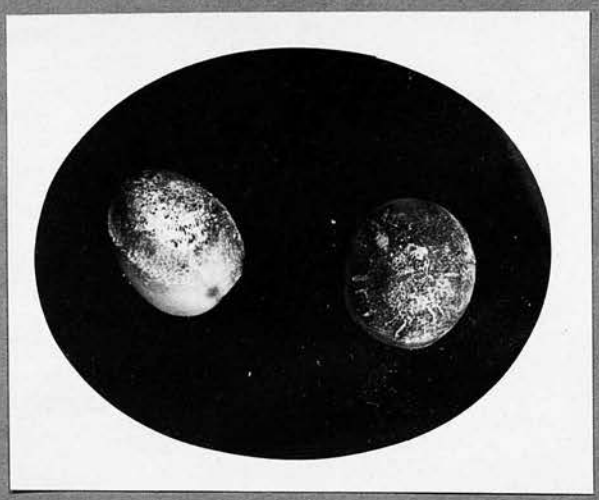
Fig. 3. Pycnidia forming on the pod without causing a canker.

Fig. 4. Germinating seed cut across to show deep-seated lesion at L caused by the fungus.

Fig. 5. At C, a canker on the pod. At S infected seed bearing caused by contact with the canker on the pod.

Plate 2.

1.



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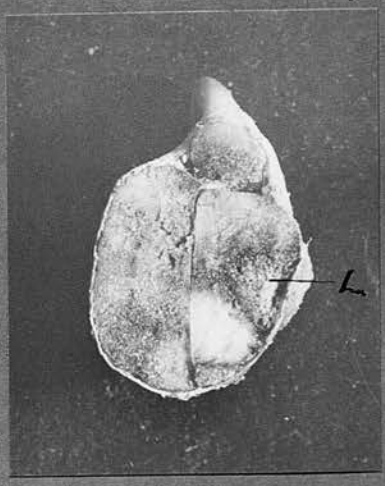
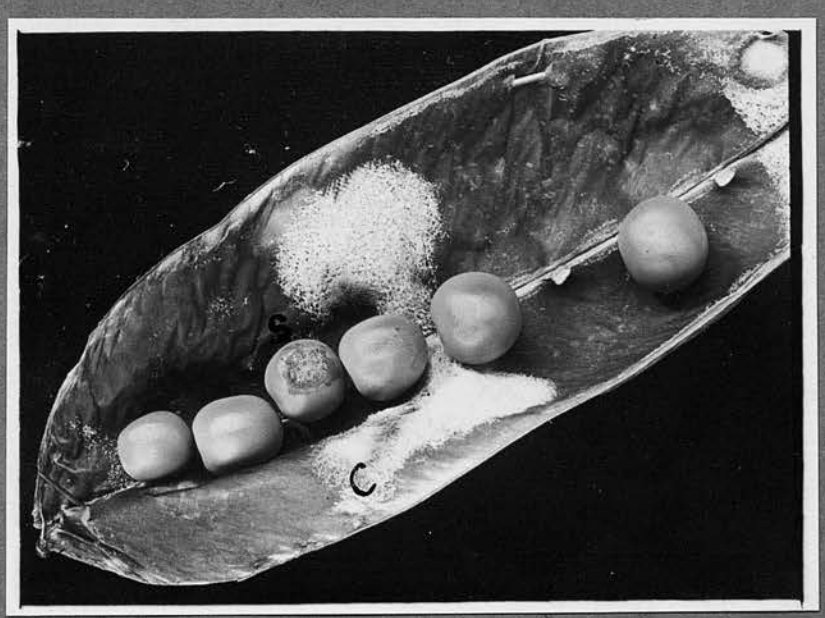




5.

Plate 3.

Plate 3.

Ascochyta Pisi.

Fig. 1. Artificial infection of seedling , caused by soaking healthy seed in a suspension of spores.
Typical lesions on the leaves at L.

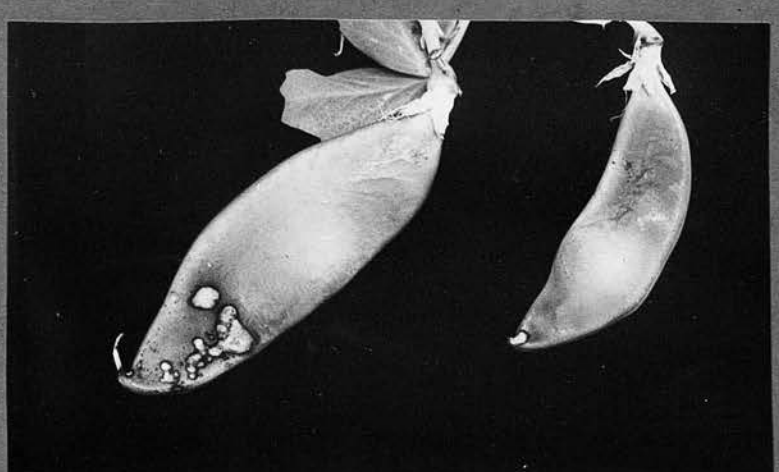
Fig. 2. Canker on the pod showing spore tendrils exuding from the pycnidia. x8 approx.

Fig. 3. Artificial infection of pods, caused by inoculating sti of young flowers with spores.

Plate 3.

1.

2.



3.

Plate 4.

The testing of fungicides in the Laboratory.

Figs. 1-3. Seeds infected with *Mycosphaerella pinodes* germinating on damp filter paper in Petri dishes.

Fig. 1. Treated with steriliser "A".

Fig. 2. Treated with steriliser "C".

Fig. 3. Untreated.

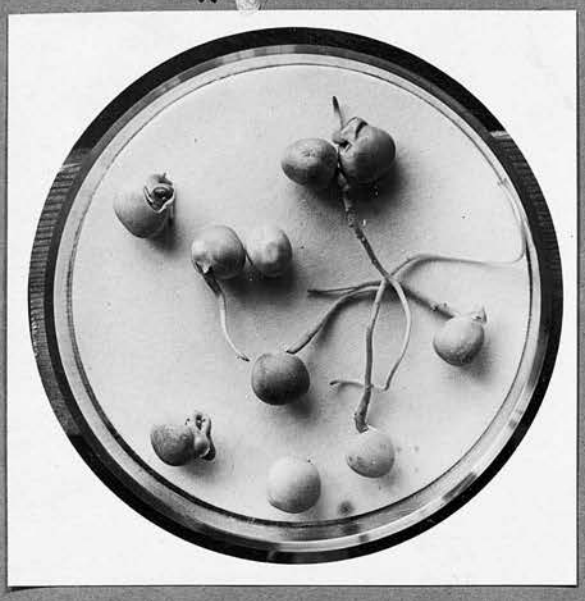
Figs 4-5. Seeds infected with *Ascochyta Pisi* germinating in Petri dishes of oat agar medium.

Fig. 4. Treated with steriliser "C"

Fig. 5. Untreated. At F the fungus has grown out from the seeds into the medium.

Plate 4.

1.



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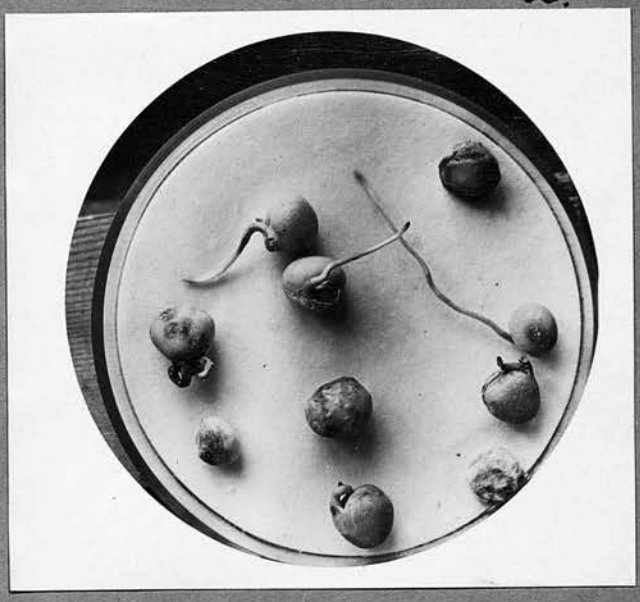

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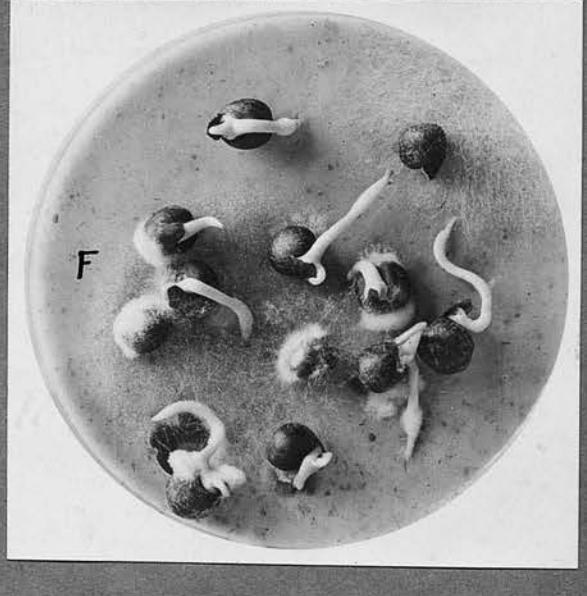

Plate 5.

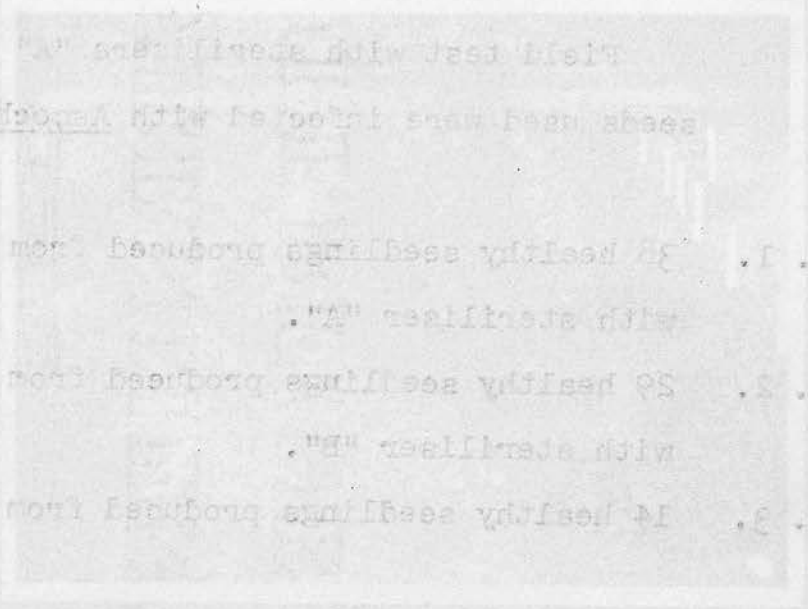

Plate 5.

Field test with sterilisers "A" and "B". The seeds used were infected with *Ascochyta Pisi*.

Fig. 1. 38 healthy seedlings produced from 50 seeds treated with steriliser "A".

Fig. 2. 29 healthy seedlings produeed from 50 seeds treated with steriliser "B".

Fig. 3. 14 healthy seedlings produced from 50 untreated seeds

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Plate 5.

1.

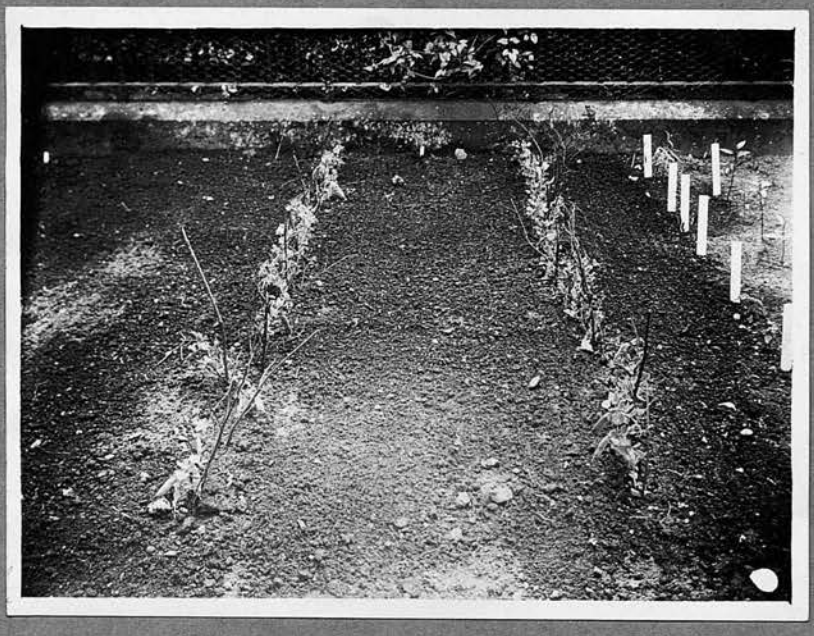

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Plate 6.

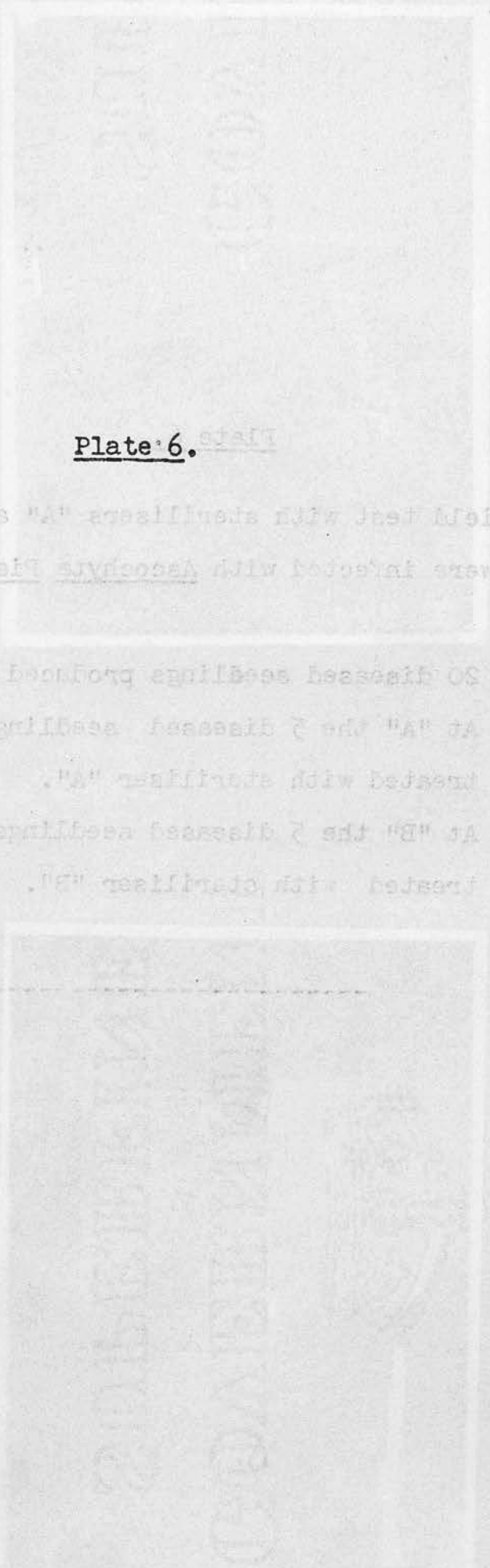


Plate 6.

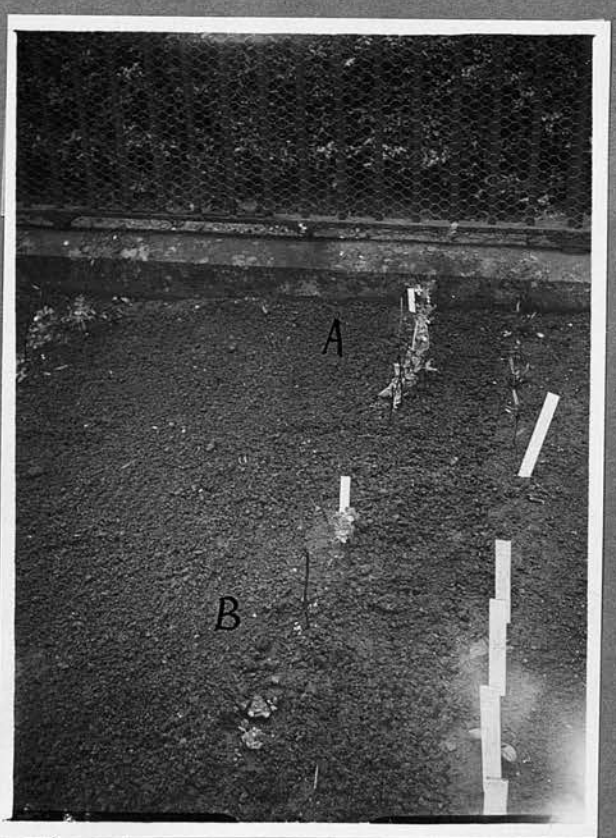
Field test with sterilisers "A" and "B". The seeds were infected with Ascochyta Pisi.

Fig. 1. 20 diseased seedlings produced from untreated seed.

Fig. 2. At "A" the 5 diseased seedlings produced from seed treated with steriliser "A".
At "B" the 5 diseased seedlings produced from seed treated with steriliser "B".

Plate 6.

1.



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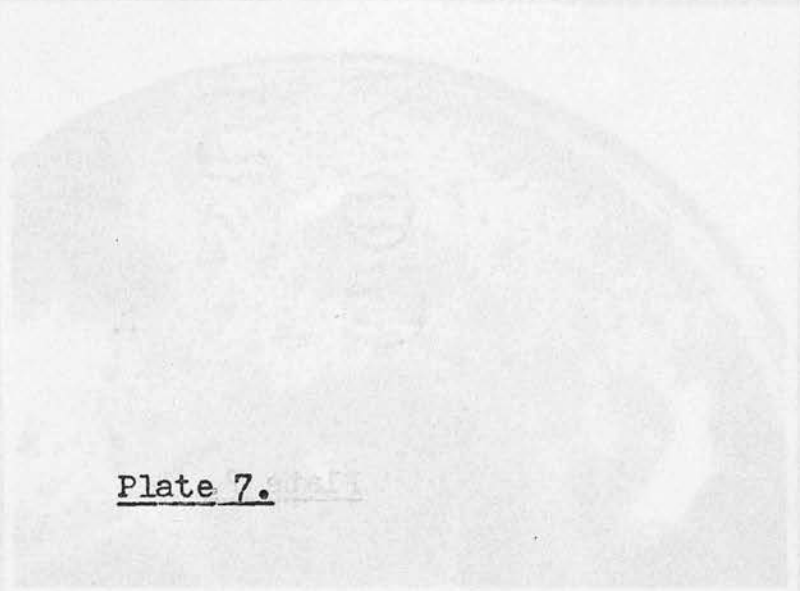

Plate 7.

Plate 7.

Figs. 1& 2. Testing seeds for the presence of parasitic fun using the technique devised by Wilson (p.1 of t paper).

Fig. 1. Seed which was infected with Ascochyta Pisi. T fungus has grown out into the agar and formed pycnidia which are seen as small black dots in t agar around the seed.

Fig. 2. Seeds which had been attacked by the larva of a insect, and also infected with Ascochyta Pisi. pycnidia are seen at P.

Fig. 3. Apparatus used for mixing seeds and dust steril in the Laboratory. The seeds and steriliser a enclosed in the glass bottle and the whole rota like a churn.

Plate 7.

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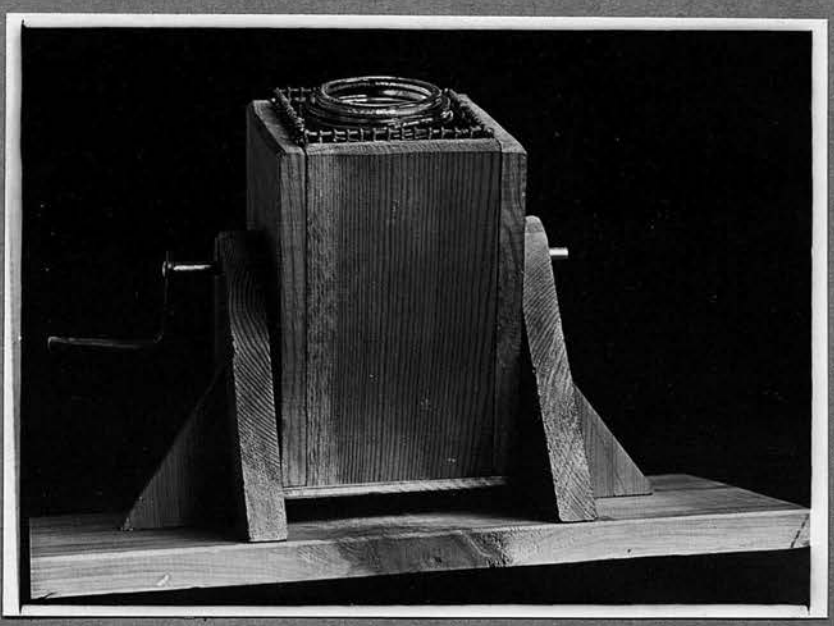

3.

Plate 8.

Plate 8.

The disease of peas caused by *Mycosphaerella pinodes*.

Fig. 1. Infected pod.

Fig. 2. Infected pod opened . The seeds at C have failed to develop owing to heavy infection by the fungus.

Fig. 3. Lesion on the pod showing pycnidia at PY and perithec at PR.

Fig. 4. Leaves showing dark brown lesions .

Fig. 5. Seedling showing foot-rot caused by the fungus which was present in the seed.

Plate 8.

2.

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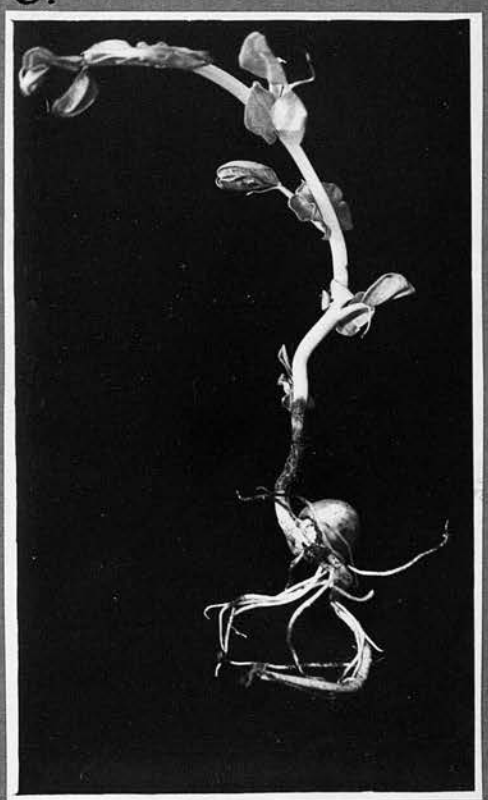

Plate 9.

Plate 9.

The disease of Beans caused by the fungus *Ascochyta Fabae*.

Figs 1 & 2. Seedlings bearing lesions on the radicle.

Fig. 3. Seedlings bearing lesions on the leaves.

Fig. 4. Single leaflet from the seedlings in Fig.3. natural size.

Figs. 5 & 6. The fungus in culture.

PLATE. 9.

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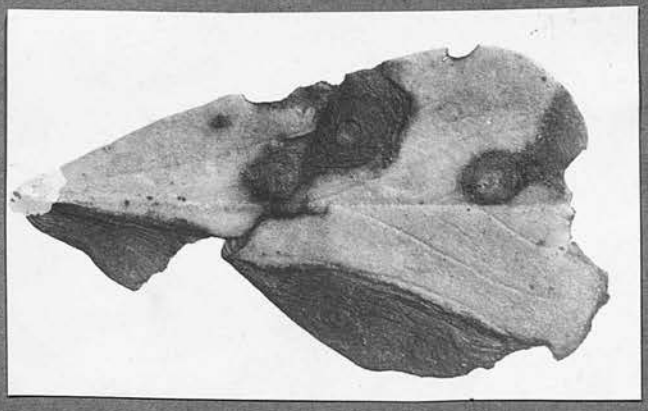
3.



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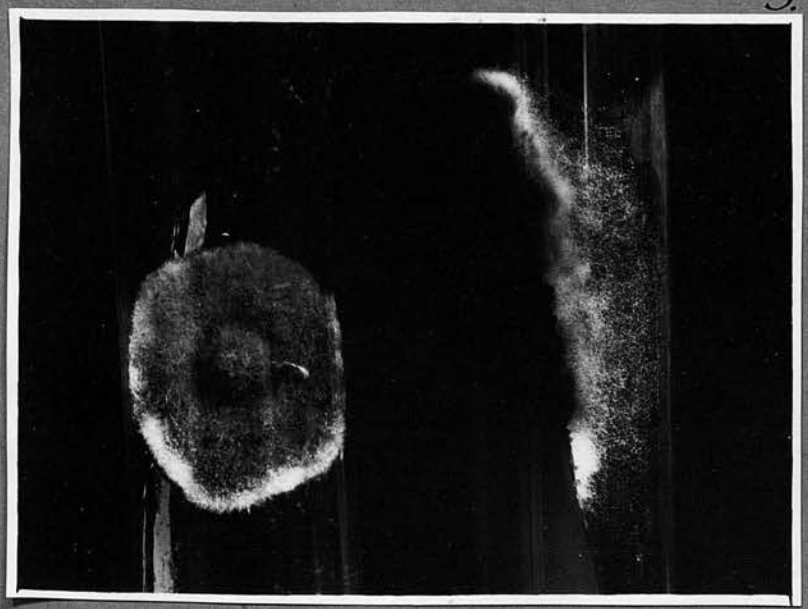

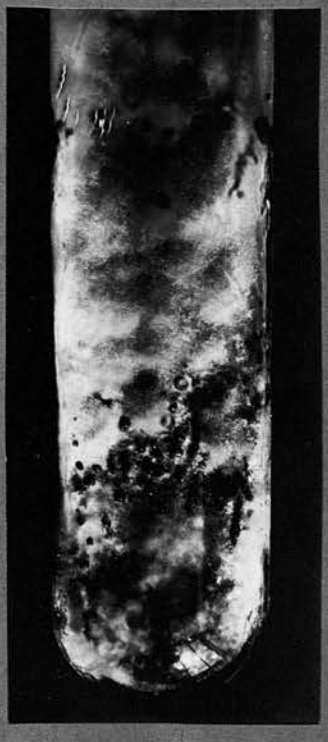

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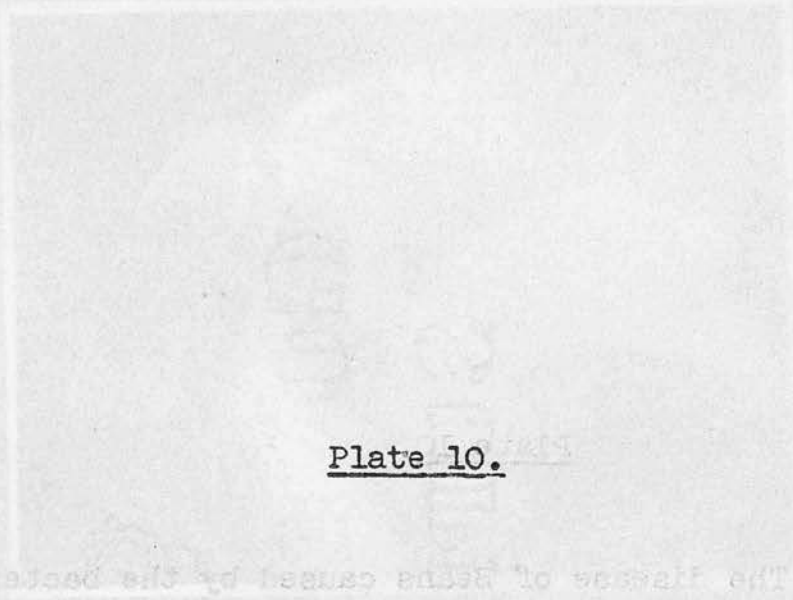
Plate 10.



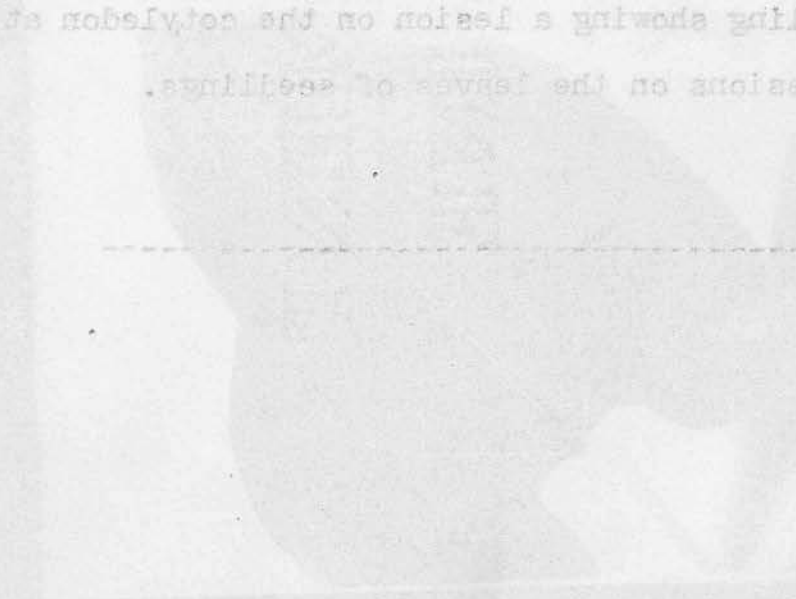


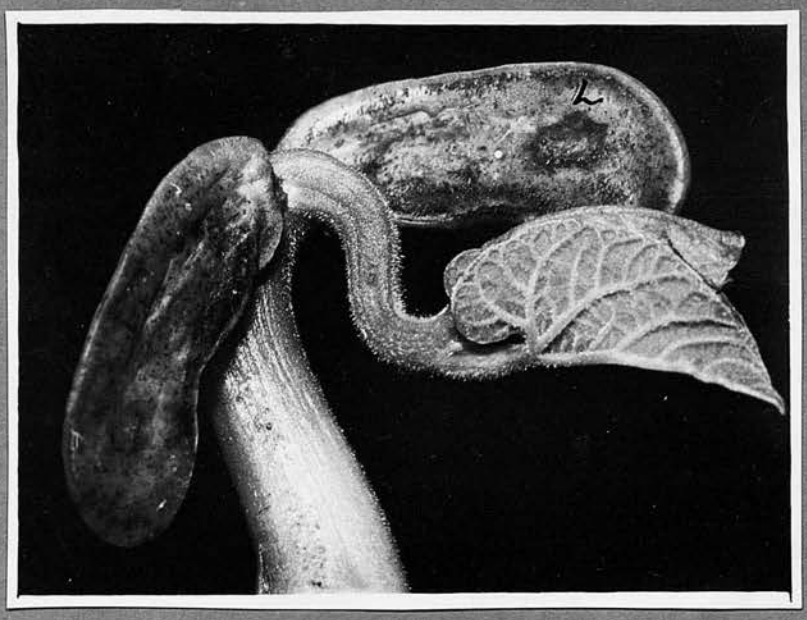
Plate 10.

The disease of Beans caused by the bacterium B. medicaginis. var. Phaseoli. "Halo Blight".

Fig. 1. Seedling showing a lesion on the cotyledon at L.

Figs. 2.& 3. Lesions on the leaves of seedlings.

Plate 10.



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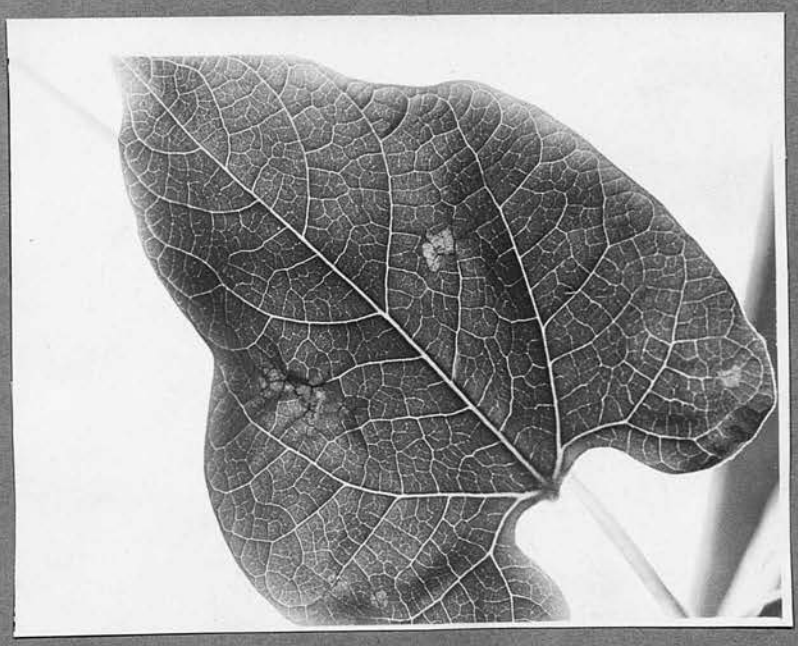

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Plate 11.

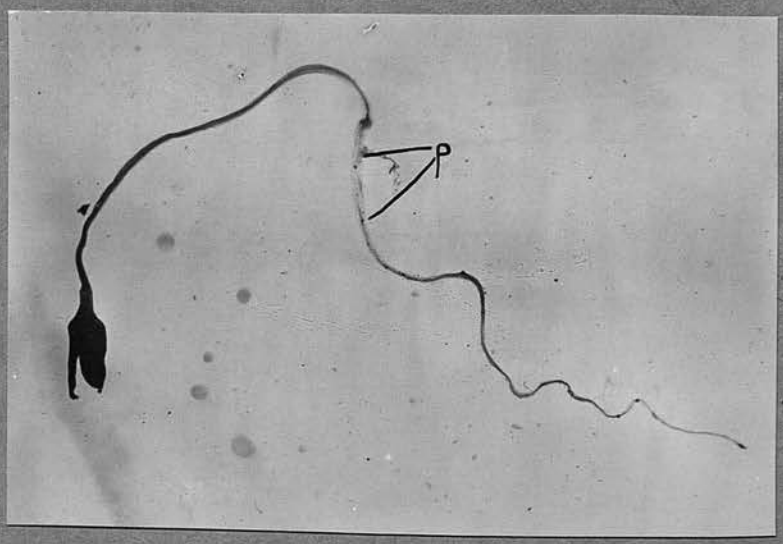
Plate 11.

The disease of Celery caused by the fungus *Phoma apiicola*.

Fig. 1. Seedling showing the pycnidia in the rootlet at P.

Fig. 2. The fungus in culture showing the formation of pycnidia.

Plate II.



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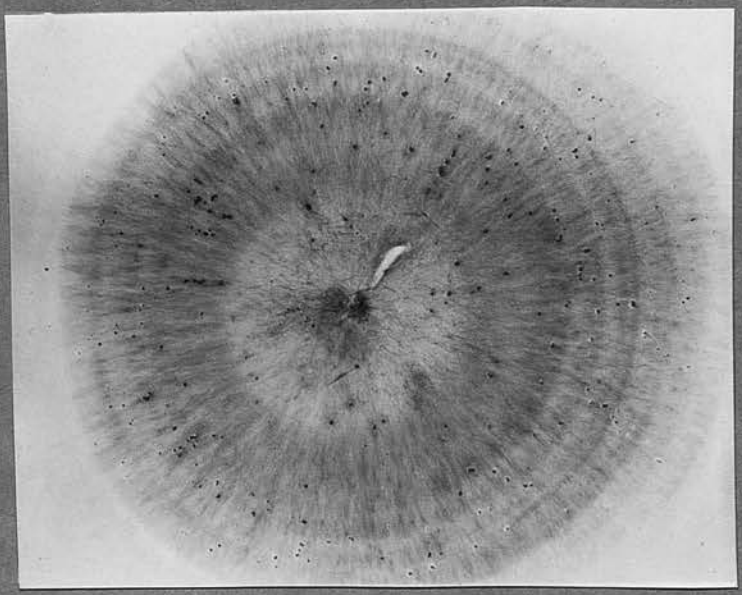

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Plate 12.

Plate 12.

Fig. 1. The disease known as Marsh Spot of peas. Seeds cut op to show the dark marks on the cotyledons. The cause o this disease is not yet determined.

Fig. 2. Parsley seeds showing the small black pycnidia of the fungus Septoria Petroselini.

Figs 3 & 4. An unknown fungus whose sclerotia were isolated fro Clover seed.

Fig. 3. The fungus in culture.

Fig. 4. The sclerotium germinating.

Figs 5 &6. Two "diseases" of beans whose cause has not yet been determined.

Fig. 5. This "disease" is known as Black Spot"

Fig. 6. This "disease"is known as "Rust"

Neither Black Spot or Rust appears to affect the seed in any way.

Plate 12.

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3.

4.

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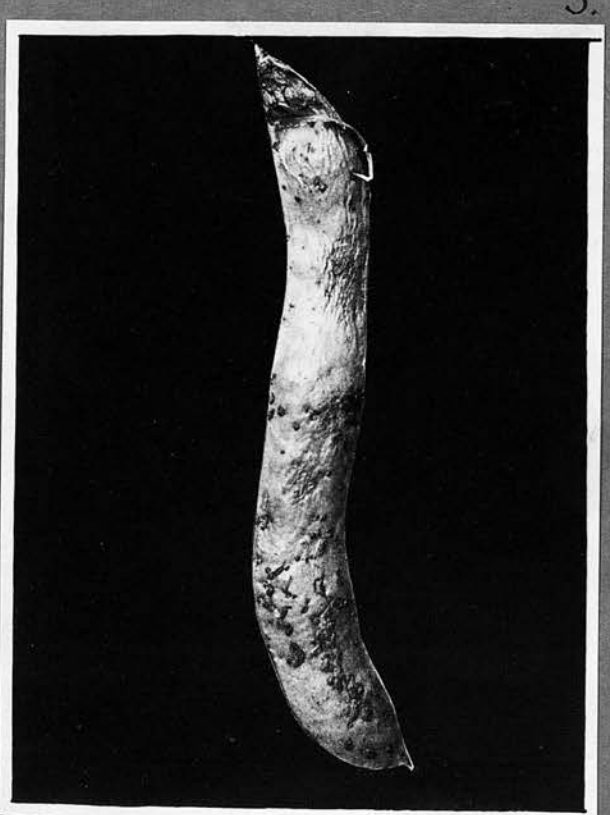

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