South African Locust Fungus

Source: *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)*, Vol. 1901, No. 172/174 (Apr. - May, 1901), pp. 94-99
Published by: Springer on behalf of Royal Botanic Gardens, Kew
Stable URL: http://www.jstor.org/stable/4114943
Accessed: 16-10-2015 00:44 UTC

The real source of the drug was cleared up when the specimen of *Eucommia*, collected in Hupeh in 1887 by Dr. A. Henry, was described in 1890 by Prof. Oliver in the *Icones Plantarum*. Dr. Henry's specimens were accompanied by the following note :—

The *Tu chung* tree, 20–30 feet. The bark of this tree is a most valued medicine with the Chinese, selling at 4*s*. to 8*s*. a lb.

Mons. Pierre concurred that the suggested identification with *Parameria* must be abandoned.

Subsequently further specimens were received from the Museum d'Histoire Naturelle, Paris. These had been collected in Szechuen in 1874 by Rev. Père Farges. They were accompanied by the following note :—

Lorsqu'on brise l'écorce les vaisseaux corticaux s'étirent comme des fils de soies ; c'est pour cela qu'il est appelé aussi vulgairement *sè mien*. Ecorce officinale usitée dans les maladies des reins et comme une charpie dans les blessures.

Eucommia is a tree of mountainous districts. The name *Tu chung* is, however, applied by the Chinese to a tree of the plains, which is almost certainly a *Euonymus*, and not improbably *E. hamiltonianus*, Wall. (See *Kew Bulletin*, 1899, p. 219).

III.—SOUTH AFRICAN LOCUST FUNGUS.

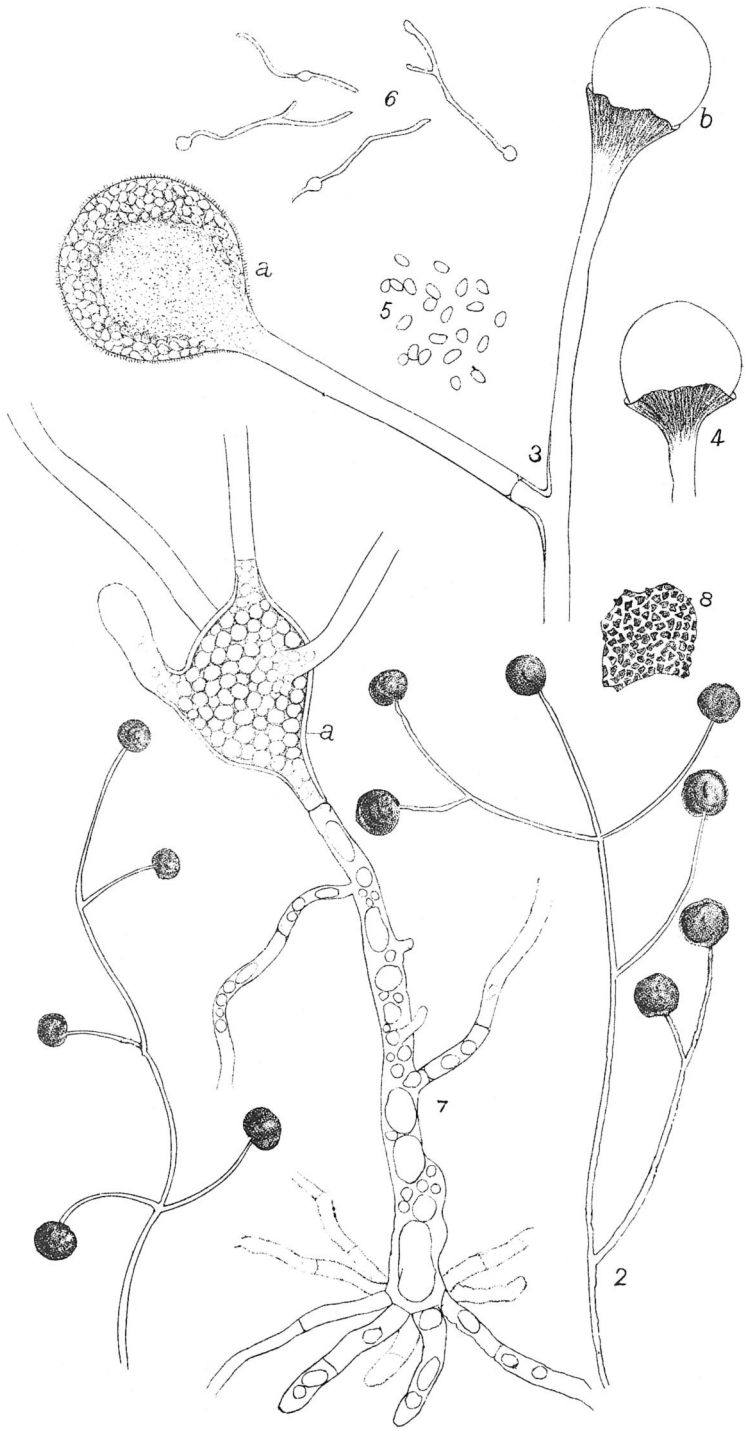
(With Plate.)

In many parts of the world the hopes of the agriculturist are frustrated by the sudden appearance of devastating clouds of locusts. Ingenuity has been taxed to find means of destroying them. Some account of the methods employed in the Caucasus was given in the *Kew Bulletin* for 1894 (pp. 215–217).

More recently a method has been devised in South Africa for effecting the destruction of locusts by spreading a disease amongst them. This disease is the result of their infection by a fungus. It admits of easy cultivation, and can readily be distributed to any distance in a portable form.

Some doubts having arisen as to the precise nature of the fungus, specimens were sent to Kew in January, 1900, by the Department of Agriculture, Cape of Good Hope, for examination and report. The whole subject has been carefully discussed in the following paper by Mr. Massee, F.L.S., Principal Assistant (Cryptogams) in the Herbarium of the Royal Botanic Gardens :—

The earliest observations relating to the presence of fungi on living insects refer to species included at the present day under the genus *Cordyceps*, Fries. The well-known "vegetable wasp," or *Guêpe Végétale*, of the West Indies was one of these. In the latest monograph treating of the genus *Cordyceps*[1] 62 species are described as growing on the bodies of different kinds of insects, ants, and scale insects. Among such are included *Cordyceps sinensis*, Sacc., the celebrated Chinese drug, called *Tong-chong-pa-cho*, signifying that it is a plant in summer and



Mucor exitiosus, Massee.

1680.9.1901

a worm in winter, and *C. Barberi*, Giard, parasitic on the larva of *Diatræa saccharalis*, Fab., the "moth borer," a moth which is very injurious to sugar-cane in the West Indies. (See *Kew Bulletin*, 1892, pp. 153–178.)

Among the earliest of strictly scientific accounts of entomogenous fungi is the one by Balsamo, an Italian, who clearly demonstrated that the destructive silk-worm disease called muscardine is caused by a fungus to which he gave the name of *Botrytis paradoxa*[2], and afterwards changed it to *Botrytis bassiana*[3] in honour of M. Bassi, an Italian interested in silk-worm culture.

In 1853, Robin, a Frenchman, produced an elaborate account, beautifully illustrated, of plants—mostly fungi—parasitic on living animals[4].

Up to this year, in discussing the relation between parasitic fungi and their hosts, the former were looked on as the factor to be combated, and correctly so in the case of "muscardine" and of human diseases supposed to be due to fungi. However, at a later date the idea occurred that entomogenous fungi might possibly be utilised as a means of destroying those insect scourges which from time to time cause such devastation to our crops. The original inspiration of far-reaching results is often difficult to trace. Professor Sebert first suggested[5] the modern idea of utilising entomogenous fungi in the way already indicated. Sebert's observations were briefly as follows : A number of caterpillars of *Arctia villica* were collected for the purpose of observing their development. The caterpillars were attacked by a fungus, their bodies becoming covered by a white mould. It was observed that if diseased caterpillars were placed in a tree along with healthy ones, the latter soon contracted the disease.

Still more recently, Thaxter, in a beautifully illustrated monograph of the *Entomophthoreæ* of the United States, informs us of the widespread destruction among insects caused by various species of fungi[6].

During the last ten years extensive experiments have been conducted, more especially in France and the United States, with the object of perfecting some method by means of which the destruction of noxious insects could be effected in a wholesale manner, and by a process so simple and inexpensive that it could be practised by farmers and horticulturists. The line followed in all instances has been the preparation of a pure culture of the particular fungus found most effective for the purpose required. Tubes or flasks of such pure cultures were distributed free, or sold at a low price, and all the practical man had to do was to dissolve the contents of a tube in a small quantity of water and spray a portion of the ground or tree infested with larvæ or caterpillars ; or, on the other hand, to inoculate a number of captive larvæ or caterpillars, and when the disease manifested itself to liberate the infected victims among their companions in the field. In either case, the assumption is that the disease will spread from infected to healthy individuals. Theoretically the conception is excellent, and under certain atmospheric conditions the result is all that could be desired, but unfortunately the suitable conditions rarely prevail. When the atmosphere is dry the spores or conidia do not germinate, and inoculation by

contact takes place but slowly, whereas during an excess of moisture the conidia are washed into the ground and perish, while the larvæ or caterpillars do not move about, and contact-inoculation is arrested. During calm, damp weather the results are, as already stated, satisfactory.

In France the most destructive insect pest is the larva of the common cockchafer—*Melolontha vulgaris*, Linn.—known as *le ver blanc*, and the fungus utilised for its destruction is *Isaria densa*, Fries.

In the United States the "chinch bug"—*Blissus leucopterus*, Say—is very destructive to cereals. The fungus used for its destruction is *Sporotrichum globuliferum*, Speg., and, after the expenditure of a considerable amount of time and money, Professor Duggar, of the Cornell Agricultural Experiment Station, has expressed his opinion that, although effecting a certain amount of good at times, the outcome is not sufficiently efficient to be of any practical value.

A far greater measure of success appears to have attended the attempt to exterminate the devastating hordes of locusts, more especially the red-winged locust—*Acridium purpuriferum*, Walk.—in South Africa, by means of a fungous parasite.

The fungus was first observed, and its significance realised in 1896, by Mr. A. W. Cooper, of Richmond, Natal, who demonstrated that it could be readily cultivated, that it proved fatal in its effects on locusts, and that it was very contagious. (*Agricultural Journal, Cape of Good Hope*, viii., 1896, pp. 330–331.)

Mr. Cooper afterwards continued his investigations on the locust fungus in the Cape of Good Hope Colonial Bacteriological Institute, being aided by Dr. Black of that Institution, with the result that pure cultures were produced in large quantities, and tubes containing a small amount of the fungus were sold to farmers at sixpence each. In the report of the above-mentioned Institute for 1898, Dr. Edington, the Director, gives a fuller account of the fungus, accompanied by extracts from persons who had proved its efficacy on a large scale. The method of its application is so simple that the natives can use it with benefit. Dr. Edington thinks the fungus probably belongs to the *Entomophthoreæ*, but his very clear description and figures show conclusively that the fungus is a species of *Mucor*[7]. Up to the present, however, the fungus has been distributed as "the locust fungus," and no scientific name has been used.

Quite recently Mr. C. P. Lounsburg, Government Entomologist, Cape of Good Hope, addressed a letter to Kew, asking for a correct determination of the fungus, which, on account of its proved utility as a destroyer of locusts, it was presumed might also be of value in destroying fruit-tree caterpillars. In the meantime, Mr. D. McAlpine, Government Vegetable Pathologist of Victoria, had announced[8] that the Cape locust fungus was *Mucor racemosus*, Fres., hence a correct determination of the fungus became a necessity, as it is known that certain species of *Mucor* are destructive to fruit.

Six tubes containing the "locust fungus," two from Natal and four from Cape Colony, accompanied the letter from Mr. Lounsburg, and, on cultivation, proved to be pure cultures

of one and the same fungus—a species of *Mucor*. Spores obtained from this material were sown on sterilized bread paste, pineapple, and uninjured grapes respectively, and in each instance the matrix was completely covered with a dense snow-white mycelium within 24 hours. Six hours later the mycelium assumed a greyish tint, which microscopic examination showed to be due to the presence of myriads of globose sporangia of a pale grey colour, the mycelium remaining pure white. Forty hours from the sowing of the spores, the entire mass of mycelium was dark grey to the naked eye ; microscopic examination showed this appearance to be due to the innumerable mature black sporangia, the mycelium still remaining colourless, or at most here and there tinged with amber. The temperature ranged from 70° to 75° F.

The sporangia are globose and black at maturity, and the surface is frosted with a very delicate layer of lime crystals. The size varies considerably, depending on the substance on which the fungus is grown, but the average diameter is about 80 μ, although in many instances more than double that size is attained. The wall of the sporangium is pale steel-grey when seen by transmitted light. The large globose or broadly obovate columella is colourless. The spores are colourless, elliptical, and average 5–6 × 3·5–4 μ.

The sporangia are produced in a racemose or corymbose manner on short branchlets, which are often furnished with a transverse septum near the point of origin from the main branch, and are always immersed in the loose weft of superficial mycelium, contrary to what occurs in other species of *Mucor*, where the sporangia are elevated on elongated sporangiophores. The vegetative mycelium immersed in the matrix is very abundant, densely branched—the thickest portions varying from 10–25 μ in diameter—and expanding at intervals into irregular swellings containing reserve material. The thicker branches of immersed mycelium often contain large masses of a highly refractive substance in their interior. Septa are abundant in the mycelium immersed in the matrix, and are by no means rare in the aërial portions.

In addition to the nutritive media already enumerated, the fungus grew readily on gelatine containing a decoction of plum juice, in water containing a 10 per cent. solution of cane sugar, and in a sterilized decoction of decaying vegetable matter.

These experiments prove that the fungus is by no means circumscribed in its choice of a matrix, and consequently it would be unwise, without further knowledge of the possibilities of the fungus, to spray its spores on fruit trees, as those spores, carried to the ground in the solution, would probably be able to develope as a saprophyte on decaying vegetable matter, and the resulting spores would be very likely to attack the partly matured fruit.

It remains to state that the fungus attacks and kills cockroaches quite as quickly as it does locusts. An exotic species—*Periplaneta Australasiæ*, abundant in the warm houses in Kew Gardens—was experimented upon. Four half-grown specimens were sprinkled with water containing the spores of the fungus in suspension, and

fed with bread mixed with mycelium and spores. Twelve hours afterwards the cockroaches were only just able to crawl slowly; one of the number that was allowed to remain undisturbed died shortly afterwards, and within two days was covered with a dense white mycelium which eventually produced sporangia.

The remaining three enfeebled specimens were placed along with a dozen newly captured full-grown specimens, who, as was expected, promptly ate up their weakly companions. Within 24 hours the whole of the cannibals were dead and becoming covered with the *Mucor*.

In the letter referred to it is stated that there is a suspicion that the Natal locust fungus of to-day is not the same as the species discovered by Cooper.

The following may explain this suspicion. A fungus called *Entomophthora Grylli*, Fres., has long been known as a parasite on various species of crickets and locusts. Some years ago specimens of a fungus attacking locusts in South Africa were sent to the British Museum, and it was suggested by Miss A. L. Smith in *Science Gossip*, June, 1895, that the fungus was an *Entomophthora*. Some months ago Mr. J. H. Hart, Superintendent of the Botanic Garden, Trinidad, sent to Kew for determination a culture said to have been prepared from an example of the "locust fungus" received from the Cape Bacteriological Institution. This example was not a pure culture, but certainly included *Entomophthora Grylli*, Fres.

It is quite possible that *E. Grylli* does occur as a parasite on the South African locust, and that it may have found its way into certain of the cultures, but it is equally certain that it is not *E. Grylli*, but the *Mucor* described above, that is the potent factor in the "locust fungus" prepared at the Cape.

The following is a description of the *Mucor*, which proves to be an undescribed species :—

Mucor exitiosus, *Massee*. *Mycelium* lanosum, niveum ; hyphæ sporangiferæ decumbentes, racemose ramosæ, sæpius septatæ. *Sporangia* globosa, atra, 60–100 μ diam. ; columella globosa vel obovata. *Sporæ* hyalinæ, ellipsoideæ, 5-6 × 3·5–4 μ. *Zygosporæ* ignotæ.

Bibliography.

1. A revision of the Genus *Cordyceps* ; Geo. Massee, Ann. Bot., ix. (1895), p. 1.
2. Gazette de Milan (1835).
3. Biblioteca Italiana, lxxix. (1835).
4. Hist. Nat. des Végétaux qui croissent sur l'Homme et sur les animaux vivants (1853).
5. Berlin Entom. Zeit., 1858, p. 178.
6. The *Entomophthoreæ* of the United States ; Roland Thaxter, Mem. Boston Soc. Nat. Hist., iv., No. vi., 1888.
7. Report of the Director of the Colonial Bacteriological Institute for 1898 ; Cape of Good Hope, 1899, p. 84.
8. Brief report on Locust—Fungus imported from the Cape ; D. McAlpine ; N.S. Wales Agric. Gaz., x., Nov., 1899, p. 1213, and xi., March, 1900, p. 184.

Description of the Figures.

1–2. *Mucor exitiosus*, showing racemose and corymbose arrangement of the sporangia ; × 60.
3. Fertile branch bearing two sporangia ; *a*, entire, in optical section ; *b*, the sporangial wall and spores have disappeared, exposing the columella ; × 400.
4. A columella and base of sporangial wall ; × 400.
5. Spores ; × 400.
6. Spores germinating ; × 400.
7. Portion of vegetative mycelium immersed in the matrix, showing an irregularly swollen portion at *a* ; × 400.
8. Portion of a sporangial wall studded with minute crystals of lime ; × 800.

IV.—PLANT POISONOUS TO TREK OXEN IN TRANSVAAL.

The following correspondence gives all the available information as to a plant extremely fatal to oxen in the Northern Transvaal. Its deleterious properties appear to have been known locally for some time, but only recently to have attracted more general attention :—

WAR OFFICE to ROYAL BOTANIC GARDENS, KEW.

(116/Cape/1657.) War Office, London, S.W.,
8th November, 1900.

SIR,

I AM directed by the Secretary of State for War to forward for your consideration a report on the death of a number of trek oxen alleged to have been poisoned by eating certain plants while grazing in South Africa.

Specimens of (*a*) a poisonous plant, *Euphorbium* (reputed), and (*b*) a non-poisonous plant are enclosed, and the Secretary of State would be obliged if you would cause them to be examined and identified, and would be grateful for any information that may be forthcoming as to their alleged poisonous action.

I am, &c.,
The Director, (Signed) R. H. KNOX.
Royal Botanic Gardens, Kew.

(Enclosure.)

To the PRINCIPAL VETERINARY OFFICER, SOUTH AFRICA.

"*Re* alleged poisoning of trek oxen, the result of eating certain plants when at the grazing grounds."

I have seen no cases myself, and am indebted to Veterinary Lieutenant Sawyer for the symptoms and post-mortem appearances. He states : "In the majority of cases progress is rapid ; often the first thing noticed is the animal halts, trembles for a few seconds, and drops dead. In cases less severe the animal is tympanitic, lies down, groans with pain, there is a green discharge from both nostrils, and symptoms of gastro-enteritis are present."