II.—On some Microscopic Leaf Fungi from the Himalayas.

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(Read before the ROYAL MICROSCOPICAL SOCIETY, Nov. 4, 1874.)

PLATE LXXXVI.

SOME years ago, when the supposed fungoid origin of disease drew the attention and observation of many practical physicians and scientific men to that subject, more so perhaps than at the present time, I was led—no doubt as many other observers were—in the course of certain special investigations in India to make the acquaintance, though slight and for the first time, of that interesting and not generally known department of cryptogamic botany. Though not at any time successful in associating for certainty the presence of undoubted fungi with constitutional or epidemic disease, it frequently happened, as other observers both at home and abroad have noted, that certain forms were seen both in the human subject and in some of the lower animals while in perfect health.

However, in the present state of the question I would not pretend to affirm that many specific and constitutional diseases in man and animals are not caused by the presence of fungi or their sporidia in the body; and I cannot but believe that as our knowledge of them increases, and with the assistance of the higher magnifying powers, in conjunction with a careful co-relative analyses of symptoms, secretions, excretions, &c., we ultimately shall be able to say to what extent certain diseases may be owing to the lower forms of animal or vegetable life. I know the subject is a difficult one, and nowadays it must be confessed there are few men qualified for such investigations, simply because there are less material inducements than there ought to be, and hence men speculate and invent new theories, which are often more convenient and

DESCRIPTION OF PLATE LXXXVI.

- FIGS. 1 and 2.—*Uromyces ambiens*, on leaf of Himalayan box.
FIG. 3.—*Trichobasis* sp.
" 4.—Lower corner of leaf.
FIGS. 5 and 6.—Probably *Uredo clematidis*.
FIG. 7.—Part of leaf, with *Uredo punctoidea*.
" 8.—Spores of *Uredo punctoidea*.
" 9.—Cells of *Septotrichum*.
" 10.—Probably *Volutella* or *Vermicularia*.
" 11.—Spores of *Coleosporium pingue* [?].
FIGS. 12 and 13.—Part of leaf, with spores of *Puccinia dissiliens*.
" 14 and 15.—Part of leaf, with spores of *Puccinia cruciferarum*.
FIG. 16.—Spores of *P. umbelliferarum*.
" 17.—*Eriueum* [deformed cells].

satisfactory, rather than putting their shoulders to the wheel, and by experiment and observation trying to eliminate the truth.

It happened that for a period of two months in the autumn of 1870 I obtained leave to visit the Himalayas north of Deyrah Dhoon, and employed most of my time there in shooting game and large animals, especially bears, which are very plentiful in many parts of those truly magnificent mountains. In my search for sport, sometimes in places most difficult of access, I frequently observed fungi on the leaves or stems of living plants, and as opportunities permitted I made collections of the affected leaves, and preserved them for examination, which I regret to say has never been done until the present time.

During the space of four years many have changed their colour, and others cannot now be detected on the leaves, and some, indeed, have been lost; nevertheless I have endeavoured to collect a few, some of which no doubt are rare or even unknown in this country. I am not aware of the existence of any work on the fungi of the Himalayas, otherwise I should have consulted it prior to writing the present paper, and thus have saved myself from useless repetition and a little anxiety lest I should be imperfectly performing a labour which has already been well done by another. Since my return to England I have had the advantage of Mr. M. C. Cooke's opinion of the objects figured in Plate LXXXVI., which he has kindly named. Judging from what I observed in September and October, 1870, I should say that fungi are very common throughout the whole range of the Himalayas, and it is probable that all the English species, and maybe many new ones, are to be found with little trouble to any energetic and adventurous mycologist who may be fortunate enough to traverse those regions.

On some banks and sunny slopes of the hills the wild strawberry and raspberry are to be found in abundance, and on the under surface of the leaves of many will be noticed black spots, which on microscopical examination are proved to be the *Aregma* (Phragmidium) *obtusum* and *Aregma* (P.) *gracile* respectively, and differing in no way from the English species.

On the under surface of the leaves of the thistle (*Carduus lanceolatus*) the *Puccinia syngenesiarum* was frequently noticed, and so was the *Puccinia variabilis* on the upper and under surface of the leaves of the dandelion.

The blackberry brand, the *Aregma* (Phragmidium) *bulbosum*, was quite common on the under surfaces of the leaves of the blackberry bushes, and occasionally a white, tough, cotton-like fungus was met with, growing either from the under surface of the venation of the leaf or from the petiole, or both. This fungus will be referred to farther on.

The *Aregma* (Phragmidium) *mucronatum* was found on the

under surface of the leaves of the wild rose, and another form which was also common on oak leaves, laurels, and other species, and which will be referred to presently.

Peridermium pini was plentiful on the leaves of the silver fir and other pines, which grew in abundance in every direction, and a similar fungus was commonly noticed on the pine leaves about Dalhousie, more than a hundred miles from the hills north of Deyrah Dhoon.

The various grasses as well as the leaves of Mudwa (a species of millet) and the leaves of the rice plant, which is cultivated in many of the valleys, appeared to possess their share of fungi.

In the accompanying Plate the portions of leaves have been drawn the natural size from the actual specimens, and the spores are magnified about 320 diameters.

In a valley about twenty miles from the military station of Landour, between Deyrah Dhoon and Duncoltie, but close to and behind a high hill at the latter place, there is a considerable extent of forest, principally composed of a species of boxwood tree (*Buxus*), from 20 to 30 feet high, and with wide-spreading branches and with stems averaging from a few inches to $1\frac{1}{2}$ feet in diameter. During my travels of many hundred miles through the Himalayas I never happened to come across a single specimen of box tree except in the place mentioned, and in which they appeared to grow well.

The under surface of most of the leaves contained a dark-brown fungus, resembling in outward appearance an *Æcidium*, varying in diameter from $\frac{1}{8}$ to more than $\frac{1}{4}$ of an inch, and frequently two or three of these orbicular patches may be found on one leaf.

The peridium bursts regularly in circular patches and the margins become irregular and recurved, exposing the dark-brown spherical spores. The spores appear to be peculiar and to belong to the genus *Uromyces*, having short peduncles, a thick cell-wall, and a light amber-coloured endochrome, which communicates externally by a funnel-shaped orifice on the side opposite the attachment of the peduncle, i. e. the upper part of the spore. This description will be better understood by referring to Fig. 1, which represents a box leaf with the fungus *in situ*, and Fig. 2, which shows three of the spores magnified. [*Uromyces ambiens*, Cooke.]

Fig. 3 represents spores from the under surface of the leaf of a plant which I fail to recognize, and which exhibits small light-brown spots made up of an aggregate collection of oval yellowish spores attached by short peduncles to the epidermis of the leaf (*Trichobasis*). The plant apparently belongs to the order Convolvulacea, is herbaceous, about 2 feet in height, and the stem, &c., contains a milky juice as well as the roots, which are used by the natives as a purgative. A species of clematis (probably the

Traveller's Joy) is common on the hills and in the valleys, and sometimes a beautiful orange-red fungus may be observed on the under surface of the leaves. This fungus on the fresh leaf emitted an odious smell—the smell of a recently killed bug—and was quite unbearable, but now both the red colour and the smell have disappeared. When the leaf is examined with a low power the spores are found to be arranged in little button-like clusters (Fig. 5) firmly packed side by side and of yellow colour (Fig. 6), and growing from the cellular dermis of the leaf almost at right angles. [*Uredo clematidis*,* Berk.]

Fig. 7 shows the appearance of the leaf of a species of mimosa with a fungus on the under surface, and Fig. 8 the spores with three sporidia above. [*Uredo punctoidea*, Cooke.]

I found also a leaf of an unknown shrub with rust spots irregularly distributed on the under surface. The spores are many-celled, irregular, elongated, yellowish, and easily separate as a yellowish-brown dust without any traces of mycelium, vide Fig. 9. [This is a *Septotrichum* formerly included with fungi, but now discarded as a diseased condition of the tissues.—M. C. C.]

On the leaf of a species of willow, I observed on the upper and under surface a number of black spots, which were easily scraped off. On microscopical examination, these black spots were found to be made up of a number of bodies like that depicted in Fig. 10. They consist of a circular, yellow-coloured matrix, with an interior dark-brown-coloured nucleus, made up of fine mycelium, and interspersed throughout the latter there are numerous small cells. Outside the central nucleus, and arranged in a radiating manner, there is a number of jet black spine-shaped processes, apparently very brittle, as they are easily broken by pressure under the covering glass. [No fruit: probably a *Volutella*.]

Fig. 12 represents the appearance of a portion of the under surface of a leaf resembling the *Rumex acetosa*, on which raised circular reddish-brown spots of fungi are observed. The spores (*Puccinia*) are shown in Fig. 13, magnified, the cells being nearly separate, and attached to long, tapering peduncles. [*Puccinia dissiliens*, Cooke.]

On the leaf of the common dock, which differs in no way from that seen in this country, the upper and lower surfaces were studded with rusty minute fungoid spots, which appear to belong to the order *Æcidia*cei. The spores are circular, tuberculated, and of a yellowish colour. [*Æcidium rubellum*, P.]

Fig. 14 represents the appearance of a piece of the under surface of the leaf of a cruciferous plant, very common in the

* On the leaf I find *Uredo clematidis*, but not the structure indicated in the drawing. If this is manifest in its fresh state, then the *Uredo* would be a *Coleosporium*.—[M. C. C.]

Himalayas, and which is frequently found covered with dark-brown spots of fungi. The spores are septate, with short peduncles (which are liable to be easily detached), oval in shape, and with a comparatively transparent, nipple-like projection on the upper part, vide Fig. 15. [*Puccinia cruciferarum*, Cooke.]

Fig. 16 shows the appearance of the spores of a *Puccinia* found on the upper and lower surfaces of the leaves of an umbelliferous plant. [*Puccinia umbelliferarum*, D. C.]

Fig. 17 represents the magnified appearance of bodies which form patches on the under surfaces of the leaves of the oak, species of laurel, wild rose, &c. They resemble the agarics in shape, are hollow, or filled with a pink fluid, which, when pressure of the covering glass is used, exudes through the lower part of the stipe or stalk. [An *Erineum*, not a fungus, but diseased tissue.—M. C. C.]

Fig. 11 illustrates two of the sporangia which form the tough, cotton-like fungus met with on the under surface of the briar leaves, or on the petiole. The conceptacles which contain the spores are bi- and tri-partite, and terminate in long filiform appendages. Two of the nearly colourless tuberculated spores are depicted to the right of the sporangia. [I have seen no specimen of this. The figures might belong to *Coleosporium pingue*, but the description is rather that of some *Erineum*.—M. C. C.]

I feel that an apology is necessary for writing on a subject with which I am so little acquainted; but as I had collected the materials many years ago, I considered it better that they should be made public at once, rather than be lost. Perhaps others more competent may be induced to pursue the subject more fully than I have been able to do, as it is one of great interest, and not without some advantage, and indeed, at all events, the small collection of leaves now before me recalls to my memory many pleasant days spent amidst most beautiful scenery in one of the finest climates of the world.*

* The technical descriptions of such of the foregoing fungi as are new to science are published in the current number of 'Grevillea.'