

NOTES ON RESUPINATE HYMENOMYCETES—I

On *Pellicularia* Cooke

M. A. DONK*

SUMMARY

The author concludes that *Pellicularia* Cooke is to be regarded as the name of an inseparable mixtum compositum (nomen confusum) and hence as illegitimate (impriorable). He believes that, apart from a hypothetical gelatinous medium, Cooke's original material consisted of the combination of the vegetative hyphae of a resupinate hymenomycete and the spores of a pervading imperfect fungus. If one of these constituent elements were to be selected as type, the choice would be the spores rather than the vegetative byphae selected by Rogers.

This genus was established for one species, *Pellicularia koleroga* Cooke, received from Mysore, India, where it caused a disease (kole roga or black rot) of the coffee plant. It appears to have been mentioned for the first time in "The Gardeners' Chronicle" of February 19, 1876 (p. 246). All that was published at the time were the following lines:

[Reports of Societies. Royal Horticultural: February 16. Scientific Committee.]
"MYSORE COFFEE-LEAF FUNGUS.—Dr. M. C. Cooke showed a leaf of the Coffee plant from Mysore affected with a new fungus, different from the Hemileia of Ceylon, and called *Pellicularia Koleroga* (Grevillea, iv., 1876) .

"Mr. Berkeley considered that this might be a form of some lichen, or an undeveloped condition of some hymenomycetous fungus."

This does not constitute a valid publication (nomen nudum). The next time the fungus was mentioned by Cooke was in the cited volume of "Grevillea," number 31, of March, 1876.

The generic and specific Latin diagnoses run:

Pellicularia: "Parasitica. Floccis repentibus ramosis, septatis, in pelliculam sutagelatinosam intertextis. Sporibus sessilibus, simplicibus, hyalinis."

Pellicularia koleroga: "Hypophylla, effusa, griseo-alba, sporibus globosis, hyalinis, echinulatis."—Cooke (1876a: 116).

A more extensive description of the species in English was added, while in the same number of the periodical (pp. 134-135) a two-page discussion was included on the "Affinities of *Pellicularia*" In the same year Cooke (1876b, 1876c) also published two more accounts of the fungus, both

* Keeper of Herbarium Eogoriense, Kebun Raya Indonesia.

illustrated. In the first of these the Latin descriptions are repeated (except that "hyalinis" was omitted in the specific description) and *Pellicularia* again indicated as "Gen. nov."; the illustrations in both papers are similar but not identical. The sequence of the three papers seems to be that given in the "Bibliography" of the present contribution: in 1876b no reference is found to 1876a, while in a footnote of 1876c the account in "Grevillea" (1876a) is cited first, followed by the "Report on diseased leaves of coffee and other plants" (1876b). The label of the type collection gives "Grevillea vol. iv. 1876" as the place of publication.¹

The true nature of the fungus as a resupinate hymenomycete was not recognized by its author and such a possibility was even deliberately rejected; the presence of basidia was denied. Cooke thought that the most tenable conclusion was that the fungus in question belonged to the hyphomycetes. He ascribed to it solitary, globose, hyaline, echinulate spores 7.5 μ . in diameter, scattered and attached along the sides of the hyphae. He did not doubt that the globose bodies were spores ("as spores are undoubtedly present"), but owing to "an investing gelatinous medium" it was exceedingly difficult to obtain a free spore. In the original specific description the fruit-body was described as consisting of creeping threads interwoven into a subgelatinous pellicle which could be stripped off from the substratum (leaf) when moist. A portion of the type has been preserved and was restudied by Von Höhnelt and by Miss E. M. Wakefield who communicated preparations and her annotations to Burt.

Cooke's descriptions and accounts are defective in some crucial points. For instance, the normal fruit-bodies are not subgelatinous. This was pointed out by Burt (1918: 122-123). Cooke was led to assume the presence of a gelatinous medium to account for the fact that the spores described did not float loose from the hyphae upon which they were supposed to be borne. Later on he seemed to have abandoned the hypothetical gelatinous matrix himself for he wrote a few years afterwards that "the fungus is . . . spreading over the leaves in a compact filamentous film," and that the hyphae are "felted" (Cooke, 1881: 461). Von Höhnelt (1910) did not mention the subgelatinous nature of the fruit-bodies in his redescription of what remains of the type collection, and Burt concluded that the cell walls of the hyphae of the type portion still preserved of *Pellicularia koleroga* in the preparations received from Miss Wakefield are not in the least degree gelatinously modified.

¹Lindau & Sydow (Thesaurus 1: 296. 1908) reported 1876b as published in February, but this is the month in which the article was written, rather than the date of publication.

This gelatinous medium played a very important rôle among the considerations that resulted in the publication of the genus. Presumably the idea of it was forced upon Cooke's attention by a reply made by Mr. G. Porter: "'Kole roga,' or black rot . . . makes its appearance about July, when the leaves of trees affected by it get covered with a slimy gelatinous matter . . ."—Cooke (1876*b*, 1876*c*). This observation might be consistent with one made by Narasimhan (1933: 884): during later stages of the coffee black rot, the leaves begin to decompose as a result of invasion by bacteria, and a brownish liquid oozes out. Films of the fungus that have soaked up this liquid and are observed during rainy weather may well impress one as a slimy gelatinous matter. Such films would be an excellent substratum for secondary fungi. Yet all this together is hardly enough to explain Cooke's gelatinous medium. The following extracts may show how exceedingly important the rôle of the gelatinous medium was to him.

"The threads and spores seem to be agglutinated together into a film by some gelatinous medium, so that not a spore or thread can be removed from the mass without difficulty. In this feature the 'rot' differs from all the *mucedines*, in which the spores are so slightly attached that they float away on the application of moisture, whilst in the present instance no application of fluid avails to disturb a single spore."—Cooke (1876*b*, 1876*c*).

"From the examination of this rot, with a view to the determination of its scientific relationship, the conclusion appears to be that it has no very close affinities—that it is not only specifically new, but will have to be accepted as the type of a new genus. It, doubtless, must be grouped with the *mucedines* or white moulds, but the presence of the gelatinous element is a novelty. . . .

"It is especially desirable that more information should be obtained concerning the method by which the spores are disseminated and whether they ever appear on the surface free from the gelatinous stratum; this can only be determined by a series of careful observations. . . .

"The fact of an epiphytal fungus, which does not penetrate the tissues of the leaf being so destructive to the foster plant, may at first seem strange, until it is remembered that in plants with coriaceous leaves, all, or nearly all, the stomata are confined to the under surface of the leaf. If, therefore, a filmy substance like the present fungus overspreads the under surface of the leaf, and securely seals up all the stomata, it is but reasonable to expect, not only that the leaves should fall, but that the plants should suffer injury. . . . It might be worth the experiment to ascertain if a coating of gelatin washed over the under surface of the leaves of a coffee tree, so as to act artificially in the same manner as the 'rot', would produce similar results."—Cooke (1876*b*).

"The conclusion at which we have arrived appears to us the most tenable one, that the fungus in question belongs to the *Hyphomycetes*, or moulds, in habit and external appearance it strongly reminds one of the white moulds which precedes many species of *Erysipke* . . ., or that which precedes *Uncinula* . . . Even under the microscope there seems to be some kind of relationship; the interwoven, septate,

colourless branched threads are present, but there is an addition of a somewhat gelatinous medium, which binds the threads together into a pellicle. . . . It is very true that the structure, as seen in a drawing, resembles closely that of some species of *Zygoeamus*; but . . . there are two or three features which appear to us conclusive for rejecting the coffee rot from this genus. In all species of *Zygoeasmus* the threads are free from any investing medium, the spores are pulverulent, and, moreover, the threads are more or less coloured. . . .

"The presence of the gelatinous element which binds together the threads and spores into a thin pellicle, which is easily separable from the matrix when moist, is an important feature in determining the affinities of the 'Coffee rot/ In the genus *Amphiblatrum* of Corda there is said to be such a gelatinous medium. In many species of *Fusisporium* there is something of the same kind; in *Alytosporium* as constituted by Link, and in some other genera allied to *Sporotrichum*. Still, from all these there are manifest points of divergence that no one would venture to associate the present species with any of them."—Cooke (1876a, 1876c).

The spores, as described by Cooke, are a more difficult problem to solve. In one of his figures Cooke (1876b, 1876c)' depicted all of the rather numerous spores as lying against the hyphae; in another more detailed figure³ he drew two of them attached to the hyphae, in one case showing the actual attachment as a very narrow and very short, cylindrical connection. In his original account Cooke (1876a) stated that the spores were "sessile, scattered over the threads" (p. 116) and that they are "seated, at irregular intervals" on the threads (p. 134). When he published drawings of the fungus, his text (Cooke, 1876b; 1876c) is more elaborate on this point and brought into agreement with the figures; on this occasion he wrote of "spores, which are seated upon the threads, without any visible pedicel, although when first formed there appears to be a short stem, which is ultimately absorbed." This mode of attachment is obviously imaginary like the device of the gelatinous matrix.

The spores, as drawn by Cooke, are strictly globular, minutely warty-spiny, and of about the same size as the diameter of the hyphae; all of these particulars agree with what was said about them in the text of the original publication.

Von Höhnelt (1910), Burt (1918: 122), and others concluded that the spores were the basidia. This is at first sight a tempting solution, especially if one looks at a drawing of a related species by Wolf & Bach (1927: f. 10) and the microphotograph published by Coleman, Venkata Rao, & Narasimhan (1923: pi. 1 f. 1). These latter authors (1923: 3) were of the opinion that "some of the spherical structures seen and figured by Cooke

² Reproduced by Delacroix (1900: f. 12). This reproduction is not faithful: it shows all the spores as detached from the hyphae!

³ Reproduced by Delacroix (l.e.) and by Coleman, Venkata Rao, & Narasimhan (1923: text-f.1).

as young spores were simply the spherical basidia upon which the basidiospores are borne."

A point in favour of the supposition that the spores described by Cooke were the young, still more or less globular basidia of the kole-ropa fungus might be sought in the fact that spores did not float in liquid mounts. As we have seen Cooke introduced a gelatinous medium to account for this situation. However, in this connection it must be remembered that everything in his preparations appeared to be immobile: even the threads did not separate (Cooke, 1867*b*, 1867*c*)! And compare: "Owing to the investing medium, it is exceedingly difficult to separate one thread from another, or to obtain a free spore."—Cooke (1876*a*: 134). It is significant that for an explanation Cooke did not resort to the "short stem, which is ultimately absorbed," already mentioned, and with which the spores were supposed to be attached to the hyphae. Evidently he had his own reasons for having no faith in this device that might have accounted for the short lateral branches on which many basidia are borne, if they had not been depicted as much too slender and too short or were not imaginary.

Yet, on reconsideration, the conclusion that basidia are the spores seen by Cooke seems far-fetched: (i) the basidia are never really, and the young ones often not exactly, globular; (ii) they are smooth (except for the sterigmata), and (iii) they are broadly and permanently attached to the hyphae, being formed rarely in poorly developed clusters or mostly solitary on short side-branches which hardly could have escaped the attention if what Cooke described as the spores were in reality basidia; (iv) young basidia are larger than 7.5 μ as given by Cooke for the diameter of the spores and quite distinctly wider than the hyphae.⁴ The basidia would never have led him to his statement (Cooke 1876*a*: 135) that they are very similar in size and form to the spores of *Zygodemus* (e.g. *Z. fuscus* Corda), as he stated of the spores he observed.

Another solution is here suggested. The spores were present, but as foreign elements, that is, as spores from a contaminating fungus. They were also met with by Fawcett who described them from specimens collected in Mysore, where Cooke's original specimens were obtained. This is his account of them:

"In the original description *Pellicularia koleroga* is described as possessing spores, hyaline, echinulate, of about the same diameter as the hyphae, in which they

⁴ The diameter of the hyphae was given as 5—7.5 μ . (Cooke, 1876*a*: 134), which is correct; there is no reason to assume that the numerous spores seen were measured incorrectly.

lie without apparent connection. . . . On one leaf of the Indian specimen examined, spores were found which agree with the original description They had no connection with the larger hyphae, but were seen to be attached to very fine hyphae belonging, apparently, to some fungus other than *Pellicularia koleroga*—possibly to some of the saprophytes by which it is sometimes accompanied."—Fawcett (1914: 232-233 / 3).

Here then, is the reason why Cooke did not see the spores float: the hypothesis, now offered as an explanation, is that they were connected by a system of extremely fine foreign hyphal threads which escaped his attention; as abundant spores were drawn, it is possible that these hyphae were empty and had collapsed. A direct comparison of Cooke's and Fawcett's cited figures will be highly convincing, I am sure. The spores described by Cooke could not be found in the portion of the type that still remains—but neither are young (globular) basidia numerous and distinct (in fact none could be detected in the preparations I made). I accept the foreign spores as having been present in the portion he studied microscopically.¹ The contaminating fungus may perhaps have been a small-spored species of *Sepedonium* Link ex Fr., or an extremely small-spored species of *Mycogone* Link ex Pers,

Not until the present paper was made ready for the press, did I become aware of a very short note in "The Gardeners' Chronicle" of March 1, 1876 (p. 308), in which the above conclusion proves to have been anticipated more than three quarters of a century ago. This note is here given in full:

[Reports of Societies. Royal Horticultural: March 1. Scientific Committee.]

"COFFEE DISEASE.—With reference to the specimens shown on a former occasion (p. 246), Mr. Berkeley reported that he had examined them, and considered them to be attacked by the spawn of a fungus, probably a species of *Acremonium*."

The former occasion referred to dates from two weeks earlier; the note in question is quoted at the beginning of the present paper,

That of the collection at his disposal Cooke discarded certain portions which he studied can be easily proved. He stated that "in order to examine the specimens in as complete a manner as possible, a portion of a leaf was immersed for 12 hours in water, but this does not dissolve the mucus so as to free the spores" (1876b, 1876c). The single leaf preserved is a complete one and, moreover, bears no marks of having been treated in the manner indicated. Thus, it may well be that old fruit-bodies were

* The type collection (Kew Herbarium) consists of a single leaf and is labelled: "Coffee Leaf Rot / *Pellicularia Koleroga* Cooke (Grevillea vol. iv. 1867 / on Coffee Leaves. Mysore (1875) / M. C. Cooke." It is rather poor. Presumably Cooke retained only a small portion of the collection.

studied, such as had become more or less slimy by bacteria and lacked young basidia.

Personally I do not doubt that *Pellicularia* and *P. koleroga* are nomina confusa (Art. 76).

Rogers (1951) acted as follows: He said that the suggestion has been made that *Pellicularia koleroga* and *Pellicularia* may be nomina confusa as defined by the article as worded both before and after the Stockholm congress. No evidence has been published, he said, that they really are nomina confusa. In spite of this absence of evidence that the names are properly subject to the Rule quoted, it seemed advisable to him to preclude any obligation that might arise, from future evidence or opinion, for someone to compile a new set of binomials in *Pellicularia* (in Rogers' sense, *Botrijobasidium* Donk plus *Pellicularia*). *Pellicularia koleroga*, was therefore typified by the portion of the type specimen that gives rise to and includes the basidia illustrated by Burt ("in Mo. Bot. Card. Ann. 5:124, fig. 1a. 1918; 13: 293, fig. 1a. 1926"). Since the type is completely fertile, it is said to be as "satisfactory" as any rule could require. (The illustrations referred to were made by Miss Wakefield and published by Burt.)

Thus, in spite of the absence of evidence that we are dealing in this case with a mixtum compositum, Rogers appointed a specified part of Cooke's type specimen as *the* type! This was done "to preclude any obligation to compile a new set of binomials." This new set he had in mind would be only supplementary. It would partially replace his own set under *Pellicularia* (Rogers, 191,3); there exists already a considerable, earlier, set under *Botrijobasidium* (Donk, 1931; Rogers, 1935). Previously Rogers (1943: 97) regretted that "there was no choice but to reduce *Botryobasidium* to synonymy, and to take up as soon as possible the valid name *Pellicularia*," which he at that time had apparently failed to scrutinize in the light of Art. 76.

Did Rogers attain his goal? Cooke's *original description*, not the type specimen, is the principal legal basis for guiding the selection of a type, and, by extension in case this would be required, of the type portion of a type specimen." The description covered three elements, (i) the vegetative hyphae, (ii) the echinulate spores, and (iii) the hypothetical gelatinous medium. If a choice has to be made, and if it would be permissible to disregard the gelatinous medium, it should be made between the one fungus of which only the vegetative hyphae were described (the basidia,

ⁱ Compare the Appendix for the determination of types, which contains in connection with selected types, for instance: "The original description of the taxon concerned should be the basic guide."

which were present **but** were emphatically stated to be absent and not seen by Cooke, do not count at all) and the other one, pervading the first, of which only the spores were described. Only by starting from this premise a well-founded choice could have been made, in my opinion; not from one which totally ignores the 'spores,' as was done by Rogers. It is evident under these circumstances that one would really arrive at the embarrassing selection of the spores, rather than of the vegetative part (selected by Rogers), in view of Arts. 19 and 21, and Suggestions 4(a), 4(b), and 4(d) of the Appendix for the determination of types! What Cooke regarded as the essential characters is comprised in his Latin description quoted above. At the end of his discussion on the affinities of *Pellicularia* he summarized his views at the time of publication of the (generic and specific) names as follow:

^bHence no other course appeared to be open to us but to constitute *Pellicidaria koleroga* the type of a new genus allied to those just alluded to [*Amphiblistrum* Corda, *Fusisporium*, *Alytosporium* Link, and "some other genera allied to *Sporotrichum*"], but distinguished therefrom by its parasitic habit, sessile, echinulate, globose spores, and the freedom with which it separates from the matrix."—Cooke (1876a: 135).

There is relatively much about the spores in this summary and next to nothing about what Rogers selected as the ultimate type. Indirectly there is also relatively much about the gelatinous medium, for the genera mentioned were all discussed in relation to this medium, as may be gathered from the pertinent quotations inserted above. The character of the freedom with which the fruit-body separates from the matrix mentioned is not to be found in the two Latin descriptions. It was in the first place the gelatinous medium and the spores that induced the introduction of the genus *Pellicularia*!

The hyphae alone would never have contributed to the establishing of the genus, as was exceptionally clearly expressed by Cooke:

"Apropos of the suggestion which has been offered through the medium of a horticultural newspaper, that the 'black rot' appears to be the *mycelium* of some fungus, it will be sufficient to remark that the term 'mycelium' is, by general consent, confined to productions which consists of barren threads. The presence of spores, in this instance, clearly removes the production beyond the limits of the term 'mycelium.' Unless terms are employed with their recognised meaning and limitations, some explanation should accompany their use to prevent misconception."—Cooke (1876c).

However, it appears indicated to refrain from selecting anything and I would prefer to leave some sense in Art. 76/ which otherwise would

⁷ "A name of a taxon must be rejected if its characters were derived from two or more entirely discordant elements, unless? it is possible to select one of these elements as a satisfactory type."—Art. 76,

become entirely superfluous. As long as the comparable example of *Actinotinus*^s has not been deleted from the Code, it needs not be explained why one is fully authorized to consider *Pellicularia* and *P. koleroga* as nomina confusa and hence as impriorable.

Venkatarayan (1949) has already rejected *Pellicularia* for various reasons. His main argument seems to be that "Cooke did not see the basidial state and gave the name *Pellicularia* to the imperfect state" (p. 4), that is, to the vegetative hyphae. This line of reasoning has not been adopted in the above discussion.

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^s "The characters of the genus *Actinotinus* Oliv. . . . were derived from the two genera *Viburnim* and *Aesculus*, owing to the insertion of the inflorescence of a *Viburnum* in the terminal bud of an *Aesculus* by a native collector. The [name] . . . *Actinotinus* must therefore be abandoned."

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