

# THE VALIDITY OF THE NAME DISCOMYCES FOR THE GENUS OF FUNGI VARIOUSLY CALLED ACTINOMYCES, STREPTOTHRIX, AND NOCARDIA

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The nomenclature of the group of fungi the pathogenic members of which produce the various actinomycoses, so-called, has been the subject of a confusion that resulted from an unusual combination of circumstances. For some time it was a moot question whether the organisms were of bacterial or of fungous nature, in part because of erroneous conceptions of their morphology, which is complex and variable, and differs widely in different strains; even yet opinions differ as to whether or not the forms involved should be included in a single genus. One of the types, a saprophyte, *Streptothrix foersteri* Cohn, was for a time erroneously included in a genus of the higher bacteria, while the first pathogenic species described, *Actinomyces bovis* Harz, having been recognized as a fungus, was given a different generic name. The question was further complicated by the fact that both names had long before been employed for entirely different organisms. Since then some authors have held one invalid, some the other, and some have rejected both. Other names have been misapplied from time to time, while new ones have been proposed, the list now including a total of ten.

As is too frequently the case, the systematist and the pathologist have tended to ignore the work and the viewpoint of one another. Medical writers, who almost exclusively have been concerned with the study of these organisms and consequently the use of their names, have been very prone to choose these from the viewpoint of convenience and local custom rather than to recognize and adhere to the rules of nomenclature by which modern biologists are bound. On the other hand, botanists have overlooked or ignored—and they still do this—names and descriptions that have, in sincerity but without the formality customary with themselves, been published by medical writers. It is to consider the matter from both viewpoints in an effort to determine the actually correct designation that we have collaborated in a review of the vicissitudes of nomenclature that this group has undergone.



## HISTORICAL

The phase of the confusion in which the characteristic of true branching in these organisms was not appreciated began in 1875, when Cohn(18) described, among others, two organisms that he made the types of new genera. One, which he named *Cladothrix dichotoma*, a colorless, filamentous plant found abundantly in water containing decomposing algæ, was characterized by a false branching that he compared to that of certain algæ; the other, which, apparently in ignorance of Corda's(19) previous use of the same generic name, he called *Streptothrix foersteri*, was a branching filamentous organism said to have been found first by Graefe and then by Foerster in concretions in the lachrymal canal of man and classified by Waldeyer as *Leptothrix buccalis*. Cohn did not accept this conclusion, the mode of branching suggesting the mycelium of fungi. It has been pointed out by Sauvageau and Radais(56) that the distinction between his *Cladothrix* and *Streptothrix* was so clear to Cohn that in the text he did not even compare them; furthermore, that his illustrations of them are quite distinct. They quote his diagnoses:

*Cladothrix*—n. g. filamenta leptothricoidea tenerrima, achroa, non articulata, stricta vel subundulata, *pseudo-dichotoma*.

*Streptothrix*—n. g. filamenta leptothricoidea tenerrima, achroa, non articulata vel anguste spiralia, *parce ramosa*.

In his summary, however, Cohn did not clearly differentiate them. According to Migula(44) he put them together among organisms showing false branching, although indicating uncertainty as to *Streptothrix* by an interrogation point:

Zellfäden durch falsche Astbildung verzweigt.

Fäden cylindrisch, farblos—*Cladothrix* Cohn.

*Streptothrix*?

Cohn's later understanding of the morphology of the latter is evident from Israel's article cited below. However, it is hardly to be suspected from this arrangement that, as is now generally recognized, the dividing line between the higher bacteria and the lower fungi separates these two genera.

Bollinger, in 1876, demonstrated the fungous nature of the granules, or "drusen," from the lumpy jaw of cattle. Attempts at cultivation and inoculation had been without result. In the following year(10) he published a description in which he stated that Harz, to whom he had submitted fresh material, had concluded that the ray fungus (*Strahlenpilz*) belonged to the mold fungi and that it was related to *Botrytis*, *Monosporium*, and *Polyactis*; the name *Actinomyces bovis* was proposed for it.



Rivolta, (53) in 1878, changed the generic name to *Discomyces*. After amplifying the descriptions of the granules (*corpuscoli discoidi*) that he had made in 1868 and 1875, he said in part:

E vero chi i corpuscoli discoidi compressi si risolvono in pennelli od in ventagli fatti di rami e ramoscelli, mar perciò non si ponno dire *raggiati*. Questa parola in storia naturale ha un senso ben determinato. Il complesso dei dischi che ci rappresenta, se si vuole, un micelio, non ha la forma raggiata, e per conseguenza non si può denominar raggiata o come venne detto *actinomyces*, e nemmeno si debbono indicare i danni o le lesioni che produce con la parola *actinomicosi*. Il solo nome conveniente, a mio avviso, sarebbe quello di *discomyces bovis*, e con la parola *sarcomicosi* si potrebbero indicare le lesioni che produce vel corpo del bue.

Harz (28) then published a separate description of the fungus, rejecting Rivolta's change.

Israel, (29) in 1878, used *Actinomyces*, but called attention to the similarity between the organism found in lesions in man and Cohn's *Streptothrix foersteri*, a resemblance which, he said, Cohn himself had confirmed. Perroncito, (49) although himself employing *Actinomyces*, quoted a communication from Professor Garovaglio, director of the Cryptogamic Laboratories of the University of Padua, in which its previous use by Meyen (42) was noted.

Rivolta (54) later declared that he was willing to accept *Actinomyces bovis*, but added that one could, nevertheless, form a group of pathogenic discomycetes containing: (1) *Actinomyces bovis* Harz; (2) *Discomyces pleuriticus canis familiaris* Rivolta; and (3) *Discomyces equi* Rivolta and Micellone. The second is now *Cladothrix canis* Rabe. (1898), and the third is known as a *Micrococcus* (*M. botryogenes* Rabe., *M. ascoformans* John, etc.). The first is, therefore, the only one of these organisms remaining in Rivolta's genus, as thus amplified by him, and is the type of the genus, both as originally published and as later amplified.

During this period systematists, who placed these organisms among the bacteria, denied the generic validity of Cohn's *Streptothrix*. Winter, (61) Zopf, (63) Schröter, (58) and Baumgarten (5) considered it to be a synonym of *Cladothrix*. Schröter included, in the same family, the genus *Actinomyces*, this being apparently the first recognition of Harz's organism in systematic classification. Baumgarten concluded that the ray fungi belonged among the pleomorphic higher bacteria in the genus *Cladothrix*. MacFadyean (39) agreed that the organisms of actinomycosis probably belonged to the Schizomycetes; he held that the occurrence of clublike elements in the granules was not of specific value because inconstantly formed.



Macé(37) also confused the genera, but in a new fashion. In 1888 he erroneously described for *Cladothrix dichotoma* a process of true branching and adopted(38) this generic name for the ray-fungus group. Sauvageau and Radais hold that he had never had the true *Cladothrix* under observation.

Affanassiew(1) at first called the organism of actinomycosis *Bacterium actinocladothrix*, but in the following year, 1889, Affanassiew and Schulz(2) gave the term *Actinocladothrix* generic rank. The only evidence that we have encountered of the use of this name by anyone else is the mention, without reference, of "*Actinocladothrix nocardii*," in an article by Haass.(27)

De Toni and Trevisan, in Saccardo's *Sylloge Fungorum*,(20) accepted these organisms as belonging to the Schizomycetaceæ. In the Cladothriceæ: "Sporae (arthrospora) in filamentis normalibus obvenientes. Filamenta pseudo-ramosa" they included *Sphaerotilus*, *Cladothrix*, and a genus that they called *Nocardia* Trevisan: "Filamenta evaginata. Arthrospora transformatione cocci singuli ortae." In this genus they included *Streptothrix* Cohn, non Corda; *Actinomyces* Harz, non Meyen; and *Discomyces* Rivolta, five species being defined. The description of these organisms as falsely branching was, of course, erroneous.

In 1890 Almquist(3) and Gasperini(23) described certain organisms that they identified as species of Cohn's *Streptothrix*. Kruse held that these species fell, with the organism of actinomycosis, into Zopf's *Cladothrix* group. Rossi-Doria (55) soon described six new species of *Streptothrix* from the air and classed *Actinomyces bovis* Harz, which he is said to have renamed *Streptothrix actinomyces*, with them. Kruse(31) later also employed *Streptothrix*, differentiating it from *Cladothrix*.

From cases of actinomycosis in man Bostroem(11) repeatedly cultivated an organism that differed distinctly from that cultivated by Israel. He concluded that it belonged to the *Cladothrix* group of the Schizomycetes and pointed out that it might be related to, or even identical with, *Streptothrix foersteri* Cohn.

Grüber,(26) in 1891, described as *Micromyces hofmanni* an organism that subsequent authors have included in the group under discussion.

Sauvageau and Radais's(56) discussion of the confusion of Cohn's *Cladothrix* and *Streptothrix* has been referred to. They believed that the two were distinct; that *Cladothrix*, the most differentiated of the Bacteriaceæ, was falsely branched; and that *Streptothrix*, a true though very low hyphomycetous fungus,



to which the organism of actinomycosis belonged, showed true branching. They concluded that the latter really belonged to *Oospora* Wallroth (1831), but that, whether or not this was correct, it was necessary to discard *Streptothrix* Cohn because of Corda's use of this name in 1839. De Toni and Trevisan's description of *Nocardia* as falsely branching was incorrect, for although Nocard(47) had originally so described his "Bacille de farcin," Metchinkoff had found that it was a true-branching organism. Kanthack(30) accepted *Oospora* and created the name *Oospora indica* for the parasite of Madura disease, having demonstrated the identity of actinomycosis and of certain mycetomas. Lehmann and Neumann,(33) in 1896, introduced *Mycobacterium* as a family name for a group that they considered intermediate between the Hyphomycetes and the Schizomycetes, but rather more closely related to the former, and at first adopted *Oospora* as the generic name for the organisms under discussion.

Gasperini,(24) in 1894, proposed the use of *Actinomyces* to include the whole group, discarding *Streptothrix*; he listed eighteen species. Berestnew,(6) in 1897, accepted *Actinomyces* as valid and later(7) called attention to Gasperini's publication, which apparently had been overlooked. Lachner-Sandoval,(32) in 1898, pointed out the invalidity of *Oospora* in this connection and also adopted *Actinomyces*. Levy(34) reviewed the question, concluding that all the described types were generically related and that *Actinomyces* was the proper designation for them. He did not note Rivolta's original application of *Discomyces*. Lehmann and Neumann, in the second (1899) edition of their work, substituted the family name Actinomycetes Lachner-Sandoval for their own *Mycobacterium*, the pathogenic forms placed in the genus *Oospora* now becoming *Actinomyces*. This broader application of the term to the entire group is not now widely accepted, though Mallory,(40) after Gasperini, employed it tentatively, and Babes(4) and other German authors still use it.

Migula, in his earlier (1895) classification,(43) included these organisms among the higher bacteria, in his family Chlamydobacteriaceæ. He separated *Streptothrix* Cohn from *Cladothrix*, giving it a much modified diagnosis. In *Cladothrix* Cohn he included *C. bovis* (Harz) Migula (*Actinomyces bovis* Harz) and *C. foersteri* (Cohn) Schröter (*Streptothrix foersteri* Cohn), thus perpetuating the error of the earlier systematists. As already noted, Macé had adopted this generic name, although from a different viewpoint. Later(45) Migula modified this genus rad-



ically, removing those species that are now recognized to belong to the fungi.

Engler, in his Syllabus,(21) included Harz's organism in the genus *Sphaerotilus* as "*Sph. (Actinomyces) bovis*," thus adding a new name to the list of synonyms. He had not revised this grouping in the fifth (1907) edition.

*Discomyces* Rivolta was shown to be the correct designation for the genus by Blanchard(9) who, stimulated by Levy's and Berestnew's articles, reviewed the question of nomenclature. In adopting this term he had changed his earlier opinion, for he had previously(8) employed *Nocardia*. His argument is based on accepted principles and should carry conviction. Previous to this the term had been practically ignored. It is true that Sheube(57) cites Nocard and then Blanchard as having advocated this term for *Discomyces (Streptothrix) indica*, but we have been unable to find any publication by Nocard in which it is used; on the other hand, in the third (1903) edition of Nocard and le Clainche's *Maladies Microbiennes des Animaux*,(48) *Actinomyces* is used in connection with actinomycosis and *Streptothrix* with "farcin du boeuf." Gedoelst(25) evidently accepted Blanchard's decision, for he designated the genus *Discomyces* Rivolta 1878, and the organism of actinomycosis *Discomyces bovis* (Harz 1877) Rivolta 1878. Stitt(59) is apparently the only American authority who has adopted this name. Brumpt(12) in a discussion of the mycetomas, used *Discomyces* and still subscribes to it, for in discussing organisms presented in 1913 by Pinoy(51) to the Société de Pathologie exotique (Paris) as *Nocardia* he used the former rather than the latter term. Manson,(41) in subscribing to Brumpt's classification of the mycetomas, also used the same nomenclature. Castellani and Chalmers(13) employed *Discomyces* in 1910, although they later discarded it.

A new name was introduced by Lignières and Spitz,(35) who called a subtype of this group *Actinobacillus*. In a later article(36) they acknowledged the strict propriety of Blanchard's argument in regard to the application of *Discomyces* to the general group, although they continued to use *Streptothrix*.

During this period certain German authors had adopted *Actinomyces* and *Streptothrix* as separate genera. This is exemplified by Petrusky's(50) classification in which they are placed in a family which he terms Trichomycetes. Wright(62) believed that *Actinomyces* should be retained for the organism of actinomycosis, which he emphatically maintained should be differentiated generically from other organisms of the group. He



rejected de Toni and Trevisan's objection that Meyen had given the name to another organism as an unreasonably strict interpretation of the principles of botanical nomenclature. On the other hand, for the rest of the group he rejected *Streptothrix* and accepted *Nocardia*. This subdivision of the group has been adopted in several American bacteriological textbooks. However, Chester(16) adopted the first classification of Lehmann and Neumann, except that *Oospora* was replaced by *Streptothrix* Cohn. Clements(17) included these organisms among the Schizomycetes; he followed Migula's earlier classification, except that *Nocardia* was substituted for *Streptothrix* Cohn, emend. Mig.

Foulerton(22) argued that, since the other names that had been proposed had dropped out of use, only *Streptothrix* and *Actinomyces* remained to be considered. He chose the former because, although Corda had used it in 1834, it had become uncertain to what particular organism the term had been applied; further, a committee of the Pathological Society of London in 1899 had recommended the term "streptotricosis" as the appropriate clinical designation for the infection. Musgrave and Clegg(46) acknowledged that *Nocardia* was probably more strictly correct, but "chiefly because of usage, and therefore somewhat arbitrarily, tentatively accepted *Streptothrix* \* \* \*." They suggested the possible advantage of substituting an entirely new name, *Carteria* (*Carterii*, sic!), evidently hoping that by this means further controversy might be eliminated.

Pinoy has divided the group into *Nocardia*, which is to include most of the species, and *Cohnistreptothrix*, said to be designed to replace Cohn's invalid *Streptothrix*. The article that contains his argument is probably one by Pinoy and Morax,(52) which is not available to us. According to Chalmers and Christopherson(15) the characteristics of this genus are preference for anaërobiosis, difficulty of cultivation, and nonproduction of arthrospores; in it they include Cohn's *Streptothrix foersteri* and Israel's *Actinomyces* from man (*Streptothrix israeli* Kruse, 1896).

Vuillemin,(60) as a result of the adoption by the 1910 meeting of the International Botanical Congress at Brussels of a program for the next congress that included the determination of the point of departure for the nomenclature of the Schizomycetes and the elaboration of lists of *nomina conservanda* for these organisms, has recently published a revised generic classification, which was intended to be submitted for consideration at the scheduled London (1915) meeting of the congress. In an appendix to this work he includes the family Microsiphones,



composed of genera to certain of which organisms such as the "bacillus" of tuberculosis and the "bacillus" of diphtheria are assigned. For the genus under discussion he adopts *Nocardia* Trevisan, which he recommends for inclusion in the list of *nomina conservanda*. He says, in effect, that systematic botany need not concern itself with the "medical genus" *Discomyces*, in which Rivolta combined, without mycological significance, the parasites of actinomycosis, botryomycosis, and canine pleurisy, nor with the genus *Cohnistrepthrix*, founded by Pinoy upon bacteriological grounds, and that *Nocardia* remains the valid name for the genus. As the Congress did not meet in 1915, Vuillemin's recommendations have not yet been acted upon.

Castellani and Chalmers have substituted, without discussion, *Nocardia* for *Discomyces* in the second edition of their work.<sup>(14)</sup> They remark that there are many points in favor of Pinoy's subdivision of the genus, which probably would be soon generally accepted.

The most recent discussion of this question is in a study of actinomycotic mycetoma by Chalmers and Christopherson,<sup>(15)</sup> who enumerate sixty-three species of *Nocardia* and eleven of *Cohnistrepthrix*. They argue the validity of *Nocardia* on the grounds: (1) that it is the oldest name against which no objections can be raised; (2) that it has been formally adopted by the Botanical Section of the First International Congress of Pathology;<sup>1</sup> (3) that there are objections to the other names in use. They eliminate *Discomyces*, because:

*Discomyces* was used by Rivolta in 1878 merely as a trivial name, and though it has not been applied to any other genus, still the word *Discomycetaceae* was introduced in 1836 by Fries for a large fungal group and has come into general use, and therefore has the double claim of priority and general use, and as its type genus should bear the name *Discomyces*, confusion is bound to arise if the same term is retained for the generic name of Bollinger's organism.

The value of these objections will not be discussed at this point.

#### SUMMARY

The source and present status of the various names that have been applied to the organisms of this group may be summarized as follows:

*Cladothrix* Cohn (1875). This name was used as generically

<sup>1</sup> This probably refers to the Congrès international de pathologie comparée, organized by the Société de pathologie comparée, the first and as yet only meeting of which was held at the Faculty of Medicine, University of Paris, in 1912.



valid over *Streptothrix* Cohn (1875) by Winter (1884) and other systematists, the distinction not being understood. The organism of actinomycosis was informally assigned to this genus by Bostroem, Baumgarten, and others, formally by Migula (1895). *Cladothrix* Cohn is a different type of organism and the name is, therefore, inapplicable.

*Streptothrix* Cohn (1875), non Corda (1839). This name was applied by Cohn to a true-branching organism but was placed in his classification as doubtfully synonymous with *Cladothrix*. The resemblance of the fungus of actinomycosis in man to it was noted by Israel (1878); the name was adopted in 1890 by Almquist and by Gasperini for nonpathogenic air organisms, and in 1891 it was adopted by Rossi-Doria for that of actinomycosis.

For a time this was probably the most widely used name for the group. At present it is frequently applied to the group minus the organism of actinomycosis. It is unquestionably invalid in either connection because previously applied by Corda (1839) to an organism distinct from those under consideration.

*Actinomyces* Harz (1877) non *Actinomyce* Meyen (1827). This name was applied by Harz to the fungus of "lumpy jaw" of cattle, by Gasperini (1894) to the entire group, replacing *Streptothrix*, and accepted in this application by Berestnew (1897), Lachner-Sandoval (1898), and others.

It is now used by many writers, particularly the German and the American, as a valid name for the organism of actinomycosis only; it is seldom used in the more general sense. As is shown below, this name is invalid because published in connection with an entirely different organism by Meyen (1827).

*Bacterium* Ehrenberg 1830. Affanassiew (1888) is said for a time to have called the organism of actinomycosis *Bacterium actinocladothrix*. This designation is manifestly inapplicable.

*Actinocladothrix* Affanassiew and Schultz (1889). This was proposed as a generic name by Affanassiew and Schultz in 1889 for the organism of actinomycosis. It did not receive the consideration to which, being of even date with the widely adopted *Nocardia*, it was certainly entitled.

*Micromyces* Grüber (1891). This name was applied by Grüber to an *Actinomyces*-like organism that he called *M. hofmanni*. This organism cannot be distinguished from the general group under consideration.

*Oospora* Wallroth (1833). This was adopted by Sauvageau and Radais (1892), who concluded that the group belonged to Wallroth's genus. Lehmann and Neumann (1896) adopted this view, but later abandoned it, Lachner and Sandoval (1898)



having shown that *Oospora* Wallroth is an organism entirely different from those under discussion.

*Sphaerotilus* Kuetz. (1883). This name was adopted by Engler for the group including *Cladothrix* (*Streptothrix*) *foersteri* Cohn, with which he included *Actinomyces bovis* Harz. This disposition was undoubtedly due to the old misapprehension as to the distinction between *Cladothrix* and *Streptothrix*.

*Actinobacillus* Lignières and Spitz (1902). This name was applied by Lignières and Spitz to a supposed subtype of this group. The distinction has not been recognized, and by most authors the name is considered a synonym.

*Carteria* Musgrave and Clegg (1908). The adoption of this new name (as "*Carterii*") was tentatively suggested by Musgrave and Clegg as possibly advantageous for the purpose of avoiding further controversy, although they did not definitely advocate this highly informal procedure.

*Nocardia* Trevisan (1889). This name was adopted by de Toni and Trevisan to cover the entire group. Blanchard used it for a time in its original application and Wright (1894) adopted it for nonpathogenic strains only. As many other authors use it in one sense or another, of late it has gained much prestige. Vuillemin, and Chalmers and Christopherson have recently adopted it for the entire genus.

The validity of this name we deny on the grounds indicated in the discussion that follows.

*Discomyces* Rivolta (1878). This name was definitely substituted by Rivolta for *Actinomyces*, with the change of name of Bollinger's fungus to *Discomyces bovis*. It was practically ignored until Blanchard (1900) argued its priority over *Nocardia*. Subsequently Gedoelst, Brumpt, Manson, Stitt, and for a time Castellani and Chalmers, adopted it.

As indicated in the discussion this name is clearly valid over *Actinomyces* and all subsequent names.

#### DISCUSSION

Before considering the validity of *Discomyces* for this group over *Nocardia* and *Actinocladothrix*, it is necessary to emphasize the invalidity of two older terms that have gained general recognition.

*Streptothrix* Cohn (1875) is invalidated by *Streptothrix* Corda (1839). It has been argued that there is doubt as to what organism is referred to by Corda's name. This is apparently not the case for in recent years several new species have been described in Corda's genus. *Streptothrix* Corda is unques-



tionably a valid, recognized genus, and *Streptothrix* Cohn must fall.

*Actinomyces* was used by Harz with but a very limited knowledge of the organism to which he applied it, evidently without suspecting its possible relationship to Cohn's *Streptothrix foersteri* and probably without being aware of Meyen's use of the name. Whether or not this newer application is valid, as most writers seem at least tacitly to agree, depends on the validity of its preëmption by Meyen. That it is valid is evident from the following transcription from the original publication:

*Actinomyce*

Sporidochia, cellulis hyalinis simplicibus enormiter et multipliciter ramificantibus sporis impletis, substantiae uniformi gelatinosa hyalina induta.

*Actinomyce Horkelii*

R. forma irregulari sphaeroidea, gelatinosa duritie ad basin augente usque ad consistentiam cartilagosam, colore hyalino-subcoeruleo. Hab. in pinguedine et pleuris animalium aquae submersis, autumno prope Coloniam Agrippinam.

Zum Schlusse wage ich noch, etwas über das beginnende Wachstum dieses Pilzes zu sagen. Der Pilz ist nicht eine Krankheitsform eines Organismus, sondern er ist ein eigener Organismus, ein eigenes Leben unabhängig von seinem Mutterboden, aber dennoch von demselben beschränkt.

It is to be noted that Meyen used the name *Actinomyce*. While by some the use of this form might conceivably be argued not to invalidate *Actinomyces*, the derivation of the two is identical, and the argument cannot hold. *Actinomyce horkelii* Meyen is now an organism of uncertain status. Although it was described by Meyen as a fungus, the description apparently applies to one of the colonial Cyanophyceæ. The genus is not recognized in either mycological or algological literature. However, the description of both the genus and the species is indisputably valid, and in the present connection the question of its identity is unimportant. In being validly published, it invalidates the further use of the same name for another group of organisms in the plant kingdom.

From the foregoing it is evident that by the accepted principles of botanical nomenclature both of these names are preoccupied. To deny on this ground either of them and yet accept the other, as has been done, is inconsistent. Recommendation of "streptotricosis" by a committee of the Pathological Society of London cannot be accepted as competent to validate *Streptothrix*, nor can the adoption by the Botanical Section of the First International Congress of Pathology validate *Nocardia*. It is true



that through formal adoption by the proper bodies *nomina conservanda* are validated; however, neither of the societies mentioned has authority to do this in botany.

There remains to be considered, then, the name next applied to this genus. This was published by Rivolta, in 1878, when he proposed, definitely and distinctly, to substitute *Discomyces* for *Actinomyces*.<sup>2</sup> The reason for which he did this is an invalid one; he believed that *Actinomyces* was not properly descriptive of the organism and, unhampered by rules of nomenclature, adopted *Discomyces* as preferable in this respect. He was undoubtedly not aware of the fact that the former had been used before, but it is on this ground rather than that on which he advanced his new name that *Discomyces* is valid.

Vuillemin, and more recently Chalmers and Christopherson, in advocating *Nocardia* as the valid generic name, hold that Rivolta's use of *Discomyces* was trivial and without botanical significance. We do not agree with this argument, which is clearly refuted by Rivolta's original paper. Here he distinctly proposes *Discomyces bovis* as the name for the organism called *Actinomyces bovis* by Harz in a manner that must be acknowledged as valid from the viewpoint of botany, even though it is not in conventional form and was advocated on irrelevant, inadequate grounds. Therefore, it is in no sense a "medical genus," as Vuillemin asserts. The fact that subsequently Rivolta erroneously referred other organisms to this genus has no bearing on the case. His original application of it was to the organism of Bollinger and Harz alone, which is, therefore, the type of the genus. Nor does the fact that, to propitiate Harz, Rivolta later agreed to accept *Actinomyces* affect the question. As Blanchard pointed out, a name once introduced

<sup>2</sup> The definite manner in which this substitution was made has been generally ignored, possibly because of the inaccessibility of the original paper, it having been published in an Italian veterinary journal. The rarity of this publication is exemplified by the difficulty that we have had in consulting it. The 1878 volume of *Clinica Veterinaria* was found to be missing from the set of this periodical in the Surgeon-General's library in Washington, whereupon Mr. P. L. Ricker, of the United States Department of Agriculture, to whom we had applied, requested it from Mr. B. B. Woodward, librarian of the British Museum. He, not finding the publication in that library, forwarded the request to Mr. F. Bullock, of the Royal College of Veterinary Surgeons, through whose kindness a separate of Rivolta's article was forwarded to Washington, where photostat reproductions were made, one of which Mr. Ricker forwarded to us. To these gentleman we express our appreciation.



is no longer the property of its originator to withdraw or modify at will.

Finally, to argue, as do Chalmers and Christopherson, that Discomycetaceæ, a group name, invalidates *Discomyces* as a generic name in the connection in which Rivolta used it, on the ground that the type genus of Fries's Discomycetaceæ, published in 1836, should bear the designation *Discomyces*, indicates an erroneous conception of the principles of nomenclature and priority in technical names; a family name such as Discomycetaceæ cannot invalidate the generic name *Discomyces* any more than a generic name can invalidate a similar specific name. This generic name was new with Rivolta, and there is no valid objection to its adoption in taxonomy.

*Nocardia* is no longer to be considered. Both it and *Actinocladothrix* of Affanassiew and Schultz, the publication of which seems to have been completely ignored, were proposed eleven years later and fall as synonyms of *Discomyces* Rivolta (1878), which genus is typified by *Discomyces bovis* (Harz) Rivolta.

The question of division of the group is a different matter. It is our conception that the group, exhibiting as it does wide differences among the species, should be subdivided. However, neither the characters upon which separation was advocated by earlier writers (granule formation in tissues, club-ended filaments in the granules), nor those advanced by Pinoy (difficulty of cultivation, anaërobiosis, absence of arthrospores), seem to be convincing for generic distinction. Granules may be formed in animal lesions by a variety of these organisms, and club formation is a variable feature even in typical actinomycosis. Anaërobiosis and difficulty of cultivation are not generically distinctive botanically, nor so considered for other groups of microorganisms from the bacteriological viewpoint. Furthermore, these features characterize both the strains described by Israel and those studied by Wright. Should it appear desirable to divide the genus, this will probably be done on the basis of morphologic rather than metabolic differences.

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