Microsporum canis Bodin in Dog, Cat and Man in Denmark.

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Introduction.

In the years immediately following the Second World War there was a considerable increase in the number of ringworm (Microsporie) cases in man, as indicated clearly in a report on the period from 1946 to 1954 submitted in 1955 by Margrete Gade to the Danish Health Department. As Margrete Gade was of the opinion that in the majority of cases the infection could be traced back to sick dogs and cats, the Health Department approached the Veterinary Directorate, who passed on the matter to The Royal Veterinary and Agricultural College. There, Professor Vald. Adsersen, head of the Clinic for Small Domestic Animals, took up the question for further investigation, entrusting Veterinarian Bjørn Gierløff, his assistant, with the task of making a detailed examination of a number of dogs and cats suffering from ringworm. In these investigations it was possible to demonstrate in a number of cases that the owners of the sick animals examined were also infested with this disease.

The *Microsporum* species belong to the pathogenic skin fungi (*Dermatophytes*), which in man and mammals attack the hairs (cf. Fig. 1) and the follicles, causing the attacked hairs to become brittle, to break or fall out. Thereby, hairless patches are formed, at the same time as concentric rings develop on the skin, the disease spreading evenly to all sides from the centre of infection. The disease owes its name of "ringworm" (Herpes tonsurans or Tinea tonsurans) to these ring-formations. Besides *Microsporum* species, also *Trichophyton* species may cause ringworm, and a distinction is therefore made between Microsporie and Trichophytie, i. e. ringworm caused by *Microsporum* species and *Trichophyton* species, respectively.

While ringworm (Trichophytie and Microsporie) has been reported on several times in Danish human-medical literature, no detailed investigations of the fungus species causing ringworm in our domestic animals are available from Danish veterinarian quarters. It would therefore be of great interest to establish whether in the

cases at hand the question was really one of attacks by *Microsporum,* and, if so, to have carried out an accurate determination of the species. Only in this way would it be possible to adopt a definite attitude towards the important question whether the disease had actually been transmitted to man from dogs and cats, such as indicated from medical quarters in the report to the Danish Health Department.

As the Clinic wanted to have a mycological investigation made, altogehter 5 different isolates of fungi, viz. from two dogs, a cat

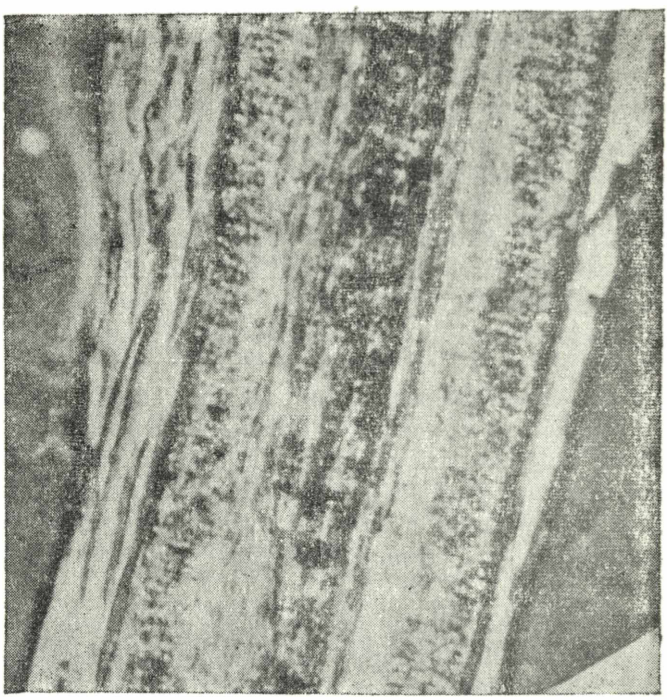

Fig. 1. *Microsporum canis* Bodin. Hair of Maltese dog. Around the hair numerous small arthrospores are seen. — Phot. Anker Hansen. ×600.

and two humans, all suffering from ringworm, were forwarded to the Plant Pathological Department in the autumn of 1955.

The isolates were:

No. 521/55, islolate from a Maltese dog, whose owner, a lady, was receiving medical treatment for ringworm.

Ad No. 521/55, isolate from the abovenamed dog-owner's daughter, who was also receiving medical treatment.

No. 582/55, isolate from a kitten, whose owner, a lady, was likewise receiving medical treatmend for ringworm.

Ad No. 582/55, isolate from a 10-year-old girl who frequently visited the owner of the said kitten. The girl was being treated for ringworm.

No. 755/55, isolate from a black poodle belonging to the lady owning the kitten.

Systematics of the Genus Microsporum.

The genus *Microsporum,* with the species *Microsporum Audouini,* was described as early as in 1843 by the Hungarian physician D. Gruby, who named it from the numerous tiny spores (arthrospores) which develop around the attacked hairs. Fig. 1). Not until 1894 was *Microsporum Audouini* rediscovered by the French dermatologist R. Sabouraud who isolated and cultivated the fungus and established with certainty that it was capable of causing ringworm (Herpes

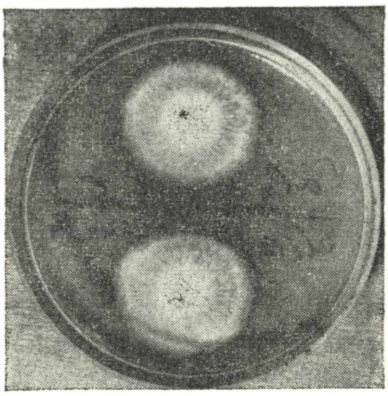

Fig. 2. *Microsporum canis* Bodin. Top.: Isolate No. 521/55 (Maltese dog). Bottom: Isolate No. ad. 521/55 (the owner). — 3-week-old cultures on pepton-agar.

tonsurans, Microsporie) in man. In the following years several new *Microsporum* species from different domestic animals such as horses, asses, dogs, cats, a. o.,were described, and in 1910 Sabouraud published his great work, "Les Teignes", the fundamental work of modern dermatology. The number of species and varieties of *Microsporum* was, however, still increasing and, in the monography "Medical Mycology" published by C. W. Dodge in 1936, they amounted to no less than 26. The same year the American dermatologist and mycologist N. F. Conant began a rational study of the systematics of the many species established, demonstrating that the criteria of the species so far applied, which were based essentially on cultural conditions, were too vague and, especially, varied greatly according to the nutrient media used. Furthermore, he established

that the most important characteristics of the genus were the large, thick-walled, septate, fusoid macrospores (closterospores, "fuseaux") (cf. Figs. 4 and 5), and that only by using the morphology of the macrospores was it posisble to arrive at a clear distinction between the species. Based on extensive investigations, Conant (1937) came to the conclusion that only five of the species described could be maintained. At the same time he described four new species, so that at the time he recognized altogether nine *Microsporum* species. Already in 1941, however, through renewed investigations, comprizing also a statistical analysis of the size of the macrospores, he arrived at the belief that the number had to be reduced further, so as to comprize only the following species:

Microsporum Audouini Gruby, 1843,

Microsporum canis Bodin, 1902,

Microsporum gypseum (Bodin) Guiart & Grigorakis, 1928 *).

The species in question are distinguished by Conant in the following way:

I. The median cell-walls of the macrospores distinctly thickened; long spores, usually above 70 μ.

A. Spores (60—)70(—82) ⇌ (8—)12(—14) μ; spores do not form on rice 1. *M. Audouini.*

B. Spores (60—)70—76(—96) ⇌ (14—)16—18(—22) μ; spores forming abundantly on rice 2. *M. canis.*

II. The median cell-walls of the macrospores not thickened; spores 40—50 μ 3. *M. gypseum.*

Conant considered most of the species discarded by him as synonyms of *Microsporum canis*; this applies, for example, to the following species dealt with in Danish medical and veterinarian literature:

Microsporum caninum Sabouraud, 1908.

Microsporum equinum (Del. et Bodin) Guegin, 1904.

Microsporum felineum Newborn, 1902.

Microsporum lanosum Sabouraud, 1907.

Own Investigations.

The abovenamed five isolates**) which were forwarded to the Plant Pathological Department, were transfered to 20 Petri dishes with 2% potato-dextrose-agar, on which they grew well at ordinary room temperature (18—20° C). All the isolates formed a low, white

*) Syn. *Achorion gypseum* Bodin, 1907.

**) In the Clinic for Small Domestic Animals the fungus was cultivated on pepton-agar and malt-pepton-agar.

air mycelium, which displayed a tendency to becoming yellowish as the cultures grew older. This tendency to yellowing was characteristic of all the isolates, but, curiously enough, did not occur in all of the 20 cultures, whatever the cause may be. The decisive thing was, however, that, culturally, all five isolates agreed so well that they resembled each other so much as to give rise to confusion (Figs. 2—4). In other words: culturally, the five isolates had to be referred to the same species.

In all cultures, numerous macroconidia of the shape characteristic of the genus *Microsporum* were developed (Figs. 5 and 6) and it was therefore beyond doubt that all five isolates had to be referred to this genus.

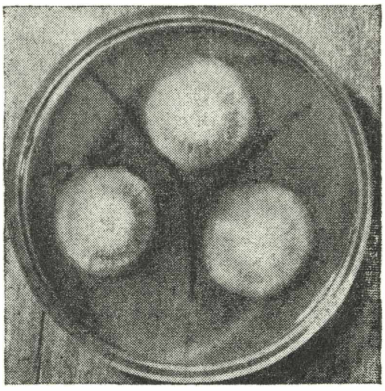

Fig. 3. *Microsporum canis* Bodin. Top: Isolate No. 577/55 (black poodle). Bottom, left: Isolate No. ad. 577/55 (the owner). Bottom, right: Isolate No. 582/55 (kitten). — 3-week-old cultures on pepton-agar.

Spore measurements were then carried out for all five isolates, 30 macroconidia chosen at random from each isolate being measured. The results of the measurements are given in the Table below:

Table.

Sizes of macroconidia of 5 *Microsporum canis* isolates.

Isolate No.	Isolate Host	Range of variation µ	Average size µ
521/55	Dog	66.0—89.5 ⇌ 16.5—24.0	76.9 ⇌ 20.7
Ad 521/55	Human (girl)	63.0—88.5 ⇌ 16.5—24.0	75.2 ⇌ 20.5
582/55	Cat	66.0—102.0⇌16.5—22.5	84.8 ⇌ 20.1
Ad 582/55	Human (girl)	63.0—90.0 ⇌ 16.5—22.5	78.5 ⇌ 20.1
577/55	Dog	61.5—90.0 ⇌ 18.0—22.5	78.2 ⇌ 20.2

From the spore dimensions listed in the Table it may be seen that there is excellent agreement between the sizes of the macroconidia of the five isolates, both in respect of range of variation in length and width and in respect of the average figures for length and width. The reason why the conidia of No. 582/55 display a somewhat larger average length (84.8 μ) than those of the other isolates, is that among the 30 macroconidia a few particularly long ones, having lengths of 99 and 102 μ, respectively, were measured. Such long conidia might undoubtedly also have been foundin the cultures of the other 4 isolates, had they been searched for. After all, 30 macroconidia are too few to provide an entirely reliable measure for the size of the conidia. The author would, however, consider it waste of

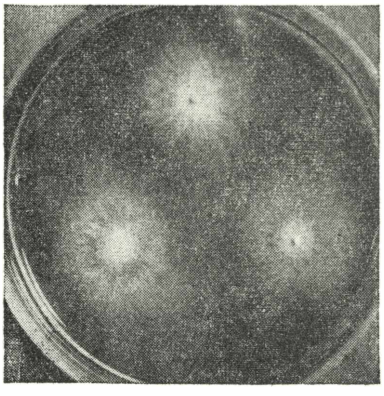

Fig. 4. *Microsporum canis* Bodin. Isolate No. 577/55 (black poodle). 3-week-old culture on malt-pepton-agar. — Note difference between appearance of colonies on malt-pepton-agar and on pepton-agar (cf. Fig. 2 and 3).

time to measure a larger number, say, 100 macroconidia, from each isolate, feeling confident that no appreciably different result would have been arrived at, because the macroconidia are of such greatly varying width and, especially, length, viz. between about 60 and 100 μ. This great variation in the size of the macroconidia appears also clearly from Conant's abovementioned investigations (1937, 1941).

The conclusion to be drawn from the spore measurements will then be that also morphologically, e. e. in respect of the size of the macroconidia, do the five isolates agree to such an extent that they must be referred to the same species.

We then come to the question as to which species of *Microsporum* it is?

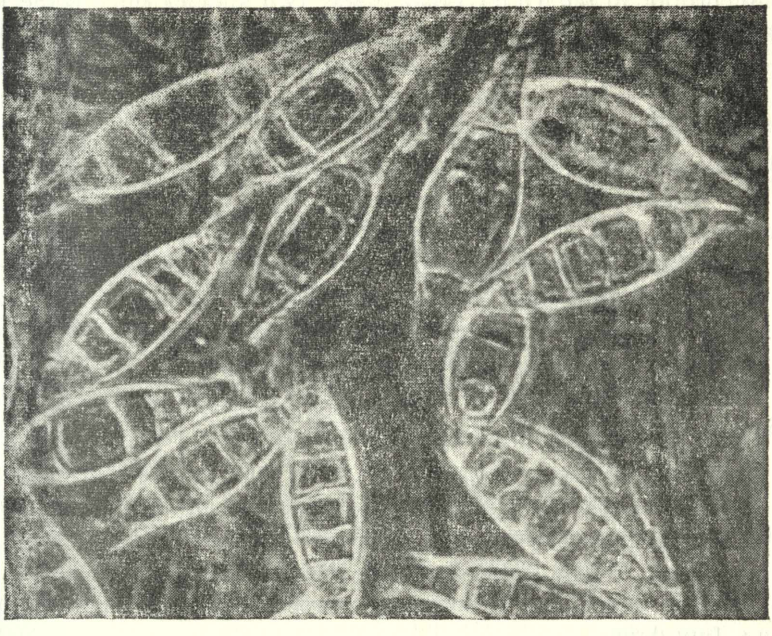

Fig. 5. *Microsporum canis* Bodin. Isolate No. 521/55 (Maltese dog). Macroconidia on malt-pepton-agar. Phase contrast. — Phot. Anker Hansen. × 500.

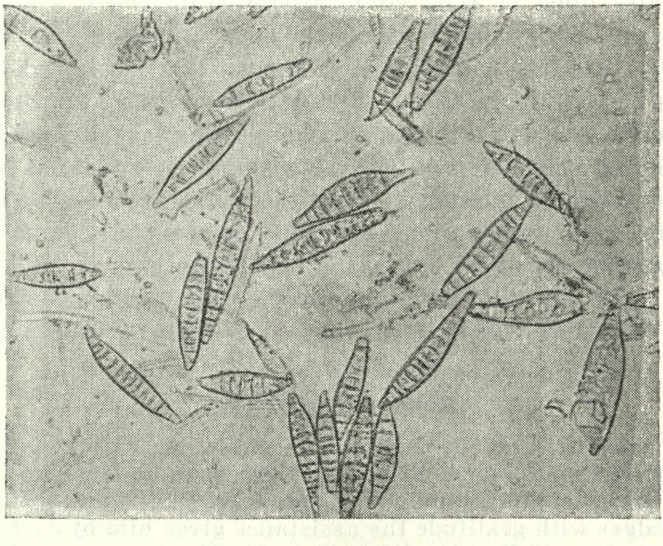

Fig. 6. *Microsporum canis* Bodin. Isolate No. 582/55 (kitten). Macroconidia from culture on rice. — Phot. E. Hellmers. — × about 200.

According to Conant (1937, 1941) two species may come into consideration, viz. *Microsporum Audouini* Gruby (1843), the type species of the genus, which primarily attacks man, and *M. canis* Bodin (1902), which originally was isolated from dogs, but which has later on also been isolated from other domestic animals, for example cats and horses. A comparison of the spore dimensions in the Table with those indicated by Conant will reveal immediately that the dimensions tally excellently — indeed, are in complete agreement — with those of *Microsporum canis,* both in regard to length and width, this species having longer and, especially, wider (thicker) macroconidia than *M. Audouini.* In none of the five isolates were found conidia as narrow (thin) as 14 μ, the dimension indicated by Conant as the maximum width of conidia of *M. Audouini.*

According to Conant, another difference in the species is the one that *Microsporum canis* forms numerous macroconidia when cultivated on rice, whereas *M. Audouini* does not form conidia on this medium. When transferred to rice in Erlenmeyer flasks the five isolates developed numerous macroconidia in all the cultures after a few days.

Conclusion.

From the cultural and morphological investigations accounted for in this paper there would thus appear to be no doubt that the five isolates must be referred to *Microsporum canis.* This fungus is, primarily, pathogenic to domestic animals, but from investigations made in other countries it is known that it may also attack man. As it appears from the clinical observations (cf. the Report to the Health Department) that ringworm has attacked both humans and dogs and cats living on the same premises, and as it has now been demonstrated through spore measurements that isolates from ringworm in domestic animals and their owners must be referred to the species *Microsporum canis,* the conclusion can, in the author's opinion, only be that the said people have with certainty been infested with this fungus through contact with the animals.

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