

ON THE FUNGI CAUSING RINGWORM IN CHILDREN ATTENDING LONDON COUNTY COUNCIL SCHOOLS.

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INTRODUCTION.

THE object of this investigation was to cultivate and identify the fungi present in cases of ringworm of children attending London County Council Schools, and to ascertain the relative prevalence of the various parasites isolated. It was also expected that the nature of the fungi obtained would afford some evidence as to the importance, if any, of animals such as cats and dogs as carriers of infection; or whether infection took place chiefly from child to child. The material, consisting of the infected hairs, which had been sent for special examination from various schools to the Public Health Department of the London County Council, was obtained through the courtesy of Dr J. A. H. Brincker, to whom we are very much indebted for continuous and generous help. As this was designed to be only a preliminary investigation to obtain a general survey of the prevalent species and their relative frequency, no attempt was made to record the particular districts or schools from which the material came.

METHODS.

Little need be said about the methods used beyond that the general technique elaborated by Sabouraud (1910) was employed. The infected hairs were inoculated on one of his "test" media ("maltose brute" or "glucose massée de Chanut"), they were grown at laboratory temperature, and, when sufficiently advanced, were subcultured on Sabouraud's peptone "preserving" medium in order to prevent pleomorphic changes, all subsequent inoculations being made from the peptone cultures. Type cultures of a large number of ringworm fungi were very kindly supplied by Dr Sabouraud and Dr Langeron, and were subcultured parallel with the species isolated and compared with them. For comparative purposes cultures were grown on the "test" media in Erlenmeyer flasks or in flat culture bottles. For direct microscopical examination, the hairs were mounted in chlorallactophenol (Langeron, 1925); and, for staining permanent preparations, "bleu de Sahli" (Sabouraud, 1910, p. 94) was found very good. For microscopical examination of the mycelium, specimens were mounted in lactophenol with cotton blue (Langeron, 1925), or in about 50 per cent. glycerine to which a little congo red was added. The latter gave excellent results.

RESULTS.

Cultures were obtained from 69 cases in all. Direct microscopical examination of the infected hairs indicated that, of the 69 cases, 3 were favus, 54 small-spored ringworm due to *Microsporums*, and 12 large-spored ringworm due to *Endothrix Trichophyton*s. The cultures bore out this determination as 3 cultures of *Achorion*, 54 of *Microsporums* and 12 *Trichophyton*s of the type placed by Sabouraud in the group *Trichophyton Endothrix*, were obtained; these figures representing approximately 4 per cent., 78 per cent., and 17 per cent. of the total number of cases.

FAVUS.

In all three cases of favus the parasite was found to be *Achorion schönleinii* Lebert 1845.

LARGE-SPORED RINGWORM.

Four different *Endothrix Trichophyton*s were found in the 12 cases of large-spored ringworm. *Trichophyton crateriforme* Sabouraud 1902 was isolated from 5 cases; *T. sulfureum* Fox 1908 from 2 cases; *T. acuminatum* Blanchard 1895 from 4 cases; and *T. violaceum* Bodin 1902 from one case.

Among the five cultures described as *T. crateriforme* there are slight but constant differences in the appearance of the cultures. One of the five exhibits the typical *crateriforme* character as described and illustrated by Sabouraud (1910). In three of the remaining forms the crateriform culture is remarkable for the great regularity of the "crater," from the centre of which very uniformly spaced splits radiating to the circumference appear as the culture ages. The colour of this form is a purer cream than cultures of the first variety. It closely resembles the species described by Sabouraud as *T. regulare*. The third variety has also a crateriform type of culture but grows much more slowly than the other varieties and cultures soon assume a dry appearance and become covered with innumerable fine cracks, the cultures then presenting an appearance very similar to the illustrations of *T. exsiccatum* in Sabouraud. These differences are, however, so comparatively slight that we prefer to regard them as varieties of *T. crateriforme*, rather than as three distinct species.

SMALL-SPORED RINGWORM.

Microsporum audouini Gruby 1843 was found in about 89 per cent. of the cases of small-spored ringworm, being isolated from 48 of the 54 cases. It is much the most prevalent of the ringworm fungi and is responsible for about 70 per cent. of all ringworm infections. *M. felineum* Fox and Blaxall 1896, and *M. lanosum* Sabouraud 1907, were each found in one case, and represent 2 per cent. of the small-spored infections and about 1 per cent. of the total cases. In addition, four *Microsporums* were isolated, which have not as yet been identified with any described species. Two of them are the same, and closely resemble the species *M. velveticum* of Sabouraud, but there is some

doubt as to the validity of this species. The other two differ from each other and from any described species. These three forms, which account for about 7 per cent. of the small-spored ringworms and 6 per cent. of the total cases, will be dealt with in detail in a subsequent paper.

Although Sabouraud's classification has been retained in discussing the species found and their comparative prevalence, from a botanical point of view the new classification of Ota and Langeron (1923) is much more satisfactory. The adoption of the new system would have complicated greatly the grouping of the different types of ringworm present, and would have made comparison with previous work on the subject very confusing. In these circumstances, it seemed best to use Sabouraud's classification and nomenclature throughout, but to give, at the same time, a list of the species found arranged according to Ota and Langeron's new classification together with the corresponding names in Sabouraud's system.

Trichophyton tonsurans Malmsten 1845 = *Trichophyton crateriforme* Sab. 1902.

Trichophyton sulphureum Fox 1908 = *Trichophyton sulfureum* Sab. 1908.

Trichophyton sabouraudi R. Blanchard 1895 = *Trichophyton acuminatum* Bodin 1902.

Sabouraudites audouini (Gruby 1843) = *Microsporum audouini* Gruby 1843.

Sabouraudites felineus (Fox and Blaxall 1896) = *Microsporum felineum* Fox and Blaxall 1896.

Sabouraudites lanosus (Sabouraud 1907) = *Microsporum lanosum* Sab. 1907.

Bodinea violacea (Bodin 1902) = *Trichophyton violaceum* Bodin 1902.

Grubyella schönleinii (Lebert 1845) = *Achorion schönleinii* Lebert 1845.

DISCUSSION.

In Paris the Endothrix Trichophytions are responsible for most of the scalp ringworm, being found in about 66 per cent. of all cases. In London, on the contrary, most of the scalp ringworm is caused by Microsporums. The figure obtained in this work, about 78 per cent. of all ringworms, agrees fairly well with that of Fox and Blaxall (1896 July) who found small-spored ringworm in London in 80-90 per cent. of the cases. Adamson (1895), who relied entirely on microscopical examination of the hairs for diagnosis, found the percentage of small-spored ringworms still higher. *Microsporum audouini* is much the commonest cause of ringworm in London, and was found in about 70 per cent. of all types of ringworm infections, and formed about 89 per cent. of the cases of small-spored ringworm. According to Sabouraud (1910), it is also much the most prevalent of the Microsporums in Paris, where it was found in about 77 per cent. of cases of small-spored ringworm. Fox and Blaxall (1896 Sept.) found four different Microsporums prevalent in London, which they describe briefly, but do not name. The description they give of the form that they found to be the commonest leaves no doubt that it was *M. audouini*.

Fox and Blaxall (1896 August) found the proportion of Endothrix ringworms only about 4 per cent. in general hospital practice in London. Adamson (1895 August) observed about the same proportion of Endothrix forms in London. Later, however, Fox (1908) found that among children chargeable to the Poor Law the incidence of Endothrix ringworms was greater, the percentage being 14.1 for 1908, and having decreased gradually since 1901-2 when it was as high as 40 per cent. As we found Endothrix Trichophyton in 17 per cent. of the cases, it appears that this type of ringworm is more prevalent among school children than in general hospital practice, and is becoming slightly more common in comparison with the small-spored ringworm. In general, our results as regards the relative frequency of the different species of Endothrix Trichophyton agree with those obtained by Fox (1908); *T. crateriforme* being the commonest, *T. violaceum* the rarest and *T. sulfureum* and *T. acuminatum* occupying intermediate positions.

It is notable that with the exception of the two species, *Microsporium lanosum* and *M. felineum*, and possibly of the four unidentified Microsporums, no animal forms were found. Not a single Ectothrix Trichophyton was met with, although Fox (1896 August) found them as prevalent as Endothrix forms. It may be concluded, therefore, that among school children in London, the infection with animal ringworm is negligible, and that the children themselves are the chief source of infection.

SUMMARY.

1. Cultures were obtained from 69 cases of ringworm of children in London County Council Schools.
2. Three of them were cases of favus, the parasite in each case being *Achorion schönleinii*.
3. Microsporums are responsible for most of the ringworm, and were isolated from 54 of the 69 cases, or 78 per cent. *Microsporium audouini* was found in 70 per cent. of the Microsporum infections; *M. lanosum* and *M. felineum* each in one case; and 4 other cultures were obtained, comprising 3 species which have not yet been identified.
4. Endothrix Trichophyton were found in 17 per cent. of the cases and include the species *Trichophyton crateriforme*, *T. sulfureum*, *T. acuminatum* and *T. violaceum*.
5. A list of the species isolated arranged, according to the new classification of Ota and Langeron, is given.
6. The results are compared with those previously obtained in London by Fox and Blaxall, and Adamson, with which they broadly agree.

In concluding we wish to thank very sincerely Dr Brincker, Public Health Department, London County Council, for his great kindness in supplying the infected material; Dr Sabouraud and Dr Langeron for providing us with numerous type cultures; and the Medical Research Council who bore the

expense of the investigation. During the course of the work one of us (P. T.) has been in receipt of a maintenance grant from the Department of Scientific and Industrial Research.

REFERENCES.

- ADAMSON, H. G. (July, 1895). Observations on the Parasites of Ringworm. *Brit. Journ. Dermat.* **8**, 201–211.
- (August, 1895). *Ibid.* **8**, 237–244.
- FOX, T. C. (1908). Further Contribution to the Study of the Endothrix Trichophyta Flora in London. *Proc. Roy. Soc. Med.* **2**, 1.
- (1897). The Biology of Ringworm. *Brit. Med. Journ.* **2**, 867.
- FOX, T. C. and BLAXALL, F. R. (July, 1896). An Inquiry into the Plurality of Fungi Causing Ringworm in Human Beings as met with in London. *Brit. Journ. Dermat.* **8**, No. 93.
- — (August, 1896). *Ibid.* **8**, No. 94.
- — (September, 1896). *Ibid.* **8**, No. 95.
- — (October, 1896). *Ibid.* **8**, No. 96.
- LANGERON, M. (1925). *Précis de Microscopie*. 4th edition. Paris: Masson and Cie.
- OTA, M. and LANGERON, M. (1923). Nouvelle Classification des Dermatophytes. *Ann. Parasit. Humaine et Comparée*, **1**, 305–336.
- SABOURAUD, R. (1910). *Les Teignes*. Paris: Masson and Cie.

(*MS. received for publication* 18. VII. 1927.—Ed.)