The Problem of Ringworm in Northern Ireland

A Report

to the Northern Ireland Hospitals Authority, May, 1952

SUPPLEMENT

To Ulster Medical Journal . . . Volume XXII, May, 1953

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GENERAL INTRODUCTION.

TOWARDS the end of 1948 the staff of the Skin Clinic at the Royal Belfast Hospital for Sick Children was confronted with the problem of dealing with ringworm patients in large numbers. An outbreak in Newtownards had been discovered earlier in the year, and the number of affected children was reaching epidemic proportions. At the same time, the number of Belfast children attending the clinic for treatment of the same condition, though not always due to the same organism, had been increasing dramatically since the inception of the Health Service the previous June. It was clear that, unless special measures were taken, the ringworm patients would dominate the clinic sessions and little or no other dermatological work would be possible.

There were two possible ways of dealing with the problem, and each had its advocates. One was to tackle it as part of the existing routine in the hope that time would cure many, and eventually, possibly after some years, the incidence would decline to "normal endemic level." The other way was to attack the disease with the utmost vigour, with a view to eradicating the epidemic varieties of ringworm from the community. The latter was the method chosen, and, in the autumn of 1951, it was possible to say that the problem had been solved.

The Newtownards outbreak was considered to present an urgent problem since a rough estimate, based on general practitioners' opinions, indicated that possibly some four hundred children were infected. The highly technical procedures of diagnosis and treatment demanded centralisation, and this was carried out at the Royal Belfast Hospital for Sick Children since it was planned to use the same organisation and equipment to deal with the more insidious problem of infection in Belfast after the end of the Newtownards outbreak. Most of the Newtownards patients had been treated by April, 1949, and, in the following month, intensified action was taken to detect all infected children in Belfast. This work progressed steadily until June, 1950, when a "reservoir" of over one hundred infected children was discovered in a residential school in the city. This school had been sending

out infected children into the general population and was, more than any other single factor, probably responsible for the continued stream of new patients from some districts in the city.

The special Ringworm Clinic at the Royal Belfast Hospital for Sick Children was started in May, 1949, and closed in July, 1951. This survey is an attempt to present and consider the facts and figures obtained during this period. The survey would be incomplete without mention of the data from the other skin clinics in the Province, and we have consequently collected all particulars about ringworm patients seen at them during the same period.

TABLE I.

Particulars of Skin Clinics in Northern Ireland, May, 1949-July, 1951.

HOSPITAL.	NUMBER OF PATIENTS SEEN.		
	All Skin Disease.		Ringworm.
Royal Belfast Hospital for Sick Children - -	3,114	...	726 (23.3)
Royal Victoria Hospital, Belfast - - - -	12,096	...	238 (2.0)
Belfast City Hospital (In-patients only) - -	895	...	37 (4.1)
Ards Hospital, Newtownards - - - -	1,049	...	23 (2.2)
Downe Hospital, Downpatrick - - - -	366	...	25 (6.8)
City and County Hospital, Londonderry - -	1,137	...	48 (4.2)
Ulster Hospital for Women and Children, Belfast -	766	...	21 (2.7)
Lurgan and Portadown Hospital, Lurgan - -	1,817	...	36 (2.0)
Mid-Ulster Hospital, Magherafelt - - -	655	...	44 (6.7)
Banbridge Hospital - - - - - - -	767	...	37 (4.8)
Route Hospital, Ballymoney (from January, 1951)	188	...	9 (4.8)
TOTAL - - - - - -	22,850	...	1,244 (5.4)

N.B. Figures in brackets represent ringworm patients as a percentage of all skin patients.

Some observations and investigations made during this study have already been published (Beare & Cheeseman, 1951a, 1951b). In the present survey, made at the request of Professor F. M. B. Allen, more complete detail is provided, and it is hoped that our efforts will satisfy this request and also prove of interest to hospital administrators, public health and school medical officers, and particularly general practitioners. If the report should prove of value to those confronted with similar problems to our own in their attempts to prevent future outbreaks, and lessen the severity of the endemic types of the disease, then our efforts will have been more than amply repaid.

CONSIDERATION OF TYPES OF RINGWORM.

The general term "ringworm" denotes a disease of the skin or its appendages caused by a vegetable parasite. It is a collective word used to include many clinical conditions caused by many types of fungus. The study of pathological conditions

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resulting from the action of any fungus is a branch of mycology which embraces the systemic mycoses, as well as the dermatomycoses or superficial infections. In so far as ringworm is concerned, the mycology is limited to the dermatomycoses.

Gregory (1935) defined the dermatophytes as "a group of fungi which parasitize man and animals by invading the keratinised layers of the epidermis and the dermal appendages such as hair, nails, hooves, horns and feathers." Dermatophytes are parasitic only to the skin. Spores have been isolated from the blood but not from internal organs.

TABLE II.

Diagnoses of Ringworm made in different Skin Clinics in Northern Ireland, May, 1949-July, 1951.

CLINIC	MALES	FEMALES	TOTAL
Royal Belfast Hospital for Sick Children :—			
Out-patient	343 (331)	162 (158)	505 (489)
From Newtownards outbreak	92 (92)	24 (24)	116 (116)
From "Residential School"	65 (65)	56 (56)	121 (121)
Total (R.B.H.S.C.)	500 (488)	242 (238)	742 (726)
Royal Victoria Hospital	175 (162)	76 (76)	251 (238)
Belfast City Hospital	24 (19)	20 (18)	44 (37)
Ards Hospital	17 (16)	7 (7)	24 (23)
Downe Hospital	18 (16)	10 (9)	28 (25)
Londonderry City and County Hospital	34 (33)	15 (15)	49 (48)
Ulster Hospital for Children and Women	14 (14)	7 (7)	21 (21)
Lurgan and Portadown Hospital	29 (28)	8 (8)	37 (36)
Mid-Ulster Hospital	31 (30)	14 (14)	45 (44)
Banbridge Hospital	22 (22)	16 (15)	38 (37)
Route Hospital	9 (8)	1 (1)	10 (9)
TOTAL	873 (836)	416 (408)	1,289 (1,244)

N.B. Figures in brackets show number of patients as distinct from number of diagnoses.

This review is confined to those types of "ringworm" which have been met during the course of the last two years' work in the Skin Clinics of Northern Ireland. The relevant statistics appear in Tables II, III, and IV. In addition, mention is made in passing of the so-called "id" reactions. These occur occasionally in association with some inflammatory skin reactions, and may be due either to spores or toxins elaborated at the site of the original ringworm and acting on hypersensitized skin. The mycological terms, "trichophytid," "microsporid," "epidermophytid," and so on, bear the same relationship to skin infection from trichophytons, microsporums, and epidermophytons as the bacteriological terms, "syphilid," "tuberculid," "leprid," for example, bear to infections with the organisms of syphilis, tuberculosis and leprosy.

Strictly speaking, infections due to monilia and other yeast-like organisms might also be included in a survey of this type, but no special study was made of them

and few were encountered. Pityriasis capitis and at least some varieties of seborrhœic dermatitis were once believed to be due to the organism pityrosporon ovale; but we have not considered these conditions since that view is not now generally held.

TABLE III.

Ringworm Patients seen at all Skin Clinics in Northern Ireland, May, 1949-July, 1951. Classified by part of the body affected.

DIAGNOSIS	MALES DIAGNOSIS			FEMALES DIAGNOSIS			TOTAL DIAGNOSIS		
	Single	Double	Total	Single	Double	Total	Single	Double	Total
Tinea capitis -	438	22	460	199	7	206	637	29	666
T. barbæ -	52	8	60	—	—	—	52	8	60
T. corporis -	232	29	261	149	8	157	381	37	418
T. manuum -	16	5	21	12	1	13	28	6	34
T. pedis -	36	5	41	35	—	35	71	5	76
T. cruris -	20	2	22	—	—	—	20	2	22
T. unguium -	5	3	8	5	—	5	10	3	13
TOTAL -	799	74	873	400	16	416	1,199	90	1,289
	(799)	(37)	(836)	(400)	(8)	(408)	(1,199)	(45)	(1,244)

N.B. Some patients (37 men and 8 women) were affected in two parts of the body—these patients are shown as double diagnoses in the table above.

Figures in brackets in "Total" row show number of patients as distinct from diagnoses.

TABLE IV.

Organisms responsible in Diagnoses of Ringworm made at Skin Clinics in Northern Ireland, May, 1949-July, 1951.

TYPE OF ORGANISM	MALES	FEMALES	TOTAL
M. audouini -	299	131	430
M. canis -	46	24	70
T. discoides -	26	9	35
T. sulphureum -	18	11	29
T. mentagrophytes -	14	2	16
T. rubrum -	1	—	1
T. schœnleini -	1	—	1
T. interdigitale -	1	—	1
E. floccosum -	1	—	1
Total cultured -	407	177	584
Total not cultured -	429	231	660
TOTAL -	836	408	1,244

NOMENCLATURE.

The varieties of ringworm have been known and recognised as entities for many centuries. All varieties are contagious, some more than others, and this has led to widespread epidemics in Europe during the last century—in all probability there were many earlier epidemics. Many different names for identical conditions have accumulated. For example, infection of the skin and hair by the *Trichophyton schonleini* has been known as "favus," "honeycomb ringworm," "tinea favosa," "tinea vera," "tinea lupinosa," and "porrigo favosa."

The clinical types considered in this review, together with their usual synonyms, are set out in Table V.

TABLE V.

CLINICAL TYPES AND THEIR SYNONYMS.

Tinea capitis:	*Tinea tonsurans,* ringworm of the scalp; *kerion* (a clinical variety). Includes ringworm of the eyebrow and eyelashes.
Tinea barbæ:	Ringworm of the beard.
Tinea corporis:	*Tinea circinata,* ringworm of the body. Includes tinea of all parts of the body except others listed in this table.
Tinea manuum:	Ringworm of the hand.
Tinea pedis:	Ringworm of the feet, athlete's foot.
Tinea cruris:	Ringworm of the groin, *eczema marginatum,* dhobie itch.
Tinea unguium:	Ringworm of the nails, *onychomycosis.*

Even more confusing than the profusion of clinical synonyms has been the evolution of the nomenclature of the responsible fungi. Fungi are simple thallus plants. Unlike the other important group of thallophyta, the algæ, they do not utilise chlorophyl for the breakdown of nutritive substances. They are saphrophytic or parasitic, and can be segregated and discriminated by the type of colony they produce, the presence or absence of mycelium, the type of mycelium, the spore character and the method of spore development. (Conant, Martin, Smith, Baker & Callaway, 1944). The dermatophytes, or the fungi which cause ringworm, are classified in the larger sub-group—"Fungi imperfecti."

Duncan (1948) suggested that the work of Schonlein, Remak, Fuchs and Langenburg in Germany and of Gruby in France, during the first half of the nineteenth century, initiated medical mycology as a science. Gruby created the genus *Microsporum* in 1843, and named the type species *Microsporum audouini* after the entomologist Audouin (1797-1841). Mycology had therefore been established as a science some years before Pasteur and Koch laid the foundations of bacteriology. Steady progress in the field culminated in the classic publication, "Les Teignes,"

by Sabouraud (1910). In this, the first important classification of ringworm fungi appeared. The genera of this classification were *Microsporum, Trichophyton,* and *Achorion,* and to these could be added *Epidermophyton* and *Endodermophyton,* which, unlike the first three, do not invade the hair. Trichophyton was subdivided into groups according to the distribution of the parasitic spores on the hair (*Endothrix, Neœndothrix,* and *Ectothrix*). Further segregation into groups and species depends upon culture characteristics, and was described by Duncan (1948). Because it utilises both clinical and botanical peculiarities, this system has met with criticism. Moreover, the determination of the species rests largely on microscopic morphology of cultures which is notoriously variable.

Following Sabouraud's classification many "new" fungi were discovered—Gregory (1935) mentioned the existence of one hundred and eighty-four species names. Nevertheless, the broad basis of the classification has not been improved, and many of the original terms persist. More recently Emmons (1934) suggested a classification, which, while compatible with that of Sabouraud, is more rational and simple. Emmons proposed three genera, based on the character of the macroconidium—*Trichophyton* (incorporating *Achorion* and *Endodermophyton*), *Microsporum,* and *Epidermophyton.* In an attempt to help solve the problem of over-classification, Davidson, Dowding & Buller (1932) advocated, as a test of species relationship, hyphal fusion between the mycelial of two separate dermatophytic strains vegetating together in hanging drop culture. Langeron (1945) was able to reduce Gregory's (1935) list of one hundred and eighty-four species to nineteen, but the simplification cannot be carried too far, and Duncan (1945) has, for example, shown that there are three separate varieties of *Microsporum canis*; Walker (1950) has described these in detail.

During World War II, ringworm sprang into prominence as a source of invalidism among troops, particularly those serving in tropical or subtropical regions—ringworm infection of the feet, hands, and groin were particularly important. Immediately after the war, outbreaks of scalp ringworm in children were reported from many parts of the United Kingdom and United States of America. This increase in the interest shown in the conditions encouraged the Medical Research Council (1949) to attempt to clarify the relevant nomenclature, and a list of the dermatophytes found in the United Kingdom and their common synonyms was published. Table VI summarises this classification in so far as it is germane to Northern Ireland.

With increased mycological knowledge, it is obvious that the most satisfactory designation of a patient's condition is one which includes both the anatomical site and the identified fungus—for example, tinea capitis (*M. audouini*). Knowing the identity of the responsible fungus, it is possible to prognosticate and treat a patient to the best advantage. Moreover, such knowledge facilitates the prevention of the spread of the disease in many instances, and probably more important, facilitates the detection of the origin of infection of an outbreak, and thereby brings within the limits of reasonable probability the eventual elimination of the responsible parasite from the community.

The present report adheres to strictly anatomical names for the clinical varieties and supplements these with the name of the responsible organism, using the Medical Research Council's terminology, where the fungus has been identified.

TABLE VI.

ORGANISMS CAUSING TINEA

(Only more common organisms are listed.)

Microsporum audouini.

Microsporum canis (*M. felineum, M. lanosum*).

"These three names are still widely used for the cat and dog ringworm fungus which commonly attacks man, causing tinea capitis (especially in children) and tinea corporis. There is general agreement among sustematists that the species described by Bodin (1902) from the dog in France is the same as that described by Mewborn (1902) later in the same year from the cat in New York. Sabouraud (1909) admitted that his *M. lanosum*, which he described in the previous year, was based on a pleomorphic culture of *M. canis*" (Medical Research Council, 1949).

Trichophyton sulphureum (*T. crateriforme flavum*).

Trichophyton discoides.

Trichophyton mentagrophytes (*T. asteroides, T. niveum, T. gypseum, T. pedis*).

Trichophyton equinum.

T. equinum is one of Sabouraud's "ectothrixmegaspores" group of trichophytons. The ectothrix character of the infection of the hair definitely excludes *T. sulphureum* and the other endothrix species, and the size of the spore distinguishes *T. equinum* from the other common parasites of the horse, *T. mentagrophytes*; besides the cultures are different (Walker, 1950).

Trichophyton interdigitale.

"This species is closely related to *T. mentagrophytes* . . ." (Medical Research Council, 1949).

Trichophyton rubrum (*Epidermophyton rubrum, T. purpureum*).

Trichophyton Schonleini (*Achorion schonleini*).

Epidermophyton floccosum (*E. cruris, E. inguinale*).

Microsporum gypseum (*Achorion gypseum, M. fulvum*).

Trichophyton concentricum* (*Endœpidermophyton indicum*).

Trichophyton flavum* (*T. cerebriforme*).

Trichophyton perisicolor.* Related to *T. mentagrophytes* (Medical Research Council, 1949).

Trichophyton quickeanum* (*Achorion quickeanum*).

Trichophyton sabouraudi* (*T. acuminatum*).

Trichophyton tonsurans* (*T. crateriforme*).

Trichophyton violaceum.*

Trichophyton beigate.*

*These have not been identified in Northern Ireland.

For fungus identification we have been extremely fortunate in a continued collaboration with Dr. J. Walker of the Department of Medical Mycology, London School of Hygiene and Tropical Medicine, and our clinical work has been correlated with mycological studies carried out by Dr. Walker on material from our cases.

METHODS OF IDENTIFICATION.

General.

The importance of identifying the invading organism as early as possible in the treatment of a patient with tinea cannot be over-emphasised; not only is this important in treatment, but also in measures necessary to prevent the spread of the infection. Four processes of identifying the fungus are available, for use separately or in combination—clinical observation, direct microscopy, examination by Wood's light and mycological culture.

Clinical Observation.

The various fungi do, to a considerable extent, produce lesions which have certain characteristics enabling a fairly reliable guess to be made in a high proportion of cases of the type of organism responsible. Even to an experienced clinical mycologist these appearances are never completely diagnostic. Additional and very valuable information may be obtained from the clinical history—for example, a duration of twelve months or more would be unusual for infection due to most of the animal types of fungus. More important still would be knowledge of a previous infected person and the identity of the fungus concerned, by whom the patient was infected. The second child in a family, or in a school, is very likely to have the same type of infection as the first child—herein lies the importance of accurate charting of all cases. Indeed, here, too, lies the importance of routine cultures, since, although the culture result may be available too late to influence treatment of a particular primary case, yet secondary cases can be accurately diagnosed at once. One should, therefore, ascertain the presence or absence of other infected persons within the family, the street or locality, or the school, and from previous studies the nature of these infections may be known. Similarly, a history of contact with infected animals (kittens, calves, etc.) gives a clue to the nature of the fungus, provided the fungi endemic in the area are known from past study, e.g., a child who has recently acquired a stray kitten with "bald spots" is almost certain to have a *M. canis* infection, and a child who has not been out of Belfast for months is most unlikely to acquire *T. discoides* infection (from cattle).

The clinical appearances of the various types of infection are described in the appropriate sections which follow, and the distribution of the various fungi within the Province are given as far as they are known.

Direct Microscopy.

If the infected hairs or epidermal scales are examined microscopically, spores and mycelial threads are apparent. With hair specimens it is often possible to form an opinion as to the identity of the offending fungus. Thus a mosaic of spores

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with few intramedullary elements suggests a microsporum. Mycelial threads or hyphæ within the hair shaft breaking into arthrospores suggest an endothrix trichophyton, while if the arthrospores are appearing outside the hair shaft as well as within an ecthrix trichophyton is probably present.

In addition, certain fungi have appearances within the hair shaft which are so characteristic that the species can be identified. Thus short lengths of irregular branching mycelium within and often at right angles to the hair shaft are characteristic of *T. schœnleini*. Associated with this feature are various sized air spaces, thought to follow the degeneration of the mycelium, but other species share this characteristic. (MacLeod & Muenda, 1946.) Again, *T. discoides* reveals closely septated hyphæ, giving flattened disc-like spores in contrast to those of other large-spored trichophytons which are of more cubical appearance (Walker, 1949).

Affected epidermal scales show branching mycelium and spores, but no further information other than that a fungus is present is available on direct microscopy.

Wood's Light Examination.

One of the major advances in mycology was the discovery by Margarot and Dévèze (1925) that some fungi produce a characteristic fluorescence of hair in ultra-violet light filtered by Wood's glass. Almost any source of ultra-violet rays is suitable. The lamp may be air- or water-cooled and the Wood's glass is sodium barium silicate containing about 9 per cent. nickel oxide. The extensive use of the Wood's light apparatus for a variety of examinations, often far beyond the field of medicine, is described by Radley & Grant (1933).

Hairs infected with microsporum fluoresce a brilliant green under Wood's light, while trichophyton-infected hairs do not give the same dramatic colour. These responses, it should be appreciated, are fluorescent and not phosphorescent since the coloration disappears immediately on removal of the hair from the light.

The reasons for the phenomenon have been subject of speculation for some time. Vigne (1927) and others thought that the fluorescence was due to the presence of spores arranged in a cluster around the hair shaft; Margarot & Dévèze (1929) attributed it to the fungus itself. Davidson & Gregory (1932) questioned these explanations and attributed the fluorescence to the hair rather than the fungus, and it is an easy matter to extract the fluorescent substance from infected hairs by boiling them in water. The last two workers suggested that the phenomenon is probably due to some change in the hair substance after invasion by a fungus and that the fluorescence may be due to a product of hydrolysis of keratin. (This aspect of the subject is well reviewed by Gregory, 1935.)

The advantages of a Wood's light lamp in examination of patients are the ease with which it can be used and the results interpreted. The light may be shone on to the patient or hairs may be placed in its rays, and it can be moved from place to place. If the limits of the test are borne in mind it is specific.

Mycological Culture.

Small pieces of infected material are placed on special media containing glucose or maltose, special peptone, and agar. The media commonly used are modifications of those originally employed by Sabouraud (French maltose, Chassaing peptone and agar). The plates are incubated at room temperature and the resultant colonies examined. Rate of growth, formation, texture of surface-spreading margin and colour can be assessed by eye. The presence, numbers, shape and size of micro- and macro-conidia and of certain other organs such as spiral, racquet, pectinate hyphæ, nodular organs and chlamydospores can be observed microscopically in seven to twenty-one days, depending on the species. The appearances are difficult to interpret unless one is regularly engaged in this type of laboratory work, since even small differences in the composition of the media will affect the final appearance of the colony. Subcultures may be necessary to free the dermatophyte from contaminating yeasts and saprophytic fungi which otherwise overgrow the plate. Certain modifications are available—such as culturing in a thin film of medium between slide and coverslip—which enable a species diagnosis to be made often in twenty-four to forty-eight hours. However, the great disadvantage of this form of investigation still remains the time required to carry it out. Nevertheless, it is usually the only way by which accurate knowledge of the organism responsible for the patient's infection can be obtained, and it is always the final court of appeal.

Summary.

The stages of diagnosis in a patient suspected of suffering from ringworm are thus :—

1. Clinical examination, including history and an attempt to determine the source of infection.
2. Wood's light examination.
3. Direct microscopic examination of infected hair or epidermal scales.
4. Mycological culture of infected material.

Occasionally the fungus can be identified after the first stage and more often after the second, but only the result of the final stage can be acceptable as a proof of the identity of the fungus. The third stage gives little information to the clinician which is not already available from the preceding stages when the infected material is hair; but when epidermal scales are affected then microscopy is of value to him. It is more reliable than culture of the suspected material, which is often overgrown with saprophytic organisms, and a certain diagnosis of tinea is often very difficult indeed. However, there are many pitfalls for the inexperienced microscopist, not the least of which is the recognition of the so-called "mosaic-fungus"—an artefact which closely resembles fungus material. To the laboratory worker stage three is of value whatever the material affected. Table VII sets out the information which can be obtained by the four methods of identification.

TABLE VII.

SUMMARY OF METHODS OF IDENTIFICATION OF INFECTION.

CLINICAL EXAMINATION		WOOD'S LIGHT	MICROSCOPIC EXAMINATION.	EXAMINATION BY CULTURE
APPEARANCE	HISTORY			
Area affected. Degree of inflammatory reaction present.	Duration. Possible contact with infected animals. Possible contact with other infected patients (a) within the family. (b) in small localities. (c) in school.	**Hairs only.** Brilliant green fluorescence with microsporum infections. Diagnostic blue-green fluorescence of long hairs with *T. schonleini* infections. No fluorescence with other infections.	(a) **Hairs.** Small or large spored. Endo or Ectœndothrix organisms. (b) **Scales.** Spores and mycelium.	Final species identification.
EXAMPLES. (a) Tinea capitis. Non-inflammatory	Contact with infected kitten. ? *M. canis.*	Brilliant green. Microsporum infection. ? *M. canis.*	Small spored organism. Microsporum infection.	*M. canis.*
(b) Tinea corporis. Inflammatory.	Contact with infected cattle. Trichophyton infection. ? *T. discoides.*	No fluorescence. Trichophyton infection.	Spores and mycelium present. Diagnosis of tinea not now in doubt.	*T. discoides.*

DIAGNOSES MADE IN NORTHERN IRELAND SKIN CLINICS. MAY, 1949, TO JULY, 1951.

THEORETICAL CONSIDERATIONS.

In theory, any one or more of the various organisms may give rise to ringworm on any one or more parts of the body at the same time. In practice, each fungus affects a particular part of the body in preference to other parts and, although a combination of two parts of the body infected by one organism is not unusual, the simultaneous presence of two organisms is very rare. In Northern Ireland, from May, 1949, to July, 1951, 45 of the 1,244 patients seen at the clinics were affected in two parts of the body, but on no occasion was simultaneous infection by more than one organism encountered. Lowenthal (1948) reported scalp infection

TABLE VII.

SUMMARY OF METHODS OF IDENTIFICATION OF INFECTION.

CLINICAL EXAMINATION		WOOD'S LIGHT	MICROSCOPIC EXAMINATION.	EXAMINATION BY CULTURE
APPEARANCE	HISTORY			
Area affected. Degree of inflammatory reaction present.	Duration. Possible contact with infected animals. Possible contact with other infected patients (a) within the family. (b) in small localities. (c) in school.	**Hairs only.** Brilliant green fluorescence with microsporum infections. Diagnostic blue-green fluorescence of long hairs with *T. schonleini* infections. No fluorescence with other infections.	(a) **Hairs.** Small or large spored. Endo or Ectœndothrix organisms. (b) **Scales.** Spores and mycelium.	Final species identification.
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in a single patient due to both *M. audouini* and *M. canis*, and Franks & Rosenbaum (1950) and Muskabilt (1941) have also reported in this context.

Diagnoses.

Table III (page 8) shows the diagnoses made in the Skin Clinics in Northern Ireland during the twenty - seven month period, May, 1949, to July, 1951. Altogether, 1,244 patients were seen; of these, 1,199 were suffering from an infection of one part of the body only and forty-five were infected in two parts—the details of these "double diagnoses" appear in the appropriate sections which follow. Thus, in all, 1,289 diagnoses were made, of which just over a half were tinea capitis and just under a third tinea corporis. The patients, for the most part, were referred to the clinics by general practitioners, school medical officers and others, and 116 of the patients with tinea capitis were among the last patients found in an outbreak of epidemic proportions in the town of Newtownards (Beare & Cheeseman, 1951b), and 121 others were patients at a residential school in Belfast where an outbreak occurred during the period of the review (Walby, 1952). We are reporting on patients seen at the clinics, whatever their source, and in some instances we know that they represent a selected group. It is most unlikely that the data as a whole are representative of ringworm in Northern Ireland in such matters as their age, sex, and geographical distribution, or that the various types and organisms appear in our sample of 1,244 patients in the same proportions as they do in the whole community.

Cultures.

In all, 584 cultures were made during the period of review in the Department of Medical Mycology at the London School of Hygiene and Tropical Medicine from specimens submitted from the clinics. Once again, it would be unwise to place too much reliance on the precise geographical distribution of the organisms found since the selection of specimens from patients was by no means random and, as has been suggested, the cases themselves are not necessarily representative of all ringworm patients in the Province. In Table IV it will be seen that most of the cultures proved to be *M. audouini* (430), and this may be because most specimens were taken from children suffering from tinea capitis in and around Belfast.

Plan Followed in Reporting the Diagnoses.

In what follows we have dealt with each of the seven clinical types, tinea capitis, barbæ, corporis, manuum, pedis, cruris, and unguium in turn. Each anatomical type has been subdivided and then discussed according to the organism responsible. Under each subdivision the clinical appearances, what information we consider reliable about the sex and age distribution, the mode of spread, prevention, and treatment of the particular type of ringworm are discussed. Finally, for each anatomical type we have included a section on differential diagnosis.

TINEA CAPITIS.

General.

Between May, 1949, and July, 1951, 666 patients with tinea capitis were seen at the clinics. Of these, twenty-eight also had tinea corporis and one tinea manuum. The latter part of the Newtownards outbreak, which occurred in 1949 and 1950, contributed 116 children to the total, and the outbreak in the Belfast residential school contributed a further 121. From 531 of the 666 patients hair specimens were taken and cultures made. The distribution of the isolated organisms appears in Table VIII.

Among the patients were three who had tinea of the eyebrow due to *M. audouini*. This type of ringworm is most conveniently classified as a variant of tinea capitis. We did not see tinea of the eyelashes due to *M. audouini*, but a case has been recorded by Montgomery & Walze (1942).

Table VIII.

Tinea Capitis—Responsible Organisms cultured from Patients in all Skin Clinics in Northern Ireland, May, 1949-July, 1951.

	Number of Patients		
Type of Organism	Males	Females	Total
M. audouini	297	130	427
M. canis	40	19	59
T. discoides	11	4	15
T. sulphureum	11	10	21
T. mentagrophytes	8	—	8
T. rubrum	—	—	—
T. schœnleini	1	—	1
T. interdigitale	—	—	—
E. floccosum	—	—	—
Total cultures	368	163	531
Total not cultured	92	43	135
Total	460	206	666

Tinea Capitis due to M. Audouini.

General.—There can be little doubt that *M. audouini* has been the most important cause of tinea capitis in the North of Ireland for some time. Of the cultures made (531) in the period reviewed, about 80 per cent. (427) resulted in the isolation of *M. audouini*. Even if the 135 patients with tinea capitis for whom no culture result is available (Table VIII) are assumed to have been infected by some other organism, the percentage of *M. audouini* organisms found would not fall below sixty.

In many communities by 1939 tinea capitis due to this organism was becoming relatively rare, but after the war a number of serious outbreaks again started, due, in the opinion of Duncan (1948), to inadequate staffing of public health, dermatological, and general practitioner services. A voluminous literature exists of outbreaks reported from many parts of the Western Hemisphere, and the more recent are listed in Table IX.

TABLE IX.

RECENT REPORTS ON TINEA CAPITIS (*M. audouini*).

SOURCE	AREA
Barlow, Chattaway, and Whewell (1950)	Huddersfield (England).
Keddie (1947)	Bathgate (Scotland).
Kinnear and Rogers (1948)	Dundee and Arbroath (Scotland).
Beare and Cheeseman (1951a)	Northern Ireland.
MacHaffie, Perry and Beck (1948)	Ottawa (9,000 public school-children) (Canada).
Lewis, Hopper and Reiss (1946)	New York Hospital (U.S.A.).
Mackee, Mutscheller and Cipollaro (1946)	New York (U.S.A.).
Miller, Lowenfish and Beattie (1946)	Vanderbilt Clinic (U.S.A.).
Price and Fainer (1948)	Los Angeles (U.S.A.).
Schaffer on Wilson (1949)	Detroit (U.S.A.).
Steven and Lynch (1947)	Minnesota (U.S.A.).
Schwartz, Peck, Botvinick, Leibovitz and Frasier (1946)	Hagerstown (Maryland) (U.S.A.).

Clinical Appearance.—Most patients infected with tinea capitis due to *M. audouini* have at the onset patches of "grey baldness," with lustreless hairs broken off about one-eighth of an inch above the surface. It is believed that the fungus implanted on the scalp surface, or stratum corneum spreads centrifugally until a hair is reached. The fungus elements then grow down the sides of the hair follicle to a point just above the bulb, and then invade the keratinised hair shaft. There is no downwards growth into the hair bulb. Minor traumata will thus break the hair shaft just above the surface (Fig. 1).

Under Wood's light the whole process can be clearly seen. Non-fluorescent hairs in the vicinity of a tinea patch when extracted often show intra-follicular fluorscence—the hair has not broken because the extra-follicular part of the shaft has not been invaded. As the infection ages fluorescent hairs lengthen, and in old infections hairs up to two inches in length are occasionally seen fluorescent to their ends, while the actual number of such hairs diminishes. Occasionally, a severe inflammatory reaction is associated with such infections, and from our data it seems that such reactions occur in about 2 per cent. of the patients infected.

Sex Incidence.—Of the 427 proved *M. audouini* infections resulting in tinea capitis, 297 (70 per cent.) were in boys and the remainder, 130 (30 per cent.), in girls—a sex ratio (boys/girls) of 2.33 : 1. The population from which these patients

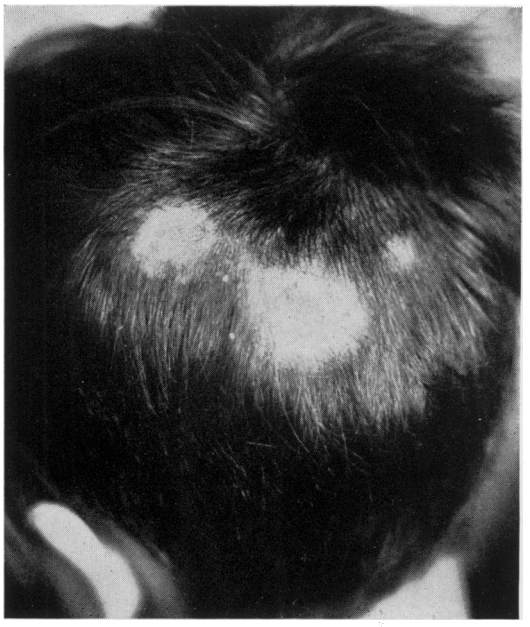

Fig. 1

Tinea capitis due to *M. audouini*, showing "grey baldness."

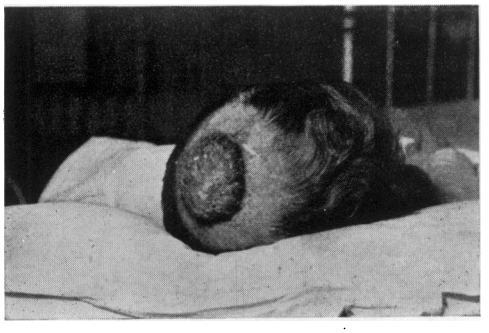

Fig. 5

Tinea capitis due to *T. discoides*, showing "kerion."

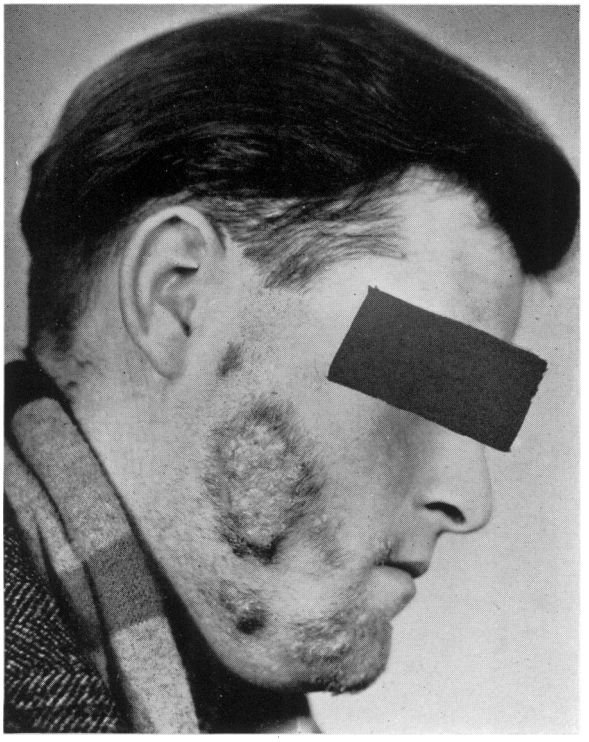

Fig. 6
Tinea barbæ due to *T. discoides*.

were drawn probably contains a slight excess of boys, but it is unlikely that the sex ratio of the population at the ages concerned exceeds 1.05 : 1; nor is there any reason to suppose that the group of affected children were selective in the matter of sex. Consequently, it appears that the excessive incidence among males is real and it is in agreement with the findings of Keddie (1947), Schwartz *et al.* (1946), Miller *et al.* (1946), Barlow *et al.* (1950), and many others. In the outbreak which occurred at Newtownards (Beare & Cheeseman, 1951b) we were able to relate the affected schoolchildren to the school populations, and by this more precise technique we found that 27.2 per cent. of the boys aged 4-14 years and 7.2 per cent. of the girls were infected by *M. audouini*—a sex ratio of 3.78 : 1. In striking contrast to this was Walby's result that 32.8 per cent. of the boys and 30.2 per cent. of the girls were infected at the residential school in Belfast. His sex ratio of 1.09 : 1 is the lowest reported, and it would be of interest to know if this phenomenon is often a feature of the disease in semi-closed communities.

Age Incidence.—This type of infection is almost entirely confined to children, although infection in adults has been reported by Hirschmann & Clansky (1950) and Fox & Fowlkes (1925).

The age distribution of the present series is given in Table X. Some caution is necessary in the interpretation of this table since we know nothing about the age distribution of the population from which the patients were drawn nor do we know whether the 427 patients are representative, in the matter of age, of tinea capitis (*M. audouini*). This difficulty is a feature of most other reports. It seems likely that our data are unduly weighted with schoolchildren and under-weighted with pre-schoolchildren, possibly because of the rigorous measures of ascertainment employed by the school health authorities. However, both the Newtownards outbreak and the residential school patients give more reliable data for estimation of the age risks. In the former there appeared to be little difference between the incidence of infection at different age groups between 4 and 14 years, although a slight tendency existed to a maximum at about ages 6-10 years. In the residential school, however, the maximum incidence occurred in the ages under 4, and it might well be that the minimum age of infection is somewhat lower than that usually reported, because affected young children are seldom detected until they reach school age and are liable for school medical inspection—but we have not sufficient data to be dogmatic about this.

TABLE X.

Tinea Capitis (*M. audouini*) Age Distribution of Patients seen in all Skin Clinics in Northern Ireland, May, 1949-July, 1951.

Age in years	0-	1-	2-	3-	4-	5-	6-	7-	8-	9-	10-	11-	12-	13-	14-	- TOTAL
No. of Patients																
Male	-	2	13	25	32	27	33	37	41	22	22	11	18	10	4	- 297
Female	-	1	5	13	16	17	21	17	13	12	5	5	5	—	—	- 130
TOTAL	-	3	18	38	48	44	54	54	54	34	27	16	23	10	4	- 427

Experience shows that spontaneous cure of the condition occurs at puberty, and until recently the reason for this was unknown. The many changes which take place at this time of life are spread out over a period of some two to four years (Hogben, Waterhouse & Hogben, 1948), and coincident with them is a change in the skin which renders it unsuitable for the growth of microsporum organisms. Clinical impressions lead one to believe that the age of such immunity is closely correlated with the age of onset of puberty.

Kingery, Williams & Kidd (1939) found that laboratory tests of the rate of growth of various fungi in artificial media containing water extracts of children's hair and adult hair was slowed by the latter. The factors responsible for this retardation were isolated by Rothman, Smiljanic & Weitkamp (1946), and Rothman, Shapiro & Weitkamp (1947), and shown to be unsaturated fatty acids such as undeclenic and proprionic acid.

However, spontaneous cure is not confined to children at puberty, and a definite immunity can be developed and may occasionally exist without previous infection. This does not necessarily occur only when host parasitic antagonism is present, and it seems likely that an antigen-antibody reaction of the bacterial type is involved. The case history of twins reported by us (Beare & Cheeseman, 1951a) is of interest in this context.

Mode of Spread.—M. audouini is a parasite only of human beings, and is passed from one to another by direct or indirect contact. Glass (1948) has shown that spores remain viable for anything up to four hundred and sixty days, and we have obtained cultures from hairs kept in sealed test tubes for a year. The high infectivity and the chronic infection of untreated patients, coupled with the frequent absence of obvious clinical signs, all contribute to the heavy incidence rates experienced in communities affected by the organism.

Various modes of transmitting the organism have been incriminated in the past—house dust, clothing, backs of cinema seats, and barber's hair-clippers. Schwartz *et al.* (1946) and others have quoted the frequency with which infection occurs in the so-called clipper area of boys' heads as evidence of the disease being disseminated from barbers' shops. We made a careful examination of this aspect of the disease (Beare & Cheeseman, 1951a), but could find no confirmation of this hypothesis with the data collected from the Belfast residential school.

The main affected areas within the City of Belfast during the last two years are shown in Fig. 2. It is clear that there are two large centres—the north and north-west, where many patients lived, while from an equally densely populated area of the south-east only a few patients were seen. However, the problem has not been confined to Belfast, and patients have been seen at many of the provincial skin clinics.

In addition to the two main foci of infection (Belfast and Newtownards), a few cases have also been seen from other areas in the North of Ireland. Since the list may be of interest to local practitioners, it is given: Whitehouse-Whitewell-Greencastle area (Co. Antrim), Lisburn (Co. Antrim), Londonderry

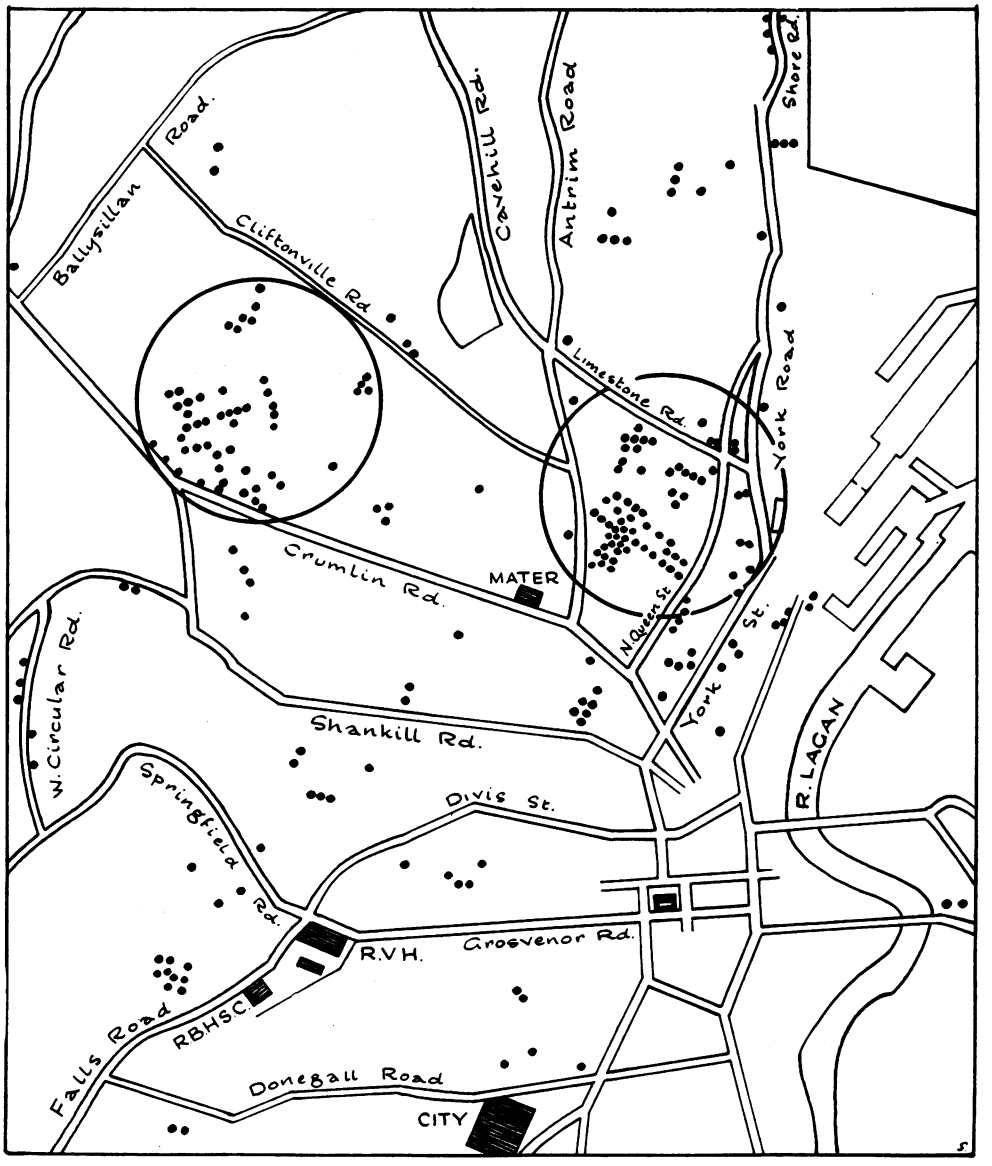

Fig. 2

Map of the north-west area of Belfast, showing the distribution of tinea capitis due to *M. audouini* during the years 1949 and 1950.

R.V.H.—Royal Victoria Hospital. R.B.H.S.C.—Royal Belfast Hospital for Sick Children. City—Belfast City Hospital.

(Co. Derry), Holywood (Co. Down), Dungannon (Co. Tyrone), Larne (Co. Antrim), Cookstown (Co. Tyrone). It is also of interest to note that among the patients seen were two children infected originally in Philadelphia (U.S.A.), one initially infected in Wales, and one in Banbury (Oxfordshire).

Treatment.—Before the introduction of an effective method of treatment, the situation in many large towns was similar to that described by Sabouraud (1906). He reported that two hundred and fifty beds in a hospital in Paris were occupied by patients with scalp ringworm—on the average, each patient occupied a bed for two years ! He and his colleagues introduced a safe method of X-ray epilation early in the twentieth century (Sabouraud & Noire, 1904) which eliminated the necessity for in-patient care, and in most cases ensured a cure within six weeks.

We would agree with MacKee & Cipollaro (1946) that experience has since shown that X-ray epilation of the scalp, when carefully and skilfully carried out, is safe and free from unpleasant sequelæ. Shanks (1944 and 1949) carried out four thousand X-ray epilations without complications.

The detailed methodology of X-ray epilation, as practised in the Royal Belfast Hospital for Sick Children for individual patients or particularly for dealing with large numbers quickly, has already been described (Beare & Cheeseman, 1951a and b).

Spontaneous cure of certain cases can occasionally be foreseen from certain peculiarities of the clinical and Wood's light appearances and of the behaviour over a period of a few weeks if observation is carefully carried out. However, in practice it is somewhat unreliable, and must not of itself be used to reduce the number of X-ray epilations carried out during epidemic times, though in the undesirable event of there being a waiting list for epilations, those children who are considered likely to clear spontaneously may be put at the end of the waiting list.

The same argument applies to a child approaching puberty who has tinea capitis. X-ray epilation should, we feel, not be delayed because of the chance of spontaneous cure—this may require a further period of some months or more, and during this time the child is infectious.

Prevention.—Local practitioners were notified of the existence of an epidemic of scalp ringworm in Belfast in 1949 and their full co-operation was requested—and obtained. School medical officers and, indeed, schoolteachers were also well aware of the seriousness of the position. Routine Wood's light examinations of some fifty thousand schoolchildren in the main affected areas in Belfast were carried out in 1950-51 by nurses of the School Medical Service. These routine examinations continued until it was felt certain that, as far as was practical, all cases had been found. From these fifty thousand examinations, two hundred and twenty-five cases of tinea capitis were discovered. Most of these cases had subclinical infections which, without Wood's light, would have remained undetected. We assume that these subclinical cases act as carriers of infection. Family contacts of the infected children revealed a further one hundred affected children of preschool age.

An awareness on the part of general practitioners and school medical officers of the clinical appearances of *M. audouini* scalp ringworm, adequate facilities for investigating and treating suspected cases, and routine Wood's lamp examinations of all schoolchildren in the areas concerned are the practical answers to the problem involved.

We have aimed at making a sound mycological diagnosis, establishing the source of infection, notifying all cases to the Public Health Officer concerned, and instituting the appropriate treatment immediately. As an ideal, X-ray epilation, when required, should be carried out at once. Very few mothers refused to allow their children to have X-ray epilation when the full consequences of not having treatment and the risks of infection to other children were explained. The final result is already discernible, and the end of *M. audouini* tinea capitis in Belfast has perhaps been reached (Fig. 3). It is at this stage that more care than ever is required. It would be tragic to lessen our efforts prematurely when so much dull routine work has already been done by the staff of the School Medical Service.

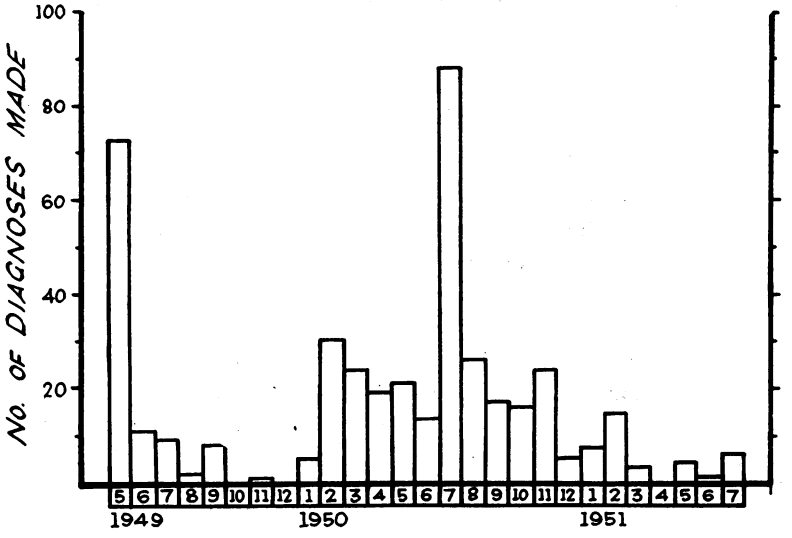

Fig. 3

Monthly diagnoses of tinea capitis due to *M. audouini* in all Skin Clinics in Northern Ireland, May, 1949, to July, 1951.

Unfortunate consequences occasionally arise through the failure to realise that X-ray epilation is the only method which offers a quick and reasonably certain cure for *M. audouini* infections of the scalp. Often, unfortunately, this reflects on the family doctor, who, without the advantage of Wood's light, is unable to judge whether or not an infection is cleared. Consequently, a child treated and judged clear may be found on a routine Wood's light examination to be still infected, and by this time other members of the family may also have become

infected. It is difficult, indeed, to explain such a situation to a mother. The only alternative, therefore, is to refer all suspected cases to a ringworm clinic; within an endemic area this means all cases of "dandruff" in children. Fortunately it requires only a few minutes to examine these children in Wood's light.

The serious outbreaks of scalp infections due to *M. audouini* which have been experienced in the past few years were so alarming and costly, and required so much time and trouble that every effort must be made to ensure that this type of infection does not appear in epidemic proportion again. The following points are therefore made :—

1. Accurate mycological diagnosis of all cases of tinea capitis is essential.
2. There should be no hindrance to practitioners wishing to send suspected cases for diagnosis; indeed, practitioners should be encouraged at all times to refer any suspicious case immediately to suitably equipped dermatological clinics.
3. Facilities for the treatment by X-ray epilation should always be readily available. Ideally the child should be treated at the initial attendance.
4. All contacts must be examined in Wood's light. Simple clinical inspection is not sufficient.
5. Facilities for these examinations at schools by nurses skilled in the use of Wood's light should always be available.
6. Close liaison has been established between the Royal Belfast Hospital for Sick Children and the Belfast School Medical Service. All Belfast cases seen at clinics are notified to the School Medical Service, and this should continue.
7. The same facilities should be available outside the Belfast area.

In short, we agree with Lee (1948) that "tinea capitis caused by *M. audouini* is an epidemic communicable disease and should be treated as such," and, as emphasised by Steven & Lynch (1947) in this context: "The protection of the community is as important as the treatment of the individual."

Tinea Capitis due to M. Canis.

General.—Of the five hundred and thirty-one cultures made from patients with tinea capitis, fifty-nine resulted in the discovery of *M. canis*. In three of these the body was also infected.

One patient was seen who had, in addition, tinea of the eyelashes—a small circinate patch on the eyelid spread to the lashes which fluoresced brilliant green under Wood's light. Franks & Mandel (1950) have reported a similar patient.

Clinical Appearance.—Like *M. audouini* infections, there may be little or no inflammatory reaction; about half the present series had no such reaction. In the other half, there was an inflammatory reaction which was frequently of great severity, and permanent alopecia from inflammatory destruction of hair follicles occasionally resulted. The condition when inflammatory presents a "dirty" or

untidy appearance due to the scattered lesions—rather like impetigo, but with associated partial alopecia. The fungus causes fluorescence in Wood's light and the remarks made with regard to *M. audouini* fluorescence apply equally to *M. canis* infections.

Sex Incidence.—Of the fifty-nine proven *M. canis* infections of the scalp, forty occurred among males and nineteen among females, giving a sex ratio of 2.1 : 1. As with *M. audouini* infections, this clearly represents a true excessive incidence among males, although it is possible that the excess is not so great as with the more common organism. It must, however, be remembered that our numbers are small, even though we have no reason to believe that boys were more often referred to the clinics than girls when either sex were attacked.

Age Incidence.—Adults are not usually infected with *M. canis*. Although fifteen adults were infected out of the total six hundred and sixty-six tinea capitis patients seen during the period under review, none of these were believed to be infected with *M. canis*. On the other hand, Gauvain (1949) has seen a male patient aged 73 years with *M. canis* infection of the scalp.

From the data which we have available, it is impossible to give any precise information about the age incidence of this type of infection, but we include the age distribution of the fifty-nine proven cases (Table XI) for what it is worth.

TABLE XI.

Tinea Capitis (*M. canis*) Age Distribution of Patients seen in all Skin Clinics in Northern Ireland, May, 1949-July, 1951.

Age in Years - No. of Patients	0-	1-	2-	3-	4-	5-	6-	7-	8-	9-	10-	11-	12-	- TOTAL
Male -	-	1	6	3	6	5	8	5	—	3	3	—	—	- 40
Female -	-	—	1	3	—	5	2	1	2	—	1	3	1	- 19
TOTAL -	-	1	7	6	6	10	10	6	2	3	4	3	1	- 59

Mode of Spread.—Tinea capitis due to this organism presents problems somewhat different from those of infections caused by *M. audouini*. Large-scale epidemics are not a feature, but rather small outbreaks involving perhaps four to six children usually occur. In the North of Ireland the animal reservoir is the cat, or rather the kitten, since *M. canis* infections are not usually seen after puberty in either animal or human. However, young dogs are also liable to infection and in certain other parts of the world are as important as kittens as reservoirs of this infection.

Though one child may transfer infection directly to another, it is found that after a maximum of about four transfers the condition dies out; indeed, the fourth infection is usually abortive (Duncan, 1945). Further cases occur only by renewed contact with the animal reservoir.

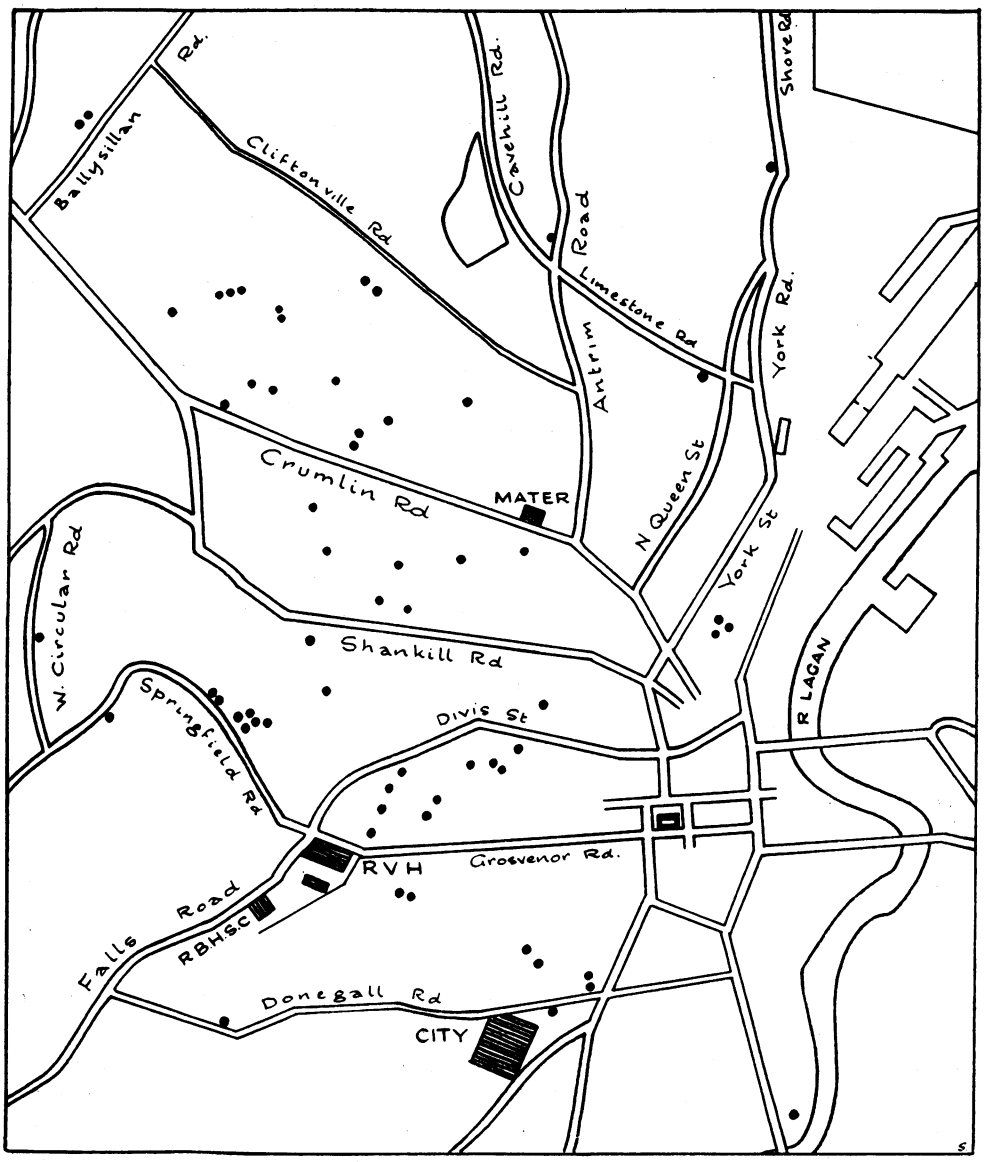

Fig. 4

Map of the north-west area of Belfast, showing the distribution of tinea capitis due to *M. canis* during the years 1949 and 1950.

R.V.H.—Royal Victoria Hospital. R.B.H.S.C.—Royal Belfast Hospital for Sick Children.
City—Belfast City Hospital.

Undoubtedly indirect spread will also occur from time to time (see also page 20 remarks on this aspect of *M. audouini*—mode of spread), and spores have been kept viable for long periods—Glass (1948) kept specimens alive for three hundred and sixty-six days.

The majority of our cases of *M. canis* infections occurred in Belfast and the distribution of the cases throughout the city—shown in Fig. 4—it will be noted that there are no foci similar to those obtained in this distribution of *M. audouini* infections. A few small outbreaks occurred elsewhere: Bonecastle (Co. Down), Bangor (Co. Down), Shaw's Bridge (Co. Antrim), Downpatrick (Co. Down), Portadown (Co. Armagh), Clandeboye (Co. Down), and Dunmurry (Co. Antrim).

As far as could be ascertained, all the primary infections were from infected kittens. We did, however, have a child home from the Mediterranean area who contracted his infection from a dog in Cyprus.

Treatment.—Infections of the scalp with *M. canis* are always spontaneously cured within a reasonably short time, according to Lewis (1935), within three to nine months. In certain cases, however, X-ray epilation is justifiable (e.g., in a child with a non-reactive type of infection to prevent spread of infection to other children within a large family). It is usually sufficient, however, to keep the scalp covered with Whitfield's ointment under a scarf or cap, and at intervals to remove the affected hairs with forceps in Wood's light. The infectivity of the disease has, of course, to be explained to the mother, and, if possible, the infected kitten concerned should be found and destroyed. (Infected kittens show fluorescence in Wood's light and occasionally at the clinics we were able to identify the animal.) The real danger with regard to *M. canis* scalp infections is that the nature of the organism may be assumed and no mycological culture made, and thus *M. audouini* infections may then be missed.

Prevention.—It is always difficult in practice to establish the exact size of an outbreak of *M. canis* infections in any one area, since to do so would necessitate examining every child within the area, and there is little point in so doing in practice. Yet there is no doubt that considerable alarm may be felt by school-teachers, school medical officers, and parents when they hear of such an outbreak in their own district. Most of the children will probably have tinea corporis with or without associated tinea capitis. Quite recently a large number of cases appeared at the Royal Belfast Hospital for Sick Children within a short time, and enquiries revealed the fact that all the children lived in an area immediately surrounding an old bombed site. This site was rat-infested, and therefore cat-infested, and *M. canis* had appeared in the cat population. The children in this neighbourhood, having no other place to play, spent their time (it was during a school holiday) in the bombed site—among the cats. Undoubtedly there was reason for alarm! However, the whole outbreak died down within a few weeks, though no very strenuous effort was made to isolate the infected children. We have no doubt that Duncan (1945) was correct in giving three to four transfers as the maximum for

M. canis. Even the fourth transfer produces an abortive type of infection in the child. Presumably this phenomenon is due to loss of virulence on the part of the organism.

It is difficult to see how *M. canis* infections can be eliminated from the community. Stray cats are difficult animals to catch, let alone examine and treat (or destroy). Occasionally one may be able to identify the affected kitten and have the source of the infection removed at once. A few words of explanation to the fathers of affected children at times originates a cat-hunting expedition which may have advantages.

Tinea Capitis due to T. Sulphureum.

General.—*T. sulphureum* was cultured from twenty-one patients with tinea capitis during the period reviewed. In no case was any other part of the body infected.

The infection is fairly common in the North of Ireland, though at least two of our patients were first noticed to be affected while attending schools in Eire. It is of interest that Lewis & Hopper (1948) stated that they had seen only one case.

Clinical Appearances.—In the majority of our cases there was minimal inflammatory reaction, and indeed, on naked eye examination, the disorder is indistinguishable from microsporosis capitis, especially that variety due to *M. audouini*. The duration of infection, as given by the mother, in our cases varied from one week to over eighteen months.

Under Wood's light there is no fluorescence, and this is the first clue that the case is not a microsporum infection. Reference to the charted areas of infection within the city boundary often substantiated the diagnosis since our cases were, fortuitously, in areas other than those affected by *M. audouini*.

The infectivity of the condition does not appear to be great. On occasions we have been able to establish a possible source of infection in another child, but more usually the cases were isolated, and the source of infection remained in doubt. They seemed to be scattered over the city, but our numbers are too small to allow more dogmatic statements on this point.

Sex Incidence.—The 21 patients known to be infected with *T. sulphureum* were 11 males and 10 females and, in view of the smallness of the sample and lack of knowledge of the numbers exposed to risk, we make no further comment on this aspect of the condition.

Age Incidence.—The ages of our patients ranged from one to fourteen years.

Mode of Spread.—Since there is no animal host, spread of infection must take place directly or indirectly from case to case. On clinical grounds we believe that a large number of cases of *T. sulphureum* infection go undetected or misdiagnosed as seborrhœic dermatitis, etc. Presumably such cases act as carriers of infection.

Treatment.—X-ray epilation is the treatment of choice, since, if left untreated, the condition will certainly remain active and the patient infectious for a number of months—possibly a few years. Many of our cases had a single lesion on the

scalp, and local epilation was successfully employed on five occasions. The low infectivity probably explains the success of local epilations.

Prevention.—It is reasonable to assume that, if an effort is made to treat all cases effectively as soon as possible, in time the condition may eventually disappear from the community. The number of cases seen is too small to warrant any special effort such as is essential for *M. audouini* infections.

Tinea Capitis due to T. Discoides.

General.—During the period under review, *T. discoides* was cultured from fifteen patients with tinea capitis. It is unlikely that this small sample is in any way representative of this type of infection in Northern Ireland, since it is well known that animal ringworm is extremely common, particularly in the western farming areas.

Communication with general practitioners suggests that this is probably one of the most common skin conditions which they see, and their experience in the treatment of such patients results in very few being referred to specialist clinics.

Of the few cases referred, all have had mycological examination since 1949, and fifteen have proved to be *T. discoides*. It is of interest to note that Duncan (1945) and Walker (1950) concluded that the same organism was responsible for much of the cattle ringworm in Britain.

Since the infection may linger as a subacute granuloma for a period of up to a year, it is clear that long periods of absence from work result among those exposed to infection. It is understandable that practitioners are hesitant to certify patients as fit for work when they have a condition which may still be contagious.

It is assumed that the animal host is, in the vast majority of cases, the cow or calf. The assumption, as far as we are concerned, is based on the frequency with which patients are able to describe cattle ringworm on the farm at which they work or, in the case of children, at which they have recently stayed. It may well be that other domestic animals are affected, but we have not heard of such examples, even after direct questioning. The infection is quite as severe in cattle, and farmers go to considerable trouble to treat their animals—only too often they themselves acquire infection in the process.

Clinical Appearances.—The scalp infection produced by *T. discoides* is a violent inflammatory reaction constituting a true kerion. (See Fig. 5.) This kerion is more severe than that produced by any other fungus found in the North of Ireland and, although theoretically it is possible that the milder degrees of inflammatory reaction may from time to time result, we have not seen this happen. The infection may be isolated or there may be multiple lesions either on the scalp or on more than one part of the skin surface. The hairy areas of scalp and beard are the most frequently affected. A large deep granuloma develops within a few days and usually remains severe for a number of weeks or months. A subacute granuloma may persist for up to one year. After such an infection scarring is inevitable. Often this is most

disfiguring with large areas of puckering and baldness. Scars are frequently hypertrophic and often deep cysts are associated. Surgical repair may be necessary.

It is often thought that these severe granulomata are secondarily infected. There is no reason why this explanation need be incriminated. Host-parasitic antagonism is so great that the sensitivity reaction at the site of infection—deep in the hair follicles—is sufficient to cause necrosis of surrounding tissue and secondary inflammatory reaction. Bacteriological cultures have, when carried out, been negative. A general reaction with the really severe infection is the rule, and it is often necessary to admit the patient to hospital. Trichophytid eruptions on the trunk are frequently seen. This intense inflammatory reaction results in destruction of the fungus, but the granuloma will remain until all dead tissue is removed and the area heals by scarring. Mycological cultures taken late in the infection are usually negative.

The infection is usually easily recognised as due to *T. discoides* because of the violence of the reaction and the history of exposure to cattle ringworm. Wood's light reveals no fluorescence. Hairs from the infected area are loose and can be painlessly extracted with forceps—a good diagnostic test of inflammatory ringworm.

Sex Incidence.—The obvious inadequacy of our sample prevents any conclusion being drawn from the fact that 11 of our 15 known patients were men.

Age Incidence.—The age of the 15 patients ranged from one to 20 and only four were over 16 years, which reveals, in the light of our knowledge of the disease, how inadequate our series is in giving a general picture of the disease in Northern Ireland.

Mode of Spread.—Direct spread from patient to patient is not common, but does occasionally occur among children who play together. Usually infection is transmitted from animal (calf) to human.

Our figures are too small to chart accurately the distribution within the Province, but undoubtedly the bulk of infection lies in the areas farthest away from Belfast, i.e., North Antrim, South Down, Derry, Tyrone, and Fermanagh.

Treatment.—This is conservative except for the manual epilation of loose hairs with fungus elements contained within. Frequent application of boric-starch poultices are not only soothing, but also help in the removal of loose hairs which stick to the undersurface of the poultice. If there is acute discomfort, warm boracic fomentations are more soothing. The disfiguring scars which follow can often be improved by simple excision of the affected area or by surgical grafting.

Immunity is established by the infection.

Since there is no specific treatment there is little point in highly experienced general practitioners from the country districts referring such cases to dermatological clinics often many hours' travelling distance from the home of the patient.

The ringworm charmer is still, even in 1951, a most important therapist in Ulster. Since *T. discoides* will always cure itself spontaneously and since the inflammatory reaction reaches a maximum within ten to fourteen days, the charm is

certain to be followed by some improvement. It might be said, indeed, that the charmer is "batting on a plumb wicket." It is possibly worth recording that the most popular method is to wait for a new moon, then to remove a small twig from a hedge, burn and wave it (without touching the skin) three times around the area of ringworm. Cure follows. It is quite incredible that such a ritual is still looked on as a cure for ringworm. Cynics might say, however, that it is preferable to the risk of an iodine dermatitis from the unnecessary application of a strong solution of iodine to an already severely injured tissue. They may be right!

Prevention.—In a lecture to the St. John's Hospital Dermatological Society, Holmes (1951) said that ringworm in cattle usually improves when the cattle are turned out to pasture in the spring, though spores remain viable in the woodwork of the cow-houses for months. Extensive infections may prove fatal. The animals should be housed in yards, the walls of which are composed of bales of straw which may subsequently be burnt. Disinfection of cow-houses may be achieved with a blow lamp, but, with very old buildings, it is generally necessary to carry out structural alterations, adding more windows, facing with cement, and destroying much of the old woodwork.

The problem is a veterinary one, with which the authors are not competent to deal. The advantages of a joint veterinary and medical attack on the infection would, from a commonsense point of view, appear to be desirable.

Tinea Capitis due to T. Mentagrophytes.

The remarks in the section on *T. discoides* infections are, with some slight modification, applicable to *T. mentagrophytes* infections, of which eight were seen.

The organism is another parasite of cattle, and both adults and children are susceptible to infection. Although an ectothrix trichophyton, the reaction produced is not so violent as that described for *T. discoides* infections. Constitutional disturbance is not a feature and "id" eruptions are rare. Long-lasting granulomata and severe scarring are seldom seen.

The localities within the North of Ireland affected by this fungus seem to be mainly in the vicinity of Belfast, e.g., South Antrim and North Down. We would, therefore, expect to see a larger number of patients at the skin clinic in Belfast if the infection was in any way troublesome to the community. This was not so, and in the period under review we had only eight isolates of this organism from cases of tinea capitis. Again, however, we point out that no special search for these cases was made.

There is little doubt, however, that the fungus is not such a common nor such a troublesome one as *T. discoides*.

Treatment is on the same lines as for *T. discoides* infections.

Tinea Capitis due to T. Schonleini.

Only one case of scalp infection due to this fungus was seen in the period under review. The organism is responsible for the clinical condition known as favus. It is parasitic on humans only.

A number of cases of favus were seen in the North of Ireland before 1939 and two cases were treated in the Belfast City Hospital by Dr. Reginald Hall in 1948. The child seen by us during the period of this review was a mentally defective boy, a cousin of the original two cases, and curiously now maintained in the ward of the Belfast City Hospital reserved for mentally backward children. On examination there was a rather moth-eaten alopecia on the top of the scalp with many crusted areas. There were no clinical scutulæ (i.e., the small saucer-shaped masses of spores easily seen in classical examples of favus scattered over the scalp). Under Wood's light the hairs of the affected area fluoresced a green-blue colour, the fluorescence extending to the tip of each fluorescent hair. This appearance under Wood's light is alone diagnostic of favus.

X-ray epilation is required for favus, but it is also essential that, at the same time, vigorous fungicidal treatment to the scalp is carried out, since in this condition removal of the hair does not remove all the fungus elements and those which remain (e.g., as scutulæ) will immediately reinfect the new hair. Whitfield's ointment is a suitable fungicide for such therapy.

Favus is essentially a disease of children, but occasionally it is seen in adults. There are good grounds for believing, however, that when an adult with the infection is detected he (or she) has had the infection since childhood. The condition will persist indefinitely in the absence of treatment.

Favus is not a problem in our community.

A Note on Tinea Capitis due to T. Equinum.

This fungus, of low infectivity to man, is a parasite of horses. Some years ago, when horse-drawn traffic was popular, ringworm infection due to *T. equinum* was quite common among grooms and carters.

During the period of this review no patients were detected as suffering from tinea capitis due to this organism, but before May, 1949, two boys, aged 7 and 8 years, were encountered. In these cases there was no inflammatory reaction and no fluorescence under Wood's light. The sources of infection remained undiscovered and the conditions cleared within two months under treatment with Whitfield's ointment.

Differential Diagnosis of Tinea Capitis.

In our opinion, it is essential that when a child is presented with tinea capitis an immediate decision should be made on whether epilation should be carried out, since parents are generally reluctant to agree to X-ray epilation, and any hesitation or lack of confidence on the part of the consultant certainly increases that reluctance. In Northern Ireland, where the bulk of such cases were infected with *M. audouini*, for which epilation is usually essential, the parents' co-operation had to be quickly won. We therefore attempted to establish the most important points of differentiation between *M. canis* and *M. audouini* infections, and we believe that the following six points are the most helpful.

1. From study of previous cases the detailed distribution of the organism within any locality can be charted on a map. This often gives a strong and reliable clue as to the type of infection present when the home address or school of the affected child are known.

2. In general, a larger proportion of *M. canis* infections show moderate to severe inflammatory reactions than do *M. audouini* infections.

3. *M. audouini* infections do not lose their brilliance under Wood's light for some months. The brilliant fluorescence of *M. canis* infections is replaced by a dull green fluorescence within a few weeks of onset.

4. The visible changes in the sequence of *M. canis* infection are much more rapid than in *M. audouini*; it is therefore of importance to assess the time of onset, since a short duration, coupled with the appearance of an advanced microsporisis capitis, would indicate *M. canis* rather than *M. audouini.*

5. A careful taking of the history often reveals in *M. canis* infections the presence of an infected kitten in the household.

6. Tinea corporis is, without doubt, much more commonly associated with tinea capitis in *M. canis* infections than with *M. audouini* infections.

"It is considered that these six points, none of them in themselves absolute, can, when taken together, allow a diagnosis of the type of microsporum present to be made with considerable accuracy" (Beare & Cheeseman, 1951a).

It is probably impossible to differentiate *M. audouini* infections from *T. sulphureum* infections on clinical grounds alone. The reaction is of the same intensity, but a clue may be forthcoming from the patient's school and address if details of the known cases within the area served by the clinic are known. However, *T. sulphureum* infections do not show any fluorescence in Wood's light. It has occasionally been stated that a dull blue colour is apparent; we do not believe this.

The cattle types of ringworm may be expected to show a severe host-parasitic antagonism with formation of kerion and, of course, they, too, do not fluoresce.

Of the non-ringworm differential diagnoses, the most important by far is alopecia areata. Careful scrutiny here will show that the hairs are absent from the follicles within the affected area and not broken off above the surface. The Wood's light test and culture, if necessary, will settle the few cases about which doubt still remains.

Pityriasis capitis and other manifestations of seborrhœic dermatitis occasionally give difficulty, but these conditions are diseases of the dermis and epidermis, and though a certain thinning of the hair may occur, this is diffuse and there are no "patches" of baldness. The hairs which remain are quite healthy. As mentioned elsewhere, a few old cases of *M. audouini* infections may cause confusion at times, but examination in Wood's light settles the diagnosis.

Severe inflammatory ringworm may be confused with carbuncle, but in the latter, pain, and especially tenderness, is usually present, and when any attempt is made to pull out the hair this pain is intense.

TINEA BARBÆ.

General.

Between May, 1949, and July, 1951, sixty men suffering from tinea barbæ were referred to the skin clinics; of these five also had tinea corporis and three tinea manuum. From thirteen of these patients *T. discoides* was isolated nine times, *T. mentagrophytes* three times, and *M. canis* once. The latter should be considered a mycological curiosity. No other fungi were suspected on clinical grounds.

With such small numbers it is impossible to make any definite comment on the ages, sex and geographical distribution.

All the remarks which were made with reference to tinea capitis due to these fungi apply with even more emphasis to tinea barbæ. Since the hair follicles of a man's beard are larger and more deeply situated in the dermis than those of the scalp, the reaction is correspondingly even more severe. Marked constitutional disturbance is frequently found. Subacute long-lasting granulomata and severe disfiguring scars are frequent sequelæ. Admission to hospital would, in almost all cases, be justifiable, if only for the relief of symptoms which follows good nursing.

An example of the clinical appearance of tinea barbæ due to *T. discoides* is shown in Fig. 6.

Differential Diagnosis.

The important differential diagnoses include sycosis barbæ and epitheliomata. Sycosis barbæ is usually more diffuse, is more chronic, and the affected area is more tender on pressure, though the inflammatory reaction is not so intense; hairs are not loose and do not come out painlessly. Small areas of tinea barbæ occasionally resemble basal-cell epitheliomata, but this mistake will not occur if the possibility is remembered.

TINEA CORPORIS.

General.

Since the term tinea corporis is rather vague, including as it does infections of the face in children and adult females, the non-hairy areas in men, the neck, limbs, trunk and excluding only those specific areas such as have received definite terms to cover infections thereon, it is not possible to pigeon-hole with any accuracy the various eruptions included in the term.

Numerically, however, cases classified as tinea corporis were second only in importance to tinea capitis. (See Table III.) In 418 patients this diagnosis was made—in 381 as a single diagnosis. This compares with 666 and 637 cases respectively of tinea capitis. The details of the diagnosis appear in Table XII.

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TABLE XII.

Tinea Corporis—Patients seen in all Skin Clinics in Northern Ireland, May, 1949—July, 1951.

DIAGNOSIS	MALES	FEMALES	TOTAL
Tinea corporis alone - -	232 ...	149 ...	381
Tinea corporis and capitis -	21 ...	7 ...	28
Tinea corporis and barbæ -	5 ...	— ...	5
Tinea corporis and manuum -	— ...	1 ...	1
Tinea corporis and pedis -	1 ...	— ...	1
Tinea corporis and cruris -	1 ...	— ...	1
Tinea corporis and unguium -	1 ...	— ...	1
TOTAL - - -	261 ...	157 ...	418

Very few (44) of these cases were cultured, and it is difficult to assess the comparative importance of the responsible organisms, although *M. canis* would appear to be the most common in the North of Ireland. Other fungi which we have isolated or which we have suspected on clinical grounds include *M. audouini*, *T. sulphureum, T. discoides, T. mentagrophytes, T. schonleini, T. purpureum,* and *T. violaceum*, although the last three were not cultured in the period reviewed.

Irrespective of offending organism, 261 men and 157 women were seen of ages varying from the first year of life to the seventieth.

TINEA CORPORIS DUE TO M. AUDOUINI.

This condition is commonly seen in epidemic times. The clinical appearances are of a mildly inflammatory pink scaly circumscribed lesion usually on the face, upper arm or trunk. There are few or no subjective symptoms. Of itself the lesion is of no importance to the patient. Occasionally a few lanugo hairs may be seen to fluoresce within the patch. The importance of this condition lies in the fact that it is infectious, and from it other children or the same child may acquire a scalp infection. The condition usually clears within a few weeks and can, in any event, be satisfactorily dealt with by local application of Liq. Iod. Mit. or Whitfield's ointment. Tinea corporis (*M. audouini*) is occasionally seen in adults who spend much time with infected children (e.g., X-ray technicians).

TINEA CORPORIS DUE TO M. CANIS.

The lesion is usually moderately inflammatory with crusting and rather tender raw underlying surfaces. Lesions are well circumscribed, but are seldom single, and one often only finds a large area with surrounding smaller ones. Often the lanugo hairs within the area fluoresce under Wood's light, but equally often this is not a feature. It is difficult to understand why this happens in some cases and not in others.

The initial lesion is usually located on an exposed part of the body, e.g., the face or arm. Infection is often then transferred by the hand to other parts of the body. Curiously, the fingers are not often affected—perhaps because of the frequency of hand washing.

Associated tinea capitis is often found and is always an unwelcome possibility. If the scalp does become involved then, of course, the period of infectivity of the child is prolonged.

The lesion of tinea corporis is itchy rather than painful, and does not scar.

The child being infectious must be isolated. The affected part should be occluded with a dressing and reliable fungicides such as weak iodine solution or Whitfield's ointment applied. The most important thing is to minimise the chance of tinea capitis either in this patient or in others.

Tinea Corporis due to T. Sulphureum.

This in itself is a trivial affair for the patient—the danger lies in the possibility of scalp infection either in the same patient or in others.

There is usually little or no inflammatory reaction—simply a circumscribed area of circinate scaly erythema. It is probably larger and more long-lasting than tinea corporis due to *M. audouini*, but the clinical differentiation is very difficult. Mild local fungicides suffice in the treatment of this condition. The affected area should be occluded by dressings.

For origin, mode of spread, etc., see under tinea capitis due to *T. sulphureum*.

Tinea Corporis due to T. Discoides.

The infection is a highly inflammatory affair, though not so intense as beard or scalp infection with this organism. Lanugo hairs are often involved and quite a severe granuloma may result.

The exposed parts—hand and arms—are, of course, usually affected, but secondary lesions may occur from direct transference elsewhere. The area is circumscribed, boggy, painful, and may scar.

Spontaneous cure results in a few weeks or two to three months at the most.

Soothing poultices and later mild fungicides are sufficient in the treatment of this infection.

Tinea Corporis due to T. Mentagrophytes.

Once again the inflammatory reaction is on a lower plane than that of *T. discoides*. Other features have been discussed in the sections on tinea capitis and tinea barbæ.

A Note on Tinea Corporis due to Other Organisms.

One case of favus of the arm (*T. schonleini*) has been seen and described in detail (Beare & Cheeseman, 1951a), but this was seen before the period of the present review. Clearly, tinea corporis, due to *T. Schonleini*, is uncommon in Northern Ireland.

T. purpureum has not been isolated from cases of tinea corporis in the Province, but the reaction is described as a psoriasiform plaque, with no tendency to central clearing (Lewis & Hopper, 1948). *T. purpureum* is endemic in tropical zones.

Similarly, *T. violaceum* has not been isolated during the period of this review from patients with tinea corporis. It produces small areas of ill-defined scaling of the type associated with *T. sulphureum* infections. Both fungi are endothrix trichophytons.

Differential Diagnosis of Tinea Corporis.

The types of tinea corporis with little inflammatory reaction may closely resemble pityriasis alba, but in the latter there is no central clearing and the lesion is not so well circumscribed. *M. canis* infections often resemble impetigo, but again the ringworm lesion is more circumscribed. The duration, distribution (especially symmetry) and absence of irritation are features which suggest psoriasis rather than tinea. Seborrhœic dermatitis and patchy eczema may be difficult to differentiate on occasions, but again distribution, duration, and absence of central clearing sometimes will help.

TINEA MANUUM.

The various dermatophytic eruptions of the hand and their causative fungi differ little from eruptions of the body. There are no special points to make and, with appropriate modifications, the remarks in the section, "tinea corporis," suffice.

The so-called dermatophytid eruption (trichophytid, epidermophytid, microsporid) is commonly found on the sides of the fingers in association with cases of fungus infection between the toes. This dermatosis is a sensitivity eruption, is not contagious, and should be treated as an eczema (not with fungicides). The eruption will settle only when the tinea pedis has been eradicated. It is often mistakenly diagnosed as contact eczema or dermatitis, or even as scabies. The feet require inspection in all cases of this type of eczema of the hand.

In the period reviewed, 34 patients were seen; 28 had tinea manuum alone, three had associated tinea barbæ, and one each tinea capitis, corporis, and pedis. Of three cultures made, two resulted in *T. discoides* and one in *T. mentagrophytes*.

TINEA PEDIS.

General.

This is an important variety of ringworm in Northern Ireland—76 patients were seen in the period under review, five of these were associated with tinea of other parts of the body (unguium two, manuum one, cruris one, and corporis one). Only three cultures were made and *T. rubrum, T. interdigitale,* and *E. floccosum* were isolated.

Tinea pedis caused great inconvenience and discomfort to Allied troops stationed abroad during World War II. Especially was this the case in Burma, where the hot, damp climate favours infection. The condition is so common in India that at

T. purpureum has not been isolated from cases of tinea corporis in the Province, but the reaction is described as a psoriasiform plaque, with no tendency to central clearing (Lewis & Hopper, 1948). *T. purpureum* is endemic in tropical zones.

Similarly, *T. violaceum* has not been isolated during the period of this review from patients with tinea corporis. It produces small areas of ill-defined scaling of the type associated with *T. sulphureum* infections. Both fungi are endothrix trichophytons.

Differential Diagnosis of Tinea Corporis.

The types of tinea corporis with little inflammatory reaction may closely resemble pityriasis alba, but in the latter there is no central clearing and the lesion is not so well circumscribed. *M. canis* infections often resemble impetigo, but again the ringworm lesion is more circumscribed. The duration, distribution (especially symmetry) and absence of irritation are features which suggest psoriasis rather than tinea. Seborrhœic dermatitis and patchy eczema may be difficult to differentiate on occasions, but again distribution, duration, and absence of central clearing sometimes will help.

TINEA MANUUM.

The various dermatophytic eruptions of the hand and their causative fungi differ little from eruptions of the body. There are no special points to make and, with appropriate modifications, the remarks in the section, "tinea corporis," suffice.

The so-called dermatophytid eruption (trichophytid, epidermophytid, microsporid) is commonly found on the sides of the fingers in association with cases of fungus infection between the toes. This dermatosis is a sensitivity eruption, is not contagious, and should be treated as an eczema (not with fungicides). The eruption will settle only when the tinea pedis has been eradicated. It is often mistakenly diagnosed as contact eczema or dermatitis, or even as scabies. The feet require inspection in all cases of this type of eczema of the hand.

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Tinea pedis caused great inconvenience and discomfort to Allied troops stationed abroad during World War II. Especially was this the case in Burma, where the hot, damp climate favours infection. The condition is so common in India that at

all times some slight fungus infection of the feet is usual among white people living there. It was expected that, following the return of the Allied troops after the war, tinea pedis might prove troublesome in this country. Although we have notes of 76 patients, this is not a large proportion of the total number of dermatological conditions seen at the various skin externs during the survey period. Also, it must be noted that the cold climate of this country does not favour fungus infection of the feet, and many patients, on return from abroad, undoubtedly observed their infection decrease in severity and perhaps disappear after a few months in this climate. However, young adults who engage in vigorous sports, necessitating the wearing of rubber shoes—which favour sweating of the feet and maceration between the toes—are often victims of tinea pedis, or, as the British Army troops call it—"Hong Kong Rot."

Walker (1950) has given an account of an examination carried out on 1,010 Army recruits at the time of intake into the Services. On clinical inspection, 857 of the 1,010 men showed no evident abnormality of the skin of the feet, 123 showed some questionable signs such as scaling or fissuring between the toes, and the remaining 30 presented signs clearly suggestive of infection. From 39 of 1,010 men (this 39 included the 30 with clinical signs) dermatophytes were isolated. The 39 isolates were made up as follows :—*Trichophyton interdigitale* 29,* *Trichophyton rubrum* 4, and *Epidermophyton floccosum* 6.

The nine symptomless carriers all had *T. interdigitale* isolates, thus the infection rate of these young healthy adults, who had (presumably) not been abroad and exposed to infection, was 3.8 per cent.

Muenda (1950) nominated *E. floccosum* and *T. mentagrophytes* as the fungi most commonly responsible for tinea pedis in Great Britain.

Montgomery & Casper (1945) stated that between 1940 and 1943 the United States Navy "hospitalised" 14,068 patients for fungus infections of the skin, the large majority of these involving the groins and the feet. This accounted for 17.1 per cent. of sick days lost for all skin diseases. These authors stated that, even in normal times, 50-90 per cent. of young American adults are affected at some period. They gave the figures of isolates from 1,557 cases of tinea pedis made at the New York Skin and Cancer Unit during the period 1935-43 as follows : *T. gypseum* (see Table VI on p. 11) 65.4 per cent., *T. purpureum* (syn., *T. rubrum*) 15.7 per cent., *T. albicans* (not a dermatophyte) 13.5 per cent., *E. inquinale* (syn., *E. floccosum*) 2.8 per cent., and other organisms 2.6 per cent.; they thought that *E. floccosum* was more prevalent in England and France, but Walker's figures do not necessarily substantiate this, and they quote Sabouraud's estimate that 80 per cent. of all intertrigo of the toes in France was due to *E. floccosum*.

Clinical Appearance.—Of course, the figures given by Montgomery & Casper and by Walker are not comparable, since the former were obtained from patients seeking treatment at skin clinics, the latter from a routine examination of 1,010 uncomplaining young adults. This is more important when one comes to consider

*"This species is closely related to *T. mentagrophytes*, but as it is a recognisable entity it is at present kept distinct" (Medical Research Council, 1949).

the clinical appearances of the various types of fungus infection of the feet—*E. floccosum* causes a trivial peeling and maceration between the fourth and fifth toes, not a condition which is likely to send a patient to seek dermatological opinion. *T. mentagrophytes* produces an acute inflammatory reaction which more often would require medical attention.

Unfortunately, only three of our cases of tinea pedis gave positive cultures. These revealed *T. rubrum, T. interdigitale,* and *E. floccosum*—one from each case.

As has been noted, *T. interdigitale* is closely related to *T. mentagrophytes*—a large spored ectothrix fungus responsible for much tinea capitis, barbæ, and corporis in the North of Ireland, and the mycological features of the fungus explain the inflammatory nature of the reaction on the feet. This type of ringworm is not confined to the toes, but spreads from plantar surface on to the dorsum of the feet and may be most incapacitating. The condition may be bilateral, but is seldom quite symmetrical. The active spreading, perhaps vesicular edge so characteristic of other forms of ringworm, is much in evidence. The condition is fairly readily distinguished from *T. rubrum* infections, since the latter are mainly on the plantar surfaces and are not so inflammatory. Infection due to *E. floccosum* shows maceration, and is usually interdigital.

T. rubrum is one of the most important fungi of the Far East and is responsible for a mildly inflammatory dull red, scaly and thickened dermatitis of the interdigital webs, soles, and sides of the feet. When the hair follicle is invaded the fungus is an ectothrix trichophyton, but there are no animal hosts.

E. flocossum produces the characteristic soft macerated dermatitis invariably between the fourth and fifth toes, or, if the infection is severe, spreading on to the adjacent nails and over the adjacent plantar and dorsal surfaces of the feet. The condition is frequently symptomless.

Sex Incidence.—During the 27 months of this review we saw 41 men with this condition and 35 women. The numbers are too small and drawn from too indefinite a population to attempt an estimate of the comparative sex incidence.

Age Incidence.—The ages of our patients range from 8 to 75 years.

Mode of Spread.—Swimming baths are invariably incriminated as the source of infection in tinea pedis. One's experience, however, makes it clear that this cannot be so, and that sports pavilions and dressing-rooms, where young adults may walk over flooring in bare feet, especially after having played tennis or badminton, in rubber shoes, with the resultant sweating of the feet, is by far the most important method for spread of infection. Infection is usually indirect from case to case. There is no known animal reservoir.

Treatment.—*T. rubrum* and *E. floccosum* infections are most difficult to eradicate, the former especially may take months of careful management. The choice of a fungicide is not so important as the treatment of associated conditions and prevention of frequent reinfection. For example, hyperhidrosis must be controlled if present (e.g., with 3 per cent. formalin), even if the control is only temporary. Associated tinea cruris or unguium is frequent enough to require that

every patient be examined for it (our figures should not be relied on here). Obviously, undetected tinea of the nail will act as a source of reinfection for the feet. The socks and shoes must be dealt with so that reinfection from these cannot take place.

There are so many good fungicides available (all extensively advertised) that it is only sufficient to mention that the newer proprionic-undecylenic acid groups are at least not irritable. Management is much more important than choice of fungicide.

Prevention.—This is largely a question of personal hygiene. People who are infected should not contaminate flooring with their feet. Much good work is undoubtedly done in schools by school medical officers in their routine feet inspections, though many cases must obviously be missed, judging from Walker's 1,010 Army recruits.

Differential Diagnosis of Tinea Pedis.—The most confusing diagnosis is a form of regional eczema which is possibly more common in the North of Ireland than tinea pedis. Although not specifically mentioned in standard text-books, this particular variety of eczema has special characteristics and may be considered a clinical entity. This type of eczema is symmetrical and affects first the great toe, spreading laterally on both feet, mainly on the dorsal surfaces. It is possibly a contact type of eczema, due to sweating, maceration, and friction from shoes.

TINEA CRURIS.

General.

The same three fungi—*T. rubrum*, *T. mentagrophytes*, and *E. floccosum*—are usually responsible for most cases of tinea cruris. The reactions described for these fungi when the feet are infected are seen in the groin. *T. mentagrophytes* is responsible for an inflammatory reaction, with an active, perhaps vesicular, spreading margin; *T. rubrum* for dull, scaly thickened plaques; *E. floccosum* produces a well-marginated scaly dermatitis, with little tendency to central scaling (Lewis & Hopper, 1948).

In our small series of 22 patients, no cultures were made—one patient had associated tinea pedis and one tinea corporis.

The condition is commonly known as Dhobie itch, and can be a most distressing complaint. It is not common in the North of Ireland.

Sex Incidence.—Over a period of the review we saw 22 male patients, but no female patients. From our data alone, this difference might not be surprising; but from other sources, the undoubted preponderance of male infection is curious, in view of the suspected mode of spread.

An inquiry in public schools before the war resulted in the medical officers of a number of girls' schools (10) reporting that they had "never seen a case" over the period 1932-34. In 19 boys' schools, however, the termly attack rates varied from 0.06 to 5.60 per cent. of the school population (Medical Research Council,

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1938). In a later report, one of us (Cheeseman, 1950) reported no cases in five girls' schools examined and attack rates varying from 2.61 to 10.39 per cent. per term in 11 boys' schools.

Age Incidence.—The ages of the patients in the present series ranged from 11 to 60 years. According to the Medical Research Council (1938) most authorities agree that tinea cruris is seldom seen before puberty, but little information is available about relative risks at varying ages of adult life.

Mode of Spread.—It is assumed that infection may be spread via underclothing, athletic straps, sportswear, etc., but in practice this theory is seldom substantiated. It may be that infection may be spread via the fingers, since the groin area is a most favourable site for fungus infection due to the frequency of excessive perspiration, and the fingers themselves are not infected. Other infections undoubtedly result from simple spread of infection from toes, nails, etc., to the groin.

Treatment.—Again, there are many efficient fungicides, any one of which suffices, and the important points regarding prevention of reinfection from clothing, elimination of other affected areas, such as toes and nails, are all important.

Prevention.—Personal hygiene would appear to be the most important single factor in the prevention of tinea cruris, and the general preventive measures applicable to tinea pedis apply. It is of interest to note that the attack rates in boarding schools where patients were isolated were generally much less than those in schools where isolation was not practised (Medical Research Council, 1938; Cheeseman, 1950).

Differential Diagnosis of Tinea Cruris.—The important differential diagnosis is seborrhœic intertrigo. This condition is always bilateral and is usually quite symmetrical. In addition, it frequently spreads on to the perianal region. There is little margination, and other manifestations of seborrhœic dermatitis may be found elsewhere.

TINEA UNGUIUM.

General.

T. mentagrophytes and *T. rubrum* are the organisms responsible for the majority of cases of ringworm of the nails. The condition is not particularly common in the North of Ireland (13 cases were seen, two associated with tinea pedis and one with tinea corporis), but few maladies are more difficult to eradicate than fungus infections of the nails.

Clinical Appearances.—Infected nails are opaque, friable, lustreless, yellow, and thickened. One or all nails (of hands and feet) may be infected. There is usually no pain or tenderness, but, of course, the abnormal nail is liable to frequent minor traumata. Most patients complain bitterly of the appearance of the affected nails.

The infection usually begins under the free border or along the sides of the nail plate. The nail gradually separates and debris accumulates. The nail plate itself gets thinner, more brittle, and breaks off.

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Treatment.—It is usually necessary to remove the nail plate either surgically or with repeated sandpapering. Efficient fungicides, preferably the aniline dyes, since they probably stay on the affected areas better, are applied at regular intervals. The frequency of relapse is a source of constant disappointment both to the patient and to doctor.

Prevention.—Spread of infection is directly or indirectly from case to case. The frequency of concomitant tinea pedis, cruris, corporis, etc., is important. We feel that only too often this is overlooked and that patients who have had nail infections for very long times will often have forgotten tinea of other parts from which the nails were infected (e.g., by scratching), and that, vice versa, chronic nail infections are a constant source of reinfection for tinea of other parts (e.g., tinea of toe nails reinfecting the feet).

Differential Diagnosis of Tinea Unguium.

It is difficult to differentiate the fungi from the clinical appearances of the abnormal nails, but Lewis & Hopper (1948) give the following pointers :—

(1) Tinea unguium, due to *T. rubrum*, is often associated with concomitant tinea pedis, due to the same organism.

(2) A superficial location of the infection on the nail is frequent with *T. mentagrophytes*, but practically unknown with *T. rubrum*.

(3) The duration of the infection is shorter and the progress faster with *T. mentagrophytes*.

The most confusing differential diagnosis is psoriasis, but this is seldom found in the nails alone, also it is usually bilateral and often symmetrical. Chronic paronychia (a monilial infection), which affects primarily the nail folds and produces only secondary changes in the nail plates, is more readily differentiated.

Summary.

1. The North of Ireland, in common with many other communities, has recently suffered from severe outbreaks of tinea capitis.

2. A survey of the problem was undertaken at the Royal Belfast Hospital for Sick Children, where a Ringworm Clinic was established.

3. In addition, an analysis of the whole problem of ringworm infection in the North of Ireland was carried out, using data from all those hospitals where skin clinics are held.

4. The various organisms found, the clinical manifestations produced by these organisms, and the treatments required are briefly outlined.

5. The distribution of the various types of tinea capitis within the Province is given in detail.

6. Some steps which may help to prevent further outbreaks in the North of Ireland are suggested.

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In the preparation of the report, Mr. G. A. Smith drew the diagrams; Mr. D. H. R. Mehaffey and Mr. N. C. Hughes have prepared the photographs; Miss J. R. Boyce and Miss D. B. I. Wood typed the manuscript, and Mr. J. D. Merrett prepared the statistical tables.

Professor F. M. B. Allen instigated the report and gave us every encouragement throughout.

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