

Marples and Di Menna (1949), Baer *et al.* (1955), Gentles and Holmes (1956, personal communication), and others have noted the long period of exposure before clinical infection of the feet becomes evident: this, as I have reported, has also been my experience. The evidence indicates that some breakdown in personal immunity must precede the onset of clinical disease. If a person is to become infected, this lessening of immunity must coincide with inoculation with a viable fungus. In contradistinction to the hypothesis that patients become infected after recent inoculation from an outside source, Sulzberger *et al.* (1942) and Sulzberger and Baer (1955) believe that most supposedly normal persons are carriers of fungi, and that this is the starting-point of clinical disease when immunity breaks down. Their theory is not supported by the evidence of familial infection in 11 of my 48 contacts, while only one had contracted the disease (due to *T. interdigitale*) from an outside source: a larger proportion of extraneous infections, or at least of mixed infections with two species, would have been expected. The evidence indicates continual exposure of the contacts to cross-infection in the home and a phase of lowered personal resistance which allowed the fungus to produce clinical disease.

The intractability of *T. rubrum* infections to treatment, their disfiguring nature, and the mental distress which often ensues emphasize the importance of attempting to check the spread of the disease. This is especially so in families with young children, as is shown by the infection rate of six out of eight persons over the age of 14 who had been exposed to infection as children. Precautions should be simple and have the object of preventing the shedding of infective particles in places where others may come into contact with them; for instance, avoiding walking about bare-footed, exchanging footwear, or using a communal bath-mat. The sterilization of footwear and floors is impracticable and is not likely to be performed faithfully by the patient.

In half the patients who had been referred to dermatologists the disease had already reached the nails, and was therefore practically incurable. If more patients with tinea pedis were seen by dermatologists before this stage was reached, and if the fungus concerned was identified, infection of the nails and hands might be delayed or prevented. For should *T. rubrum* be found, the patient could be warned to pay greater attention to his condition than is normally accorded to "athlete's foot."

Summary

The epidemiology of *Trichophyton rubrum* infections has been studied in 19 families in whom one member was known to be infected.

The disease had spread in nine of the families, and 13 (27%) of the 48 contacts were infected. The mycological similarity of fungi isolated from members of the same family has been demonstrated.

Six out of eight persons over the age of 14 who had been exposed to infection during childhood had contracted the disease.

Periods of exposure of from 1 to 15 years were noted before clinical signs of disease occurred, and in five families who had taken precautions for three years or more there had been no spread of infection.

The nails had been attacked in 78% of all the infected persons. In most of these the disease had begun in the toe-webs, but specialist advice had not been sought at this early stage.

Cross-infection with *T. rubrum* in families is important, and simple precautions against spreading the disease are suggested.

I thank Dr. R. P. Warin and Dr. C. D. Evans, whose patients, except for one family, were the subjects of this inquiry, for their enthusiastic support throughout; Dr. Catherine J. Maclaren, who

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ATHLETE'S FOOT FUNGI ON FLOORS OF COMMUNAL BATHING-PLACES

BY

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During a recent survey of foot ringworm in groups of industrial workers in Great Britain, Gentles and Holmes (1955, 1957) showed that there is spread of infection among users of communal bathhouses. Parasitic fungi were isolated from the floors of some of the bathhouses on a number of occasions (Gentles, 1956). There was some indication that these fungi were not present as saprophytic colonies on the floors, but the evidence was not conclusive (Gentles and Holmes, 1955; Gentles, 1956). Various opinions on the method of spread of infection have been given. Duncan (1949) and J. T. Ingram (1954, personal communication) believed that spread took place by transfer of scales from the feet of the infected to the interdigital clefts of the feet of others. Duncan also believed that the fungi could grow saprophytically on wooden floors, and Riddell (1951) stated that the increase in incidence of the disease amongst users of communal bathing-places was probably due to the lighting up of latent infections rather than to new infections caused by the fungi growing saprophytically on the floors. Peck, Botvinick, and Schwartz (1944) stated that the pH of aged concrete was compatible with growth of the dermatophytes concerned, but they did not show that growth actually took place, and the dermatophytes they isolated from sterilized concrete probably came from infected skin fragments (Gentles, 1956).

Adamson and Annan (1949) isolated *Trichophyton mentagrophytes* from a fragment of skin found on the floor of a bathhouse, and I also made one isolation in this way (Gentles, 1956).

Experiments recently carried out in this laboratory have confirmed that spores of *T. mentagrophytes* can exist for long periods on concrete surfaces and also that this species of dermatophyte can grow on moist crushed asphalt when soap is present. It seems unlikely, however, that the conditions required to enable growth to take place are ever fulfilled in practice. It is customary for floors of most institutions to be thoroughly cleaned at frequent intervals (usually daily) with detergents and disinfectants of various kinds, and these substances almost without exception exert a fungistatic action on

the fungi concerned. In an effort to obtain further information on the question of how infection spreads, the answer to which is important if satisfactory prophylactic measures are to be introduced, it was decided to investigate more fully the condition of shower floors both in the clean state and after they had been used.

Method

The experiment was carried out on two occasions, in May and three weeks later in June, 1956, in the bathhouse of a near-by colliery. The incidence of athlete's foot among those who used the showers at this colliery was estimated in 1953 to be 19% (Gentles and Holmes, 1955; 1957). The sampling of the floor, which is surfaced with asphalt, was carried out with direct samplers (Gentles, 1956). These consist essentially of a velvet pad on a wooden support, and on each of five previous occasions on which they have been used dermatophytes have been successfully isolated. In the laboratory they have proved suitable for location of both fungal spores and skin fragments on asphalt and concrete surfaces.

Three samplers were used on each of the four positions A, B, C, and X (Fig. 1) on the clean floor, and the same number two hours later after some hundred or more men had bathed. Each sampler was applied four times to the part of

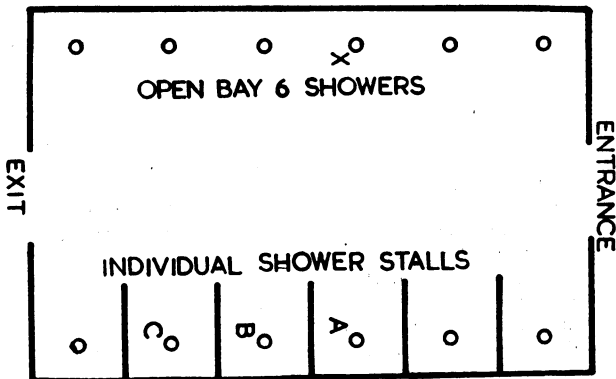


FIG. 1.—Diagram of shower bay in colliery bathhouse, showing the relative positions of the four floor areas A, B, C, and X used in the experiments.

the floor surface immediately below the shower nozzle, the area covered by three samplers on each occasion being just under 1 square foot (929 square cm.). The showers were run for a short period before sampling in order to wet the clean floor, as the samplers are not suitable for use on a dry surface. Three petri dishes containing 4% malt extract agar supplemented with cycloheximide (5 µg./ml.), penicillin (20 units/ml.), and streptomycin (40 units/ml.) were inoculated from each sampler.

The dishes were incubated at 28° C. and examined at frequent intervals.

Results

The cycloheximide inhibited the growth of most of the common saprophytic fungi for a period, and dermatophyte colonies were usually first to appear, in about five days. The identity of the isolates was in every case confirmed by microscopical examination of a slide mount. Only one species of dermatophyte, *T. mentagrophytes*, was obtained. This species is the common cause of foot ringworm in this country, and is also the predominant species in foot infections at this colliery (Gentles and Holmes, 1955). The isolates were all of the interdigitale variety, and subcultures in no way differed from those usually obtained from foot infections with this species.

The Table shows that dermatophytes were isolated from all four shower positions, but only once were they obtained on both May and June samplings from the same shower.

Results Obtained from Sampling the Floors of Four Shower Stalls on Two Occasions

Date of Sampling (1956)	No. of Colonies of Dermatophyte Obtained							
	Shower A		Shower B		Shower C		Shower X	
	Clean*	After Use	Clean	After Use	Clean	After Use	Clean	After Use
May	0	2	0	0	0	0	0	1
June	0	2	0	22	0	1	0	0
Total ..	0	4	0	22	0	1	0	1

* Sampling was carried out on the clean floors and also after the showers had been used.

Discussion

It is apparent from these results that the distribution of the fungi on the floors is not the same all the time, as would be the case if the fungi were present as saprophytic colonies. It must be assumed under such circumstances that the spread of infection takes place, as Duncan and Ingram have postulated, by transfer of infected skin fragments. Failure to isolate from the clean floors indicates that cleaning of the floors effectively removes the infective fragments and therefore spread of infection obviously takes place only among those groups who use the showers in periods between cleaning. The efficacy of the cleaning in this bathhouse, which is in no way unusual as regards either method or materials, was clearly evident by comparison of the numbers and variety of saprophytic fungi, yeasts, and bacteria in the petri dishes inoculated from the clean floor and in those inoculated from the floor after use. Two comparable series from a shower before and after use are shown in Fig 2.

In a previous article (Gentles, 1956) it was stated that the parasitic fungi were probably present on the floors in some quantity. These further isolations from a relatively small

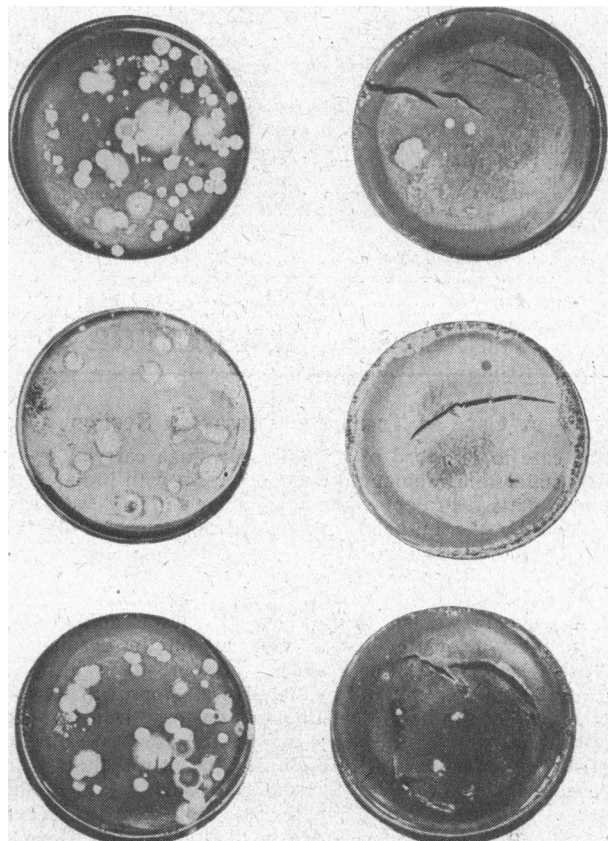


FIG. 2.—Photograph showing on the left the series of three dishes inoculated with a single sampler from the floor of shower A after use, and on the right the dishes inoculated with corresponding samplers used on the clean floor of the same shower. A single colony of *T. mentagrophytes* is present on the lower left petri dish slightly off centre in direction of 5 o'clock.

area confirm this view and show that the failure of many previous attempts was due to deficiencies in the methods used (Peck *et al.*, 1944). The large number of isolates obtained at the June sampling from shower B is probably the result of sampling the shower immediately after it had been used by an infected person. The few colonies usually obtained would seem to indicate that the infected fragments may be washed down the drains shortly after being deposited, as Peck *et al.* suggested, but it is also possible that they are carried away on the feet of subsequent bathers. The risk of skin fragments containing parasitic fungi being picked up on the feet of a person using this particular shower would at any rate be very great.

In view of these findings it seems certain that any measures for control of spread of infection must be taken by the individual, either by the use of aids such as sandals to prevent direct contact with the floors, or by application of some fungicidal preparation after bathing.

Summary

The same four shower stalls of a communal bathhouse were sampled before and after use on two separate occasions. It is clearly shown that the presence of dermatophytes as saprophytic colonies on the floor is extremely unlikely, and that the spread of infection almost certainly takes place by transfer of infected skin fragments. There is also evidence that skin fragments containing viable parasitic fungi are deposited, and are on occasion present on the floors, if even for a comparatively short time, in very large numbers. It is pointed out that measures to control spread must be of a personal nature.

I thank the medical services of the National Coal Board for their co-operation; Professor J. W. Howie and Dr. J. G. Holmes for their advice; Miss C. O. Dawson for much valuable assistance; and Mr. F. Lonsdale and Mr. G. Clark for the photography.

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although a full-term uterus was palpated and the foetal heart sounded clearly and of normal rate. The patient confirmed that foetal movements were still being felt.

At this time it was thought that the story of prolapse of foetal parts was a mistake, since such an injury was thought to be scarcely compatible with a viable child more than 24 hours later. In consequence operation was deferred for 12 hours, when the thread sutures parted to reveal a foetal hand.

At operation the foetal parts were found to be prolapsing through a transverse wound of the uterus situated 1–2 in. (2.5–5 cm.) above the usually selected site of incision for a lower-segment caesarean section. The uterus was not contracted, though the edges of the wound were everted and bleeding very little; about 1½ to 2 pints (850 to 1,140 ml.) of blood was collected from the paracolic gutters and transfused after straining through gauze into citrate solution.

The dead foetus, with the placenta and membranes, was removed without enlarging the uterine wound, and a further binovular twin, which lay in an intact sac, was similarly delivered and found to be alive.

The uterus was repaired by the method usually adopted after lower-segment caesarean section, and the abdomen was closed without drainage. Apart from some superficial wound infection which responded to chemotherapy, and an anaemia which required treatment, the post-operative course was uneventful. A very satisfied mother was discharged with her small son on the twenty-fifth post-operative day.

COMMENT

This case has a number of features in common with the case of self-inflicted caesarean section described by Sandford (1951).

Hysterectomy was not considered, and indeed it is seldom found necessary to undertake this heroic measure in cases of ruptured uterus, since repair is almost always an easier and less shocking procedure, and very often leaves a uterus capable of further normal function or one in which caesarean section may be undertaken at full term in subsequent pregnancies.

Sufficient confidence in the repair persuaded us that sterilization would also have been an unwarranted procedure. There is adequate supervision by a rural health service in this woman's district to ensure that she will receive satisfactory treatment in the event of further pregnancy.

Regarding the latter paragraph, it is of interest that Dr. Sandford's patient, who also was not sterilized, was returned before term with a further pregnancy, and after an unsuccessful trial labour was delivered of a live child by caesarean section, under my care.

My thanks are due to Dr. D. W. F. Charlton, who assisted in the management of this case.

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Medical Memoranda

A Case of Traumatic Caesarean Section

The case is described of an African woman carrying twins who suffered a traumatic caesarean section with prolapse of foetal parts. Prompt though primitive surgery was performed by the husband, thereby saving the lives of the mother and one child.

CASE REPORT

A pregnant woman of the Tugen tribe was admitted to Rift Valley Province General Hospital on the evening of November 3, 1954, after a journey of some 40 to 50 miles (64 to 80 km.) on foot and by ambulance. Approximately 24 hours earlier she had fallen forwards on to an iron spike in her garden, and sustained a 4-in. (10-cm.) transverse wound of the abdominal wall with prolapse of what was thought to be a foetal elbow. The husband had roughly sutured the wound with strong thread, and the woman had started on her journey to El Dama Ravine Hospital, from whence she was transferred by ambulance.

On admission the patient's general condition was excellent. The abdominal wound appeared slightly septic, and there was considerable tenderness and guarding over the lower abdomen so that it was difficult to determine details,

Recurrent Myxoedema and Goitre Attributed to Potassium Iodide

Myxoedema resulting from the administration of iodine to patients free from thyroid gland disorder is rare. It has been described by Léchelle and Troisier (1950), Bareau (1952), Morgans and Trotter (1953), Herbert and Petrie (1954), and Freed (1954). Acute swelling of the thyroid gland complicating treatment with iodides was reported by Edmunds (1955). Cases in which both myxoedema and goitre developed after iodide administration have been described by Bell (1952), Raben (1953), and Turner and Howard (1956).

The patient whose case is described here had four attacks of myxoedema and goitre in five years, and recovered without treatment. It is believed that potassium iodide was responsible for each episode.