Of the senior boys 40.3% had lesions and 6.6% had tinea pedis; 30.4% of senior girls had lesions and 1.6% tinea pedis; 33.2% of junior boys had lesions and 2.2% were infected.

In the girls the incidence was too low to allow correlation of results with relevant environmental factors.

In the boys the incidence of tinea pedis increased gradually to age 11 and then fluctuated irregularly.

No correlation was found between infection rate and cleanliness, the presence of non-mycotic lesions, social class, or the use of school showers.

There was a marked correlation between infection and the district in which the schools were situated. Senior and junior boys' schools in district A had 8.9% and 3.1% infection respectively; similar schools in districts B and C together had 5.5% and 0.4% infection respectively. It is concluded the local swimming-baths and the frequency with which they are used are the probable cause of this.

Of the 179 infections, 84.4% were caused by *Trichophyton mentagrophytes*, 7.2% by *T. rubrum*, 3.9% by *Epidermophyton floccosum*, and 4.4% were identified by microscopical examination only.

We acknowledge the kindness of the head teachers and staffs of the schools, without whose co-operation this investigation would have been impossible. We are indebted to Miss E. H. L. Duncan, of the Central Health Clinic, Bristol, for guidance and practical help in the statistics. Our thanks are also due to Dr. R. P. Warin and Dr. C. D. Evans, of Bristol Royal Hospital, and to Dr. R. C. Wofinden, medical officer of health, Bristol, for their advice and encouragement.

ADDENDUM.—Since writing this paper our attention has been drawn to Scheffler's (1958) investigation of tinea pedis in 2,622 German school children. Though differing from ours in the wider age range of the children and in slightly more restricted criteria for selection of those for scraping, the results should be roughly comparable. In fact, Scheffler's total incidence of infection of 3.4%, as determined by microscopical examination, is remarkably similar to ours, but the incidence in the sexes, determined microscopically, differs in being almost equal in boys and girls. However, the dominant fungus among Scheffler's subjects is *T. rubrum* (79% of 67 cultures obtained); and indications in our survey and in the investigation of this fungus in families (English, 1957) are that the incidence of *T. rubrum* in females far more nearly approaches that in males than is the case for *T. mentagrophytes*. Scheffler's results support this observation. Unfortunately Scheffler does not give the incidence of the fungus species in the sexes; nor does he relate his mycological findings to age.

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STUDIES IN THE EPIDEMIOLOGY OF TINEA PEDIS

II. DERMATOPHYTES ON THE FLOORS OF SWIMMING-BATHS

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The results of a recent investigation into the epidemiology of tinea pedis in Bristol school children (English and Gibson, 1959) suggested that the public swimming-baths were an important source of transmission of this infection.

Amrein (1953) found that school children in Zurich, with access to public swimming-baths, showed nearly the same percentage of infection as was found in the Bristol children, but that those from remote mountain villages with no public bathing facilities had no infection with tinea pedis. Amrein did not report any attempt to isolate dermatophytes from the floors of the baths.

Tritsmans and Vanbreuseghem (1955), in Belgium, showed that 30% of persons whose main recreation was swimming in public baths had tinea pedis, compared with 4.5% of gymnasts and 3.5% of a control group. They failed, however, to grow dermatophytes from material scraped from the floors of the swimming-baths used by their subjects. Attempts to isolate these fungi from the floors of shower-baths in the United States by similar sampling methods (Ajello and Getz, 1954; and other workers) have had disappointing results.

However, Gentles (1956) has developed a direct sampling technique, which he used with considerable success on the floors of pithead baths, and this method has been adopted for the examination of three swimming-baths in Bristol.

The swimming-baths investigated were baths A, B, and C, used by the school children examined in our survey of tinea pedis (English and Gibson, 1959).

Baths A and C were so laid out that the accommodation for changing opened on to passages from which the only access to the pool itself was through footbaths filled with chlorinated water. In bath B the cubicles opened straight on to the side of the pool. Sampling of the changing accommodation included showers, lavatories, passages, and wooden slats, where they existed, as well as the floors of the cubicles. Floors were made from smooth tiles patterned with grooves, with a strip of concrete 1 ft. (30 cm.) wide surrounding the pool.

All baths were cleaned twice daily with brooms and a solution of "chlorox." In addition, baths B and C were sluiced down with buckets of water frequently during the day. Bath A was not sluiced.

Procedure and Methods

Sampling was carried out during those parts of the school term falling in the period July to October, 1957. Samples were taken at 9 a.m., before the admission of bathers, and at approximately 4 p.m., up to which time the great majority of bathers were organized school

parties. Morning and afternoon samples were not taken on the same days or from precisely the same positions.

The sterile velvet-covered sampling-pads were used as described by Gentles (1956), except that the basic culture medium on to which they were stamped was glucose (4%)–peptone (1%) agar, to which the antibiotics were added. Where floors were dry they were damped with fresh water before sampling. Results were recorded in terms both of the number of pads used and of the number of colonies isolated.

In addition, cultures were made from scrapings from the feet of all swimming-bath employees.

Results

Contamination of Baths

The *interdigitale* type of *Trichophyton mentagrophytes* was the only dermatophyte isolated from the floors.

Table I shows the findings for different areas of the three baths. In baths A and B the boys' changing accommodation, after use, was far more highly contaminated than that of the girls: in bath C the only colony isolated was on the boys' side. As the physical circumstances of the boys' and girls' sides in each bath are likely to be the same, it is probable that the difference in contamination between the two areas is a real one.

From the sides of the pools dermatophytes were obtained from only 3 pads out of the 33 used, a surprisingly low figure at first sight. It is probable, however, that the constant splashing would wash most small particles, including skin fragments, either into the grooves of the tiles or into the pools themselves. Such particles, therefore, would tend to be removed from contact both with the sampling-pads and with the bathers' feet in this area. This would also be the effect of sluicing.

The efficacy of routine cleaning methods was determined by sampling the most highly contaminated part of the baths, the boys' changing accommodation, before use. Only one pad out of 21 was contaminated, and the area from which this sample was taken was noticeably dirty. It would seem that established cleaning methods are adequate if conscientiously carried out.

There was a marked difference in the incidence of contamination in the baths, many more isolations and infected pads being obtained from bath A than from B or C. The possibility that some of the colonies in bath A were obtained from particles from the feet of one bather cannot be excluded.

There was no evidence of the superiority or otherwise of baths in which the cubicles opened on to a passage rather than on to the edge of the pool, for baths A and C, the most and least contaminated respectively, were both of the passage type.

Tinea Pedis Among Staff

Table II shows the results of the examination of the feet of swimming-bath staff. Swimming instructors and bath attendants wore plimsoll-type shoes for their work unless they were actually about to swim, yet 8 out of 14 if these harboured various dermatophytes, whereas none of the 11 who never entered the water were infected. Though *T. mentagrophytes* was the only fungus isolated from the bath floors it was found in only 3 out of 6 of the staff cases where the fungus was identified. Amrein (1953), working with larger numbers, also found a high incidence of tinea pedis in swimming-bath staff.

Discussion

Gentles's direct sampling technique has proved highly satisfactory for the isolation of *T. mentagrophytes* from floors, but *T. rubrum* and *Epidermophyton floccosum* were never found. This is probably partly due to the

TABLE I.—Isolation of Dermatophytes from Swimming-baths

Position of Sample	Bath A (Passage Type)			Bath B (No Passage)			Bath C (Passage Type)			Total		
	No. of Pads Used	No. of Pads Infected	No. of Colonies	No. of Pads Used	No. of Pads Infected	No. of Colonies	No. of Pads Used	No. of Pads Infected	No. of Colonies	No. of Pads Used	No. of Pads Infected	No. of Colonies
Boys' changing accommodation* (after 7-8 hours' use) . .	6	5	29	3	2	3	8	1	1	17	8	33
Sides of bath (after 7-8 hours' use) . .	12	2	3	9	1	3	12	0	0	33	3	6
Girls' changing accommodation* (after 7-8 hours' use) . .	8	1	1	6	0	0	3	0	0	17	1	1
All positions after use of baths	26	8	33	18	3	6	23	1	1	67	12	40
Boys' changing accommodation* (after cleaning) . .	6	0	0	6	1	2	9	0	0	21	1	2

* Including cubicles, lavatories, and, where present, showers and passages.

TABLE II.—Tinea Pedis in Swimming-bath Staff

Employment	Bath A			Bath B			Bath C			Total		
	Total Personnel	No. Infected	Fungus Isolated	Total Personnel	No. Infected	Fungus Isolated	Total Personnel	No. Infected	Fungus Isolated	Total Personnel	No. Infected	Fungus Isolated
Instructors . .	2	1	Microscopically +ve only	2	1	<i>T. mentagrophytes</i>	1	1	<i>T. mentagrophytes</i>	5	3	1 microscopically +ve only 2 <i>T. mentagrophytes</i>
Bath attendants	1	1	<i>T. rubrum</i>	5	2	1 <i>T. rubrum</i> 1 <i>E. floccosum</i>	3	2	1 microscopically +ve only. 1 <i>T. mentagrophytes</i>	9	5	1 microscopically +ve only. 1 <i>T. mentagrophytes</i> . 2 <i>T. rubrum</i> . 1 <i>E. floccosum</i>
Others (clerical and cleaning)	4	0	—	5	0	—	2	0	—	11	0	—

slow growth rate of these fungi making them more susceptible than *T. mentagrophytes* to overgrowth by other organisms on the culture plate. But the main reason would seem to be their rarity on the school children's feet (English and Gibson, 1959).

The two potential reservoirs of infection in swimming-baths are the pool itself and the surrounding floors. Infection could be by fragments of skin in which the fungus is embedded, or direct by conidia and hyphae of the saprophytically growing fungus. There is no evidence that dermatophytes exist in a saprophytic condition in these baths, as brushing down effectively removes contamination. It is unlikely that fragments of skin floating in the pool could attach themselves firmly enough to the feet to start an infection, and Tritsmans and Vanbreuseghem (1955) were unable to isolate dermatophytes from swimming-baths by setting "baits" of hair in the water, a method which is successful for collecting keratophilous fungi in soil. It is probable, therefore, that the main source of infection is pieces of infected skin pressed on to the foot while walking over contaminated floors.

The frequency with which *T. mentagrophytes* was isolated from the boys' changing accommodation compared with that of the girls, which is in agreement with an incidence of tinea pedis four times greater in boys than in girls using these baths (English and Gibson, 1959), is evidence for the importance of swimming-baths as a source of infection with tinea pedis in children. Also, the greater contamination of bath A coincides with the high incidence of tinea pedis in district A, found in the same survey, and it is possible that both are attributable to the lack of sluicing down of this bath, as well as to the more extensive use made of their bath by schools in this district compared with other districts.

The implication here is of a vicious circle of foot infection and floor contamination. A highly infected population would shed more infective particles than a slightly infected one, and this in turn would increase the risk for hitherto healthy users. As cleaning methods appear to be effective, cross-infection must occur mainly between bathers using the baths between each cleaning. Almost continuous cleaning and sluicing, as is already done in some baths, would appear to be a practical way of preventing the accumulation of contaminating particles.

The high incidence of tinea pedis in those members of the staffs who enter the water compared with those who do not, also implicates the baths as a source of infection and suggests that a regular mycological examination of the feet of such people could be undertaken with advantage.

Though this investigation was not planned on a statistical basis the results do add further to the evidence of Amrein and of Tritsmans and Vanbreuseghem that swimming-baths are an important source of infection with tinea pedis.

Summary

Trichophyton mentagrophytes has been isolated repeatedly from the floors of three swimming-baths by Gentles's direct sampling technique.

The fungus was found more often in baths and parts of baths used by populations with a high incidence of tinea pedis than in those used by populations with a lower incidence.

Brushing down and frequent sluicing appear to be reasonably effective methods of removing infective particles.

Eight out of 14 members of the swimming-bath staff whose duties entailed their entering the water were found to be suffering from tinea pedis. None of the 11 persons who never swam were infected.

It is concluded that swimming-baths are an important source of infection with tinea pedis.

We are indebted to Mr. J. Hancock, chief superintendent of Bristol's swimming-baths, for his ready permission to carry out this investigation, and to Mr. J. McA. Milne, chief organizer of physical education in Bristol, and the superintendents and staffs of the baths for their co-operation. Our thanks are also due to Dr. R. P. Warin and Dr. C. D. Evans, of Bristol Royal Hospital, and to Dr. R. C. Wofinden, medical officer of health, Bristol, for their interest and encouragement.

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HOW CHRONIC IS PULMONARY TUBERCULOSIS IN THE ELDERLY ?

BY

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It is now generally recognized that pulmonary tuberculosis is increasingly becoming a disease of older people and particularly of men over the age of 65. The notification rate for pulmonary tuberculosis in men over this age in England and Wales has almost doubled in the sixteen years from 1938 to 1954 (Wilkins, 1956). Likewise in New York City the number of newly diagnosed cases in men over 45 years of age is twice that of a generation ago (Robins, 1953). This increase in the disease in older people is not accounted for merely because there is a higher percentage of elderly people in the population. In the 1957 Glasgow mass x-ray campaign, for example, the yield of active pulmonary tuberculosis was 7.0 per 1,000 examined in those over 60, compared with 4.37 per 1,000 examined in the age group 15-59 years (Glasgow Corporation, 1958).

Traditionally, pulmonary tuberculosis in older people is supposed often to masquerade for years as chronic bronchitis. From textbook to textbook the picture is painted of the elderly parent or grandparent, with "chronic bronchitis," disseminating infection among household and other contacts. Nash (1955), endorsing this view, has suggested that if men over 45 could be x-rayed once "it would drain the unknown infector pool of most of its long-term members."

On the other hand, the presenting features of many cases of pulmonary tuberculosis in the elderly seen at Ruchill Hospital suggested that the disease might be of recent origin, and it was thought that further investigation of the problem would be profitable. Accordingly, in 100 consecutive cases of pulmonary tuberculosis newly diagnosed in people over 55 every