

A brick must be suspended and not dropped, in each chamber of the tank. Full control by one brick will continue for at least one month on a moving liquid surface, and for three months on a static liquid surface, provided no scum is present.

Cement-sawdust bricks are useless, probably due to hydrolysis of the D.D.T.

ACKNOWLEDGMENTS

My thanks are due to Colonel W. A. Y. Knight, A.D.M.S., H.Q. Singapore District, for kind permission to forward this article for publication.

ARMY DERMATOLOGICAL RESEARCH UNIT

RESEARCH ON SKIN DISEASE IN F.A.R.E.L.F. 1947-8.

THE O.C., Dermatological Research Team, recently presented a report on two years' work by the Team on dermatological problems among Army personnel in the Far East. The following is a brief summary of the findings:

FUNGUS INFECTION

The most important dermatological problem among male British troops in S.E. Asia is fungus infection of the skin. Clinically this entity divides itself naturally into infection of the soles and toe clefts and infection of other areas. These conditions will be referred to as "foot ringworm" and "body ringworm" respectively. It must be constantly borne in mind that although these are clinically distinct, the same organisms can (and frequently do) give rise to both; it is therefore necessary, when dealing with epidemiology, to consider fungus infection as a whole.

A clinical consideration of body and foot ringworm follows.

Body Ringworm

Incidence.—Of some 1,700 B.O.R.s examined at skin inspections, 33.5 per cent were found to have ringworm of the body. From this overall figure, indicating infection at any given moment of 1 man in every 3, only small deviations were found among different units among troops in different localities, and among troops with different occupations (e.g. R.E.M.E. as compared with Infantry). Men were inspected in Singapore, at various stations on the western side of the Malayan peninsula, and in Hong Kong during the hot season, and in all these places an infection rate of roughly 1 in 3 was found.

Ætiology.—Body lesions from a total of 88 individuals were cultured and yielded the following pathogenic fungi (figures represent percentage incidence of each species):

Species	Abbreviation	% incidence
<i>Trichophyton mentagrophytes var. asteroides</i>	TMA	54
<i>Epidermophyton floccosum</i>	EF	33.7
<i>Trichophyton rubrum</i>	TR	8.2
<i>Trichophyton interdigitale</i>	TI	2
<i>Trichophyton violaceum</i>	TV	1
<i>Microsporon gypseum</i>	MG	1

It can be seen that over one-half of all infections were due to *TMA* and about one-third to *EF*, other fungi play a relatively unimportant part. It should be noted that several individuals were infected, either successively or simultaneously, with more than one fungus.

Clinical Description.—The lesions produced by these organisms conformed in general to the classical description of tinea circinata; the majority were annular or discoid, with scaling, erythema and minute vesicles at the edge and a tendency to heal in the centre. The anatomical distribution in 497 cases was as follows:

	No. of cases	% of total
Face	20	4
Shoulders	18	3.6
Axillæ	24	4.8
Arms	16	3.2
Hands	5	1
Trunk	49	9.9
Belt area	87	17.5
Crutch	347	70
Buttocks	99	20
Legs	68	13.7
Feet (dorsum)	40	8

Thus in nearly three-quarters of all cases the crutch was involved, buttocks and belt area come next in order of frequency but lag far behind. In 165 cases, or 33.2 per cent of the total, the crutch was the only site involved. Many cases were seen, however, of florid, widespread infection.

With regard to clinico-pathological correlation, 3 points should be noted:

All pustular, indurated lesions were due to *TMA*.

In temperate climates *EF* lesions are restricted to crutch and axillæ. In the present series, however, many cases were seen of generalized infection with *EF*, involving such areas as waist, legs and dorsum of foot as well as crutch and axillæ, and indistinguishable in this respect from an infection with *TMA*.

With the exception of pustular lesions, no certain criterion was found for the clinical diagnosis of infection with a specific organism. Two tendencies, however, were observed. *EF* usually produced confluent lesions and *TMA* separate plaques, especially in the crutch; and observations on untreated lesions indicated that while *TMA* infections showed a tendency towards spontaneous healing within, at the most, ten weeks, *EF* infections might persist longer than this (in one instance up to ninety days).

Deep Tinea

The pustular, indurated lesions mentioned above as peculiar to *TMA* infections constitute a special dermatological problem. They occur in areas where hairs are well developed, especially the scalp (Kerion), the face (deep tinea barbæ) and the limbs (agminate folliculitis). The pubis may also be involved. The lesions appear as boggy, indurated, reddened areas, discharging thick yellow pus; they are usually painful and always resistant to antifungal remedies.

In the past it has been suggested that such lesions arise by secondary coccal infection of an existing patch of tinea. However, bacteriological examination of the pus in 36 lesions showed that pathogenic staphylococci were present in only 20, and hæmolytic streptococci in none. Moreover, in 14 lesions culture of the pus yielded *TMA* only (blood agar plates kept three days at room temperature, i.e. about 27° C.). In 14 lesions no *TMA* was found but it must be remembered that the recovery of bacteria was probably more efficient than that of fungi. It seem likely that pus can be produced by the fungus alone, without the assistance of staphylococci, and that it is a natural response by the body's defences to extension of a superficial fungus infection down the hair shafts.

Treatment.—It must be emphasized at the outset that tropical body ringworm is much more difficult to treat than the ringworm seen in temperate climates, and many remedies which would prove effective in U.K. are useless in the tropics.

Certain general principles are of fundamental importance:

Early treatment is essential: The men should be encouraged to report suspected tinea lesions early, but this cannot be relied upon and regular skin inspections are necessary to enable fresh cases to be detected. As a case can become generalized within a week, it is clear that inspection at intervals of more than a week is useless.

Treatment must be regular, applied three times every day, and prescribed only by the M.O. Continual vigilance is necessary to prevent slackness in attendance, self-treatment or treatment by the M.I. room orderlies.

Light duty is advisable for all but the mildest cases, and generalized cases require treatment in bed. Sedation may be necessary if itching is severe.

Cases should be seen by the M.O. at least every three days, and preferably every other day; this is to allow the detection of new lesions as soon as possible after they appear. For the same reason each man must strip completely when presenting himself for inspection as the whole of his skin should be examined at each attendance.

As regards antifungal therapy, numerous drugs were tested, but only the following are recommended:

Chrysarobin 4 per cent in Lassar's paste: This is the preparation of choice. Reactions are few and irritation very uncommon, and the therapeutic potency is very high. Occasionally resistant lesions will not respond to the 4 per cent paste and 6 per cent chrysarobin can then be used, but the risk of reactions then becomes appreciable. Painless erythema at the site of application, not accompanied by itching, is not regarded as a "reaction" as the word is used here and is not an indication for stopping chrysarobin.

This preparation has three disadvantages:

If it enters the conjunctival sac it will cause a severe conjunctivitis. Care is therefore required in treating lesions of the face.

It rendered the skin at the site of application abnormally photosensitive, so that a solar burn may be produced by a degree of exposure which would ordinarily be inadequate. This can easily be avoided by a few words of warning to the patient.

Chrysarobin is a crude drug. Its activity depends on its content of certain active substances, and this may vary slightly from batch to batch.

Phenyl mercuric acetate or chloride, 0.5 per cent in Eucerin or Lassar's paste: This is a most potent preparation but very prone to cause severe irritation and blistering at the site of application. It should only be used by an experienced dermatologist and is not suitable for use in M.I. rooms. If the mercurial is cut down to 0.2 per cent reactions diminish but so does the therapeutic power.

6 per cent salicylic acid and 12 per cent benzoic acid in a starch-paraffin paste: This is of high potency but very apt to cause irritation and burning, especially in the crutch, and this limits its use as a routine preparation.

Vehicles

Paraffin-starch pastes seem to be the most effective vehicles; they remain on the skin for long periods of time and are not easily washed away by sweat as are the newer water miscible bases such as eucerin. Paints, using such bases as alcohol, tinct. benzoin co., and chloroform, were found to be much less satisfactory.

The chosen preparation should be applied three times a day. Alternatively it can be applied in the form of a dressing, being smeared on a piece of lint and the latter secured in position over the lesion by adhesive plaster. Such dressings can be left continuously in position for up to ninety-six hours. This method is valuable for isolated lesions but becomes very time-consuming if the ringworm is widespread.

The total duration of treatment required, excluding cases of generalized or deep tinea, is usually between seven and ten days. It is advisable to continue for at least two days after the lesions appear healed. Treatment lasting less than seven days is likely to be followed by relapse.

No antifungal remedy is of any value in the treatment of deep tinea. The most

valuable agent appears to be local heat. Healing takes place, with scarring and loss of hair from the affected follicles, in five to eight weeks.

Foot Ringworm

Incidence.—This proved less easy to assess than the incidence of body ringworm, because of the uncertainty of clinical diagnosis. Eighty to ninety per cent of male B.O.R.s had interdigital lesions resembling those caused by fungus infection, but not all these could be shown to be of fungal origin. The problem was investigated as follows. A series of 35 men chosen at random was classified according to the state of their interdigital clefts and then cultured; the percentage of positive cultures for each class was worked out. The result is summarized in the table below.

	<i>Clinical</i>	No. cases	% + culture
Grade I	No lesion detectable	0	0
Grade II	Any one or two of the following: maceration, peeling, redness, fissures	9	22.2
Grade III	Maceration, redness and peeling all present	2	50
Grade IV	Vesicles, broken vesicles or ring formation of the elements described above	24	79

The probability of obtaining a positive culture can therefore be correlated with the clinical appearances. From experience with a larger series of men it is believed that the distribution of grades in the series above is not representative of that in the general population, and the true incidence of Grade IV lesions is probably about 50 per cent. It may be presumed that between 50 and 60 per cent of the population studied have foot lesions yielding pathogenic fungi on culture.

Ætiology.—Using the same abbreviations as in the case of body ringworm, the species distribution of infections was as follows:

<i>Fungus</i>	%
TMA	40
EF	43.7
TR	3.8
TI	12.5

It will be seen that *EF* and *TI* play a more important part in foot than in body infections.

Clinical Description.—The infection principally involved the toeclefts, especially the 3rd and 4th clefts on each side. The signs of infection have been mentioned above. In many cases the lesion extends from the clefts on to the dorsum of the foot or the flexures of the toes or both. Deep, itching vesicles on the sole of the foot are found in a few cases and such lesions invariably yield cultures of pathogenic fungi without difficulty.

Treatment.—Since ringworm of the feet is rarely incapacitating and is notoriously difficult to cure completely, suppression of the infection seems the ideal at which to aim. Relatively little attention was paid, therefore, to the problem of curative treatment.

(1) 2–4 per cent chrysarobin in Lassar's paste.

(2) Salicylic acid 2 per cent, benzoic acid 4 per cent in spirit.

(3) A proprietary foot powder containing 5 per cent methyl-p-hydroxy-benzoate and 5 per cent salicylic acid in talc.

The last was definitely less effective than (1) and (2). Treatment with a foot powder containing 5 per cent methyl-p-hydroxy-benzoate and 5 per cent salicylic acid in talc was unsatisfactory.

The Epidemiology of Fungus Infection.

It has been held for many years on purely clinical grounds that body ringworm is usually acquired by extension of infection from the patient's own feet. The present

investigation supports this theory. In the first place, foot infection (50–60 per cent) is commoner than body infection (33 per cent) and in the second place, of 43 cases in which fungi were cultured from both feet and body, 86 per cent yielded the same fungus from both sites.

On the other hand, a number of cases were seen with florid body ringworm but clinically normal feet. There must be, therefore, some source of infection besides the patient's own feet.

But from the favourable results of prophylactic trials aimed at reducing foot-to-body spread it may be inferred that this mode of spread is of great importance. Probably the endemic fungus infection is maintained by being spread from one man's feet to the next man's, with frequent extension from a man's feet to his body. Existing conditions favour such a spread, it could easily take place if an uninfected man were to receive back from the dhoby not his own socks but those of an infected man. This must occur frequently as socks and stockings are seldom or never marked. Other possible channels of foot-to-foot infection are the use of communal football boots and the practice of walking barefooted in barrack-rooms and shower-rooms. Owing to the technical difficulty of obtaining cultures of ringworm fungi in the presence of very large numbers of contaminant fungi it has not been possible to furnish mycological proof of the existence of these channels of infection; but the opinion of other workers in the same field strongly favours the possibilities mentioned above.

Body-to-body infection, which appears commoner in units with high rates of body ringworm, probably occurs via borrowed towels and clothes, especially communal sports gear, and is thought to be favoured by dissemination of fungi among the men's clothes during laundering. As the fungi concerned are very sensitive to heat, it is obviously important to ensure that all non-woollen articles are boiled during laundering.

The source of the widespread fungus infection of feet described above is of great interest, particularly if preventive measures are being planned. Evidence bearing on this problem has been obtained by comparing the species distribution of fungi cultured from the feet of recruits in U.K. with the distribution observed among soldiers in the Far East. The comparative figures are as follows:

			U.K.		Far East
No. of infections	...	...	39	...	80
<i>TMA</i>	%	...	0	...	40
<i>EF</i>	%	...	15.4	...	43.7
<i>TI</i>	%	...	74.5	...	12.5
<i>TR</i>	%	...	10.3	...	3.8

(The U.K. figures are the result of work by Major Slattery, R.A.M.C.)

From these results it is clear that, if the possibility of the conversion of *TI* to the closely related species *TMA* on entering a hot climate is excluded, most of the foot infections must have been acquired in the Far East. *TMA* infections are uncommon in U.K., either on foot or on body, except in persons in close contact with animals, which constitute the main reservoir of this infection in temperate climates.

The population studied in the Far East did not have sufficient contact with animals to make the latter a likely source of *TMA*. Nor were the local inhabitants considered a probable source, since the predominant fungus infection among them was *TR*. It was concluded that newcomers to the Far East probably acquired *TMA* from their previously infected fellows, and that the original source might have been animals, or possibly an endemic infection of humans in another tropical theatre such as India.

Prophylaxis of Body Ringworm.

Early prophylactic trials aimed at preventing spread from man to man by segregation of affected men in separate units. This proved to be an ineffective measure. The effect of frequent skin inspections, with the object of detecting cases as early as possible, was

then tried, but any beneficial effect on the ringworm rate in this trial was marked by the inadequacy of the treatment then in use. Finally, it was shown that in a unit with an initial body ringworm rate of 23 per cent, frequent skin inspections and effective treatment could reduce the rate to 15–18 per cent, while a further reduction was obtained by issuing to half the men a foot paint of the following composition:

Salicylic acid	—	2%	} in spirit
Benzoic acid	—	4%	
Brilliant green	—	0.1%	

This test group were told to apply the paint twice daily, irrespective of the state of their feet. The brilliant green served simply as a "marker" to show whether the paint was being used. In ten weeks the body ringworm rate in the foot-paint group fell to 4–6 per cent, while in the control group it fell to a much lesser degree, to 10–12 per cent. During these ten weeks new cases occurred in the foot-paint group corresponding in number to 5.5 per cent of its strength: in the control group the figure was 14.5 per cent.

This foot-paint therefore appears to be of some promise as a prophylactic agent, at any rate where close supervision is possible. It should be noted, however, that a trial of its use by troops under campaign conditions was much less encouraging.

Other prophylactic measures, such as boiling of clothes during laundering, have been mentioned above.

Prophylaxis of Foot Ringworm.

The experiment quoted above aimed at prevention of body ringworm by suppression of foot ringworm. Complete eradication of foot infection is probably impossible, but attention should be paid to the following points in its suppression:

Socks and stockings should preferably be washed by their owners as the risk of confusion in a laundry is very great. In any case, and especially if socks are sent to a laundry, disinfection (after washing) by exposure to the vapour of 40 per cent formalin for twenty-four hours is advisable.

All communal sports footwear, e.g. football boots, should be disinfected in this way after use.

BULLOUS IMPETIGO

Incidence.—This varies between 6 and 8 per cent among B.O.R.s. It is almost unknown in Asiatics and very rare among A.T.S. It is a disease of warm climates; it occurs during the summer in Hong Kong but disappears during the winter.

Clinical Description.—The distribution of the lesions in 95 cases was as follows:

Site	% of cases having lesions in this site
Axillæ	83.2%
Waist	12.6%
Crutch	6.3%
Other sites	16.8%

The initial lesion is a small papule which rapidly develops into a thin-walled bulla containing thin pus. The bullæ vary between 0.3 and 1.5 cm. in diameter. They soon rupture, and a crust forms at the site and is shed in about four days. Each lesion thus lasts, if treated, for about five days, but each untreated case lasts for about 12 to 18 days.

Ætiology.—95 intact bullæ, occurring in 65 cases, were examined. All contained large numbers of coagulase-positive staphylococci. In addition two atypical bullæ also yielded hæmolytic streptococci. 25 bullæ were examined by anaerobic culture but none yielded any anaerobic streptococci. Hæmolytic streptococci were commonly found in ruptured

bullæ, together with staphylococci; they are thought to be secondary invaders only. The causative organism of the disease appears to be a coagulase-positive staphylococcus.

Skin infection with staphylococci in U.K. is very commonly associated with the presence of staphylococci of the same type in the anterior nares. This is not the case among white troops in the Far East; pathogenic staphylococci were no commoner in the noses of cases of bullous impetigo than in the noses of the rest of the population. In 35 per cent of 54 cases of bullous impetigo, the nose contained staphylococci of the same type as those in the lesions; in the remaining 65 per cent the nose yielded either no staphylococci or staphylococci of a different type from those in the lesions, and in these some other source of infection must be sought.

From investigation of histories of contact, and of distribution of cases among men living in barrack-rooms, it is thought that the most important mode of spread is infection from case to case, rather than the production of many cases by infection from one nasal carrier.

Treatment.—The most effective treatment was penicillin cream, 500 units grm., three times a day for five days. Shorter courses than this led to high relapse rates. It is essential that the tops of bullæ should be removed as soon as they occur.

No satisfactory substitute for penicillin was found. Gentian violet, 2 per cent in water twice a day for five days, gave comparable results but appeared less reliable and caused troublesome staining of clothing. "Eau d'Alibour" which was claimed by some M.O.s to be of value was found to give results indistinguishable from those obtained by withholding all treatment. Cetyl-trimethyl-ammonium-bromide (CTAB) in 1 per cent solution occasionally gave good results but in most cases was of little value.

NON-BULLOUS IMPETIGO

This is much less common than the bullous variety and was found in 1.9 per cent of men inspected. The lesions were on the face in all cases and were typical of the ordinary crusted "impetigo contagiosa" seen in temperate climates. Cultures in 10 cases gave the following results:

<i>Staphylococcus aureus</i> only	...	...	...	3 cases
<i>Streptococcus pyogenes</i> only	...	...	...	2 cases
Mixed <i>Staph. aureus</i> and <i>Str. pyogenes</i>	...	...	...	5 cases

PRICKLY HEAT

This disease was only seldom encountered in a severe form; if the mildest, even symptomless, cases are included it is found in 28 per cent of B.O.R.s. It is uncommon among A.T.S. and among Asiatics it is a rarity, though it does occur.

It has been shown by other workers that the essential lesion is an obstruction of sweat ducts by keratin plugs. No difficulty was experienced in confirming the well-established observation that sweating is diminished in an affected area of skin.

It seems likely that the actual sensation of "prickling" is the result of secretion by obstructed glands. At one time it seemed possible that flushing of the skin could be the cause, but experimental hyperæmia, either induced by inhalation of amyl nitrite, or reactive following arterial occlusion, did not cause prickling.

Three cases of "tropical anhidrosis" were seen, two of whom had recently had severe prickly heat. Anhidrosis appeared to be complete, save on the face; however, experiments with the lanoline test described by O'Brien suggested that sweating was occurring at a greatly reduced rate, the moisture normally evaporating as soon as it reached the skin but accumulating when evaporation was prevented, by application either of grease or of a watch-glass to the skin. Lanoline appeared to be of little therapeutic value in this condition.