must be opened by preliminary scrubbing, otherwise the ointment cannot penetrate. Although this is impressed on the patient he often neglects it and so makes the treatment only partially effective.

Benzyl Benzoate Lotion: Equal Quantities of Benzyl Benzoate, Soft Soap, and Methylated Spirits.—This lotion I have used on children at a school clinic. In any case with open sores or septic infection of the burrows the lotion proved too painful. Application of soap and methylated spirits to a raw area was more than most children could bear, and I found that this factor alone nullified its effectiveness as a sarcopticide. Regular attendance at a treatment centre is difficult enough to get with a non-stinging application; it is well-nigh impossible with a "burning lotion"! Reference to the literature shows, too, that erythema of the skin, oedema of the prepuce and scrotum, and conjunctivitis have been noted in adults.

Benzyl Benzoate Cream.—Recently, in order to overcome the stinging effect of the lotion, benzyl benzoate has been incorporated in a cream (Touraine and Leroux, 1938). I have not used this preparation because it is much more expensive than the other sarcopticides. Published reports show, however, that it is an improvement on the lotion from the point of view of the "burning," and is also quick-drying.

Marcussen's Ointment: Ung. Pot. Polysulph. B.P.C., or Kathiolan.—I used this preparation on evacuated school children. It is said to be effective in twenty-four hours; also that the incidence of sulphur dermatitis is small. Among my cases three applications were usually necessary; I had no cases of dermatitis. But this treatment has, like ung. sulph., the disadvantages of being an ointment and therefore "messy" to use.

Sodium Thiosulphate 25% *with Hydrochloric Acid* 5%; *Rotenone Lotion.*—I have not used either of these preparations, but as they are present-day remedies I have appended references to them.

Conclusion

A new method of applying sulphur is outlined and compared with other modern methods of treatment. In my experience a really satisfactory treatment for scabies is a step on the way to control of the disease, in that it makes cure of the active case more certain. But the basic problem lies not in finding a cure for the active cases but in preventing the rapid spread of the disease, and this means control and treatment of contacts and control of the reservoir of the untreated. This is no easy matter, for it involves inspection of every member of a family in which a case of scabies has occurred; the efficient treatment or supervision of them as soon as the case has been diagnosed; and immediate disinfestation of all clothing and bedding. Even if applied only to children of school age this plan would be effective in reducing materially the incidence of scabies.

I should like to express my thanks to Dr. C. Metcalfe Brown, medical officer of health for Middlesbrough, for permission to publish this investigation, and to the Glaxo Laboratories for supplying me with the sulphur lather tablets.

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SCABIES TREATED BY A BENZYL BENZOATE EMULSION

BY

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The increase in the numbers of cases of scabies which has been reported from widely separated parts of the country (Gray, 1941; Corfield, 1941; Harris, 1941) presents us with a problem of considerable complexity and of no little importance to the maintenance of the sustained national effort demanded at the present time. Prolonged loss of sleep or the disturbed sleep produced by the almost intolerable pruritus in many cases cannot fail to have a deleterious action on the capacity of the worker, the efficiency of the soldier, and the morale of all, civilian and soldier alike. As Percival (1939) has said: "Under war conditions the consequences of the disease may be serious from a military point of view."

That this parasitic disease may become rampant throughout the country is obvious when one remembers the nucleus of infection known to exist in almost every industrial area, and considers the movements of population that are taking place now and which will increase as industrial mobilization gains momentum. Control of sufferers and adequate supervision of billets, with particular attention to those known to have been occupied by infected persons, are imperative, since "transmission takes place by sleeping with an infected subject or in an infected bed or by the wearing of infected clothes" (Parsons and Barling, 1933). In view of special acquaintance with scabies in children I would add the handling of infected articles, such as books or towels, by the school child and the conveying of the infection by him to an as yet scabies-free household. This is perhaps the most frequent means of spread under peacetime conditions, and it is not without significance now. A feature of the group of cases recently treated by us, with results summarized below, is the relatively high proportion of families with no history of previous infection.

This communication is an account of the results obtained from the first 100 cases treated with a benzyl benzoate emulsion ("proscabin," Bayer), and for comparison there is included a short survey of the last 100 cases of scabies treated by the sulphur inunction method. We feel that the urgency of the question and the undoubted advantages of this latest form of treatment justify the publication of the results of even such a limited group of cases. All cases were treated as notified and diagnosed and without any selection. The classification adopted was based on the distribution and extent of the disease and not on its character, whether burrows or vesicles or a follicular papular eruption predominated. Slight or early cases were marked such, and particular attention was paid to those having severe secondary infection—a relatively small number.

Outline of Treatment

Each patient received a hot bath and the body was well lathered with soap and scrubbed. The skin was dried and proscabin was brushed on to the whole body surface from the neck to the toes; parts badly affected received a second painting immediately after the first had dried. The previously worn clothing was then put on. Bath and painting were repeated on the second day and clean underwear used. Parents were advised to have bedclothes changed and disinfested. Two days later the child was examined, and when treatment had been successful it was usual to find that

scratching had ceased and that the areas of skin most involved looked dull and brown in contrast to the bright pinkish points normally distributed freely in the scratched areas. Each child was re-examined after four days and again a week later. Subsequently the number of examinations was curtailed by omitting the second. The crusted or pustular areas of secondary infection were treated with a 1% ammoniated mercury ointment, after completion of the proscabin treatment. Under the procedure now in operation a child can be pronounced free from infection on the fifth day after diagnosis—that is, three days elapse between the signing of the exclusion form (school) and the issue of a return-to-school certificate, on two of which days proscabin is being applied. If a second course is deemed necessary the child can be passed fit for school on the ninth day. These results compare favourably with Canadian experience (Ministry of Health Memorandum, 1940). All cases are, of course, being observed one week later as a precautionary measure (Table I).

TABLE I.—*Benzyl Benzoate Cases*

Group	Number of Benzyl Benzoate Courses	Distribution of the Infection			Totals	Having Secondary Infection	Later Sulphur Inunction	Previous Infection with Scabies	Number of Defaulters
		Trunk and Limbs	Limbs Only	Slight Cases					
I	1	40 (57·1%)	10 (83·3%)	17 (94·4%)	67 (%)	4 (%)	13 (%)	9 (%)	2 (%)
II	2	26 (37·2%)	2 (16·7%)	1 (5·6%)	29 (%)	6 (%)	4 (%)	13 (%)	0
III	3	4 (5·7%)	0	0	4 (%)	0	0	0	1 (%)
Totals		70(%)	12(%)	18(%)	100	10(%)	17(%)	22(%)	3(%)

It will be noted that the group requiring one course comprised 67% of the total cases treated; 29% required two courses before being pronounced free from infection; while four cases (4%) were given three courses. The proportion of cases given two courses is higher than it might have been because a misunderstanding on the part of the nurse attendant led to the omission of the preliminary bathing in about twelve cases. Most of these were early and mild, and it was the failure of cure to take place immediately—an expectation based on earlier experience—which led to the omission being discovered.

Twenty-five of the Group II cases were classed as not cured after one course of proscabin, and four were regarded as possible reinfections, recurrence taking place after an interval of one week or more. In this connexion I would like to emphasize the importance of having the everyday outer garments disinfested as well as underwear. Recurring infection of the thighs and groin from trousers (usually worn without underpants in most of our cases) and of the wrists from dirty and contaminated sleeves is of particular importance among poor children who have one suit of clothes only.

It will be noted further that seventeen cases of the one hundred treated were given sulphur inunction subsequent to benzyl benzoate. The ointment was applied solely to the cases in which itch continued, and only to the parts which are known to be particularly resistant to treatment and to be likely to harbour residual infection—namely, the thickened papule-ridden folds at the wrists, elbows, ankles, and groin. Thirteen of Group I cases (19.4%) and four of Group II cases (13.8%) were given such additional treatment. It is probable that a second course of benzyl benzoate might have cleared a number of those in Group I without the assistance of sulphur ointment, and we are proceeding along these lines now. The incubation period of the ova being three to three and a half days (Gray, 1933), it is not unlikely that, if any ova remained viable within the thickened skin, larvae might appear after the completion of the single course of benzyl benzoate. Sulphur ointment was therefore prescribed as a prophylactic and precautionary measure.

I have already mentioned that quite a number of the cases which came under observation were from previous scabies-free households; these amounted to 88% of the total. The remaining 12% had had anti-scabies treatment within the preceding two years, and some were the victims of repeated attacks. In the group receiving only one course of benzyl benzoate there were nine cases (13.43%), while in the smaller Group II there were thirteen cases, or 44.82% of the group. These habitual sufferers formed almost half of the group which required two courses; they are the most difficult to cure and the most prone to reinfection. Default was practically negligible, only three cases being recorded. Two of these were due to intercurrent infection (mumps); the third patient was unwilling to attend after initial treatment.

Sulphur Inunction Cases

For comparison with the above and with particular reference to the length of time required to effect cure I include a brief summary of the last 100 cases treated by the sulphur inunction (ung. sulph. 5%) method. These cases are arranged according to the length of time between exclusion from school on account of scabies and the issue of a return-to-school certificate (Table II).

TABLE II.—*Showing Length of Time to Effect Cure with Sulphur Inunction*

Distribution of Infection	Cured within One Week	Cured within One to Two Weeks	Cured within Two to Three Weeks	Cured within Three to Four Weeks	Requiring Four or More Weeks	Prolonged Absence (Illness, etc.)	Recurrences with Distribution of Infection			Totals
							1st Infection	2nd Infection	3rd Infection	
Trunk and limbs	7	16	17	12	15	6	11	10	1	84 (%)
Limbs only	6	5	4	0	0	0	1	2	1	16 (%)
Totals	13(%)	21(%)	21(%)	12(%)	15(%)	6(%)		12(%)		100

It will be seen that only 13% of this series were reported fit to attend school after one week's treatment, as compared with 67% of the benzyl benzoate group, an as many as 15% were still uncured four weeks after diagnosis. These results cannot be used as a valid criticism of the efficacy of sulphur inunction, but they illustrate the difficulties of this method for out-patients who are receiving voluntary treatment and of whom many are apathetic and non-co-operative. As an indication of the position ten children in the "two to three weeks" group received no treatment on eight days or more of that period, so that in addition to week-ends without treatment each of these was absent on several days at least, usually irregularly and quite often at the most active stage of the treatment. Default during treatment reached even higher proportions in the "three to four weeks" and in the "four weeks and over" groups. Irregular attendance at the clinic, principally due to the dislike many of the children have for this rather greasy and odoriferous treatment, and the prolongation of the course which default entails, are responsible for the deplorable figures that we have to record. That our experience is not unique is suggested by the recent Rotherham view that "the usual method of dealing with scabies . . . is not only inadequate but is, in the majority of cases, a futile expression of hope" (MacDonald, 1941); while Potts, referring to his cases in Yorkshire, complains also of the difficulty of obtaining thorough treatment in the early stages of infection (*Medical Officer*, 1940). With regard to the

twelve recurrences recorded, all took place after an interval of one month or more from cessation of treatment for the previous attack ; one case had had two previous attacks.

Conclusion

In my opinion the introduction of the benzyl benzoate treatment is an important advance in the treatment of scabies, and it is particularly valuable where large numbers are infected. The ease and speed with which the applications can be carried out, the absence of unpleasant effects apart from a temporary prickly sensation during the painting process, the rapidity of cure, and the almost immediate relief from itching combine to make it a satisfactory remedy from both the clinical and the public health aspects.

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THE TRANSMISSION OF SCABIES

BY

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There has been a good deal of controversy concerning the way in which scabies is transmitted. Much importance has been attached to blankets, and an extreme view is expressed by Lydon (1941), who says that, at least in the Army, "it cannot be stressed too strongly that blankets are the chief means of spread of scabies infection, and unless strict control is instituted cases will continue to appear in their present numbers." The view that blankets are a common method of transmission is widely held in the Army, and the first reply made to the medical officer by the scabies patient when questioned concerning infection usually suggests that blankets were concerned—even from men recently on leave to homes ridden with the disease. On the other hand, certain workers, particularly those in France, have considered that scabies is primarily spread by personal contact, and have suggested that it may be considered as a venereal disease. Working under controlled conditions, Munro (1919) has shown that scabies may be transmitted by fomites, but his results do not indicate how often such transmission is likely. The experiments described here are part of an investigation to find out exactly how the disease is normally transmitted.

These experiments were made using volunteers who lived under controlled institutional conditions and who were subjected to different types of contact with scabies infection. The volunteers were all pacifists who had offered to co-operate in this work and who, during the experiments, received board and lodging and a weekly payment similar to that which they would have received had they been called up for military service. They agreed to submit themselves to infection and to allow the course of the disease to be followed on their persons. Throughout the experiments the volunteers co-operated loyally, and I have had no reason to suspect that all instructions were not always conscientiously carried out. The expenses of the investigation were paid by the Ministry of Health.

Experimental Work

Fomites.—The volunteers were put in contact with blankets and underclothing previously used by scabies patients. Care was taken to use fomites only from patients about whom there was no doubt of the diagnosis of scabies. Where bedding was used it had normally been in contact with the patient for several weeks, and for the last twenty-four hours before transfer the two inside blankets in contact with the patient were the same as those subsequently in contact with the volunteer. In most of the experiments using blankets alone the volunteer was naked so as to ensure contact. The volunteer never bathed for a period of at least a fortnight after the beginning of an experiment ; and later, when it was felt that it might be a disadvantage for him to start with too clean a skin, bathing was prevented for a further week before the experiment started. Bedding and underclothing were used by the volunteers for a period of seven days, the bedding being slept in at night only, whereas the underclothing was worn continuously, day and night. In the earlier experiments the blankets and underclothing were kept for periods of several days under conditions of known temperature and humidity. I hoped thereby to discover how climatic conditions influenced the infectivity of the materials. When a dozen or more experiments had been made without infecting the volunteers it was thought best to work under conditions which would appear to offer the maximum chance of infection. The results obtained in all these experiments may be summarized as follows :

(*a*) Volunteer used blankets one to seven days after they had been used by scabies patient: 6 experiments, all negative (i.e., no volunteers infected).

(*b*) Volunteer used underclothing two to seven days after it had been used by scabies patient: 6 experiments, all negative.

(*c*) Volunteer used bed immediately it was vacated by scabies patient: 19 experiments, all negative.

(*d*) Volunteer used underclothing immediately after it was removed from scabies patient: 32 experiments—30 negative, 2 *positive* (i.e., 2 volunteers became infected).

The men were stripped and inspected daily for a period of about a month (sometimes longer) after each experiment. The inspection took several minutes, and any suspicious lesions or areas in which irritation was felt were scrutinized with a high-power lens or a binocular microscope. Although work at present in progress shows that in some cases at least seven weeks may pass before *clinical* signs of scabies develop in an infected volunteer, some signs of infection are always visible to careful inspection at an earlier date, and, considering the care with which the daily inspections were carried out, I do not think it would be possible for any inspections to have been missed. Furthermore, the same men were used throughout the whole series of experiments, so that a slowly developing case would have eventually been detected.

Personal Contact.—When two infected volunteers were at last obtained it became possible to test the effects of personal contact. On four occasions uninfected volunteers slept together in the same beds as these men suffering from scabies. The scabies patients both had a general infection of the body (this was two to three months after their contact with infected underclothing), and the disease would probably have been detected at a routine inspection such as is commonly held in the Services, but the degree of infection was very much less than that usually seen in patients coming for treatment. The men wore pyjamas during these experiments. In three instances the volunteer and the infected man slept together for seven nights, and mites were found on all three volunteers after periods of