1914 the work has continued to increase, the average of admissions has been 680 a year, and admission has had to be refused almost daily for lack of beds. There has been an average abnormality of 37 per cent. The death rate has been 21 per 1,000, and the operative work is about double the amount of the previous ten years, and goes on increasing. A very large proportion of the cases of eclampsia that occur in Liverpool are treated in our hospital; in 1917 there were in Liverpool 6 deaths, 5 in hospital; in 1916 9 deaths, 6 in hospital; in 1915 7 deaths, 3 in hospital. I would draw attention to the figures connected with eclampsia in the first twenty years—42 per cent. were fatal. In the last fourteen years 22 per cent. died.

I think no one can avoid concluding that there is a rapidly increasing call for hospital treatment. Sepsis in cases dealt with entirely in hospital has almost disappeared. There can be no doubt that we are now saving many lives both of mothers and children by the increased possibilities of abdominal surgery; every year Caesarean section is increasingly resorted to, and its field extends. At the beginning of the period I review it was limited to cases which could not possibly be delivered any other way, and for some time only extreme deformity was considered to justify the operation. We have done it successfully for rupture of the uterus, for concealed accidental haemorrhage, for placenta praevia, and it has been done for eclampsia and for cases in which renal disease has caused oedema and threatened eclampsia. Our fatal cases have been mostly those in which attempts had previously been made to deliver, or in almost hopeless cases of ruptured uterus.

Another, and perhaps the greatest, advance in the past few years has been the systematic measuring, especially of primiparae, at the hospital and at the pre-maternity centres; many cases are found with unsuspected pelvic deformity of the minor degree in which a judicious induction about three weeks before full time results usually in a comparatively easy confinement and a live child. High forceps cases become less and less frequent.

What may we look for in the future? Is midwifery to leave the general practitioner altogether? I think most of them look upon midwifery as a nuisance, and in the advertising columns of the medical papers "no midwifery or very few" seems to enhance the chance of a sale. I think few in Liverpool will collect 3,900 cases like Dr. Park.

Is midwifery and infant welfare to become a branch of the public health service? The supervising authority is already in charge of 83 per cent. of the births in Liverpool. No specialist in obstetrics could make a living out of it alone, for the bulk of the operative work is among those who expect the State to provide, and those who can pay are limiting their families, so the two specialties must, for economic as well as other good reasons, be practised together.

From another point of view, the more one sees of confinements the less one likes the makeshift arrangements that are usually considered sufficient in private practice. There is no doubt that the training of the midwife has lessened the mortality from sepsis, but I should like to see all women attended under hospital conditions, and all labours conducted with all the care and preparation that are given to any serious operation in surgery. There can be no greater loss to the State than by carelessness in midwifery; no loss is so sad as the death of a young mother. Further, even short of death, the injuries and incapacities inflicted on women in childbirth and on the children themselves are a matter of most urgent consideration.

CONCLUSIONS.

1. The results of obstetric practice remain unsatisfactory; the death rate from childbirth, largely preventable, remains too high; too many injuries follow, too many children are lost and injured.
2. More adequate hospital accommodation is required.
3. Midwifery is passing into the hands of midwives and specialists.
4. Adequate and complete training in midwifery for all medical students is impossible even with increased hospital beds, and is not necessary for all, as many will never practise obstetrics. As to this last clause I hold no very fixed convictions.

D

EXPERIMENTS ON THE DESTRUCTION OF LICE AND NITS.

I.

THE SURVIVAL PERIOD OF LICE AND NITS (*Pediculus humanus*) WHEN SUBMERGED IN TAP WATER AND WATER CONTAINING 1 PER CENT. OF SALT AT VARIOUS TEMPERATURES.

BY

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THE series of experiments with which this paper deals were carried out in order to test the correctness of a claim made by an official of the London County Council that an effective method of dealing with verminous sheets was to soak them for twenty-four hours in water containing salt in the proportion of 1 lb. to 10 or 12 gallons of water; the temperature of the water was not stated.

METHOD.

The method adopted was to immerse nits on slips of army shirt flannel and active lice on similar material in tubes containing tap water or 1 per cent. salt solution kept at various temperatures. The number of nits available for the trials, owing to other calls, was somewhat restricted, and in consequence of the females crowding their eggs into small clusters, the numbers used for the different tests varied from 36 to 120, with an average of 72. In the case of eggs immersed at 30° F. and 46° F. the batches were divided, one-half being removed for incubation after 50 hours and the remainder at the end of a week. The number of active lice in each trial was 20 to 25. The plan adopted was to remove a few at a time, dry them on filter paper, and place in card boxes kept at 82° F. The period needed for revival of the apparently drowned lice was generally not more than an hour, but in several instances revivals took place after 3 hours, and in two cases after 5 hours (at 60° to 63° F.).

Active Lice.

At 91° F. no mortality resulted from four hours' immersion; after 7 hours 4 out of 5 removed from the salt solution recovered, but only one out of the same number taken from the tap water. None survived 24 hours in either tap or salt water. At 82° F. all were killed within 31 hours. At 60° to 63° F. all of the lice removed after 19 hours from both tap and salt water recovered; single lice removed after 46 hours revived, but all the remainder (over 50 per cent.) were dead when removed after 47 hours. At 46° F. no mortality occurred among samples of 6 lice removed from both salt and tap water after 19 hours, nor among further samples of 5 taken out after 47 hours, but after 67 hours 1 out of 3 had been killed by immersion in tap water, though all of a similar sample from the salt water revived. Samples removed after 96 hours from both tubes were dead, as were also the remainder taken out after 168 hours. At 30° F. 4 out of 7 revived when taken out of salt water after 67 hours, and 2 out of 3 removed from the tap water; of the remainder, after 168 hours' immersion, 1 out of 18 survived the effects of salt water, but all of the 17 in tap water were killed.

Nits.

Four per cent. hatched after 22 hours in salt water at 91° F., but none in tap water. At 82° F. 45 per cent. survived 26 hours in salt water and 53 per cent. in tap water. At 60° to 63° F. 68 per cent. hatched after 45 hours in salt water and 42 per cent. after a similar period in tap water. The figures at 46° F. were, in salt water 75 per cent. after 50 hours and 5 per cent. after 168 hours, while in tap water at this temperature 72 per cent. hatched after 50 hours but none after 168. At 30° F. 76 per cent. survived 50 hours in salt water, but all were dead after 168 hours; in tap water at 30° F. only 58 per cent. hatched after 50 hours, but 18 per cent. survived 168 hours' immersion.

It will be noted that for both lice and nits the survival period increased with the decrease of temperature, presumably owing to the slowing down of physiological action due to cold rendering their need for oxygen less acute. The nits showed a much longer survival period than the active lice. As regards the practical point at issue, no apparent advantage is gained by the addition of salt, plain tap water giving results just as good, and in some cases better. Temperature, however, proved to be a very important factor. It is quite within the bounds of possibility that the practice of immersing sheets in salt water gave successful results during hot summer weather, active lice being destroyed, and nits, if present, failing to hatch owing to the want of the continued heat necessary for their incubation; but the evidence obtained shows that no reliance can be placed on the simple soaking of verminous textiles in water even for so long a period as 24 hours unless the temperature of the water is above 90° F.

II.

EXPERIMENTS CONCERNING THE DESTRUCTION OF ACTIVE LICE (*Pediculus humanus*) BY SOLUTIONS OF CRESOL SOAP EMULSION AND LYSOL, AND OF LICE AND NITS WITH KEROSENE, WITH A VIEW TO THE USE OF THESE REMEDIES FOR THE TREATMENT OF VERMINOUS HEADS.

BY

A. BACOT, F.E.S., AND CAPTAIN L. LLOYD, R.A.M.C.(T.).

IN a previous paper dealing with the destruction of the nits of *Pediculus humanus*¹ our object was to ascertain the value of cresol soap emulsion and lysol as an aid to military officers in charge of baths and washhouses in ridding garments of lice and nits. The present paper is published rather with a view to assist civil authorities by indicating what reliance may be placed upon these and other means for the treatment of verminous heads, together with the modifications of the methods of application necessary to ensure the greatest efficiency.

It was assumed in our previous work that active lice would be less likely to survive the combined processes of washing and immersion in dilute lysol and cresol than their nits, and if the period of starvation that this process and laundering together involve be allowed for, our assumption was probably correct. When, however, we tested these means of louse destruction for verminous heads, which after a thorough sponging with cold dilute lysol were rinsed with water till they were free from the disinfectant, we found that lice proved more resistant to the treatment than nits, and suffered but little from it. This induced us to begin again experiments *in vitro* in order to discover the potency of the various factors which might play their parts in affecting the toxic action of the solutions. The effects of varying the time of immersion, the temperature and strength of the solution, as well as the method of experiment, were studied. Lysol solutions alone were used in the earlier experiments.

The first method of experiment adopted was to drop active lice free into the solutions, and at the end of the immersion to place them on filter paper to drain in an incubator at a temperature of 80° F. The result was judged at the end of twenty-four hours after their removal from the solutions.

First Series of Experiments.

In the first series the effect of varying the strength of the solution and the time of immersion was tested, the temperature of the solution being roughly constant at 65° to 68° F. Immersion in solutions of 0.5 per cent., 1 per cent., and 2 per cent. strength for 30 minutes showed a mortality of 1 out of 25 in the 2 per cent. solution only. This was apparently, however, a chance result, as none were killed in the 2 per cent. solution after a 40 minutes' immersion, though 2 out of 10 died as a result of 60 minutes' exposure to the same conditions.

A 3 per cent. solution killed 1 out of 5 after 30 minutes, and also gave the same result after 60 minutes. At 4 per cent. 2 out of 5 were killed after 30 minutes, and none out of 5 at 60 minutes. A 5 per cent. solution killed 3 out of 5 in 30, and only 1 out of 5 in 60 minutes. With a 7.5 per cent. solution 3 out of 5 died from the effects of 30 minutes', and 5 out of 5 from the effects of a 60 minutes' immersion. A 10 per cent. solution killed 4 out of 5 in 30 minutes and 4 out of 5 in 60 minutes.

It will be seen from these figures that the results were erratic, 60 minutes' immersion in 4 per cent. and 5 per cent. solutions being less effective than 30 minutes, while some lice survived the apparently drastic treatment of 30 minutes' immersion in 7.5 per cent. and 10 per cent. solutions of lysol.

Second Series of Experiments.

In the second series the effect of varying the temperature of the solution and keeping constant the strength of the solution at 2 per cent. and the time of immersion at 30 minutes was tried, the treatment of the lice after removal from the fluid remaining the same. In the first three tests at 65° F., 74° to 79° F., and 79° to 86° F., none were killed. Of the batch immersed at 84° F., rising to 93° F., 40 per cent. were killed. Of the next three batches, immersed respectively at 97° F., 86° F., rising to 99° F., and at 99° F., 60 per cent. were killed; while the mortality in the remaining five tests, the lice being immersed respectively at 100° F., 99° F. rising to 102° F., 102° F., 93° F. rising to 104° F., and 104° F., was 100 per cent.

In this case the results showed a steadily increasing toxicity as the temperature increased from 86° F. to body heat. At 100° F. and upwards the mortality was constantly 100 per cent. Such brief immersions in water at 104° F. have no ill effects upon lice.

From the foregoing facts it seems clear that if lice are immersed in fluids at temperatures somewhat below that which they experience on man they are able, within limits, to resist their penetration. If, however, garments infested with lice are immersed in a 2 per cent. solution of

lysol at 100° to 104° F. for 30 minutes they are rendered safe whatever the subsequent treatment may be, since the lethal point for both lice and their nits has been passed during the immersion. From these two series of experiments the conclusion drawn is that the raising of the temperature gives a more certain result than increasing the strength of the solutions in question or the period of immersion.

The aim of a third and fourth series of trials was to test the effect of lysol or cresol when allowed to remain in the fabric on active lice that had presumably survived the period of immersion but were not removed from the impregnated garments.

Third and Fourth Series of Experiments.

The method adopted was to put slips of army shirt flannel on which a number of active lice were placed into solutions of varying strength and temperature for 5, 20, or 60 minutes; then to allow the excess fluid to drain off by laying them on filter paper, after which the slips were put into card boxes and kept at 65° F. for 20 to 24 hours; the general scheme of the experiments being to use such conditions as would probably apply if verminous garments, after dipping, were allowed to dry without further washing or rinsing. The fluids used were 1½ per cent. and 2 per cent. dilutions of lysol and liquor cresoli saponatus fortis, each series of trials being repeated at 32° F., 59° F., 69° F., 82° F., and 97° F. respectively. The results of this lengthy series, amounting in all to 60 separate experiments, show that 20 minutes in 2 per cent. solutions of either cresol soap or lysol at 68° F. or over, and 60 minutes in 1½ per cent. solutions at 32° F. and upwards, will kill all the active lice under these conditions.

It appears, therefore, that if it is not possible to use heated solutions, the complete disinfection of garments or bedding may still be achieved with cold solutions, provided that their strength is not less than 1½ per cent. with an immersion period of one hour, and that the solution remaining in the fabric after dipping be allowed to dry in.

The Destruction of Lice and Nits in Hair.

That the conclusions respecting the use of heated solutions of cresol soap or lysol do not apply equally to the destruction of lice in hair is shown by the following experiment:

Two muslin bags, each containing 20 active lice, were bound close to the scalp of a man with a heavy crop of hair, and two cotton threads covered with nits were similarly fastened amongst his hair. The hair was then continuously sponged for 30 minutes with a 2 per cent. solution of lysol, which had at the commencement a temperature of 104° F., falling to 91° F. at the end of the operation. The head was then washed with water, the lice were removed and placed in an incubator, while the nits were incubated on the body. Two of the lice, one male and one female, survived, but none of the treated nits hatched. A control series of eggs of the same parentage hatched normally.

A certainly effective result cannot therefore be obtained for head infestation by sponging the head with 2 per cent. lysol, either warm or cold, if the sponging is followed by an immediate rinsing of the hair.

The crucial point seems to be indicated by the following experiment:

A piece of flannel, containing 40 adult lice, was immersed in a 2 per cent. lysol solution at a temperature of 68° F. for 30 minutes; 20 of the lice were then removed from the flannel, drained, and placed in an incubator. Of these, 90 per cent. recovered. The flannel, without rinsing and with the remaining 20 lice upon it, was also incubated, and none of the lice recovered.

An obvious explanation of these results is that the lice are not passive but active factors in the process, possibly protecting themselves against the entrance of fluids into the system by closing their spiracles. If the period of immersion is short, lasting for a few minutes only, no penetration occurs, but when it is prolonged, or if the temperature is sufficiently high to allow of the insects' metabolism being maintained at its normal speed, the need for oxygen leads to attempted breathing, and the fluid finds entrance through the tracheal passages, killing in a longer or shorter time, according to its toxicity.

Such an explanation would also account for the irregularities of the results shown in Series 3 and 4 when experimenting under cool conditions. The results, as noted above, obtained by Bacot and Talbot, working with lice immersed in tap water at various temperatures, are confirmatory in that they bring out clearly the lengthening survival period due to cooler conditions, presumably due to

the slowing down of physiological action; while the evidence obtained by the authors in sterilizing lice outwardly by immersion in lysol solution in connexion with trench fever research also points in the same direction.

In order to obtain further evidence on this question, which is of great importance from the point of view of the treatment of verminous heads, the following experiment was made:

EXPERIMENT V.—Effect of Immersion in Kerosene.

Kerosene as supplied at retail shops was used at a temperature of 20°C. (68°F.), the period of immersion being 5 minutes. Most of the lice made active movements while immersed, and one or two made slight movements immediately after removal.

METHOD.

Active Lice.

Active lice were placed on slips of flannel shirt material on which nits had been laid by a number of females during a period of one week.

First Batch (16 adults, 6 nymphs, 3 larvae).—After immersion the slip of flannel was laid for 10 minutes on filter paper to drain, then put into a cardboard box and kept in incubator at 80°F. No recovery.

Second Batch (10 adults, 6 nymphs, 9 larvae).—After immersion the lice were removed to filter paper, dried off and placed on a fresh slip of flannel in a cardboard box and kept in incubator at 80°F. When examined 18 hours later 6 were living (2 feeble and 4 nearly dead), 19 dead. The survivors died without recovering full activity.

Third Batch (7 adults, 5 nymphs, 9 larvae).—After immersion the lice were placed in soapy water at 82°F, then transferred to clean water at the same temperature and drained off on filter paper, transferred to a fresh slip of flannel in a cardboard box and kept in incubator at 80°F. On examination 18 hours later 2 (nymphs) were active, 2 were feeble, 8 very feeble, and 9 dead. The survivors died within 48 hours, but as no attempt at feeding was made it cannot be concluded that the nymphs which recovered their activity died from the after-effects of their immersion, though this is probable.

Nits.

These received similar treatment to the active lice, save that in the case of the second batch a number of the eggs were removed from the flannel to which they were attached, and incubated apart from the remainder, which were left attached to it. The results were as follows:

First Batch (170 nits).—None hatched.

Second Batch (191 nits).—101 nits were removed from the flannel; of these 82 hatched; 90 nits were left on the flannel, which was drained of oil so far as possible by gentle pressure between filter paper; only 2 hatched.

Third Batch (182 nits).—At least 3 of these eggs developed, but the young lice died during the process of emergence from the egg. None of the remainder hatched.

Conclusions.

That fatality to active lice following immersion in kerosene is due rather to the oil on the surface of the insect or the object to which it clings obtaining entrance to its body after removal from the fluid than during the short period of immersion.

As regards nits, penetration by kerosene is too slow for its entrance into the egg to occur within the few minutes of immersion, but subsequent to their removal the fluid or its vapour inhibits development. In the case of Batch 3, the subsequent washing produced some modification in the egg or its membranes, which prevents normal hatching on the part of the young louse.

In view of this experiment it seems clear that the explanation as set forth above in regard to the closing of the spiracles against the entrance of fluids must be correct, and that provided the insects are not rendered too sluggish to react owing to cold or prevented by their need for oxygen, they can resist the entrance of fluids into their bodies. Probably the action is not volitional, but a necessary reflex (similar to winking) evolved to guard against the dangers arising owing to sudden submersion in sweat.

In the case of nits, where the question of penetration seems likely to be largely a matter of surface tension due to the nature and temperature of the fluid, possibly conditioned by the stage of development which the eggs have attained, it seems possible that eggs that are wetted by the fluid but not entirely immersed, may be more readily penetrated than those completely immersed, while the possibility must be considered of death resulting from the vapour rather than the fluid itself finding entrance into the egg.

REFERENCE.

¹ Bacet and Lloyd: Destruction of Nits of the Clothes Louse by Solutions of Cresol Soap Emulsion and Lysol, BRITISH MEDICAL JOURNAL, April 27th, 1918.

A Bulletin of the Air Medical Service will shortly be issued by the United States. It will be under the authority of the Director of the Air Service, and will make public the results of studies and experiments made by medical research laboratories.

RADIUM IN THE TREATMENT OF TUBERCULOUS ADENITIS.

BY

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THE therapeutic properties of radium have always been a fascinating subject, both to the medical profession and the laity, and the medical profession have by no means, I think, reached the limits of the subject yet.

During 1913-14 I thought I would see what could be done for tuberculous glands by radium. As a result I am convinced that the day of radical operation will soon be past, that it will no longer be necessary to send children thus affected for prolonged periods to the seaside, and that the unsightly scars which disfigure the necks of so many girls can now be avoided. Radium is, if properly used, a safe, and as far as I can see a certain, cure, whether for an early or an advanced case of tuberculous glands. Within the period named I treated between twenty and thirty cases of every grade with radium. In every case the swellings and even old sinuses faded away. Unless there were already sinuses present, no scars were left. The skin was in some a little red for a few weeks from the action of the radium, but this always disappeared.

In no case was any ulceration caused. It is unnecessary to describe all the initial experiments and the doses used. As a result I find as follows:

Fifteen milligrams of radium bromide, spread out on a flat circular applicator $1\frac{1}{4}$ in. in diameter, and mixed with a special varnish to keep it even and prevent loss, is sufficient for this kind of treatment. The applicator has a screen of silver 1 mm. thick, and a piece of thin gutta-percha tissue tied over the whole to prevent soiling of the radium. The applicator is strapped on over the tuberculous glands. I have found ten hours a suitable time for each application of the above strength—that is, 150 milligram hours. The applicator is applied when the patient goes to bed and taken off in the morning. A different gland or group of glands can be attacked at each sitting till all have been covered, and the course then started again.

The patients usually have had two applications a week. Nothing was noticed for from a week to ten days, but from that time a gradual shrinkage of the glands was observed till nothing could be felt except a few fibrous nodules. I continue the treatment till all signs of trouble have disappeared. In very bad cases I usually gave in addition a few applications three months later, but doubt whether this is really necessary if the first treatment is properly carried out.

Since my demobilization from the R.A.M.C. I have had an opportunity of inspecting many of the patients I treated in 1913-14. In none of them can I find a trace of any further trouble, nor have I heard of any I have not actually seen having any signs of recurrence. Evidently, therefore, the cure is usually a lasting one. Should a case recur, I have no doubt that a further course of treatment would restore the patient to health again.

I will briefly quote three typical cases to illustrate the different degrees of the disease treated.

CASE I.

A boy aged 4. Early tuberculous glands of the left tonsillar and carotid region; no obvious signs of softening.

He had five applications of 15 mg. of radium, ten hours each application, at intervals of seven days. At the end of this time all signs of the disease had disappeared.

CASE II.

A woman, aged about 30, had had a swelling on the right side of the neck for a year. It had been treated by iodex, tonics, change of air, and all the usual remedies. When I first saw her the mass of glands was nearly the size of an orange, and there were marked signs of caseation; I was, in fact, afraid lest they would break down and suppurate through the skin before the action of the radium could have much effect. Her general health had suffered considerably.

I treated her twice a week with 15 mg. of radium, ten hours each time for ten sittings. There was an interval of a month, while she was paying a visit, in the middle of the treatment. At the end of that time the neck was perfectly normal. Fortunately the radium began its work before surface suppuration had occurred; I saw her three months later, and she was