DISCUSSION

James R. Busvine.[1] *Appropriate formulations of insecticide for different louse control situations.* The form in which an insecticide is applied for the control of lice is very nearly as important as the potency and safety of the compound used. Quite different formulations are required for maximum efficiency in different infestation situations, which will now be considered.

Widespread louse infestation with possible risk of louse-borne disease

There is no doubt that a powder preparation is most efficient for dealing with the threat of epidemic louse-borne diseases. This has been demonstrated several times, beginning with the dramatic quelling of the typhus epidemic in Naples in 1943. The advantage of the powder preparation is that it can be applied very rapidly to infested people without the complication of their undressing. Hand-dusting guns applied to openings in the clothing are quite adequate, but the use of dusting pistols, operated by compressed air from a portable compressor adds extra efficiency (*5*). In addition to dusting for body lice inside the clothing, the hair and headgear should also be dusted if head lice are common. In the Naples epidemic, about 40 delousing stations were set up by the U.S.A. Typhus Commission, so that the numbers of people treated daily reached a maximum of 70,000. (Unfortunately, a full account of that epidemic does not seem to have been published (*1*).)

Various contact insecticides, safe enough to be used next to the human skin, can be used in such powder formulations. Some residual action is desirable to protect treated people from rapid reinfestation. Conditions of general lousiness are likely to occur only when people very seldom change or wash their underwear. Consequently, some of the powder may remain in the garments for a week or two. The residual protection obtained in this way is an additional advantage of the method over heat or fumigation delousing, as practiced during and after World War I.

People treated with powder insecticides show obvious signs of being deloused by the presence of traces of dust in their clothing and hair. In normal circumstances, this would be resented and people would try to avoid treatment, but in the presence (or threat) of typhus or relapsing fever such scruples are overcome.

Protection of personnel in conditions of general lousiness

Allied troops who landed in Europe towards the end of World War II were all supplied with DDT-impregnated underwear which protected them from becoming lousy during the inevitably unhygienic conditions of field warfare.

It has been suggested that such impregnated clothing might be desirable for sanitary per-

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sonnel working in a focus of louse-borne disease. On the other hand, this would demand special impregnating facilities, which would be less adaptable to changes that might be necessary in the face of developing resistance.

Disinfestation of small numbers of body louse-ridden persons in a clean environment

In Britain infestations of body lice are now quite rare; but they do occur, and they present various authorities with the problem of satisfactory disinfestation. Thus, lousy people come into hospital or prison or to hostels maintained by various authorities. If they are not properly disinfested, there may be the additional problem of disinfecting the bedding they use.

The use of insecticide powders in such cases is not satisfactory. Their action may be slow, so that all lice (and eggs!) are not killed immediately, a matter that is relatively unimportant in achieving reduction of general lousiness. Also, the obvious signs of a powder treatment are resented by both the treated people and the inmates of institutions they enter.

Disinfestation of clothing and bedding can be done quite satisfactorily by heat treatment in these circumstances. But the usual large steam disinfectors, as used in hospitals for destroying pathogens, are unnecessarily cumbrous.

We have shown that disinfestation by a liquid fumigant, using a metal bin or a plastic sack, is simple and effective (*3*). Ethyl formate used at 2 g/liter for one hour or 0.5 g/liter for five hours, is the fumigant of choice. The short treatment may be given while the infested person takes a bath, while the longer fumigation may be used to treat clothing overnight. On removal there is only a mild ethyl formate odor, which disperses rapidly. Its mammalian toxicity and its inflammability are about the same as those of benzene, so that handling small quantities is not very dangerous.

Treatments for head lice

In order to eradicate head lice, it is very desirable to gain the cooperation of the infested people and their relatives. The commonest cases are children, whose mothers must be convinced of the acceptability and effectiveness of the treatment. The focus of infestation is very often the family group, not all of whom are inspected (e.g., only the children's infestation may be detected, at school). If the parents accept the desirability of treatment, they may continue it at home and extend it to other cases in the family. In Britain, as perhaps in other countries, we can invoke compulsory powers to get children disinfested, but these are used only as a last resort.

From what has been said, it is evident that the insecticide should be applied in a form that leaves no obvious trace. Usually a liquid preparation is best. Emulsion concentrates resembling hair cream have been employed, but though they were formerly acceptable to boys and men, they were always disliked by women and girls since they tend to leave the hair somewhat greasy. (With changing hair styles, this dislike is now extending to young men!)

A fairly acceptable type of preparation is the concentrate that is diluted with water (1:5) just before use. Examples are the American NBIN formulation (68 per cent benzyl benzoate, 6 per cent DDT, 12 per cent benzocaine, and 14 per cent emulsifier) and a British commercial preparation containing 1 per cent lindane in alcohol. About 10 ml of the aqueous lotion is used per head.

More recently, solutions that are applied directly, without dilution, have become popular in Britain (e.g., 0.5 per cent malathion in propyl alcohol, together with stabilizers and perfume (*6*)). In some cases,

single doses are available in plastic containers to simplify rapid treatment.

Such preparations may not be universally popular, however. In certain countries people like to anoint their hair with oil to give it a glossy sheen. In Malaya we found that the most acceptable preparation for head lice was a vegetable-oil solution of the insecticide (*2*). A little blue dye was added as a warning color to prevent its consumption.

Whichever type of treatment is used against head lice, the patient should be asked not to wash the hair for a week after treatment; this allows for some residual action, not only against reinfestation but also against nymphs hatching from nits that may have survived. If the hair is very dirty, a wash should precede treatment.

From time to time, insecticidal shampoos for use against head lice have been marketed. They are of dubious value, because the insecticide is seldom of sufficient concentration to kill all lice and nits in the very short exposure time involved. Shampoos nevertheless tend to be popular with some sanitary personnel, probably because they consider lice to be a form of dirt or to be dependent on dirt.

Treatments against crab lice

People infested with crab lice rarely consult a doctor or sanitarian and usually treat themselves with commercially available domestic insecticides or such things as kerosene. Infestations are often detected at venereal disease clinics or hospitals, however (*4*).

In Britain, DDT or gamma BHC have been used for treatment in the form of emulsions, according to the National Formulary (2 per cent DDT or 0.1 per cent gamma BHC, 4 per cent emulsifying wax, 15 per cent xylene, 0.5 to 1 per cent perfume, in water). Shaving of the pubic hair is not recommended.

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Bruce F. Eldridge.[1] *Repellents and impregnants for the control of body lice.*[2] In insect control terminology, impregnants are toxic or repellent substances that are bound to cloth materials, usually by dipping the materials in a solution of the substance. Repellents, which may also be impregnants, prevent insect bites primarily by contact or spatial repellency, although they may also be toxicants. Repellents may be liquids, creams, aerosols, or solids. There are some significant adventages of repellents and impregnants over the use of toxicant powders, fumigants, or steam sterilization for louse control. Impregnants can be incorporated into clothing or bedding by the manufacturer or at large-volume laundries, obviating the necessity of assembling people for mass delousing. Materials so impregnated may re-

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[2] The opinions and assertions herein are those of the author and are not to be construed as official or reflecting the views of the U.S. Department of the Army.