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Eugene J. Gerberg.[1] *Head lice: control and nit removal. Pediculus humanus capitis* de Geer has undoubtedly plagued man throughout his entire evolution as a mammal. The relationship and similarity between *P. h. capitis* and *P. h. corporis* (*P. humanus humanus* L.) has been detailed by Bacot (*1*), Ferris (*3*), Keilin and Nuttall (*8*), Sikora (*15, 16*), and others. Whatever difference may exist, it is probably a physiologic rather than morphologic one. If there is a taxonomic difference, *P. h. corporis* apparently derived from *P. h. capitis*. This probably occurred when man began to clothe himself.

In 1909 Nicolle and coworkers (*11*) noted the role of *Pediculus* in the transmission of epidemic typhus. Da Rocha-Lima (*12*) in 1916 demonstrated the causative relationship of *Rickettsia prowazeki* to epidemic typhus. Though *P. h. corporis* has been considered the prime vector of epidemic typhus, the capabilities of *P. h. capitis* should not be disregarded. Goldberger and Anderson (*4*) succeeded in transmitting typhus experimentally to monkeys by cutaneous injection of infected, crushed head lice. Haight (*5*) discussed the possibility that a typhus case in Toronto might have been transmitted by *P. h. capitis*. Bequaert (*2*) reported that *P. h. capitis* was a carrier of exanthematic typhus in Guatemala. Ruiz Castefieda (*13*) believed that *P. h. capitis* was responsible for a mild form of typhus in Mexico. Mackenzie (*10*) stated that the body louse was an evolutionary form of the head louse and that both are regarded as vectors of typhus. As infestations of head lice are generally more abundant in urban populations than body lice, the possibility of a potential hazard exists.

The materials used for control of head lice have changed over the years, from herbs and secret formulas to the more mundane pesticides. Some of the more recent chemicals used to control or eliminate head lice are listed below.

Lindane (gamma benzene hexachloride)
- 1 per cent in water dispersible cream (Kwell cream)
- 1 per cent in lotion (Kwell lotion)
- 1 per cent in alcohol (Lorexane), diluted 1:5 in water

DDT
- 10 per cent in pyrophylin
- 68 per cent benzyl benzoate, 6 per cent DDT, 12 per cent benzocaine, and 14 per cent emulsifier (NBIN), diluted 1:5 with water

Malathion
- 0.5 per cent lotion (Prioderm)

Pyrethrum
- 0.16 per cent pyrethrins, 2 per cent piperonyl butoxide, 5 per cent kerosene (A-200 Pyrinate liquid)

[1] Insect Control & Research, Inc., Baltimore, Maryland, USA.

pyrethrins, N-isobutyl undecylenamide, 2,4-dinitroanisole, phenol (MYL)

Lethane

12.5 per cent N-butyl carbitol thiocyanate, 37.5 per cent beta-thiocyanoethyl laurate, 50 per cent refined paraffin

Thanite

5 per cent isobornyl thiocyanoacetate and related compounds, 35 per cent propylene glycol (BARC liquid)

At present, lindane (gamma benzene hexachloride), malathion, and pyrethrum appear to be the pesticides of choice.

Many of the control measures aimed at the imago and nymphal stages will also kill the eggs or nits. Removal of the nits requires additional treatments and is necessary to ascertain completeness of the control measures. Perhaps just as important are aesthetic or cosmetic considerations. In developed countries, where head lice may be quite prevalent among children, nits in the hair can be quite embarrassing; they can even become a problem in human hair wigs (*17*).

Materials to remove nits (in contrast to ovicides) have been mentioned only a few times in the literature. Janke (*6*) describes a product called 'Lausofan', a hexamethylene ketone plus cyclohexanol, which is supposed to remove lice and nits in one application. Jeney (*7*) reported the eradication of louse eggs with an antiformin solution. Kuhn and Grundherr (*9*) mention a secret proprietary substance called 'Nissotax' which they say is able to dissolve eggs from hairs, but no formula is provided.

Combing and nit-picking have been used from ancient times, but they have their obvious drawbacks.

In our laboratory we have adapted a colony of body lice to lay eggs on human hairs. These hairs with nits attached are dipped into a solution of the experimental compound for four to 10 minutes, washed in water for two minutes, and attempts are then made to remove the egg. An insect-mounting pin fastened to a wooden probe is pushed against the egg. If the experimental compound does not work, the pin will bend before the egg can be loosened.

To reduce the variables resulting from the use of a hand probe to test the resistance of the nit to the effect of experimental compounds, a mechanical means of testing the effectiveness was devised (Figure 1). This machine consists of a bar to which hairs with nits can be fastened. The ends of the hairs with attached nits are then placed in a slit in a rubber "comb." A series of hairs can then be lined up. To test the effectiveness of the compound in facilitating nit removal, the device's operator turns a hand screw that pulls the bar, which in turn slowly draws the hairs and nits through the rubber "comb." Untreated nits will pass through the "comb," but those that have been treated effectively will be pulled off.

The egg is fastened to the hair shaft with a binder. As the eggs are passed, they are followed by a clear drop of matter that hardens, firmly holding the egg to the hair. Schmidt (*14*) examined this bonding agent and found it composed of flexible parallel fibers that form a sort of egg cup to hold the egg. The fibers or filaments result from an excretion by the insect and are actually a hardened binder or natural adhesive peculiar to the louse. Judging from the nature of this material, it may be postulated that this ad-

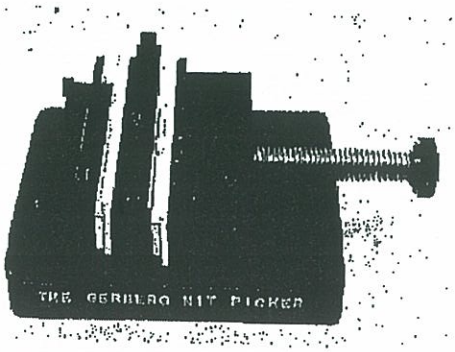

Figure 1. Gerberg nit-picker.

hesive is either a protein compound similar to hemoglobin or a complex polysaccharide.

In a preliminary effort to determine the probable composition of the adhesive, the action of a number of enzymes of different properties and activities was investigated. They were two enzymes specific for gelatin, casein, and other proteinaceous materials; two enzymes specific for certain classes of polysaccharides, one active against polysaccharides of the hexose and pentose polymers and the other specific for oligosaccharides such as stachyose and raffinose; and an enzyme chosen for its high activity on hemoglobin. A 1 per cent solution of enzyme, with and without 0.5 per cent of a nonionic wetting agent (Triton X-100) was used in all cases.

The enzyme that showed the greatest activity was the one highly effective against hemoglobin and, considering the diet of the louse, this seeems logical. This enzyme is a derivative of *Aspergillus oryzae*. What has probably occurred is that the bond between the egg and hair has been hydrolyzed and weakened, if not dissolved. The egg can now be readily removed. Further investigations are being conducted to determine the actual chemical structure of the binder or cement, and materials to loosen or dissolve it.

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George Makara.[1] *Chlorphenamidine as an ovicide and the efficiency of heat in killing lice and nits.*

Chlorphenamidine as an ovicide

All louse stages must be killed instantly if head lice are to be eradicated in a single short treatment, but most insecticides used today have little or no effect on nits. Some ovicides such as mercury, salts, phenols, and n-butyl-acetanilide are potent, yet also toxic, irritating, or not susceptible to water dilution.

In 1969, Mrs. M. Sztankay and I tested the efficacy of chlorphenamidine against nits. This compound is an acaricide with an oral LD_{50} rate of 250, which Ciba-Geigy sells for

[1] State Institute of Hygiene, Budapest, Hungary.