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### UNDERSTANDING AND TREATING INFESTATIONS OF LICE ON HUMANS

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Infestation with human lice, or pediculosis, still occurs even in societies with generally high standards of sanitation. Public health agencies may become involved if infestations include or expose a substantial number of people, which occasionally happens especially at public institutions such as jails, schools, and state or county hospitals.

This compilation is presented as a guide to the accurate recognition and proper treatment of those occasional infestations of human lice which still annoy and potentially threaten our citizens.

#### *Identification and Biology of Human Lice*

Human lice are part of a rather large group of insects known as sucking lice which are permanent parasites on the bodies of mammals throughout the world. These insects spend their entire life on the bodies of their animal hosts where they suck blood for nourishment and obtain necessary moisture and warmth. The eggs of lice, which are called nits, are attached to the hair of the host, and in the case of the human body louse, to clothing fibers. Many different kinds of sucking lice are found on warm-blooded animals throughout the world, and each kind of louse is closely adapted to and is often restricted to a certain kind of animal. Human lice can establish and maintain themselves only on humans.

Therefore, sucking lice found established upon humans can only be human lice, of which there are three distinct kinds: head lice, body lice, and crab lice. More than one of these kinds may infest a person at the same time.

The common and scientific names of human lice now accepted by the Entomological Society of America (Blickenstaff, 1970) and several common synonyms found in the older literature are:

1.) head louse — *Pediculus humanus capitis* De Geer

synonym — *Pediculus capititis* De Geer

2.) body louse — *Pediculus humanus humanus* Linnaeus

synonyms — *Pediculus humanus corporis* De Geer; *Pediculus corporis* De Geer; *Pediculus vestimenti* Nitzsch

3.) crab louse — *Pthirus pubis* (Linnaeus)

synonyms — *Phthirus pubis* (Linnaeus); *Phthirius pubis* (Linnaeus); *Phthirius inquinatus* Leach

It is important that an accurate identification of the louse involved be made so that the most effective treatment and preventive measures can be recommended. In some instances, errors in diagnoses of pediculosis have been made on the basis of inconclusive evidence, particularly when head lice have been suspected.

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Head lice and body lice are different forms (subspecies) of the same louse species, *Pediculus humanus*, and are superficially similar in appearance, but both are easily distinguishable from the crab louse with the aid of a magnifying glass. Body and head lice have the three pairs of legs about equal in size, and the abdomen is distinctly longer than wide (Figure 1). The crab louse has the middle and hind legs and claws greatly enlarged, and the abdomen is wider than long, giving the creature a crab-like appearance (Figure 2).

Adult body and head lice are approximately 2 mm (males) to 3 mm (females) in length and vary in color from dirty white to greyish-black. Head lice can adapt their coloration somewhat to the hair color of the host, so that lice from blondes tend to be paler than those from people with dark hair. Body lice and head lice are quite similar in appearance, and even an expert will have difficulty in positively distinguishing between all specimens of the two on the basis of morphology alone. However, their habits differ significantly. Head lice almost always live in the head hair and attach their nits (eggs) to the hair. Body lice prefer to live in the clothing and attach their nits to clothing fibers (infrequently to the body hair).

Adult crab lice are greyish-white to slightly pink and are only about 1 mm long. Crab lice mainly infest the pubic hair, occasionally the hair elsewhere on the body, and attach their nits only to hair.

Immature lice (nymphs) look very much like the adult but are smaller. There are three growth stages or instars between the nit stage and the adult. Immature crab lice are easily separable from immature head lice and body lice, but the young of head lice and body lice look very much alike.

Human lice attach their nits firmly to hair or clothing fibers by a ring of cement. The nits are about 0.8 mm long and 0.3 mm wide, thus two nits placed end-to-end would cover the diameter of the head of an ordinary pin. The nits are oval in shape and yellowish opalescent in color. Each nit has a cap (operculum) which comes off intact when it hatches. After the nit has hatched, the cement-like attachment and empty shell may remain on the hair. These empty shells are not easily removed by shampooing or washing, and thus are useful in diagnosing lousiness even if hatched lice are not located.

The head louse usually attaches the nit close to the base of the hair about 1 mm from the scalp (Nuttall, 1918). The hair is assumed to grow at the rate of 0.4 mm per day (Mellanby, 1942). Since the nits of the head louse hatch in about nine days one would expect most of the unhatched nits to be within 5 mm (about 3/16 of an inch) from the scalp. Empty shells which lack the cap and are no longer turgid to the touch are likely to be farther from the scalp.

The nits of head lice (Figure 3) and body lice (Figure 4) are quite similar in appearance, but those of crab lice (Figure 5) are slightly smaller, have prominent respiratory globules on the cap, and have a longer cement attachment on the hair. The fact that the nits are cemented at an oblique angle to the hair (like a stubby branch) is very helpful in distinguishing them from foreign material which frequently surrounds the hair and may readily slide up and down.

Lice, as well as hairs bearing louse nits, can be preserved in alcohol and submitted to an entomologist for identification or verification of a diagnosis. The Bureau of Vector Control and Solid Waste Management will make such determinations for California health personnel.

*The body louse:* The body louse has been the object of much attention. It alone, among the three kinds of human lice, has been definitely implicated as a vector of louse-borne relapsing fever and epidemic typhus. Historically, the massive epidemics of louse-borne diseases were transmitted by large populations of body lice which infested people living in unsanitary conditions, especially during times of famine, disaster, or war. Although there is some experimental evidence that both the crab louse and the head louse might serve as vectors, their actual role as such has not been established. Neither of the two louse-borne diseases has been reported in the United States for the past 35 years. The bites of the body louse are annoying, and the skin of persons who continuously harbor these lice becomes hardened and darkly pigmented, a condition known as "vagabond's disease".

All stages of body lice are found on clothing. The adults and nymphs move to the skin at intervals to feed and are most numerous where clothing is in continuous close contact with the body, such as the armpits and belt-

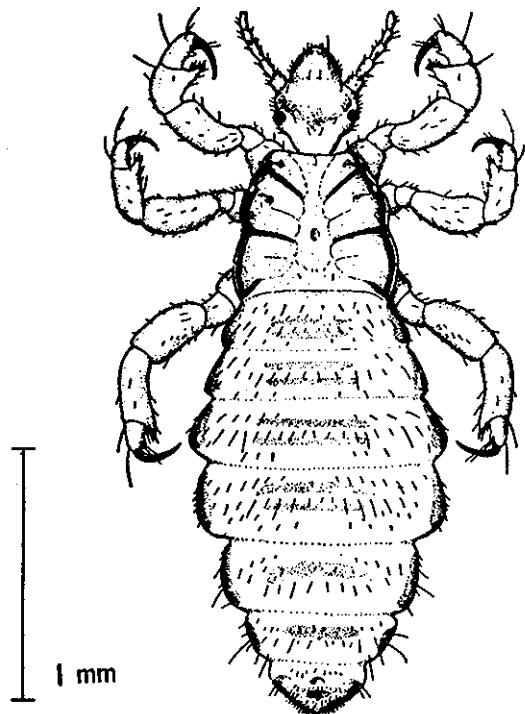


FIGURE 1

*Pediculus humanus capitis*, head louse.

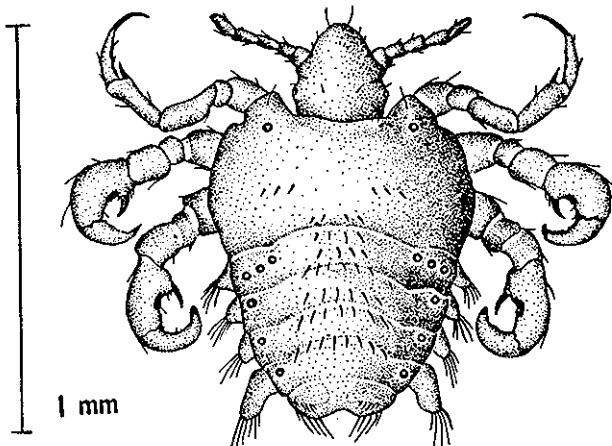


FIGURE 2

*Pthirus pubis*, crab louse.

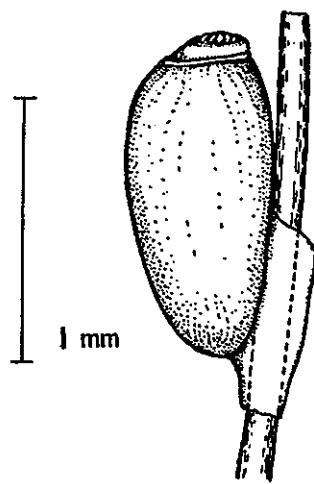


FIGURE 3

Nit or egg of head louse  
attached to head hair.

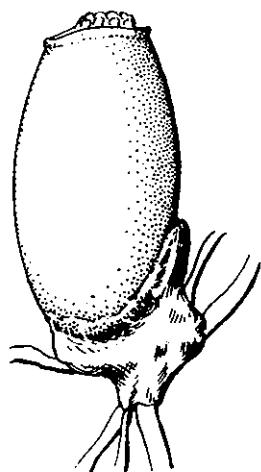


FIGURE 4

Nit or egg of body louse  
attached to clothing  
fibers.

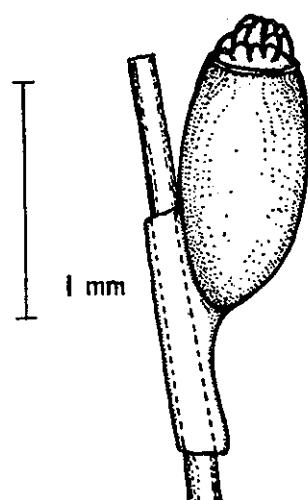


FIGURE 5

Nit or egg of crab louse  
attached to pubic hair.

Illustrations taken from Matheson, R., 1950, Medical Entomology, by permission of Cornell University Press, except Figure 4, from Ferris, G. F., 1951, The Sucking Lice, by permission of the Pacific Coast Entomological Society.

line. The number of lice that normally occur on an infested person is usually a dozen or so, but an occasional individual may harbor hundreds or even thousands of lice.

A female body louse may lay 200 or more nits at a rate of 10 per day. One generation requires on the average about 3 weeks to complete. In experiments with body lice under laboratory conditions, Busvine (1948) found the nit incubation period at 30°C to be 8 to 10 days, and when held 24 hours on the host the combined nymphal periods averaged 8.3 days, and the adults survived for about 20 days. These time periods may be prolonged under natural conditions, as for example when clothing is worn intermittently.

Human body lice are closely adapted to humans and cannot survive independently for long periods of time. They leave the host or the clothing voluntarily only when the host has died or becomes hot with fever, or when there is close personal contact with another host. According to Buxton (1946) lice and their nits die when exposed to temperatures of 50°C (122°F) for a half hour. Both lice and nits have failed experimentally to survive 24 hours at -10°C (14°F) or 12 hours at -15°C (5°F). When off the host, all stages can be expected to die within 30 days regardless of temperature. Unfed lice survive up to 10 days, the length of survival time depending largely upon temperature. They are averse to direct light and frantically move to escape it when exposed. It is helpful to bear these characteristics in mind when dealing with louse problems, since they represent important considerations in applying control measures and preventing the spread of infestations.

Body lice can spread quite rapidly under unsanitary crowded conditions where there is close personal contact. During periods of social upheaval when many individuals are crowded together and are unable to change clothes frequently, louse populations thrive. Occasionally, however, an infestation may be acquired under the most sanitary and uncrowded conditions if there is close contact with infested persons or infested clothing. Under ordinary circumstances where people are able to change clothes frequently, the lice in unworn clothes soon starve to death or are destroyed by the washing or cleaning process, so that the infestation does not persist.

**The head louse:** Although there is no substantial evidence that under natural circumstances head lice are vectors of human disease, their status as annoying ectoparasites of man is sufficient reason to consider them undesirable and to justify the effort to eliminate them. Head lice and their nits are usually found in the hair behind the ears and on the nape but also may be found in headgear and possibly on hair elsewhere on the body. The incidence of head lice seems to be greater among individuals with long hair or dense hair than in persons with short or sparse hair. They are most frequently found on the young, the old, and the incapacitated, who are unable to groom themselves effectively. The grooming behavior of the infested person in response to the irritation caused by the lice is considered an important factor in keeping the population of lice at a low level.

The female head louse can lay 50 to 150 nits, which hatch in 5 to 10 days. The generation time is similar to the body louse, about 3 weeks. The survival off the host and responses to temperature extremes are also essentially the same as that of the body louse as discussed above.

The diagnosis of head lice infestation is usually based upon finding the nits. The head lice themselves are less frequently seen. One should be aware that foreign material or hair casts may be present which can be mistaken for nits. For example, solidified globules of hair spray may to the casual observer, be confused with nits. Kligman (1957), Brunner and Facq (1957), and Anderson (1958) reported that certain accretions on hair shafts have been mistaken for nits and offered the explanation that these nodules were probably casts from the hair follicles. There may be several casts on a long hair.

Dr. C. Russell Anderson, dermatologist, (personal communication, 1971) has described a hair cast as "a persistence of the inner hair root sheath that normally disappears at the level of the entrance of the sebaceous gland duct into the hair follicle". He further states that "these casts slide along the hair shaft with the greatest of ease, a diagnostic point". (See Figure 6.)

Osgood, Jellison, and Kohls (1961) reported an instance of suspected pediculosis

in which several thousand children were sent home from school because it had been found that many individuals, both children and adults, had small whitish objects attached to their hair. However, only a very few actual cases of head lice were discovered. Nits can readily be distinguished from other objects upon examination under a stereoscopic microscope.

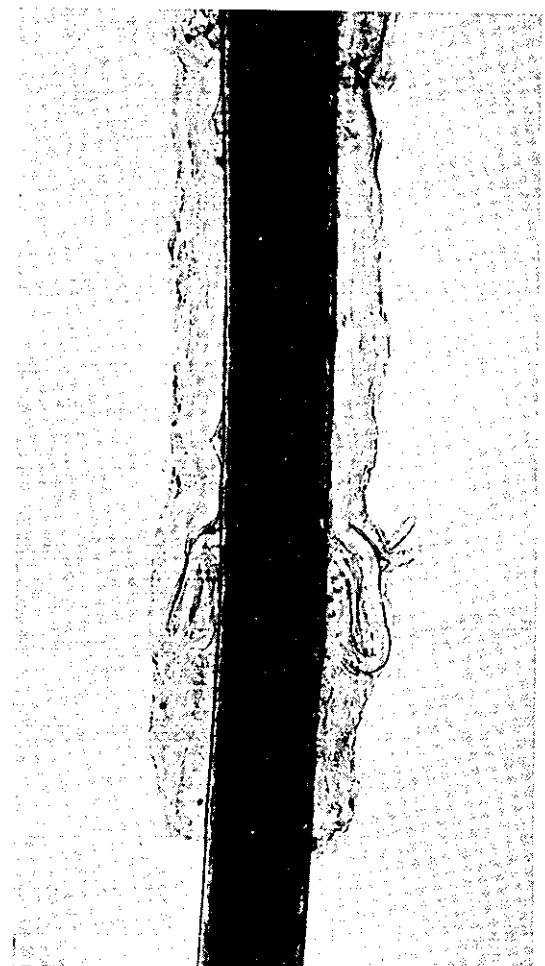


FIGURE 6. A hair cast on a human head hair. Photomicrograph by R. E. Doty.

As in the case of body lice, head lice are activated by temperature increases. This observation might be utilized to detect their presence or to reduce their numbers on the host. According to Howlett (1917): "If a comb, warmed enough to be pleasantly hot to the hand, be used, the lice become much excited and are as it were tempted into the open instead of sticking to their dug-outs among the bases of the hairs. The comb thus gets free play among them, and they are removed with a very marked economy of time and trouble."

Head lice can be spread by the shared use of a personal item such as a hat, hairbrush, comb, or towel. They are also known to wander from an infested person onto upholstered furniture, bedding, etc. While the eradication of a head louse infestation consists primarily of treating the infested person, personal items likely to harbor lice should also be freed from lice.

The temporary presence of head lice is not necessarily an indication of the lack of hygiene. An infestation might be acquired by almost anyone. Lice are able to survive submersion in water for a number of hours. Buxton (1946) writes: "It is sometimes stated if people wash they will get rid of lice and nits. This is not the case, for soap and water at temperatures which can be tolerated do not assure the destruction of either. In many parts of the world there are people who are very clean in the sense that they continually wash away dirt, but they remain very lousy...."

*The crab louse:* There is no evidence that the crab louse is a vector of disease. However, the bites of this louse frequently cause itching and annoyance to the infested person. The pruritus may be severe, and occasionally secondary infection results from consequent scratching. Characteristic small "blue spots" may appear in the skin tissue of the host as a result of the bites and persist for several days. These blue spots are associated only with crab louse bites and are not caused by head or body lice.

The crab louse is adapted to live in the coarser hairs of the human body, which it grasps firmly with the two pairs of enlarged claws. It is most often found on the hairs of the pubic and perianal areas. Infrequently it may occur on hairs of the other parts of the body, such as the hairs of the thigh, abdomen, axilla, and head as well as on the eyelash, eyebrow, beard, or mustache. The presence of crab lice on the eyelashes or head hairs of a person does not necessarily mean that the pubic area is also infested. On infants and young children the infestation is confined to the head hairs and eyelashes.

Like other human lice, the crab louse is found on humans almost exclusively. The very few exceptions have been reported from dogs. Frye and Furman (1968) reported one instance in which crab lice were found on a male dog.

The owner who also was infested shared his bed with the dog. The authors expressed the opinion, "The presence of a number of specimens on a single host seemed suggestive of more than a casual relationship between the dog and lice."

The life history of crab lice is similar to that of head lice and body lice. Nits are attached to the coarser hairs of the body and not to clothing, and they hatch in about a week. The three nymphal stages are passed in 2- $\frac{1}{2}$  weeks, and the adult louse lives for about a month.

Crab lice die in about 24 hours when separated from their human host. This and the lethargic movements of the louse serve to inhibit the spread of infestations from person to person. Although sexual contact is the most important means of transmission, it is not the exclusive means. Buxton (1946) states, "There are records of *Phthirus* being found on seats of water closets and in beds, and there is the strong probability that they or their eggs may be spread on loose hairs dropped by infested persons." He further notes that crab lice can readily spread among seamen or soldiers living in crowded quarters. A recommendation that the toilet seats in public rest rooms be raised after each use is designed to make it difficult for any stray crab louse to retain its footing, thus reducing the possibility of subsequent users acquiring an infestation.

Apparently there has been an increase in the incidence of crab louse infestation in recent years (Ackerman, 1968). These occurrences are not restricted to any one socio-economic group. This resurgence of crab louse infestations is thought to be associated with a climate of cultural permissiveness. Inquiries one receives frequently betray almost complete lack of knowledge about crab lice, indicating the initiation of a new generation of persons poorly informed on this subject.

#### *Treatment of Human Louse Infestations*

The best way to control human lice is to prevent them from becoming established in an area, by seeing that the people are educated and are living in a sanitary environment. However, once an infestation is discovered, it is desirable to treat the infested persons immediately with an insecticidal preparation (a pediculicide) to kill the lice and nits, con-

comitant with the institution of measures to prevent reinestation.

Since the chemical treatment of louse infestations depends primarily upon products readily available on the present market, those preparations known to be available in California are listed in Table 1. The reader will note that no insecticidal louse powder is included in Table 1, although louse powders are recommended by the U.S. Public Health Service (1971) and the World Health Organization (1970). At the time of this writing no louse powder is registered for use in California.

The most common louse powders contain 10% DDT, 1% lindane, or 1% deodorized malathion. Their most important use is during emergency situations when many people must be treated rapidly for body lice and when personal appearance is a consideration secondary to the control of a louse-borne epidemic. While resistance to DDT and lindane has been reported for body lice in some parts of the world, no resistance has been reported for California. However, one should be alert to manifestations of insecticide resistance as evidenced by the failure to achieve satisfactory control.

Head lice and crab lice infest the hair, and to eliminate the lice and their nits it usually is necessary to apply an insecticidal chemical to the affected areas. A liquid insecticide preparation is desirable when the head hair is treated, as a powder is unsightly and not very acceptable to the individual being treated. The liquid preparations of insecticide rapidly kill all stages of the lice and are removed after a specific short time by a thorough wash or shower. If immediate bathing facilities are inadequate or infeasible, an insecticidal salve, lotion, or powder may be used. A louse powder may be used to treat the headgear or other garments used by the infested person when adequate washing or cleaning is infeasible. For the treatment of crab lice and their nits occurring on the eyelash, an ophthalmic ointment containing 0.25% physostigmine has been recommended by Ackerman (1968) and by the World Health Organization (1970).

Except in extreme infestation with head lice, it no longer is necessary to cut the hair prior to treatment because the modern insecticidal preparations are efficient. Unsightly nits remaining after the shower can be combed

TABLE 1. Some pediculicides currently available in California<sup>a</sup>

Brand name <sup>b</sup>	Active ingredients	Manufacturer or distributor	Length of application
No Prescription Required			
A-200 Pyrinate (shampoo)	Pyrethrins Piperonyl butoxide Deodorized ketosene	0.165% 2.000% 5.0%	Norcliff Laboratories, Inc., Fairfield, CT 06430
Cuprex (lotion)	Tetrahydronaphthalene Copper oleate	30.97% 0.03%	Calgon Corp. Pittsburgh, PA 15230
Bornate (lotion)	Isobornyl thiocyanacetate Diethyl sodium sulfosuccinate	5.0% 0.6%	Wyeth Laboratories, Inc. Philadelphia, PA 19101
Prescription Required			
Topocide (lotion)	Benzyl benzoate Benzocaine DDT (dichloro-diphenyl-trichloroethane) [concentrate known as NBIN]	12.0% 2.0% 1.0%	Eli Lilly & Company Indianapolis, IN 46206
Kwell Shampoo	Lindane (gamma benzene hexachloride)	1.0%	Reed & Carnick Kenilworth, NJ 07033
Kwell Lotion	Lindane (gamma benzene hexachloride)	1.0%	Reed & Carnick Kenilworth, NJ 07033
Kwell Cream	Lindane (gamma benzene hexachloride)	1.0%	Reed & Carnick Kenilworth, NJ 07033

<sup>a</sup> All listed preparations kill louse nits, nymphs, and adults.

<sup>b</sup> Brand names are cited for the convenience of the purchaser, and do not constitute endorsement over similar products available under other brand names, or insecticidal preparations which do not appear on this list.

<sup>c</sup> The manufacturer's directions for the use of Topocide give 10 days as the length of application for head lice and 2 days for pubic lice. Other sources, while recommending 24-48 hours for both pubic lice and head lice, state that it may be necessary to repeat treatment.

out with a fine-toothed comb. This removal is desirable so that any nits appearing after the initial treatment can be detected by inspection, thus gauging the success of the control measures.

Body lice infest the clothing, particularly at the seams of undergarments, so that special attention should be directed to control lice and nits found in undergarments, other clothing, and bedding. Laundering with hot water, or dry cleaning is enough to kill the adults, nymphs and nits. Body lice are killed in five minutes at 51.5°C (124.5°F) and their nits are killed in 10 minutes at 52.0°C (125.6°F) (Buxton, 1946). With frequent changes to properly laundered clothing, an infestation of body lice will eventually end without treatment unless the person is reinfested.

Public institutions, such as hospitals and prisons, occasionally may find incoming persons infested with lice. If the incidence is high, it may be necessary to apply a pediculicide routinely to all admittees, but a preferable practice is to treat only those persons found to have lice after inspection and diagnosis by experienced health personnel. When lice are found, it is desirable to treat both the infested person and the clothing no matter which louse species is involved. To disinfect the person, a mild insecticidal liquid preparation such as a shampoo containing pyrethrins is suggested. Such an application will kill both lice and nits within a few minutes' treatment, after which the shampoo is removed by thorough rinsing. An insecticidal powder is not suited to this particular situation, as such a formulation is slow to act and must remain on the body for several days.

If laundry and dry cleaning facilities are not available, the clothing of each individual can be stored separately in airtight metal or plastic cans or plastic bags. The proper addition of an insecticide such as a louse powder to the container will kill nits and stray lice, to prevent spread of the infestation or possible reinfestation of the individual. An entomologist should be consulted if such a storage practice is put into operation. If the clothing must be returned immediately to the treated person, it can be thoroughly dusted with a louse powder.

An infested school-child who returns home daily must be treated, and the family and social

contacts should be examined and treated if necessary. Otherwise the child is likely to become reinfested and the condition may spread to his classmates. This situation may sometimes require the involvement of local health authorities, and the development of an educational program for the affected family and community. One can refer to the *Manual for the Control of Communicable Diseases in California* (California State Department of Public Health, 1966<sup>2</sup>) for an outline of such a louse control program and a detailed presentation of nursing responsibilities.

The decision to apply a pediculicide to the human body should be made thoughtfully, as all these chemicals are poisonous by definition and can be harmful if improperly used. In their desire to rid themselves of lice, people sometimes over-react and expose themselves to these chemical remedies excessively. All users should be advised to read and follow precisely the directions given by the manufacturers regarding their products. Frequency of application should be restricted and application to the mucous membranes and eyes is always to be avoided.

Occasional infestations of human lice will be found for many years to come, especially in the case of head lice and crab lice. There should be no cause for alarm, as adequate control measures are easily available to all. However, the continued presence of a louse infestation is inexcusable. As an old saying goes, "It is no disgrace to have lice, but it is to keep them."

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<sup>2</sup>The 1971 revision is in press.

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