

## OPEN DISCUSSION

Moderator: Dr. Busvine

**Dr. Gaon:** Dr. Busvine, why do you think head lice spread to other people more easily than body lice? Is that generally true or is it simply that the longer the hair, the more the head lice? Also, why do head lice seem to be on the increase, as you mentioned is happening in England?

Second, what is the likelihood of lice more readily attacking dirty, sweaty shirts or shirts covered with louse feces?

**Dr. Busvine:** First of all, Professor Buxton summarizes in his classic book a number of investigations in different parts of the world on the relationship between hair length and infestations. This was found to be correlated not only within populations but within different groups. For example, races of people who do not shave or cut their hair tend to be rather more infested than those who wear their hair short. Thus, one would readily expect hippies or young people who like long hair to be more prone to infestation and, in fact, a British newspaper made this suggestion quite recently.

Unfortunately for the theory, the difference in lousiness between girls, who in the past traditionally wore their hair longer, and boys still obtains. Girls are still more prone to lousiness than boys, even through many boys are wearing their hair as long as girls. There is also quite a big difference between very young girls and boys when it comes to lousiness.

As to the so-called preference of body lice for people with dirty shirts, I think that is probably an error of observation. People who don't wash their shirts do not affect lice, and therefore their shirts tend to be dirty. On the other hand, Prof. Vincent Wigglesworth did some experiments many years ago

in which he confined body lice in a choice chamber, on one side of which was a shirt that had been worn and was covered with perspiration and on the other side of which was a clean shirt. The lice preferred to sit on the dirty shirt.

**Dr. Murray:** You said you observed that lice were relatively scarce on lousy individuals. We feel that it is necessary for a large number of lice to be present on a Brill-Zinsser disease patient in order for such a person to infect enough lice to cause an epidemic. I would be interested in hearing about the experiences of Drs. Snyder, Wisseman, and Gaon in counting lice and getting estimates of the numbers of lice on individuals during an epidemic such as occurred in Egypt, Burundi, and Yugoslavia.

**Dr. Busvine:** There are one or two published accounts that give figures about counts of lice on infested people, though the counts may not necessarily have been made during epidemics. I think that counting lice under epidemic circumstances would be a very unpleasant, dangerous thing to do. The counts I have in mind were made among British troops in World War I and among indigent men in London in more recent times.

**Dr. Wisseman:** In Burundi we did not make counts, but in collecting lice to conduct resistance tests it was very easy to get the requisite number from the clothing of people who just crowded around. I think we got as many as 400 lice from one person, but this was an unusually large number. Nevertheless, they were easy to find, and it took very few pieces of clothing to get several hundred lice in satisfactory health with which to conduct the insecticide sensitivity tests. They were sufficiently numerous so that very often

they were seen crawling on the outer aspects of the clothing, which indicated a very heavy infestation. These lice came from people who visited a dispensary. We found it much easier to collect lice if we went to the jails, but prisoners are a special population, of course.

**Dr. Fabrikant:** The situation in Burundi made it virtually impossible for people to get rid of their own lice. They were too poor to have a change of clothing. Water supplies were distant, and water was carried in pots on heads. The insecticide louse eradication program was inadequate because of poor logistics. As Dr. Wisseman said, although we didn't count lice for that purpose, it was not at all difficult in the dispensary at Katara to acquire lice on oneself just by wandering among patients.

**Dr. Busvine:** I think the point about these numbers is that lousy people do something about their lice if they can, but at a certain point they become a little immune to the bites and don't trouble to remove the lice any more. But small numbers of lice are usually due to the efforts that people take to kill their own lice.

**Dr. Woodward:** One additional word about the degree of lousiness under epidemic conditions. I certainly support Dr. Wisseman's statement in that during the epidemic among the native population in North Africa in 1943 it was quite common to find two, three, or four hundred lice in the clothes of one patient. When Dr. Snyder was in Cairo, I would go into my typhus ward and ask for two lice for one cigarette. I would put 10 lice in a tube, send them off to him in Cairo, and I think he always isolated *Rickettsia prowazeki* from those dried, dead lice. Later, in Naples, one had but to turn the shirt back and pick off a hundred or more lice without any trouble at all.

**Dr. Snyder:** Just a comment to corroborate what Dr. Woodward has already said. It was usually assumed that louse infestation

would decrease in very hot places in the summertime. In Egypt during the summers of 1943 and 1944 we were able to get a tablespoonful of lice even on the hottest day by etherizing a villager's garment and shaking it lightly into a pan.

**Dr. Kostrzewski:** Dr. Busvine, were your data on louse infestation in Poland about school children?

**Dr. Busvine:** No, the data I presented were from Buxton's work and were about prisoners. My personal experience is only with infested vagrants in London.

**Dr. Gear:** Dr. Busvine, is there any evidence that the effectiveness of the host's immunity mechanism determines the number of lice or the degree of louse infestation? With the diminishing effectiveness associated with disease, old age, or starvation, is there any evidence that the lice increase in number? It has been noticed that physically and mentally defective people tend to be much more lousy than others. There are obvious physical reasons why this may be so. But are there any biologic reasons?

**Dr. Busvine:** Anyone who is a veterinarian will know that animals in poor health become heavily infested with parasites. There may be some parallel with man.

**Dr. Wegner:** With reference to Dr. Busvine's paper, I would like to note that in Poland Pokorny, in his research on *Pediculus humanus* biology, found that when lice were fed once a day and kept at 32° C under laboratory conditions, their life span was about 40 days. A female was able to lay between 50 and 60 eggs during its life. Regular egg-laying periods interrupted by two or three days of rest were observed. Daily egg production amounted to one to four eggs. Females of middle age laid eight, and very occasionally 13, eggs. Nymphs hatched on the fifth to seventh day after egg laying. Lower temperatures prolonged the hatching period.

When the influence of temperature on the hatching of nymphs was studied, it was found

that after the eggs were kept at room temperature for five days and then placed in a temperature of 32° C, between 90 and 100 per cent hatched. After 10 days at room temperature, only 60 per cent hatched; after 15 days, 20 per cent; and after 20 days, no nymphs at all. No nymphs hatched either after eggs had been kept at 30° to 40° C for only a few hours.

When investigating the influence of frequency of the population on the fertilization and fertility of *Pediculus humanus*, it was found that after a single population, about 70 per cent of the eggs remained unfertilized. Repeated population, although giving a higher percentage of fertilized eggs, did not influence the number of eggs laid.

**Mr. Cole:** Dr. Ludwig, did the lice that you fed on the nonspecific host or different hosts exhibit the redness that Dr. Busvine mentioned? Before you answer, I would like to comment that we have observed this redness in our lice when we were transferring them from human to rabbit feeders. At times we observed a high percentage of red lice, which always died quickly. We assumed this to be due to a rickettsia, but no one has ever worked it out. We corrected the situation merely by changing rabbit hosts, and as soon as we changed to a new rabbit host we got no further high percentage of red lice and high mortality.

Our conclusions were that this was either a higher percentage of favorable rabbits, or that the lice made a better adaptation to an unnatural host. We now find a higher percentage of rabbits that are favorable hosts when we buy them for our use in rearing.

**Dr. Ludwig:** All lice fed on guinea pigs become red and die. The redness is due to the rupture of the intestine, as Professor Kryński showed about 20 years ago. A certain percentage of lice fed on other hosts always die because of the redness. This percentage depends on the host's suitability as a substitute.

**Dr. Brooks:** Have you made any histologic examination of the lice that fed on blood containing antibiotics? Do you know if the symbiotes were affected?

**Dr. Ludwig:** No, we have not yet made a histologic examination, but we intend to. Our experience so far has only been with *Haematopinus suis*, but we want to investigate this problem in *Pediculus humanus* as well.

**Dr. Ormsbee:** We did one thing in investigating the possible involvement of animals in typhus spread in Egypt that may be of some interest. To simulate a situation that might occur, we reared lice on camels and men on alternate days. We succeeded in rearing head lice through such a cycle. This might be of some importance in other diseases.

**Dr. Smith:** Medical entomologists, I have noticed, have one thing in common with fishermen: when fishermen get together they always tell stories about who caught the biggest fish and where, and when medical entomologists get together they very frequently, if not invariably, get into a contest about who found the lousiest person and where.

I too have found some very lousy people, and I too have an observation I would like to make. I collected lice in various places in Africa, one of which was Freetown, Sierra Leone, where the climate is very humid. I had extreme difficulty finding lice: I found lousy people, but only one to 10 or 20 lice per person. In places where the humidity was not so high, such as Saint-Louis, Senegal, I found quite heavily infested people. The market beggars I examined in Freetown were just as filthy and had had their rags on just as long as those in Saint-Louis, but they were much less infested.

The only conclusion I could reach was that humidity was deleterious to lice. We know that in our rearing cabinets the need is not to maintain high humidity, as for many other insects, but to decrease it. No one else

has mentioned this point, but I would like you to keep it in mind as you observe louse infestations in different environments.

I would also like to confirm what Dr. Ormsbee said about alternating hosts. This can be done not only by alternation between a favorable and an unfavorable host, but between several unfavorable hosts. In the early days of the Gainesville body louse colony we found that there were certain rabbits on which the strain could be main-

tained day after day. There were other rabbits on which the colony would die over a period of days. But if one took four of these rabbits, none of which individually would support a louse colony, and fed the lice first on No. 1, the next day on No. 2, the next day on No. 3, and the next day on No. 4, one could maintain the strain on unfavorable animals by alternating from one unfavorable animal to another. The lice did not thrive, but it could be done.