SHORT COMMUNICATION

Body Louse Remains Found in Textiles Excavated at Masada, Israel

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ABSTRACT A leg of the body louse, *Pediculus humanus humanus* L. (Phthiraptera: Pediculidae), was found in a storeroom at Masada build during the reign of King Herod the Great. The unearthed culture material clearly indicates that the room was occupied by the rebels during the first Jewish revolt against the Romans (AD 66–73/4). The context of the textiles associated with the louse and their nature suggest a rebel origin. An exuvium of a leg of the third nymphal stage of body louse was found. The first three parts of the leg (tarsus, including the tarsal claw, tibia and femur) were preserved entirely, while the fourth segment of the leg, the trochanter, was only partially conserved. The comparison of the tarsus of this specimen with the legs of present day third instar nymphs of body and head lice revealed that the leg found within the archaeological debris belongs to a body louse.

KEY WORDS *Pediculus humanus humanus*, body louse, archaeology, Masada, Israel

HUMANS ARE INFESTED by two species of lice, *Pthirus pubis* L., the pubic louse, and *Pediculus humanus* L. The latter exists as two differentiated subspecies, *Pediculus humanus capitis* De Geer, the head louse, and *Pediculus humanus humanus* L., the body louse (Kim et al. 1986). Alternatively, some authors consider them separate species (Busvine 1978). Lice have been most probably associated with humans since the time of our prehominid ancestors, and were dispersed throughout the world by early human migrants (Marsch 1964, Maunder 1983, Aufderheide and Rodriguez-Martin 1998).

The head louse is most likely one of the oldest permanent ectoparasites of man (Zinsser 1935). Head louse eggs were recovered from human hair found in Brazil and carbon dated to ≈10,000 yr (Araujo et al. 2000) and from hair samples of an individual who lived 9,000 yr ago in Nahal Hemar Cave near the Dead Sea (Zias and Mumcuoglu 1991). Wen et al. (1987) found a large number of lice on a 3800-yr-old Loulan period female mummy.

In the 16th century BC, an Egyptian text, known as the Papyrus Ebers, described a remedy for lice prepared from date flour. Head lice and egg were found on the hair of Egyptian mummies (Ewing 1924). Royal combs from Pharonic times in Egypt were used for delousing (Kamal 1967).

Body louse recoveries are less commonly reported. Body louse eggs were found in a prehistoric textile from Hallstaetter Salzberg in Austria (Hundt 1960). This louse was also recovered from deposits of farmers in Viking Greenland and dated to AD 986-1350 (Sadler 1990).

The current study provides evidence that the Jewish rebels living in very crowded conditions in Masada during the first revolt were infested with body lice.

Materials and Methods

The louse remains were observed in basket 747, among fragmentary textiles that were excavated in 1964 at locus 1093. This locus designates an elongated room that is located in the eastern section of storerooms complex at Masada (Netzer 1991) built originally during the reign of King Herod the Great.

During the period of the First Revolt (AD 66–73/4) a newly constructed wall partitioned some 4 m off its south part. The unearthed culture material clearly indicates that the room was occupied by the rebels. In addition to five coins from the First Revolt the epigraphic finds are of particular importance: several Aramaic and Hebrew *ostraca* with names were uncovered in this locus. Not destroyed by fire, this locus was abandoned at the end of the revolt and was never reoccupied. The louse remains were found in association with a group of textiles that is dated to the time of the revolt (Sheffer and Granger-Taylor 1994).

The textiles were first surfaced cleaned, after which the loose soiling and debris were collected. Thereafter, the textiles were preliminarily relaxed and later were wet cleaned. The debris, dust and soil particles were first examined under a stereo-microscope (× 6). Later light and heavy particles were separated using a saturated solution of NaCl. The supernatant was filtered through a Whatman No. 4 filter paper (9 cm in diameter) and the filtered material was examined un-

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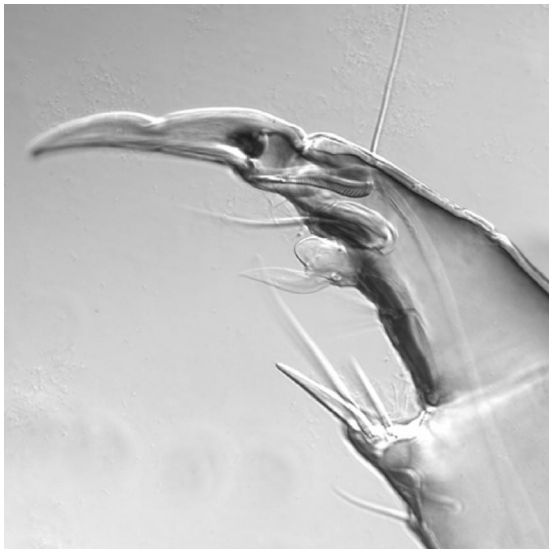

Fig. 1. Leg of the third nymphal stage of a body louse found in archaeological material from Masada.

der the stereo-microscope. Insect parts or particles, which could not be identified under this magnification, were transferred first to 70% ethyl alcohol for cleaning purposes and then to a slide with a drop of Hoyer's medium and secured with a cover glass.

Present day head and body lice were used for comparison. Head lice were collected from the hair of infested children in Jerusalem. A human body louse colony was originally obtained from Dr. J. Maunder (London School of Tropical Medicine and Hygiene) and has been maintained in our laboratory since 1983.

The insects were studied using a Zeiss 410 laser scanning confocal system attached to Zeiss Axiovert 135M inverted microscope with 10x Plan-Neofluar lens (Zeiss, Jena, Germany).

Results

The exuvium of a leg of the third nymphal stage of the body louse was found. The first three parts of the leg (tarsus, including the tarsal claw, tibia, and femur) were preserved entirely, whereas only part of the fourth segment of the leg, the trochanter, remained (Fig. 1). The comparison of the tarsus of this specimen (Fig. 2) with the legs of modern third instar nymphs of body louse and head louse revealed that the leg found within the archaeological debris belongs to a body louse. The lamella of the body louse is round with a feather like protuberance (Fig. 3), whereas the lamella of the head louse is elongated and triangular in form (Fig. 4).

Discussion

Human lice were apparently a common ectoparasite in Israel throughout the ages. Head lice 1500–9000 yr old, were found in combs and hair samples in

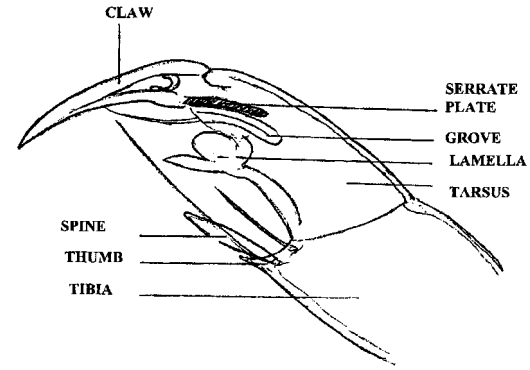

Fig. 2. Detail from the leg with the tarsal claw and lamella on the tarsus and the spine of the thumb on tibia.

Masada and other part of Israel (Mumcuoglu and Zias 1988, Zias and Mumcuoglu 1991).

Lice were mentioned in the Bible (JPS Bible 1917) and the "vermin," which is mentioned on several occasions in the Babylonian Talmud (Epstein 1961) most likely refers to body lice, e.g., (1) "... our rabbis taught: if one searches his garments (on the Sabbath), he may press (the vermin) and throw it away, providing he does not kill it..."; (Sabbath, 12a); (2) "... our rabbis thought one must not search (his garments) in the street, out of decency..."; (Sabbath 12a); (3) "... he who kills vermin on Sabbath is as though he killed a camel on Sabbath" (Sabbath 107b); and (4) "... if one launders his garments and does not wait eight days before putting it on, the vermin, which may still be in it, are produced and harmful..."; (Pesahim 112b).

The palatial fortress of Masada, which is situated in the Judaean desert close to the Dead Sea, was build by Herod as a winter palace as well as a place of refuge. Yet Masada is most famous for the stand of the Jewish

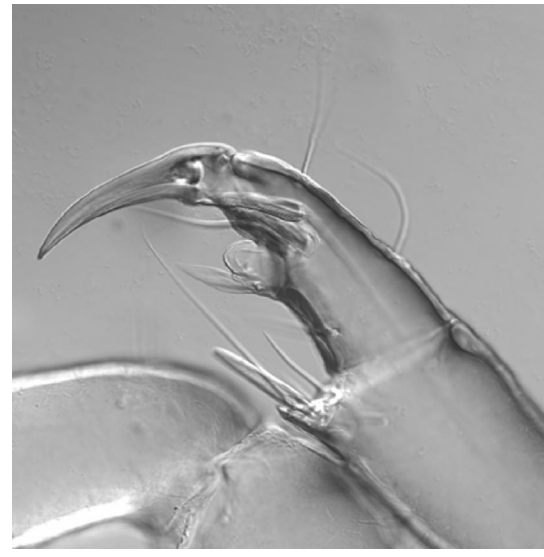

Fig. 3. Tarsus and tibia of a present-day body louse.

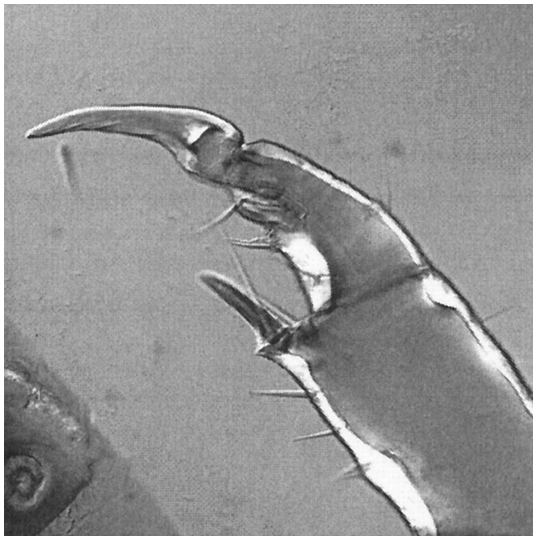

Fig. 4. Tarsus and tibia of a present-day head louse.

rebelling community in AD 73/74. Occupied by the rebels as early as AD 66, Masada was the last free stronghold to face the Romans, under the command of Eleazar ben Ya'ir. After a siege, which lasted for few months (AD 73/74), the rebels committed a collective suicide, choosing death over life of slavery and subordination to Caesar. During this period they were living in overcrowded conditions, which encouraged the transmission of body lice from one person to the other.

This is the first time to our knowledge that body lice have been found in archaeological material in Israel. The differences in leg morphology, which were found between the head and body louse, could be used to easily differentiate between the two forms.

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