they retain their rigidity best when cutting chitinous material.

The two edges of the bevel at the tip of the needle are quite sharp, cutting through chitin easily. In addition, the point is fine enough to be used as a micro-needle. The bevel also provides a flat surface for transferring tiny pieces of tissue. In practice it was found that, however small the tissue, it did not fall into the hole at the bevel, when using the #27 gauge needle. If desired, however, the hole can be filled with a waterproof or metal cement, or plugged with a piece of non-corrosive wire.

The hypodermic needle, being of stainless steel or other non-corroding metal, has the advantage of being very suitable for use under damp or tropical conditions. The needle unit may be detached from the rod and carried separately. If handled and stored properly, neither the cutting edges nor the point become dull. Also, the needle is relatively inexpensive, and it is easily replaced if lost or damaged. When using it as a micro-scalpel, it is recommended that the tissue being cut be held with a plain, fine needle, except when it is desired to cut with two scapels simultaneously.

Anopheles indefinitus AND *Culex fuscanus* (DIPTERA:CULICIDAE) IN SAIPAN

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A "malaria free" area in the Western Pacific, including Guam and Saipan, has long been of interest to malariologists because of the absence of malaria mosquitoes of the genus *Anopheles* (Russell *et al.*, 1963).

Although a number of medical entomologists were stationed in the Marianas during World War II, *Anopheles indefinitus* (Ludlow) apparently was not collected in either Guam or Saipan during this period. Sometime during the period 1945 to 1948 this species became established in Guam. It was first collected in March 1948 by the 207th Malaria Survey Unit, U. S. Army, as reported by Yamaguti and LaCasse (1950), and later in 1948 by Reeves and Rudnick (1951), mostly in southern Guam. It spread to central Guam fairly rapidly, as reported by Hull (1952). By 1969 it was considered generally distributed throughout the island, according to information furnished by the Guam Department of Public Health and Social Services. However, it apparently has never been reported previously from the neighboring island of Saipan, approximately 75 miles to the north of Guam.

Yamaguti and LaCasse (1950), Reeves and Rudnick (1951), Hull (1952), and Bohart (1957) all reported the *Anopheles* as *Anopheles subpictus indefinitus* (Ludlow). However, Reid (1966 and 1968), considers this a full species *Anopheles indefinitus* (Ludlow) in the *Pyretophorus* series, also referred to by Christophers (1933) and others as the Group *Pseudomyzomyia,* which includes *A. subpictus* and *vagus.*

Following a Vector Biology and Control Course sponsored by the World Health Organization in Kuala Lumpur, West Malaysia, during the fall of 1969, the junior author returned to his home station and collected larvae of *Anopheles indefinitus* (Ludlow) and *Culex (Lutzia) fuscanus* Wiedemann on Saipan. Neither species has previously been reported from Saipan.

The specimens were found in a ditch near a village house during the first half of January 1970. The *Culex (Lutzia) fuscanus* larvae, which were larger than the *Anopheles* larvae, ate *Anopheles, Culex,* and *Aedes* larvae voraciously. When the *Anopheles* larvae were collected, among them were larger larvae *Culex (Lutzia),* and both were placed in the same container. About an hour or so later, practically all the *Anopheles* larvae were gone. The *Culex (Lutzia)* were eating both the *Anopheles* larvae and the first or second instar of their own kind. Ten of them were kept in separate containers and fed daily with *Culex* and *Aedes* larvae. Each ate an average of 3 to 5 larvae per hour before pupation.

There is some travel between Guam and Saipan. *Anopheles indefinitus* may have been introduced from Guam into Saipan following World War II.

Specimens of larvae and adults of both newly introduced species were sent to the U. S. National Museum and are now in the Museum collection. Dr. Alan Stone confirmed the identification of *A. indefinitus* (Ludlow) and Suthorn Sirivanakarn of the Southeast Asia Mosquito Project identified the *Culex (Lutzia) fuscanus* Wiedemann. Dr. Richard F. Darsie, Entomologist with the Malaria Eradication Training Center in Manila, Philippines, also has confirmed the identification of the *A. indefinitus* and has checked the characters of the Saipan specimens with the key he and Ramos published in 1970.

The introduction of *Anopheles indefinitus* into Guam and Saipan is of interest because American military personnel with malarial infections acquired in Southeast Asia were being hospitalized in Guam during 1969 and may possibly visit Saipan. While there is a possibility of local transmission of malaria if *A. indefinitus* should bite an infected person and, later, bite an uninfected one, Reid (1968) has written, "Adults feed mainly on cattle and there is no evidence in the Philippines or

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Malaya that it is a vector of human disease though adults can be found in houses."

References

Bohart, R. M. 1957. Insects of Micronesia: Culicidae. Bernice Bishop Museum, Honolulu, Hawaii. Insects of Micronesia 12(1):1–83.

Christophers, S. R. 1933. The fauna of British India, including Ceylon and Burma: Diptera. 4., Family Culicidae, Tribe Anophelini. Taylor and Francis, London, 371 p.

Hull, W. B. 1952. Mosquito survey of Guam. U. S. Armed Forces Med. J. 3:1287–1295.

Ramos, A. Cagampang and Darsie, R. F. 1970. Illustrated keys to the *Anopheles* mosquitoes of the Philippine Islands. Tech Report 70–1, U.S.A.F., Fifth Epidemiological Flight, P.A.C.A.F APO SF 96528.

Reeves, W. C. and Rudnick, A. 1951. A survey of the mosquitoes of Guam in two periods in 1948 and 1949 and its epidemiological implications. Am. J. Trop. Med. 31:633–658.

Reid, J. A. 1966. A note on *Anopheles subpictus* Grassi and *A. indefinitus* Ludlow (Diptera: Culicidae). J. Med. Ent. 3(3–4):327–331.

Reid, J. A. 1968. Anopheline mosquitoes of Malaya and Borneo. Studies Inst. Med. Res., Malaysia, No. 31: 520 pp.

Russell, P. F., West, L. S., Manwell, R. D. and McDonald, G. 1963. Practical malariology. 2nd Edit. Oxford Univ. Press, New York, 750 pp.

Yamaguti, S. and LaCasse, W. J. 1950. Mosquito Fauna of Guam. Office of the Surgeon, Hq. 8th Army APO 343. Prepared by 207 Malaria Survey Detachment, APO 301. Plates 1 and 2, p. 12.

AN EFFECTIVE REPELLENT FOR *Leptoconops kerteszi* KIEFFER (DIPTERA:CERATOPOGONIDAE)

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The problem of human annoyance caused by the attack of the Bodega Black Gnat *Leptoconops kerteszi* Kieffer has been related by a number of workers (Smith and Lowe, 1948; Rees and Smith, 1950; Foulk and Sjogren, 1967; and Foulk, 1969).

This insect has been a particular problem since 1965 along the Santa Ana River in Southern California. Extensive breeding areas have been created by floods which eliminated a well defined river channel, forming damp sand bars suitable for immature gnat development. Gnat populations have increased in direct proportion to an increase in the available breeding grounds of this insect. In 1969 attack rates of 200–300 female gnats/minute were common within the river bottom and adjacent residential areas. Peak attack rates as high as 1,813 gnats/minute were recorded using the standard sampling method reported by Foulk and Sjogren (*op. cit.*).

Until recently, scarves or bandannas were used on the head for protection. These were applied holding opposite corners in each hand and passing the straight line over the head to the nape of the neck, then pulling the ends forward over the ears to tie above the forehead. If the bandannas were used with a hat and glasses, little annoyance was experienced even during periods of heavy attack. The intermediate valley strain of this insect which occurs along the Santa Ana River attacks primarily around the head and neck, in contrast to the desert strain which appears to prefer the head but will also feed on other hirsute portions of the body. The attack behavior of the former strain is characterized by repeated sequences of landing, crawling and taking flight again, with only an occasional female remaining to feed. Efforts to obtain numerical data based on landing rates met with difficulty due to the minute size of the gnat and its rapid movement prior to flight. Since the crawling sensation is as annoying to most humans as the bite, the criterion for effectiveness was established as one which prevented the gnats from landing on the treated area.

In 1966, all known commercially available insect repellent formulations were tested for their efficacy against this insect. Due to the habit of the local strain to preferentially attack the human head around the nape of the neck and ears, candidate materials were applied on one side of the head, the opposite side serving as a control. Evaluations were performed on two persons, each applying a material to be tested on three successive days. Attack rates during the testing periods averaged 300 females/minute on untreated human hosts. Initial efforts to locate a repellent which prevented the gnats from landing were unsuccessful. Several cream base materials, if applied heavily, gave the wearer the impression of relief; however the gnats only became stuck on the skin.

Commercially available insect repellents were again tested during the summer of 1969. Solutions containing 25, 50 and 75 percent N,N-diethyl-metatoluamide (Deet), dimethyl phthalate and Indalone in isopropyl alcohol were also tested. The latter two materials have been reported to be of value against *Culicoides*, a blood sucking genus in the same family as *Leptoconops*, by Pijoan *et al.* (1946), Cameron (1946), Peacock *et al.* (1948), Travis and Morton (1950), Applewhite and Smith (1950), and Applewhite and Cross (1951). None of the commercial formulations employing Deet or 2-ethyl- 1,3 hexanediol as the primary active

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