A Lectotype Designation and Description for Anopheles (An.) sinensis Wiedemann 1828, with a Discussion of the Classification and Vector Status of This and Some Other Oriental Anopheles

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ABSTRACT

The true identity of Anopheles sinensis is established by the designation and description of a lectotype. The status of An. lesteri and other cryptic species hidden under the name "sinensis" in China, is summarized. The confusion produced by these cryptic species, in regard to our understanding of the vector capabilities of sinensis, is also discussed. Characters are noted that can be used to separate lesteri from sinensis, and lesteri is recorded from the Ryukyu Islands for the first time. Recommendations are made for priority studies that are needed to help clarify our understanding of sinensis in the Orient.

INTRODUCTION

Anopheles (Anopheles) sinensis Wiedemann 1828, is one of the oldest and best known anopheline names. Many entomologists and public health officials associate this name with a common Oriental mosquito vector of human malarial and filarial parasites. During the last 25 years the taxonomic concept and vector status of sinensis have been significantly altered as outlined below. Despite these changes the type specimens have not been examined since 1924, and up to now the name "sinensis" could not be assigned with certainty to a particular species. Therefore, I have found it necessary to re-examine the type specimens and fix the identity of sinensis by designating a lectotype.

CHANGES IN SYSTEMATICS AND VECTOR STATUS

Prior to 1953 the name sinensis was generally used as a subspecies of Anopheles hyrcanus (Pallas) 1771 (another name currently needing definition), and applied to a variable Oriental mosquito that was distinguished from the other Oriental hyrcanus subspecies, nigerrimus Giles 1900, by minor wing characters and the extent of hind tarsal banding (Christophers 1933). Yamada

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(1924), last examined the sinensis types, and determined that this subspecies was characterized by narrow pale hind tarsal bands. By World War II several forms of sinensis had been described. These held the rank of "varieties" and the concept of a variable subspecies remained in general use.

The abundance of sinensis in the Orient led to early suspicions of its vector role. Apparently the first successful experimental malaria transmission studies using sinensis were conducted by Tsuzuki in Japan in 1902 (as jesoensis) and Kinoshita in Formosa in 1906 (Covell 1927). Covell lists a large number of early experimental transmission attempts with hyrcanus sinensis from many areas of the Orient, and a number of these were successful. Although malaria laboratory experiments with sinensis became common, the discovery of naturally infected sinensis came more slowly. According to Covell (1927) the first natural malaria infection in this subspecies was reported by Stanton in Malaya in 1914. Other natural infections were reported in the early 1920's by Dutch workers in Sumatra. The search for natural vectors in China began even later, for sinensis was not found naturally infected until the early 1930's. At that time, Feng (1931, 1932) found it naturally infected with Wuchereria bancrofti and malarial parasites in the Shanghai area. During the remainder of the 1930's other successful parasite isolations were made from this subspecies from widely separated areas of China. By World War II sinensis was considered a primary vector of filarial and malarial parasites wherever it was found in China. With the increased vector surveillance conducted in the Orient during WW II, it became evident that the different varieties of sinensis from different areas were not all important vectors. The latter view was accepted by Covell (1944) for that form found in Indochina. The significance of the different sinensis varieties and their variable vector capabilities did not become apparent until the early 1950's.

Reid (1953) abruptly changed the concepts surrounding sinensis when he determined that Anopheles hyrcanus sensu stricto, did not occur in Southeast Asia, and that what had been called hyrcanus there, was actually at least 8 distinct species, not 2 highly variable subspecies. Under this new concept sinensis was still defined on the basis of Yamada's (1924) examination of the type specimens, and was still one of the most widely distributed species in the Orient. This range extends from northern China, Korea and Japan down to Malaya, Sumatra and Java in the South and to Assam in the West. In this concept Reid also suggested that the sinensis from the Palearctic areas may be a different species from the South China - Southeast Asian sinensis.

This new species concept casts light on the older varieties of sinensis and their differing vector capabilities. However, due to the highly variable nature of the early sinensis, the exact identities of early "species" tested are questionable. Some certainties do exist, the early records of studies using sinensis in Sri Lanka (Ceylon) and most of India, probably refer to either nigerrimus or peditaeniatus (Leicester) 1908, for sinensis is not known west of Assam. Also, the identities of the "sinensis" found naturally infected with malaria parasites in Malaya and Sumatra are now suspect, for sinensis in Malaya, as defined by Reid (1953, 1968) is highly zoophilic, and has not been incriminated there as a vector of disease pathogens.

Japanese researchers working at approximately the same time as Reid, discovered their "sinensis" was actually composed of 3 species: sinensis, yatsushiroensis Miyazaki 1951, and lesteri Baisas and Hu 1936; and, that at least 2-3 egg forms of sinensis existed in South China (Otsuru and Ohmori 1960). Anopheles lesteri, prior to Reid (1953) was defined as a variety of sinensis from China and the Philippines. In the late 1950's two Chinese studies (Feng and Ma 1957; Feng et al. 1958) reported that 3 egg types of sinensis

occurred in the hilly areas of South China; and, that both their narrow decked egg type sinensis and wide decked egg type sinensis were vectors of Brugia malayi parasites. Of more importance, these studies showed the narrow decked egg type sinensis was significantly more important as a vector because it was almost entirely anthropophilic, while the wide decked egg type was primarily zoophilic. These 2 species were not identified until Ho et al. (1962), determined the wide decked egg type was equal to sinensis and the narrow decked egg type was lesteri. The latter was originally described, in part, from China, but its existence there was forgotten by many authors, even as late as Foote and Cook (1959). Ho et al. (1962) also showed that lesteri, besides being the primary vector of filarial parasites, was also the primary vector of malarial parasites in the hilly regions of the Yangtze valley in South China. This study pointed out that sinensis, due to its zoophilic behavior, is actually an inefficient vector that is only significant in maintaining a low malaria endemicity in the broad flat rice plains of South China. Since then, other Chinese studies (Feng 1964; Ma 1964; Ma 1968a, b & c) have determined that not just one species (lesteri), but at least 3, possibly 4 species beside sinensis, are being confused under the name "sinensis" in China. These cryptic species are defined best by egg characters. The adults are nearly identical and not all of the larvae and pupae can be differentiated. The exact significance of these finds in regard to sinensis vector capabilities in China is not yet known; however, the above mentioned elucidation of the true role of sinensis as a vector in South China, certainly points to the need for a re-examination of its vector capabilities in other areas. Otsuru and Ohmori (1960) in summarizing the Japanese malaria vector situation, note that although they had insufficient evidence to incriminate lesteri as a vector in Japan, it was most important to differentiate this species from sinensis because of its vector potential. These authors suggest "that malaria epidemiology in the Far East should be re-investigated from a new taxomonical point of view."

DISCUSSION

At present, at least 14 species and subspecies in the Orient are members of, or related to Reid's Southeast Asia Anopheles hyrcanus complex (Harrison 1972). Of this list at least 8 species and subspecies were originally hidden in the old variable "sinensis" concept. Some of the cryptic species defined by egg types in the Chinese studies cannot be associated with current known species without further studies. These are: (1) narrow decked egg form (Feng 1964, not Feng et al. 1958); (2) small wide decked type Anopheles (Ma 1968b); and (3) large narrow decked type Anopheles (Ma 1968b). Others can be assigned probable identities on the basis of current information. Feng's (1964) "broad decked egg type" and Ma's (1964) "large wide decked type" are probably equal to sinensis sensu stricto. Recently, Harrison (1972) suggested the "medium decked egg type" of Feng (1964) is probably equivalent to An. peditaeniatus (Leicester) 1908, with reduced hind tarsal bands. This claim was based on a complete analysis of Feng's descriptions and peditaeniatus, particularly the close examination of peditaeniatus specimens found in the U.S. National Museum from China (Fukien, Kweichow and Yunnan provinces). Earlier records (Yao and Ling 1937; Ho 1938) of An. hyrcanus nigerrimus in Yunnan and Kwangtung (Hainan Island) provinces respectively, probably also refer to peditaeniatus rather than nigerrimus (Reid 1953).

The identity of Ma's (1968b) "X type Anopheles" found in Sinkiang province, is probably equivalent to Palearctic An. hyrcanus even though Ma (1968b) claims it probably does not belong to this species. The taxonomy of Palearctic hyrcanus is very confused and in need of revision. A number of described species and varieties have been synonymized under this name. A thorough study of these, with associated immature skins, will probably reveal some deserving specific rank. Ward (1972) found hyrcanus common in northern Afghanistan and noted the majority of the specimens had hind tarsomere 4 entirely pale. This is exactly the same as Ma noted in his description of the hind tarsi of his unknown species. I have examined the Afghanistan hyrcanus collected by Ward and deposited in the USNM, and two specimens of hyrcanus from Astrakhan, near the type locality of hyrcanus in the northern Caspian region of the U.S.S.R. These hyrcanus closely match Ma's description of "X type Anopheles" in every respect.

Ho et al. (1962) considered the species in southern China with a narrow egg deck as equivalent to lesteri. This species is also recognizable in Feng (1964) as the "extremely narrow decked egg type" of sinensis, and in Ma (1964, 1968b) as the "small narrow-decked egg type", however, both these latter authors felt this species was not the same as lesteri, or even lesteri paraliae Sandosham 1959, which is found in Malaysia and Thailand. During the past several years I have examined all the lesteri and lesteri paraliae specimens in the USNM and British Museum (NH) collections, plus I have collected, reared and examined a considerable number of adults of lesteri with associated skins from the Philippines and New Territories, Hong Kong Colony. To date, I have not found any significant differences between lesteri from China and those from the Philippines. Thus, I agree with Baisas and Hu (1936) and Ho et al. (1962) that the southern China lesteri is conspecific with the Philippine lesteri. A comparison of the biology and behavior of lesteri from these 2 areas was attempted by Ma (1968b), but this needs re-evaluation because very little work has been conducted on these aspects of Philippine lesteri.

Anopheles sinensis is still recognized as a primary vector of malarial parasites in Korea, Taiwan and North and Central China. Previously, before malaria eradication, it was considered the primary vector in Japan and a secondary vector in Okinawa. Beside malarial incriminations it is also recognized as a primary vector of human filarial parasites in parts of China. However, recent studies are casting serious doubts on some of these incriminations. Already sinensis has been relieved of its primary vector roles in South China, and lesteri is now recognized as the more important vector in that area. It is also evident that our knowledge of lesteri and its distribution is very limited. Otsuru and Ohmori (1960) suggested that lesteri from Japan and central and northern China may be a different species from lesteri in southern China. Whang (1962) found lesteri widely distributed, though not abundant, in South Korea. Recently, I found a considerable number of lesteri with associated skins, deposited in the USNM, from the Ryukyu Islands (Okinawa and Iriomote). Apparently this is the first record of lesteri from the Ryukyus. To date, lesteri has not been recorded from Taiwan, but a clue to its possible presence there is found in Sun (1964). Sun shows an annual abundance chart for sinensis which exhibits a bimodal curve. The first (summer) peak noted for Taiwanese sinensis is nearly the same as that found for sinensis on the southern Chinese mainland, while the second (late fall) peak shown for Taiwanese sinensis is nearly identical to that noted for lesteri on the mainland.

Beside the growing awareness of the distribution and vector capabilities of lesteri, there appear to be other species in China hidden under the name "sinensis." Only very specific studies will determine whether these are new or previously described. Regardless of the names finally assigned to these cryptic species, their presence will alter our image of sinensis and its vector roles even more. Unfortunately, our current image is based on taxonomic concepts in vogue in 1924. In view of this and the current confusion surrounding the vector status and systematics of sinensis, it seemed essential that the existing type material be re-examined and the identity of sinensis be firmly established by a lectotype designation.

THE IDENTITY OF SINENSIS

The source of the specimens used by Wiedemann (1828) to describe sinensis is listed by him only as "China." Fortunately, one of the existing syntypes (see below) still retains a label saying "Canton" which indicates at least one of the types came from southern China. Actually, all of the type specimens have the appearance of southern or Southeast Asian specimens rather than the characters noted by Reid (1953) on Palearctic specimens. Recent Chinese researchers seem agreed that of all the cryptic "sinensis" forms in China, only lesteri and sinensis are common in southern China. Apparently the former is common only in hilly areas where deep, clear and cool-shaded water is abundant, while the latter is found in the hilly areas and the flat rice plains where the water is usually shallow, turbid or polluted and warm. These views are all consistent with my findings in the New Territories of Hong Kong Colony, where only these two members of the S.E. Asian hyrcanus complex were found in immature and resting adult collections.

Adult and pupal characters to separate lesteri and sinensis were described by Reid (1953). Patches of mid coxal pale scales on sinensis and white scales on the gonocoxites of male sinensis are absent on lesteri, while the rim on the pupal trumpet of sinensis is thin and uniform and that on lesteri is thick and saw-toothed. Specimens of lesteri and sinensis collected in Hong Kong that had their identity confirmed by individually reared-associated immature skins, all adhered to these characters. Feng (1964) also found the absence of mid coxal pale scales a prime character for separating his lesteri (extremely narrow decked egg type) from sinensis (wide decked egg type). Certain characters used by Otsuru and Ohmori (1960) to separate Japanese lesteri and sinensis were evaluated using Hong Kong (South China) specimens and found useless, they are: the size of the subcostal pale spot on wing vein C; the presence or absence of a pale fringe spot at the termination of wing vein Cu_2; and the dark dorsal spots between the pupal trumpets. While the subcostal spot was consistently small on lesteri, it was highly variable on sinensis. Likewise, lesteri never exhibited a pale fringe spot at the termination of wing vein Cu_2, but only 50-60% of the sinensis exhibited this spot. Many of the lesteri pupae had no trace of dark-dorsal spots between the trumpets.

The presence of confirmed-reared lesteri and sinensis from Hong Kong became extremely important when the sinensis type material was examined. Fortunately, all 4 (1♂, 3♀♀) of Wiedemann's types are easily identified as sinensis. The 3 females exhibit the lateral clypeal scale patches found in S.E. Asia only on members of the An. hyrcanus complex. Two of the 3 females also exhibit a ventral scale tuft on abdominal sternum VII (1♀ has the abdomen missing). The male can be identified with the S.E. Asian hyrcanus complex by the wings and pale palpal bands. Unfortunately, the male genitalia is missing. All 4

specimens exhibit a patch of pale scales on the upper portion of the mid coxae. These character combinations, plus narrow tarsal bands, pleural chaetotaxy and the general habitus, leave no doubt that their identity is sinensis, as it is currently recognized (Reid, 1953, 1963, 1968; Harrison 1972).

TYPE MATERIAL

Fortunately, I was able to borrow all the known syntype specimens from the Natural History Museum, Wien, Austria, and the Zoological Museum, Copenhagen, Denmark. Prior to 1954 there were only 2 syntypes known, both in the Wien Museum where Yamada (1924) examined them. These specimens consist of a male with the genitalia previously clipped and not available for study, and a female with only the head with palps, thorax and 1 wing remaining. Both specimens have "Coll. Winthem" labels and the female bears a "Sinensis, Wied., Canton" label which is probably in Wiedemann's handwriting (Horn and Kahle 1937). This locality is listed by Yamada (1924) and Stone et al. (1959) as being on the type. The male has a handwritten "sinensis" on a "Det. Wiedem." label, but the handwriting is very different from that displayed for Wiedemann by Horn and Kahle (1937).

While cataloging Wiedemann types in the Zoological Museum, Copenhagen, Zimsen (1954) found 2 more female syntypes in the Westermann Collection. These two specimens are in excellent condition. Both bear "Coll, Westerm." labels and one has a "Anopheles sinensis Wied. China, Trentepohl" label definitely hand penned by Westermann (Horn and Kahle 1935). The Copenhagen syntypes reached that museum through Dr. Trentepohl, a very close friend of Wiedemann. In the original description of sinensis, Wiedemann (1828) clearly states that specimens of sinensis are "In Dr. Trentepohl's and my collection," but the numbers placed in each collection is not given. The male and female in the Wien Museum apparently represent the syntypes retained by Wiedemann and later given to that museum, while the two females in Copenhagen represent the syntypes given to Dr. Trentepohl, who then gave them to Westermann. Additional evidence exists for the original association of these specimens, as the insect pins used with the two Copenhagen females are identical with the pin used in mounting the Wien female. Furthermore, all 3 females are pinned identically. It is unfortunate that the Copenhagen females lack locality labels, but Zimsen pointed out that Westermann was very particular about his specimens and labels, and that early collection curators were less particular than modern curators about preserving original labels. The fact that Westermann put Trentepohl's name on the one Copenhagen label certainly implies the specimen came from Trentepohl. The thoroughness with which Zimsen researched the history behind the Wiedemann types in Copenhagen, and the additional evidence (above) of the original association of the Copenhagen females with the Wien female, leaves little doubt that the Copenhagen females are part of Wiedemann's original type series of sinensis. Therefore, the Copenhagen and Wien specimens are of equal status and I treat them accordingly.

The selection of the lectotype specimen was relatively simple. The male syntype was not acceptable because of generally poor condition and the missing genitalia. Besides, no salient male genitalia characters are known that will identify the respective species of this complex. The female from Wien with the "Canton" label would be the logical choice, but this specimen is in extremely poor condition, with the proboscis, antennae, legs, one wing and the abdomen missing. Clypeal, mid-coxal and wing characters show this specimen is sinensis, but the absence of the other body parts rule out its selection. Of the two Copenhagen females, both are in excellent condition, however, one

female has the tarsal segments of both hind legs missing. The other female has all the body parts present (excepting some scales and setae) and bears the label with Trentepohl's name; therefore, this specimen is my choice for lectotype designation.

LECTOTYPE

A lectotype is herein designated for Anopheles (Anopheles) sinensis Wiedemann 1828. The lectotype female bears the following data on two labels: "Coll. Westerm." and "Anopheles sinensis Wied. China, Trentepohl." The latter label is hand penned by Westermann (Horn and Kahle 1935). The lectotype is deposited in the Universitetets Zoologiske Museum, Copenhagen, Denmark.

Anopheles (Anopheles) sinensis Wiedemann

(Fig. 1)

Anopheles sinensis Wiedemann 1828, Aussereurop. Zweifl. Ins. 1:547 (♂, ♀). Type-locality: China.

Head. Vertex and occiput with erect scales only, vertex with white median scales, tan to brown lateral scales; frontal tuft with pale scales and pale setae; clypeus with patch of erect brown scales on each side; palpus with bushy erect scales from base to segment 3, approximately equal length of proboscis; fifth palpal segment with narrow apical and basal pale bands, apical band approximately 1/4 length of segment, basal band shorter; fourth palpal segment with small dorsal patch of pale scales at base; third palpal segment with small dorsal patch of pale scales at base; second palpal segment with dorso-mesal pale scales; proboscis with dark scales, those near base somewhat erect, those more distal appressed; antennal pedicel with several pale scales on dorso-lateral aspect; most basal 4-5 antennal flagellomeres with several pale scales. Thorax. Anterior promontory with long fine pale scales mesally, broader and darker scales laterally; scutal integument light brown with faint dark brown line on midline extending caudally to where pin enters in prescutellar area, with faint eyespots; scutum sparsely covered with fine, curved silvery-yellow scales; scutal setae usually equal in size to scales, with longer stout setae in pre and supra alar areas, dorsal central row (except anterior portion), and widely separated on acrostichal row; anterior pronotum with patch of dorso-anterior dark erect scales, setae posteriorly; pleuron light brown with dark areas in form of two lines, uppermost extending from posterior pronotum to upper portion of metapleuron, lowermost extending from just below propleural area, across sternopleuron to meron; lower mesepimeron with small dark area; pleuron with 2-3 scales on lower sternopleuron; pleural setae as follow: 6-7 propleural, 2-3 spiracular, 12-13 prealar, 5 upper and 9 lower sternopleural, 7 upper mesepimeral; scutellum with long stout setae and fine curved pale scales. Wing. Costa mostly dark scaled, with several pale scales on caudal margin at humeral cross vein, with distinct subcostal and preapical pale spots; subcostal pale spot includes costa, tip of subcosta and R_1; preapical pale spot includes costa, R_1 and R_2; remigium pale on anterior margin, posterior margin with proximal and distal dark spots; humeral cross vein without scales; subcosta with scattered pale scales along distal 60 percent; R-R_1 dark scaled at base, with large presector and sector pale marks, with scattered pale scales between sector and subcostal pale marks, and few scattered pale scales on

preapical dark area near subcostal pale spot, subcostal and preapical pale spots equal those on costa, tip dark scaled. R_s with dark scales; R_{2+3} dark scaled basally, gradually paler to pale scaled just before fork; R_2 dark scaled except for pale spot equal to preapical pale spot on costa and R_1, tip dark scaled; R_3 dark scaled on basal third, then pale scaled except for tip; R_{4+5} with distinct dark spots at base and apex, mixed pale and dark scales in between; M mostly dark scaled, with paler area just before fork; M_{1+2} with basal one third and tip dark scaled, remainder pale scaled; M_{3+4} pale scaled except for small dark spots at base and apex; Cu with very small dark spot at base followed by pale mark, then dark mark that is shorter than basal pale mark, remainder pale scaled to fork; Cu_1 with basal 40 percent and tip dark scaled, remainder pale scaled except for some dark lateral scales; Cu_2 white scaled except small dark mark at tip; 1A pale scaled except small dark mark approximately midway along vein, and dark scaled distal one sixth; large basal dark mark on Cu separated from most basal dark mark on 1A by slightly more than its length on both wings; apical dark mark on 1A twice or more length of apical dark mark on Cu_2; apical pale fringe spot extends from R_1 down to slightly below R_{4+5}; caudal margin of wing with faint pale fringe spot adjacent to tip of Cu_2. Halter. With dark scales. Legs. Coxae with pale scales, mid coxa with 3-4 upper coxal setae and upper and lower patches of flat white scales. Fore leg: femur swollen on basal half, with dirty yellow scales except for few brown scales on dorsal aspect of apex; tibia with dark scales dorsally, dirty yellow scales ventrally; tarsomeres dark scaled except yellow scales on venter of T_1, and a narrow apical pale band approximately equal segment width on T_1, T_2 and T_3. Mid leg: femur with dirty yellow scales except for dark brown scales on dorso-anterior aspect; tibia with dark scales on dorso-anterior aspect, with dirty yellow scales on ventro-posterior aspect; tarsomeres dark scaled except yellow scales on venter of T_1, and a small dorso-apical white scale patch on T_1, T_2 and T_3. Hind leg: femur dark scaled dorsally and apically, with ventral yellow scales except at apex; tibia dark scaled except for dorsal white scale patch at apex and yellow scales on proximal 80 percent of venter; tarsomeres dark scaled except for few yellow scales on venter of T_1, and a small dorso-apical white scale patch on T_1, T_2, T_3 and T_4. White scale patches on mid and hind tarsomeres not forming complete apical bands. Abdomen. Integument dark brown, without dorsal scales but with long golden setae; sterna without scales, except sternum VII with 4 dark median scales near caudad margin (segment rubbed).

The lectotype is in excellent condition considering its age, with all major body parts present. The dark body and wing colors are somewhat faded, often blending into the paler colors, thus, the color patterns are less distinct than on a fresh specimen. Slight amounts of fungus hyphae are present on the antennae and wings, but not enough to impair examination. Parts of the head, scutum, wings, pleural areas and abdomen appear slightly rubbed, consequently, some pleural setae and palpal and abdominal scales are missing, and others may have been slightly altered. The specimen has the pin (#0 or 1) entering the scutum in the prescutellar area and emerging between the fore and mid coxae, pushing the fore coxae forward and up, thus partially obscuring and damaging the propleural and prosternal areas. One further observation may be of value in identifying this specimen, i.e., the left mesospiracle has a mite partially protruding from the orifice.

One variation was noted on the wings of the lectotype that is not normally found on sinensis. Both humeral cross veins lack scales, while normal sinensis usually possess 3-6 small scales on this vein and only infrequent or rare

individuals have none or 1 to 2 (Harrison 1972). It is possible these scales have been lost from this specimen, however, the scales on adjacent areas do not appear altered. The absence of HCV scales was also noted on one of the other female syntypes and on several sinensis females collected in Hong Kong. Apparently, the presence or absence of these scales is more variable in sinensis, than in some of the other members of the Southeast Asian hyrcanus complex.

CONCLUSIONS

For many years sinensis has been tagged as a vector of disease pathogens in many parts of the Orient, yet, during this entire period no one actually knew the true identity of sinensis. It is a credit to some of the earlier taxonomists, mixed with a bit of luck, that the type specimens of sinensis are now found to actually represent the species we have been calling sinensis. Now that sinensis is identified, the re-investigation of malaria epidemiology in the Far East from a new taxonomical point of view (Otsuru and Ohmori 1960), is definitely in order and most pertinent. Of highest priority should be the re-examination of the type specimens (if they still exist) of An. plumiger Donitz 1901, and An. jesoensis Tsuzuki 1902, which are currently considered synonyms of sinensis. The types of plumiger are located in the Zoologisches Museum, Humboldt Universitat, Berlin, while the location of the type of jesoensis is unknown (Stone et al. 1959). These names may actually be valid, and they predate names such as lesteri and yatsushiroensis. Another priority is to determine the distribution, behavior and malarial and filarial parasite susceptibilities of lesteri throughout its range, for this species, instead of sinensis, may have been or may now be the more significant parasite vector in Taiwan, Okinawa, Japan, Korea and central and northern China. Very critical and precise studies are also needed to define the other cryptic species in China hidden under the name "sinensis," and their relation to disease transmission.

Finally, the current usage of complexes of cryptic or sibling species is very evident, and the significance of genetics in parasite susceptibility (Macdonald 1962; Macdonald and Ramachandran 1965; Ward 1963; Rutledge et al. 1970) and the behavior of mosquitoes is generally recognized. Therefore, the use of blanket vector incriminations (Stojanovich and Scott 1966; Reisen et al. 1972; and other recent authors) seems out of date. The vector capabilities of a given mosquito species can only be correctly determined by a thorough study of the ecological and disease factors in an area at that time, not on the basis of old data from some distant area.

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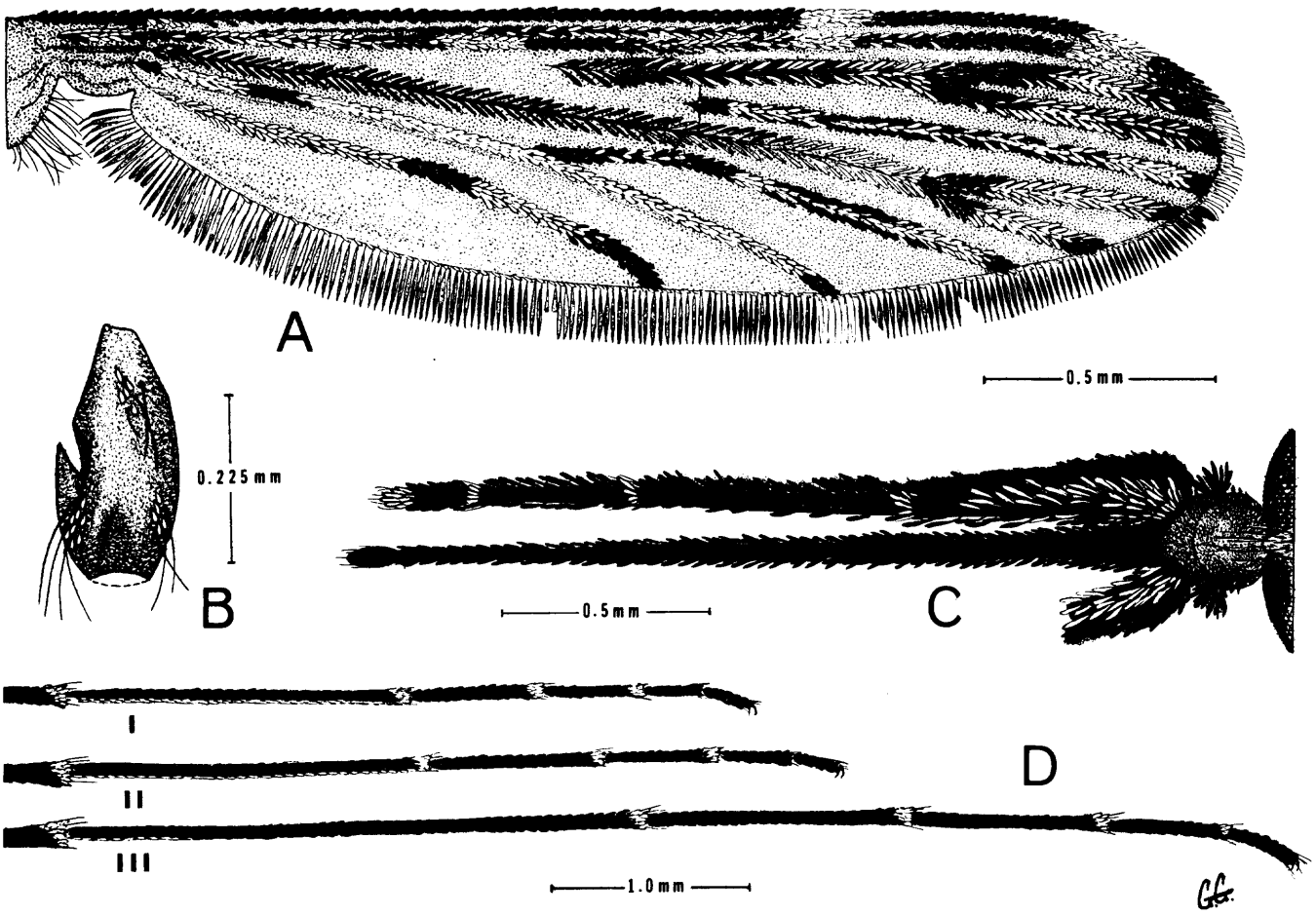

Fig. 1 Anopheles (Anopheles) sinensis Wiedemann. Lectotype female. A. dorsum of right wing; B. lateral view of right mid coxa; C. dorsum of proboscis, right palpus and clypeus; D. lateral view of fore, mid and hind tarsomeres.