30 April 1981

PROC. ENTOMOL. SOC. WASH.
83(2), 1981, pp. 339–358

THE *TABANUS STRIATUS* COMPLEX (DIPTERA: TABANIDAE): A REVISION OF SOME ORIENTAL HORSE FLY VECTORS OF SURRA[1]

JOHN F. BURGER AND F. CHRISTIAN THOMPSON

(JFB) Department of Entomology, University of New Hampshire, Durham, New Hampshire 03824; (FCT) Systematic Entomology Laboratory, IIBIII, Agric. Res., Sci. and Educ. Admin., USDA, %U.S. National Museum of Natural History, Washington, D.C. 20560.

Abstract.—Three distinct species previously confused with and called *Tabanus striatus* are characterized: *Tabanus striatus* Fabricius in the northern and western part of the Oriental Region; *T. partitus* Walker in the eastern and southern part of the Oriental Region and Micronesia; and *T. triceps* Thunberg on the Indian subcontinent. Illustrations and a key are given, along with a review of the previous literature on these bloodsucking pests and vectors of livestock diseases.

Three species of *Tabanus* in the Oriental Region with trivittate abdomen (*Tabanus striatus* Fabricius, *Tabanus partitus* Walker and *Tabanus triceps* Thunberg) have, since their description, been subject to misinterpretation by many authors. One of the species previously called *striatus* has been incriminated as a vector of surra, an important disease of horses. Many of the fundamental studies on this species and others in the complex have been published under incorrect names. Determination of correct synonymy and application of correct names have not been possible with confidence due to inaccessibility of types, a myriad of synonyms incorrectly placed, and critical morphological characters misconstrued or ignored. Burton (1978) aptly termed the problems associated with these species "chaotic." To resolve these taxonomic problems, their history is reviewed. Complete synonymy, diagnosis, history, and distribution are given for each species.

We recognize three distinct taxa previously confused with and called *Tabanus striatus*: *Tabanus striatus* Fabricius in the northern and western part of the Oriental Region, from Pakistan, India, and Sri Lanka to China; *T.*

---

[1] Scientific Contribution Number 1066 from the New Hampshire Agricultural Experiment Station.

partitus Walker from Thailand (and possibly Burma), Malaysia, Indonesia, Philippines, and Micronesia; and *T. triceps* Thunberg from Sri Lanka, India, and Pakistan. These species can be separated by the following key:

1. Females (eyes separated) 2
– Males (eyes contiguous) 4
2. Usually larger species (14–16 mm); foretibia uniformly orange to orange brown, not noticeably darkened apically (Fig. 3); frontal callosity with basal portion long and narrow, narrowly separated from eye margins ventrally and receding from eye margins dorsally (Fig. 1); abdominal venter uniformly gray tomentose and pale pilose, lacking a median dark stripe (Fig. 7) ..... *triceps* Thunberg
– Usually smaller species (10–13 mm); foretibia sharply bicolored, pale on basal ⅔, blackish on apical ⅓ (Fig. 6); frontal callosity with basal portion contiguous with eye margins for most or all its length (Fig. 2); abdominal venter with distinct broad median dark stripe (Fig. 8) 3
3. Abdomen with dorsal median pale stripe evanescent or absent on tergum 2 (Fig. 5); abdominal ground color blackish .... *striatus* Fabricius
– Abdomen with dorsal median pale stripe complete, fully developed on tergum 2 (Fig. 4); abdominal ground color dark brown to brown black ..... *partitus* Walker
4. Foretibia uniformly orange to orange brown (Fig. 3); abdominal venter uniformly pale yellowish white to yellow tomentose and pilose (Fig. 7) ..... *triceps* Thunberg
– Foretibia bicolored, pale basally, becoming blackish on apical 1/4 (Fig. 6); abdominal venter yellowish white tomentose with a broad dark midstripe (Fig. 8) 5
5. Costal cell clear, never tinted ..... *striatus* Fabricius
– Costal cell yellow tinted ..... *partitus* Walker

Tabanus striatus Fabricius

Tabanus striatus Fabricius, 1787: 356. Type-locality: China. Lectotype UZMC. Subsequent references: Surcouf, 1923: 196 (taxonomy); Isaac, 1924b: 108 (biology, immature stages); Chvála and Lyneborg, 1970b: 546 (lectotype designation); Stone, 1972: 639 (taxonomy), 1975: 70 (catalog citation); Burton, 1978: 71 (taxonomy, Laos, Thailand distribution records, biology).

Tabanus hilaris Walker, 1850: 49. Type-locality: East India. Holotype male BM(NH). Subsequent references: Bigot, 1891: 269, van der Wulp, 1896: 60, Kertész, 1900: 53, 1908: 249 (catalog citations); Ricardo, 1911: 153

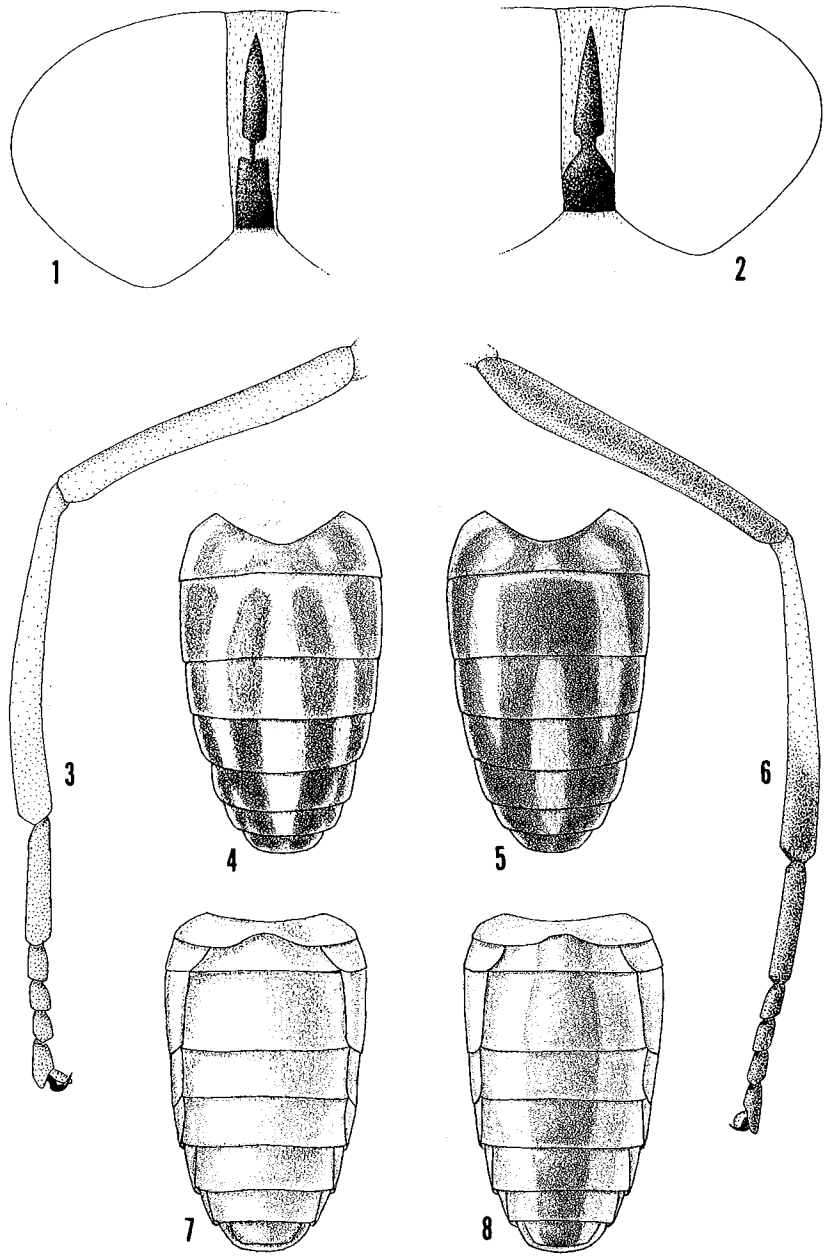
(taxonomy), 1916: 407 (Hong Kong); Fletcher, 1916 (life history), 1917 (oviposition).

Tabanus tenens subform *cambodiensis* Toumanoff, 1953: 201. Type-locality: not stated (Cambodia). Holotype lost.

Tabanus striatus (in part); Bigot, 1891: 268, van der Wulp, 1896: 58 (catalog citations); Kertész, 1900: 71, 1908: 281 (world catalogs); Ricardo, 1911: 149 (taxonomy); Fletcher, 1916 (life history, surra vector), 1917 (oviposition); Austen, 1922a: 445 (taxonomy); Schuurmans Stekhoven, 1926: 63, 1928: 438, 1932a: 65 (taxonomy, distribution); Senior-White, 1927: 51 (catalog citation); Wu, 1940: 186 (catalog citation); Philip, 1959: 606, 1960: 57, 1973: 60 (taxonomy, synonymy, distribution); Chvála and Lyneborg, 1970a: 365 (taxonomy, distribution); Moucha, 1976: 152 (world catalog).

erroneous citations to *striatus* (in total or part): van der Wulp, 1880: 163, 1881: 16, 1885: 71, 1896: 58 (includes also *dorsilinea* and *partitus*); Bigot, 1891: 208 (includes also *dorsilinea* and *partitus*); Kertész, 1900: 71, 1908: 281 (includes also *dorsilinea* and *partitus*); Ricardo, 1911: 149 (includes also *triceps* and *partitus*); Mitzmain, 1913 (refers to *partitus*); Fletcher, 1916, 1917 (may also include *triceps*); Kröber, 1924: 18 (refers to *partitus*); Schuurmans Stekhoven, 1926: 63, 1928: 438, 1932a: 65 (includes *partitus*); Senior-White, 1927: 51 (includes *partitus* and *triceps*); Nieschulz, 1926a–c, 1927a–c, 1928, 1929a–b, 1935a–b, 1936, Nieschulz and Ponto, 1927 (refers to *partitus*); Kelser, 1927 (refers to *partitus*); Wu, 1940: 186 (includes *triceps* and *partitus*); Philip, 1959: 606, 1960: 57, 1973: 60 (includes *partitus*); Stone, 1960: 52 (refers to *partitus*); Chvála and Lyneborg, 1970a: 365 (includes *partitus*); Moucha, 1976: 142 (includes *triceps* and *partitus*).

Diagnosis.—*Tabanus striatus* Fabricius is closely related to *partitus*. Burton (1978) provided characters to separate the two in Thailand (as *striatus* and *megalops*), and these can be applied elsewhere in the range of both species. In particular, females of *striatus* do not have a pale tomentose and pale haired midstripe on the second tergum. These characters will separate it from both *partitus* and *triceps* females that do not have an abbreviated midstripe. The ground color of the dorsal abdominal surface is black in *striatus* females, dark brown in *partitus*. Males of both *striatus* and at least some *partitus* have the midstripe abbreviated, i.e. absent or evanescent on the second tergum, but the costal cell is completely hyaline in *striatus* and yellow tinted in *partitus*. Other differences were noted between *striatus* and *partitus*, but these may not hold up when more material is examined from intervening localities. In females, the apical segment of the palpus is slightly shorter, more stout and less yellowish in *striatus* than in Philippine *partitus*; the scutellum has the black pilosity (pale in *partitus*); the prescutellar sclerite has black pilosity (pale in *partitus*); the foretibia is less extensively or-



Figs. 1–2. Head, frontal view. 3, 6. Foreleg, lateral view. 4–5. Abdomen, dorsal view. 7–8. Abdomen, ventral view. 1, 3, 7, *Tabanus triceps*. 2, 5, 6, 8, *T. striatus*. 4, *T. partitus*.

ange basally, with apical fourth black; the stem of the halter is pale brown (yellowish white in *partitus*); sublateral pale stripes on abdomen are not conspicuously jagged or steplike (distinctly jagged or steplike in *partitus* (see Figs. 4, 5)); the venter is gray tomentose (more yellowish gray in *partitus*). The male of *striatus* always lacks the midstripe on the second abdominal tergum, although traces of pale pilosity may be present. The male of *partitus* has the midstripe on the second abdominal tergum variably developed, being nearly absent on some specimens, or being present and crossing the tergum to greatly narrowed in others.

History.—*Tabanus striatus* was originally described from China by Fabricius (1787). A specimen in the Zoological Museum, Copenhagen was designated as lectotype by Chvála and Lyneborg (1970b). Since its description, this species has been frequently interpreted too broadly, usually including one or more additional species, most commonly a southern "variant form" from Thailand, Malaysia, Indonesia, and the Philippines, now known as *Tabanus partitus* Walker. Confusion about the limits of *striatus* has been discussed by Burton (1978).

Tabanus striatus and *partitus* (Java distribution records) were combined in the work of van der Wulp (1880, 1881, 1885) and the catalogs of Bigot (1891), van der Wulp (1896), and Kertész (1900, 1908), but the greatest source of confusion about the limits of *striatus* was in Ricardo's (1911) work. She included both *triceps* of India (then called *tenens* Walker) and *partitus* under *striatus*. Her concept of *striatus* was hopelessly confused, as later stated by Austen (1922a). Ricardo incorrectly gave Fabricius (1794) as the original citation and "China and Java" as the type-localities of *striatus*. Ricardo even separated *Tabanus hilaris* Walker, a synonym of *striatus*, from *striatus* by the presence of an abbreviated median abdominal stripe, the character Fabricius used to define *striatus* and which Ricardo quoted in her paper.

Most earlier authors (van der Wulp, Bigot, Kertész, Ricardo, and Wu) also included the name *dorsilinea* Wiedemann as a synonym of *striatus*, but, as shown by Burton (1978: 78), this name is the senior synonym for a species previously called *bicallosus* Bigot (Ricardo, 1911: 129) or *macer* Bigot (Austen, 1922b: 264; Senior White, 1927: 44).

Austen (1922a) distinguished *triceps* (as *tenens*) from *striatus*, but combined *partitus* with *striatus*, an interpretation followed by most subsequent workers, including Schuurmans Stekhoven (1926, 1928, 1932), Senior-White (1927), Nieschulz (all papers), Wu (1940), Oldroyd (1957), Philip (1959, 1960, 1973), Stone (1960) and Moucha (1976). Their use of characters, particularly of the legs and abdomen, did not allow differentiation of these two species (*partitus* and *striatus*).

Austen (1922a) described *striatus* as having the midstripe on the second abdominal tergum more or less obsolete, at least much less distinct than on

the following terga. He also stated, however, that specimens of *striatus,* especially those which have the midstripe not obliterated on the second tergum, are liable to be mistaken for examples of *triceps* (as *tenens*). Austen thus included specimens that do have a midstripe on tergum two (i.e. *partitus*) as well as those that do not in his concept of *striatus*. Kröber (1924), discussing "*striatus*" from the Philippines, also mentioned that the midstripe on the abdomen was not always clear, probably a reference to male *partitus,* a species that sometimes has the midstripe evanescent on the second segment.

Surcouf (1923) was the first author to distinguish three distinct taxa throughout the geographic range of the *striatus* complex. He correctly recognized *striatus* Fabricius as distinct from another species in India that he named *strophiatus,* since he mistakenly believed *tenens* Walker to be a synonym of *striatus*. He did, however, correctly associate *hilaris* Walker with *striatus*. Surcouf clearly separated *striatus* from related taxa by restricting *striatus* to those specimens with the median abdominal stripe beginning on the anterior margin of the third tergum. For specimens with the midstripe beginning on the anterior border of the second tergum, Surcouf recognized two species, one he correctly called *partitus* Walker with dark legs, with *ruficallosus* (*lapsus* for *rufocallosus* Bigot) and *manilensis* Schiner as synonyms, and *strophiatus* Surcouf with testaceous legs, a new name for *striatus* of authors from India, China, and Indochina. Surcouf's interpretation of these taxa and their names was accurate except for his mistaken synonymy of *tenens* Walker under *striatus* and the renaming of the true *tenens* (=*triceps*) as *strophiatus*. He did correctly recognize three distinct taxa, utilizing characters that will separate these taxa. Unfortunately these characters were not consistently applied by subsequent authors, who overlooked Surcouf's work.

Schuurmans Stekhoven (1926) recognized a northern, "typical" form of *striatus,* and a southern form that showed deviations from a specimen from Punjab, India that was compared with the type of *striatus* by K. L. Hendriksen. Schuurmans Stekhoven found that females caught in "southern areas" had wings with a yellow-brown costal cell and the midstripe paler but not abruptly interrupted on the second tergum. The males had wings with a yellow-brown costal cell. Thus, Schuurmans Stekhoven recognized differences that today are used to separate *striatus* from the related *partitus,* but he did not recognize these "forms" as distinct species.

The use of the name *striatus* in all of Nieschulz's fundamental work on surra and its transmission refers to *partitus* as his studies were restricted to Indonesia, principally Java.

Philip (1959) examined the types of *hilaris* Walker, *partitus* Walker and *rufocallosus* Bigot and concluded that all were variants of *striatus*. He also found that the type of *manilensis* Schiner did not disagree significantly from

the type of *striatus* except for the distally brown foretibia. Philip discussed the variable nature of the middle abdominal stripe on tergum two. He noted that the midstripe was either interrupted on tergum two in many Philippine males (but in only one female) or narrowly extended across the second tergum in "many other males" and most females, with one female showing the stripe "hardly narrowed." Although this character would more closely apply to *triceps* than *striatus,* Philip considered it to be variable throughout the broad range of *striatus* in the Oriental Region.

Isaac (1924b) discussed the life history of *striatus* in India. His illustrations of the male and female show clearly that he was working with true *striatus*.

Stone (1972) studied the types of several supposed synonyms of *striatus* and found that two distinct species were involved. He believed that the original description of *striatus* more closely agreed in abdominal coloration with specimens from China, its type-locality, than with specimens called *striatus* by earlier authors from more southern portions of the Oriental Region. He separated *triceps* (as *tenens*) from *striatus* by the strong middorsal pale stripe present from tergum I–VII, palpus longer and less swollen basally, and with the abdomen yellow brown rather than black brown. Stone believed the complete slender midstripe of *partitus* ruled out conspecificity with *striatus* and *triceps* (as *tenens*). He thereby implied that *partitus* was a distinct species. Although this character is not reliable for both sexes of *partitus,* Stone was the first author since Surcouf to recognize *partitus* as distinct from *striatus*. However, he placed *manilensis* and *rufocallosus* as synonyms of *triceps* (as *tenens*), rather than *partitus,* and did not give any taxonomic characters to support his synonymy.

Moucha (1976) did not follow Stone's interpretation, but reverted to Philip's concept of *striatus,* including under it most of the synonyms of *partitus,* as well as *strophiatus* Surcouf. He did, however, correctly synonymize *tenens* subform *cambodiensis* Toumanoff under *striatus*.

Burton (1978) has completely described *striatus* and thoroughly discussed the confusion of *striatus* with closely related *partitus* (as *megalops*), mentioning that the abdominal striping pattern will not serve to distinguish males of *striatus* and *partitus*. Herein lies at least some of the confusion previous authors encountered in attempting to define the limits of *striatus,* as the midstripe can be interrupted in males of *partitus* as well as *striatus*. However, as Burton pointed out, the yellow tinted costal cell in the male of *partitus* will separate it from *striatus* males which have a hyaline costal cell. Interestingly, this character was mentioned by Schuurmans Stekhoven (1926) in discussing the "southern form" of *striatus,* but was not considered by subsequent authors.

Distribution.—Pakistan, India, Sri Lanka, northern and eastern Thailand, Laos, Cambodia, Vietnam, China.

Specimens examined.—30. INDIA: Madras; Nedungadu; Tanjore Dist.; Sohawa; Jhelum; Karum Bagarum, Assam: Chabua; Dinjan; Doom Dooma. SRI LANKA: 10 localities throughout the island. PAKISTAN: Lahore. THAILAND: Loei. VIETNAM: "Tonkin."

Tabanus partitus Walker

Tabanus partitus Walker, 1856: 9. Type-locality: Singapore. Holotype female BM(NH). Subsequent references: Bigot, 1891: 270, van der Wulp, 1896: 60, Kertész, 1900: 64, 1908: 268 (catalog citations).

Tabanus manilensis Schiner, 1868: 84. Type-locality: Philippines, Manila. Holotype female NMW. Subsequent references: van der Wulp, 1896: 61 (as *manillensis*), Kertész, 1900: 64, 1908: 259 (catalog citations).

Tabanus rufocallosus Bigot, 1892: 197. Type-locality: Java. Holotype female BM(NH). Subsequent references: van der Wulp, 1896: 63, Kertész, 1900: 69, 1908: 276 (catalog citations).

Tabanus tenens (in part): Austen, 1922a: 445 (taxonomy); Senior-White, 1927: 53 (catalog citation); Schuurmans Steknoven, 1928: 438 (Philippines); Wu, 1940: 187 (catalog citation); Oldroyd, 1957: 59 (taxonomy); Stone, 1975: 71 (catalog citation).

Tabanus striatus (in total): Mitzmain, 1913 (biology; surra transmission in the Philippines); Kröber, 1924 (Taxonomy); Nieschulz, 1926a, 1926b (biology), 1926c (breeding sites), 1927a, 1927b (hymenopterous parasites), 1927c, 1928 (anthrax transmission), 1929a, 1929b, 1935a (distribution and abundance), 1935b (larval development), 1936 (biology, description of eggs, larva, and pupa); Nieschulz and Ponto, 1927 (most papers refer to surra transmission studies unless otherwise noted); Nieschulz and Kraneveld, 1929 (haemorrhagic septicaemia of water buffalos, transmission); Kelser, 1927 (surra transmission); Schuurmans Stekhoven, 1932b: 14 (Sumatra); Stone, 1960: 52 (taxonomy, distribution in Micronesia).

Tabanus striatus (in part): Ricardo, 1911: 149 (taxonomy); Kröber, 1924: 18 (taxonomy); Schuurmans Stekhoven, 1926: 63, 1928: 438, 1932a: 65 (taxonomy, distribution); Senior-White, 1927: 51 (catalog citation); Wu, 1940 (catalog citation); Philip, 1959: 606, 1960: 57, 1973: 60 (taxonomy); Chvála and Lyneborg, 1970a: 365 (taxonomy); Moucha, 1976: 142 (world catalog).

erroneous citations as *megalops* (in part): Stone, 1972: 639 (taxonomy); Burton, 1978: 74 (taxonomy, synonym, Thailand records, biology, includes *triceps*).

Diagnosis.—*Tabanus partitus* was redescribed in comparison with *striatus* by Burton (1978). Female *partitus* are separated from *striatus* by the presence of a midstripe on the second abdominal tergum (absent in *striatus*), and male *partitus* have a yellow tinted costal cell (hyaline in *striatus*). Also, the general abdominal coloration of *partitus* is paler, brown to gray, than

in *striatus* (black). These characters hold for both species throughout their ranges. Comparison of Burton's specimens of *partitus* (Cornell University Collection, courtesy of L. L. Pechuman) with those from the Philippines revealed differences as follows: The frons is narrower in Philippine specimens, index 1: 6.0–7.5 (1: 4.3–5.6 for Thai specimens); the apical segment of the palpus is slightly more yellowish and stouter than in Thailand specimens; the mesonotum is darker gray; the disc of the scutellum lacks yellowish tones seen on Thai specimens; mid- and hindfemora are blackish distally; the stem of the halter is brown black (yellow white in Thai specimens). Males of *partitus* from the Philippines have no yellowish tint on the scutellum as do those from Thailand.

History.—*Tabanus partitus* was described by Walker (1856) from a female from Singapore. Since its description, it has most commonly been considered a variant form of *Tabanus striatus* Fabricius, with *striatus* of authors considered to be a rather variable and widely distributed Oriental species. Various authors differentiated *striatus* from *triceps* (as *tenens*) found in India and Sri Lanka. Other authors clearly separated *striatus* from *triceps* (as *tenens*), but considered *partitus* to be the same as *triceps*. This difference in concepts was based primarily on whether characters of the head and legs were used (*partitus* + *striatus* and *triceps*) or whether differences in abdominal striping were considered important (*striatus* and *triceps* + *partitus*).

Ricardo (1911) included *partitus* as a synonym of *striatus* even though she quoted van der Wulp's description verbatim (1881: 16) in which the wing of a male from Soerian, Sumatra was described as having a yellow tinted costal cell, a characteristic of *partitus*, not *striatus*.

Mitzmain (1913), working on transmission of surra (*Trypanosoma evansi*) by horse flies in the Philippines, discussed the biology of *Tabanus partitus* (as *striatus*), including a brief description of the male and female. The wing of the female was described as transparent except for the pale brown costal and subcostal cells, a characteristic of *partitus*. We have examined voucher specimens of *striatus sensu* Mitzmain and find them to be *partitus*.

Austen (1922a) attempted to differentiate *striatus* from *triceps* (as *tenens*) by the midstripe being more or less obsolete on the second abdominal tergum, and synonymized *partitus* (as *megalops*) under *triceps* (as *tenens*). However, the tarsal characters he used will not separate *striatus* from *triceps*. Also, because he incorrectly synonymized *hilaris* (=*striatus*) with *triceps* (as *tenens*), his ability to separate these taxa is questionable.

Kröber (1924), in his study of the tabanid fauna of the Philippines discussed *partitus* under the name *striatus*, stating that the midstripe on the abdomen was not always clear on the second tergum and citing a distribution for *striatus* from India to the Moluccas.

Schuurmans Stekhoven (1926) clearly distinguished a northern typical

form and a southern form of *striatus,* stating that those from southern localities had wings with yellow-brown costal cells and midstripe on the abdomen paler but not abruptly interrupted on the second segment. Both males and females of *striatus* have a clear costal ccll, so Schuurmans Stekhoven's southern form clearly refers to *partitus*. In subsequent papers, Schuurmans Stekhoven (1928, 1932a, b) provided additional collection records from Indonesia, also listing the "typical" form (i.e. *striatus* Fabricius) from Hanoi (Vietnam) and Fukien Province (China).

Nieschulz (1935b, 1936) studied the hatching and development of the immature stages of *partitus* (as *striatus*) in Indonesia. He also provided excellent illustrations of the larva and pupa of *partitus* as well as notes on the larval habitat. The illustrations are among the best available for any Oriental horse fly by early workers and allow comparison with known larvae and pupae of other species. Unfortunately, the larvae of *triceps* and *striatus* are less well illustrated and cannot be compared easily with *partitus*. In all of the fundamental work of Nieschulz on surra, the name *striatus* refers to *partitus*.

Oldroyd (1957) accepted Austen's synonymy of *partitus* (as *megalops*) and *triceps* (as *tenens*), with *triceps* distinguished from *striatus* by the presence of three abdominal stripes, being longer and more gently tapered and the midstripe complete from front to rear. Philip (1959, 1960, 1973), however, continued to consider specimens of *partitus* as variants of *striatus*. His synonymy of *striatus* is confused because he incorrectly placed *partitus* Walker and *rufocallosus* Bigot as synonyms of *striatus* and *partitus* as a synonym of *triceps* Thunberg. He also stated that the type female of *manilensis* Schiner (=*partitus*) "did not differ significantly" from *striatus,* even though in his discussion of *striatus* from the Philippines he mentioncd the middorsal pale abdominal stripe on the second tergum as being present in Philippine material.

Stone (1960) recorded *partitus* (as *striatus*) from Guam. We have examined Stone's specimens from Guam in the USNM and did not find any major differences from *partitus*. Stone recognized that the synonymy of *striatus* was confused, involving more than one species, and he clearly distinguished *triceps* of India from his Guam specimens by the larger, browner body, entirely brown forefemora and the venter of the abdomen lacking the darkened midstripe found in *striatus*. Stone did, however, list *triceps* from the Philippines, so he may have included *partitus,* at least in part, in his concept of *triceps*.

Stone (1972), after examining the types of several supposed synonyms of *striatus,* concluded that two species were involved and that most of the synonyms did not apply to *striatus*. He recognized discrepancies between true *striatus* and the variant form from the southern Oriental Region. He

also recognized that *megalops* has a complete but slender midstripe that he believed ruled out conspecificity with either *striatus* or *triceps*. Although Stone was correct in this assertion, the length of the middorsal stripe will not suffice to separate *megalops* from *striatus* complex. Further, Stone erroneously grouped synonyms of *partitus* with *triceps* (as *tenens*) (i.e. *manilensis* and *rufocallosus*), but he was the first author since Surcouf to recognize two distinct taxa. Also he gave *triceps* a much wider distribution than it really has. In the Oriental Diptera Catalog, however, Stone (1975) synonymized *partitus* under *triceps* (as *tenens*).

Moucha (1976), unlike Stone, followed Philip's broad interpretation of *striatus* and placed *partitus, manilensis,* and *rufocallosus* in synonymy under *striatus,* as well as *dorsilinea* Wiedemann (as *macer* Bigot), a distinct spccies.

Burton (1978) summarized the past confusion surrounding the synonyms of *striatus* and *partitus* (as *megalops*) and gave excellent taxonomic characters for separating the two taxa. Unfortunately, he mistakenly believed *Tabanus megalops* Walker from Java to be conspecific with specimens he collected in Thailand. Undoubtedly, Burton was mislead by Stone's synonymy. Burger has thoroughly examined the holotype male of *megalops* in the British Museum (Natural History) and compared it to males from Thailand collected and determined as that species by Burton.

The holotype of *megalops,* in fair condition, differs from the Thailand specimens in having the body stouter, costal cell clear, middorsal abdominal pattern being a series of very narrow triangles, not a parallel-sided stripe, forecoxae and femora orange brown, foretibiae uniformly brown, not bicolored, and midventral abdominal dark stripe evanescent. Based on these differences, we believe *megalops* is not conspecific with Burton's Thailand specimens or with other material examined from throughout the southern Oriental Region. The earliest available name for the taxon conspecific with specimens collected by Burton and others examined by us is *Tabanus partitus* Walker. The holotype of *partitus* is in good condition and has distinctly bicolored foretibiae, basal callosity contiguous with eyes below, pale abdominal middorsal stripe complete (although narrowed anteriorly) on tergum two, and distinct midventral dark stripe, all the characteristics of the southern component of the *striatus* complex.

The holotype male of *megalops* closely resemblcs several males presently in the BM(NH) collection determined as *Tabanus rubidus* Wiedemann by Austen, Oldroyd, and others. The configuration of the abdominal triangles also is reminiscent of some *rubidus* males, but the triangles of the type are narrower than in the presumed *rubidus* males examined. The condition of the type is such that assignment to the *rubidus* group as defined by Burton (1978) is certain, but species assignment is difficult, especially since the

characters separating males of these species are poorly defined at present.

Distribution.—Burma, Thailand, Malaysia, Indonesia, Philippines, Micronesia (Guam).

Specimens examined.—Approximately 300. BURMA: Rangoon. THAILAND: Prae Nakhom Prov., Chon Buri Prov. MALAYSIA: Kuala Lumpur, Selangor. SINGAPORE. INDONESIA: Sumatra, Medan; Java, Passoeroean, Buitenzorg. PHILIPPINES: Luzon, Leyte, Palawan, Mindanao, Osmona, Samar, Alaband, Rizel. MICRONESIA: Guam, Togcha Point.

Tabanus triceps Thunberg

Tabanus triceps Thunberg, 1827: 59. Type-locality: Indian subcontinent (as "Cayenne et Brasilia"). Lectotype, Zool. Inst., Univ. Uppsala. Subsequent references: Kertész, 1900: 74, 1908: 286 (world catalogs); Philip, 1959: 609, 1967: 1236 (taxonomy, lectotype designation), 1960: 59 (synonymy, Thailand record), 1970: 450 (differences from *striatus* Fabricius), 1973: 60 (Ceylon records).

Tabanus tenens Walker, 1850: 49. Type-locality: East India. Holotype female BM(NH). Preoccupied by *Tabanus tenens* Walker 1850, a Neotropical species.

Tabanus strophiatus Surcouf, 1923: 197. Type-localities: "Archipel. Indien, Chine, Indo-Chine." Syntypes, at least 56 females, MNHN, Paris.

Tabanus tenens (in total): Bigot 1891: 269, van der Wulp, 1896: 60 (catalog citations); Kertész, 1900: 73, 1908: 285 (world catalog); Austen, 1922a: 445 (taxonomy); Isaac, 1924a (male, female genitalia), 1925 (immature stages); Schuurmans Stekhoven, 1926: 163 (taxonomy).

Tabanus tenens (in part): Schuurmans Stekhoven, 1928: 438 (Ceylon); Senior-White, 1927: 53 (catalog citation); Wu, 1940: 187 (catalog citation); Oldroyd, 1957: 59 (taxonomy); Stone, 1960: 52, 1972: 640 (taxonomy, synonymy), 1975: 71 (catalog citation).

Tabanus triceps (in part): Philip, 1959: 610, 1960: 59; Moucha, 1976: 147 (world catalog).

Tabanus partitus (in part): Burton, 1978: 74 (taxonomy, synonymy).

Tabanus striatus (in part): Ricardo, 1911: 149 (taxonomy)

erroneous citations to *triceps* (in part): Philip, 1959: 610 (includes *partitus*), 1960: 59 (includes *partitus* and *striatus*); Moucha, 1976: 147 (includes *partitus*).

erroneous citations to *tenens* (in part): Senior-White, 1927: 53 (may include *striatus*); Schuurmans Stekhoven, 1928: 438 (includes *partitus*); Wu, 1940: 187 (may include *partitus* and *striatus*).

Diagnosis.—*Tabanus triceps* from India and Sri Lanka is quite distinct from both *striatus* and *partitus*. Thunberg's alpha syntype (lectotype) of *triceps* has a uniformly orange forefemur and tibia, the callosity is not con-

tiguous with the eyes, receding from eye margins above, and the middorsal stripe on the second tergum broadly crosses that segment. It also has distinct thoracic stripes as mentioned by Philip (1959). The lectotype agrees with all the specimens we have seen from India and Sri Lanka previously determined as *tenens* or *triceps*.

Tabanus triceps is easily distinguished from *striatus* by the middorsal stripe of the abdomen distinctly crossing the second tergum in both sexes (occasionally obliterated in greased specimens), the unicolorous foretibia, the callosity narrowed above, not broadly contiguous with the eye margins, and the absence of a dark haired midventral stripe on the abdomen. The males of *triceps* have a yellow tinted costal cell (hyaline in *striatus*).

Tabanus triceps differs from *partitus* in having the callosity narrowly separated from eye margins below and receding from eye margins above, broadly joined to the broad, squared median extension; the apical segment of the palpus slightly longer and more slender basally; the forefemur and tibia entirely orange to orange brown; the sublateral pale abdominal stripes noticeably steplike and the venter uniformly yellowish gray, lacking a broad midventral dark stripe.

Males of *triceps* show the same differences from *partitus* as the females except for sex associated characters of the frons and palpus. The ground color of the abdomen of male *triceps* is blackish, and the middorsal stripe on the second tergum is usually well developed, while *partitus* males have a more reddish-brown abdominal ground color and the middorsal stripe on the second tergum is variably developed. Males of both species have a yellow tinted costal cell.

Most specimens of *partitus* from Thailand, the Philippines, and Java are smaller than *triceps* from Sri Lanka and India. The mean length of *partitus* was 12.7 mm (range 11.2–14.3 mm) for females and 12.2 mm (range 9.6–14.0 mm) for males. *Tabanus triceps* females averaged 15.0 mm (13.6–16.0 mm), while males averaged 14.4 mm (13.6–15.2 mm).

The pupal aster of *triceps* is different from that of *partitus* (see figures of Isaac and Nieschulz), the latter having the lateral arms directed posterodorsally in proximity to the dorsal arms while *triceps* has the lateral arms directed posteroventrally in proximity to the ventral arms.

History.—*Tabanus triceps* Thunberg has been reported under the name *Tabanus tenens* Walker in most of the literature and more recently as *megalops* by Burton (1978). This species generally has been considered distinct from *striatus,* except by Ricardo (1911). Bigot (1891), van der Wulp (1896), Kertész (1900, 1908), Senior-White (1927), and Wu (1940) list it as a distinct species. Austen (1922a) discussed Ricardo's confusion of the two species, but did not cite detailed characters to separate *triceps* (as *tenens*) from *striatus*. He did mention that the description of *striatus* by Wiedemann

(abdomen with three unabbreviated pale stripes; femora reddish rusty brown) applied better to *triceps*.

Surcouf (1923) used the name *strophiatus* for a species with the middorsal abdominal stripe beginning on the anterior border of the second tergum and the legs testaceous, a species he believed had been confused with *striatus*. This species was separated from a related one with dark legs that Surcouf called *partitus*. Thus Surcouf recognized that two species previously confused with *striatus* were distinct, one with dark legs and another with testaceous legs. The species he named *strophiatus* is the same as *triceps* and is synonymized with it.

Isaac (1924a, 1925), in a series of papers on Indian Tabanidae, discussed the immature stages and the male and female genitalia of *triceps* (as *tenens*). Isaac's figures of the adult male and female clearly show that he was dealing with *triceps*. Comparison of his pupal figure for *triceps* with that given by Nieschulz (1935) for *partitus* shows that the pupal aster is distinctly different. Other features of the immature stages could not be compared due to lack of comparable figures.

Schuurmans Stekhoven (1926) clearly differentiated *triceps* (as *tenens*) from *striatus*, but considered *partitus* to be a synonym of *triceps* (as *tenens*), based on the very distinct middorsal stripe on the second segment. His description of *tenens* was drawn from Indian specimens and therefore refers to *triceps*.

Philip (1959), in his study of Tabanidae from the Philippine Zoological Expedition of the Field Museum (Chicago), discussed *striatus* and what he considered to be its synonyms. At the same time, he discussed the status of *tenens* vis à vis *striatus*. He found that one syntype (alpha) of *Tabanus triceps*, described by Thunberg (1827) from "Cayenne et Brasilia" was not a Neotropical species, but was closest to *tenens* Walker (the Oriental species). The unpatterned eye, striped thorax, and unicolorous legs did not agree with known Neotropical species. Philip designated this alpha syntype as the lectotype of *triceps*, with *tenens* thus becoming a synonym. Philip also gave characters to separate *triceps* from *striatus*, particularly the unicolorous legs, the uninterrupted broad midstripe on abdominal tergum two, and the basal callosity narrowed above, well separated from the eyes. These characters would separate *triceps* from Philip's concept of *striatus* (=*striatus* + *partitus*), but will not adequately separate *triceps* from *partitus*.

Philip (1967), in his discussion of Thunberg's species of Tabanidae from the New World, designated another lectotype, the gamma syntype, from the type-series in competition with his 1959 designation. Despite this lapse, the earlier designation has precedence, and *triceps* remains the valid name for Walker's *tenens* of the Oriental Region. Philip also stated that the alpha syntype might not have been an original syntype. However, as Thunberg described the thorax as having five white lines and the legs as completely

testaceous, and because these are characters of the alpha syntype, there is no doubt that the alpha syntype was one of the specimens before Thunberg when *triceps* was described.

Philip (1970) stated that Thunberg's gamma syntype of *triceps* might have come from China. However, there seems to be no reason for assuming this syntype is Oriental, based on the taxonomic characters given by Philip himself in 1967. The gamma syntype is the same as *Tabanus dorsiger* var. *dorsovittatus* Macquart, a Neotropical species with a green and purple striped eye pattern and strongly bicolored foretibia. Females of Oricntal species related to *striatus* have unicolorous foretibia and unpatterned eyes. The beta syntype agrees with the description and figure of *Tabanus columbus* Fairchild, another Neotropical species. This specimen also had a patterned eye, although the precise pattern could not be discerned due to molding of the eye surface.

Stone (1960) separated *triceps* from *striatus* by its larger size, the entirely brown forefemur and the absence of a darkened ventral abdominal midstripe usually found in *striatus*. Subsequently, Stone (1972) reverted to *tenens* Walker when Philip designated a competing lectotype for *triceps*; thus *triceps* became a junior synonym of *dorsiger*, a Neotropical species. His treatment of these species in the Catalog of Oriental Diptera (Stone, 1975) followed his 1972 work. Moucha, in his catalog of World Tabanidae (1976), recognized Philip's 1959 designation and used *triceps* as the correct name. Both Stone and Moucha, however, continued to synonymize *partitus* and some of its synonyms with *tenens* (Stone) or with both *triceps* and *striatus* (Moucha).

Burton (1978) reviewed the status of *partitus* (as *megalops*), including its synonyms, in his study of the Tabanini of Thailand north of the Isthmus of Kra. He concluded that the types of *tenens* from East India and *megalops* from Java in the British Museum were conspecific, without mentioning the basis for his decision. As the type of *tenens* is a female and the type of *megalops* is a male, the association of the two may have been complicated because this would exclude use of frons characters. Burton compared the types with associated male and female specimens from Thailand. We have examined specimens from throughout the Oriental Region (including the types of *megalops*, *partitus*, *rufocallosus*, and *tenens* and a series determined as *partitus* by Burton) and determined that specimens from India and Sri Lanka (conspecific with the type of *tenens*) are specifically distinct from those collected in Thailand, Indonesia, and the Philippines (conspecific with the type of *partitus*).

We have also had the opportunity to cxamine Thunberg's syntype series of *triceps*. The alpha syntype (lectotype) agrees with specimens from India and Sri Lanka, which were compared with the type of *tenens*. The uniformly yellowish-orange femora and foretibia, basal portion of the callosity reced-

ing from eyes above, and lack of darker stripe ventrally on the abdomen are particularly distinctive of the lectotype and these other specimens. This confirms Philip's (1959) determination of *triceps* as conspecific with *tenens*. *Tabanus triceps* thus is the correct name for the species found in India and Sri Lanka, while *partitus* is the correct name for the species found in Thailand, Indonesia, the Philippines, and Micronesia.

Burton also found that the name *tenens* for the Indian species is a junior homonym of *Tabanus tenens* Walker described from Brazil, also in 1850, but four months earlier. However, since *triceps* antedates either of Walker's names by 23 years, this homonomy does not affect the correct name of the Indian species.

Distribution.—Pakistan, India, Sri Lanka.

Specimens examined.—78. INDIA: Coimbatore; Karikal; Bombay; Madras; Karum Bagaram; Trichinopoly; Singara, Nilgiri Hills; Tanjire Dist.; Calcutta; Kanchrapara (2 ♀ agree with the type of *tenens* Walker); Bengal; Shimuga; Mysore; Walayar Forest, South Malabar; Chinchona; Anamalai Hills. SRI LANKA: 26 localities throughout the island.

Unplaced Synonyms

Tabanus chinensis Thunberg, 1827.—This species was described briefly by Thunberg with the habitat given both as China and the Cape of Good Hope. It possibly could be a synonym of *striatus,* but this is uncertain from the original description, so it is left unplaced for the present.

Tabanus costalis Lichtenstein, 1796.—Bezzi (1908) first called attention to the names of Anton August Heinrich Lichtenstein. Austen (1908) discussed the Tabanidae listed in Lichtenstein's Catalogus. Since only two copies of Lichtenstein's work were known to Austen, he quoted the description of *costalis* verbatim: "295. *Tabanus striatus*; n. 39 (the number under which Fabricius described *striatus*). Item: *Tabanus costalis*; *nobis. Taban. oculis aeneis*; *ferrugineus, alis hyalinis costa flava*. Habitat in Coromandel." Ricardo (1911) stated that the species is absolutely indeterminable and should be deleted from the list of *Tabanus* species. Surcouf (1923) considered it a questionable synonym of *striatus*. Stone (1975) did not list the name in the Catalog of Oriental Diptera. Burton (1978) referred to the name under the *Tabanus striatus* complex, indicating its status was yet to be defined.

The name appears in a sale catalog, and, thereby, may not be considered available. The arrangement of the catalog follows Fabricius (1794), and *costalis* is listed under *striatus,* number 295 being the number of the item in the sale catalog. The description is short, but the mention of the yellow costal cell could refer to either *partitus* or *triceps* as the males of both species have a yellow costal cell. The notation "habitat in Coromandel"

may refer to the Coromandel Coast of India (16°–12°N Lat.), including Madras, or to Coromandel in the state of Minas Gerais, Brazil (unlikely possibility, Fairchild, *in litt.*). If the former locality is intended, then *costalis* may refer to *triceps*, but if the latter locality is intended, *costalis* may refer to *dorsiger* Wiedemann or a related species with a tinted costal cell.

Acknowledgments

We thank Graham White and John Chainey, British Museum (Natural History), London (BM(NH)); Leif Lyneborg, Universitetes Zoologiske Museet, Copenhagen (UZMC); Ruth Lichtenberg, Naturhistorisches Museum Wien, Vienna (NMW); Christine Dahl, Zoological Institute, University of Uppsala; and L. L. Pechuman, Cornell University, Ithaca (UCI), for the loan of material in their care. We also thank Arnold S. Menke, Raymond Gagné, and Ronald Hodges, Systematic Entomology Laboratory, USDA, Washington; R. M. Reeves, University of New Hampshire, Durham; G. B. Fairchild, University of Florida, Gainesville; and L. L. Pechuman, Cornell University, Ithaca, for their critical review of this manuscript.

Literature Cited

Austen, E. E. 1908. On the synonymy and systematic position of some species of Tabanidae described by Thunberg and Lichtenstein. Ann. Mag. Nat. Hist. (8) 6: 344–346.

———. 1922a. Some Siamese Tabanidae. Bull. Entomol. Res. 12: 431–455.

———. 1922b. Note on a small collection of Indian Tabanidae and other blood-sucking Diptera. Trans. R. Soc. Trop. Med. Hyg. 15: 264.

Bezzi, M. 1908. Nomenklatorisches über Dipteren. III. Wien. Entomol. Ztg. 27: 74–84.

Bigot, J. M. F. 1891. Catalog of the Diptera of the Oriental Region. Part I. J. Asiatic Soc. Bengal 60(3): 250–282.

———. 1892. Description de Diptères nouveaux (1). Mem. Soc. Zool. Fr. 5: 602–691.

Burton, J. J. S. 1978. Tabanini of Thailand above the Isthmus of Kra (Diptera: Tabanidae). Entomol. Reprint Specialists, Los Angeles. 165 pp.

Chvála, M. and L. Lyneborg. 1970a. Tabanidae (Diptera) from the Philippines, collected by the Noona Dan Expedition 1961. J. Med. Entomol. 7: 362–366.

———. 1970b. A revision of Palaearctic Tabanidae (Diptera) described by J. C. Fabricius. J. Med. Entomol. 7: 543–555.

Fabricius, J. C. 1787. Mantissa Insectorum. Vol. 2. Hafniae (=Copenhagen). 382 pp.

———. 1794. Entomologia systematica emendata et aucta. Vol. 4. Hafniae (=Copenhagen). 472 pp.

Fletcher, T. B. 1916. Report of the Imperial Pathological Entomologist. Rep. Agric. Res. Inst. and Coll., Pusa 1915–1916: 78–84.

———. 1917. Report of the Imperial Pathological Entomologist. Sci. Rep. Agric. Res. Inst., Pusa 1916–1917: 91–102.

Isaac, P. V. 1924a. Papers on Indian Tabanidae. VI. The male and female genitalia of *Tabanus tenens*, Wlk. Dep. Agric. India (Entomol.) 8: 102–108.

———. 1924b. Papers on Indian Tabanidae. VII. Notes on the life history of *Tabanus striatus*, Fabr. (=*hilaris*, Wlk.). Dep. Agric. India (Entomol.) 8: 108.

———. 1925. The bionomics and life-histories of some of the common Tabanidae of Pusa. Dep. Agric. India (Entomol.) 9: 21–28.

Kelser, R. A. 1927. Transmission of Surra among animals of the equine species. Philipp. J. Sci. 34: 115–141.

Kertész, K. 1900. Catalogus Tabanidarum orbis Terrarum Universi. Mus. Natl. Hungary, Budapestini (=Budapest). 79 pp.

———. 1908. Catalogus Dipterorum hucusque descriptorum. Vol. 3. Budapestini. ii + 366 + i pp.

Kröber, O. 1924. Die Tabaniden der Philippinen. Arch. Naturgesch. 90: 1–27.

Lichstenstein, A. A. H. 1796. Catalogus musei Zoologici ditissimi Hamburgi, d II. Februar 1796. Auctionis lege distrahendi. Sectio Tertia Continens Insecta. Verzeichniss von höchstseltenen, aus allen Welttheilen mit vieler Mühe und Kosten zusammen gebrachten, auch aus unterschiedlichen Cabinettern, Sammlungen und Auctionen ausgehobenen Naturalien welche von einem Liebhaber, als Mitglied der Batavischen und verschiedener anderer Naturforschenden Gesellschaften gesammlet worden. Drittcr Abschnitt, bestehend in wohlerhaltenen, mehrentheils ausländischen und höchstseltenen Insecten, die theils einzeln, theils mehrere zusammen in Schachteln festgesteckt sind, und welche am Mittcwochen, den 3ten Februar 1796 und den folgenden Tagen auf dem Eimbeckschen Haufe öffentlich verkauft werden sollen durch dem Mackler Peter Hinrich Packischefsky. Gottl. Friedr. Schniebess, Hamburg. xii + 222 pp. (The full citation to this work is given as the publication is so rare, and no bibliographies give it in its complete form. According to all published sources, only two copies of this work exist; however, a third copy is present in the University of North Carolina Library).

Mitzmain, M. B. 1913. The biology of *Tabanus striatus* Fabricius, the horsefly of the Philippines. Philipp. J. Sci. 8: 197–221.

Moucha, J. 1976. Horse-flies (Diptera: Tabanidae) of the World. Synoptic Catalog. Acta Entomol. Mus. Natl. Pragae, Suppl. 7, 319 pp.

Nieschulz, O. 1926a. Overbrengingsproeven mit *Tabanus rubidus,* Wied., *T. striatus,* Fabr., en *Stomoxys calcitrans,* L. Dept. Landbouw, Veeartsenijk. Meded., Buitenzorg (=Bogor) 55.

———. 1926b. Over de ontwikkeling van *Tabanus striatus* Fabr. Dept. Landbouw, Veeartsenijk. Meded., Buitcnzorg (=Bogor) 56.

———. 1926c. Over Tabaniden-broedplaatsen op Java en Sumatra. Dept. Landbouw, Veeartsenijk. Meded., Buitenzorg (=Bogor) 58.

———. 1927a. Overbrengingsproeven met *Haematopota cingulata* (Wicd.). Ned.-Ind. Bladen Diergeneesk. en Dierenteelt 38(5).

———. 1927b. Ueber Schlupfwespen als Parasiten von Tabaniden-eiern auf Java. Centralbl. Bakt. (Ite. Abt.) 72: 399–410.

———. 1927c. Ueber mehrfache Infektionen durch *Tabanus rubidus,* Wied. Centralbl. Bakt. (Ite Abt.) 105: 133–136.

———. 1928. Enkele miltvuuroverbrengingsproeven met Tabaniden, Musciden en Muskieten. Veeartsenik. Meded. 67, 23 pp.

———. 1929a. Zoologische Beiträge zum Surraproblem. xxi. Weitere Surraübertragungsversuchc mit *Tabanus striatus* Fabr. und *T. rubidus* Wied. Arch. Protistenkd. 65: 78–96.

———. 1929b. Enkele miltvuuroverbrengingsproeven met Tabaniden, Musciden en Muskieten. Veeartsenijk. Meded., Buitenzorg (=Bogor) 67: 1–23.

———. 1935a. Ueber die Verbreitung von Tabaniden in Niederländisch-Indien und ihre wirtschaftliche Bedeutung. Z. Angew. Entomol. 22: 131–142.

———. 1935b. Über die Larvenstadien von *Tabanus rubidus* Wied. und *Tabanus striatus* Fabr. Z. Parasitenkd. 7: 639–656.

———. 1936. Die Entwicklungsstadien von *Tabanus rubidus* Wied, und *T. striatus* Fabr. Arch. Naturgesch. (N.F.) 5: 230–255.

Nieschulz, O. and F. C. Kraneveld. 1929. Experimentelle Untersuchungen über die Uebertragung der Büffelseuche durch Insekten. Zentralbl. Bakteriol. (1) 113: 403–417.

Nieschulz, O. and S. A. S. Ponto. 1927. Zoölogische bijdragen tot het Surraprobleem. XVIII. Over meervoudige infecties met *Tabanus striatus*, Fabr. Veeartsenijk. Meded., Buitenzorg (=Bogor) 63, 8 pp.

Oldroyd, H. 1957. Some Tabanidae (Dipt.) from Ceylon. Verh. Naturforsch. Ges. Basel 68: 56–64.

Philip, C. B. 1959. Philippine Zoological Expedition (1946–1947). Tabanidae (Diptera). Fieldiana Zool. 33: 543–625.

———. 1960. Malaysian Parasites XXXVI. A summary review and records of Tabanidae from Malaya, Borneo, and Thailand. Stud. Inst. Med. Res. Malaya 29: 33–78.

———. 1967. Notes on Thunberg's little-known species of Tabanidae (Diptera) from the New World. Ann. Entomol. Soc. Am. 60: 1235–1238.

———. 1970. Further notes on Oriental Tabanidae (Diptera). IV. Descriptions of *Cydistomyia* and *Tabanus*, and other records, particularly from India and Sikkim. H. D. Srivastava Comm. Vol., pp. 443–452.

———. 1973. Diptera: Tabanidae from Ceylon. Entomol. Scand. Suppl. 4: 56–62.

Ricardo, G. 1911. A revision of the species of *Tabanus* from the Oriental Region, including notes on species from surrounding countries. Rec. Ind. Mus. 4: 111–258.

———. 1916. Notes on a collection of species of Tabanidae from Hong Kong. Bull. Entomol. Res. 6: 405–407.

Schiner, J. R. 1868. Diptera. (Art. 1), 388 pp., 4 pls. *In* (Wüllerstorf-Urbair, B. von, in charge), Reise der österreichischen Fregatte Novara. Zool., Vol. 2, Abt. 1, (Sect.) B. Wien.

Schuurmans Stekhoven, J. H., Jr. 1926. The tabanids of the Dutch East Indian Archipelago. Treubia 6 (suppl.), 551 pp.

———. 1928. The bloodsucking arthropods of the Dutch East Indian Archipelago. IX. Recent collections of tabanids from Sumatra, Middle East Borneo, Soemba etc. Zool. Jahrb. 54: 425–448.

———. 1932a. The bloodsucking arthropods of the Dutch East Indian Archipelago. X. Further notes on tabanids of India, Sumatra, Java, Borneo, Celebes and some of the Moluccas. Arch. Naturgesch. (N.F.) 1: 57–94.

———. 1932b. Tabanidae. Res. Sci. Voyage Ind. Or. Neerland 4(7): 11–16.

Senior-White, R. 1927. Catalog of Indian Insects. Part 12 - Tabanidae, pp. 1–70.

Stone, A. 1960. Diptera, Tabanidae. Insects Micronesia 13: 51–53.

———. 1972. Synonymic and other notes on Tabanidae, with two new species (Diptera). Ann. Entomol. Soc. Am. 65: 637–641.

———. 1975. Family Tabanidae, pp. 43–81. *In* Delfinado, M. D. and D. Elmo Hardy, eds., A catalog of the Diptera of the Oriental Region. Vol. 2, Suborder Brachycera through Division Aschiza, Suborder Cyclorrhapha. Univ. Hawaii Press, Honolulu. x + 459 pp.

Surcouf, J. M. R. 1923. Note synonymique sur un Diptère piqueur (Taon) de l'Inde. Bull. Soc. Entomol. Fr. 1923: 196–197.

Thunberg, C. P. 1827. Tabani septendecim novae species descriptae. Nova Acta Upsala 9: 53–62.

Toumanoff, C. 1953. Contribution a l'étude des tabanides de l'Indochine. (Troisième note: déscription d'une espèce nouvelle). Bull. Soc. Pathol. Exot. 46 (2): 200–205, pls. 1–2.

Walker, F. 1850. Diptera. Part I. (iv) + 1–75, pls. 1–2. *In* Saunders, W. W., ed., Insecta Saundersiana: Or characters of undescribed insects in the Collection of William Wilson Saunders, Esq. Vol. 1. London. (viii) + 474 pp., 8 pls.

———. 1854. List of the specimens of dipterous insects in the collection of the British Museum. Vol. 5: Suppl. 1: 1–330, 2 figs. London.

———. 1856. Catalogue of the Dipterous insects collected at Singapore and Malacca by Mr. A. R. Wallace, with descriptions of new species. J. Proc. Linn. Soc. (Zool.) 1: 4–39, pls. 1–2.

Wu, C. F. 1940. Catalogus Insectorum Sinensium. (Catalogue of Chinese Insects). Vol. 5, (xi) + 524 pp. Fan. Mem. Inst. Biol., Peiping.

Wulp, F. M. van der. 1880. Eenige Diptera van Nederlandisch Indie. Tijdschr. Entomol. 23: 155–194, pls. 10–11.

———. 1881. Diptera, pp. 1–63, 3 pls. *In* Midden-Sumatra. Reizen en onderzoekingen der Sumatra Expeditie, uitgerust door het aardrijkskundig genootschap, 1877–1879, beschreven door de leden der Expeditie, onder toezicht van Prof. P. J. Veth. Natuurlijke Historie, 4 Deel (=vol.), 9 Afd. (=pt.), (the parts are separately paged.). Leiden.

———. 1885. On exotic Diptera. Part 2. Notes Leyden Mus. 7: 57–86, pl. 5.

———. 1896. Catalogue of the described Diptera from South Asia. Dutch Entomol. Soc., The Hague. (v) + 219 + (i) pp.